2023 Canary Rockfish Stock Assessment: Pre-assessment Data Workshop

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January 31, 2023

Outline

1. Basic overview
2. Landings
3. Fishery Length and Age compositions
4. Indices
5. Biological information

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1. **Basic overview**
2. Landings
3. Fishery Length and Age compositions
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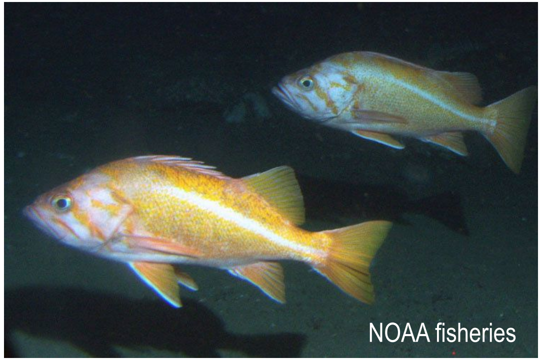
Brief biological background

- Canary rockfish range along the west coast primarily north of Pt. Conception to Alaska



- Semi-pelagic and can form schools
- Shelf species with young fish shallower than adults coastwide
- No observed genetic differentiation along their US range
- Long-lived up to 84 years

Assessment history

- First assessed in 1984
  - Full in 1990, 1994, 1996, 1999, 2002, 2005, 2007, 2015
  - Updates in 2009, 2011
  - Catch only projections in 2017, 2019, 2021
- Declared overfished in 2000, declared rebuilt in 2015

1999 used two separate models based north/south INPFC areas
2002 used single coastwide model
2005 applied regional-specific fleet structure
2015 applied state-specific fleet structure & spatial recruitment

2023 Assessment Overview

- Assessment will be based in Stock Synthesis (SS3)
- Coastwide model within US
- Benchmark: full exploration of model assumptions and data
- Data types used
  - Catch data (landings + discards mortality)
  - Length and age composition data. Conditional age at length from surveys
  - Indices
  - Biological data
- Model parameters
  - Fix some biological parameters and steepness,
  - Growth estimated within model
  - Explore estimating mortality within model
  - Estimate recruitment deviations, selectivity by fleet with blocks

Previous assessment structure

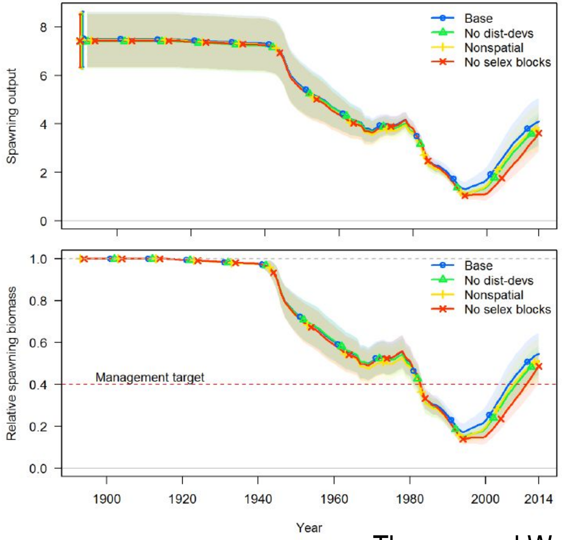
- 2015 assessment was spatially structured
  - One coastwide model
    - One stock-recruitment relationship and biological relationships
  - Spatial structure in fleets by state
  - Spatial structure in population by apportioning recruitment (distribution devs) to each state
    - No tagging or movement data to inform apportionment
    - Assume no movement of adults

Tentative Proposed Model Structure for 2023

- Explore simplifying structure from 2015 model

Sensitivities from 2015 model showed limited difference in model results across spatial assumptions

Figure 40 – Estimates of spawning output (top panel; line: maximum likelihood estimates; shaded area: 95% confidence interval) and relative spawning output (bottom panel) for the base model, a sensitivity that "turns off" interannual variation in the spatial distribution of recruitment ("No dist-devs"), a sensitivity that eliminates all spatial variation ("Nonspatial") and a sensitivity that eliminates time-blocks in selectivity ("No selex blocks").



Thorson and Wetzel (2016)

Revisiting Structure Also Based on Recent Research

ICES Journal of Marine Science

ICES CIEM
International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

ICES Journal of Marine Science (2019), 76(6), 1477–1488. doi:10.1093/icesjms/fsz059

Original Article

Overcoming long Bayesian run times in integrated fisheries stock assessments

Cole C. Monnahan[1,2*], Trevor A. Branch[1], James T. Thorson[3], Ian J. Stewart[4], and Cody S. Szuwalski[5]

"The biggest culprit for long run times was overparameterization"

Bayesian analysis helped illustrate many combinations of these parameters were similarly likely, could not be differentiated among well with the available data

Revisiting Structure Also Based on Recent Research

Eliminated spatial recruitment, simplified selectivity. Found:

- 0.8% change in terminal depletion
- 0.9% change in OFL
- -0.1% change in terminal SSB

ICES Journal of Marine Science

ICES CIEM International Council for the Exploration of the Sea / Conseil International pour l'Exploration de la Mer

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Tentative Proposed Model Structure for 2023

- Explore simplifying structure from 2015 model
  1. Exclude recruitment apportionment spatial structure
     - Keep fleet spatial structure
  2. Fix some selectivity parameters
     - estimating all 6 probably over parameterized

Tentative Proposed Model Structure for 2023

- Explore simplifying structure from 2015 model
- <u>5-15 fleets (5 types x 1-3 areas)</u>

  1-2. Commercial non-trawl, trawl

  3. Recreational

  4. Foreign

  5. At-sea hake

<u>2+ Indices</u>

1. NOAA groundfish survey
2. NOAA Triennial survey (?)
3. NOAA pre-recruit survey

4+. Many state surveys and indices

Tentative Proposed Model Structure for 2023

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2+ Indices
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2. NOAA Triennial survey (?)
3. NOAA pre-recruit survey
4+. Many state surveys and indices

- Discards added to landings
- Two sex model to account for dimorphic growth (assume growth is the same along entire coast)
- Age and length compositions with blocks

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Fishery dependent data sources

Type	Commercial	Recreational
Catches	PacFIN, State reconstructions	RecFIN, MRFSS, WA sport catches, CA reconstruction
Discards	WCGOP, Assumed historical rates	RecFIN, MRFSS, WA sport releases
Lengths & Age	PacFIN	RecFIN, MRFSS, WA sport biodata, various CA rec datasets

Note: 2022 data are preliminary at this time and will be updated for the final model

Landings Overview

Commercial separated by trawl and non-trawl gears.

Recreational combined across private/charter and private/rental modes

Majority of removals are from commercial trawl gear

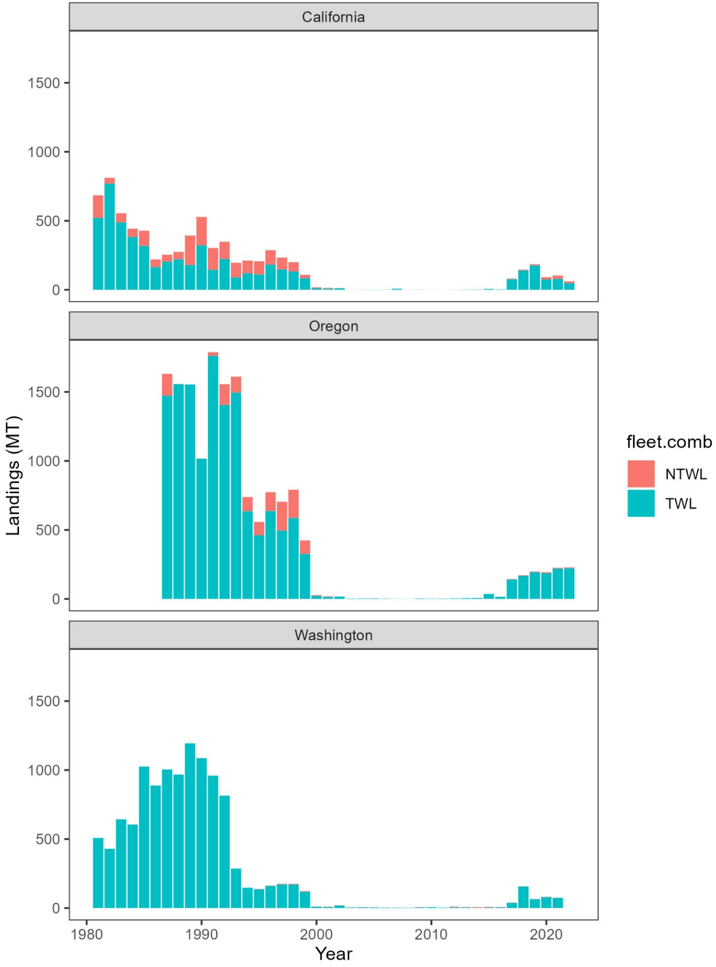
Obvious effect of the period of no retention (2000-2016)

Historical (pre-1980) commercial and CA recreational removals not yet available to the STAT but will be included in the assessment.

Commercial Landings: PacFIN

NTWL: hook and line, net gear, other
TWL: bottom trawl, midwater trawl, shrimp trawl*

Majority of landings are bottom trawl



*Note shrimp trawl was assumed as NTWL in last assessment

Commercial Landings: PacFIN

NTWL: hook and line, net gear, other
TWL: bottom trawl, midwater trawl, shrimp trawl*

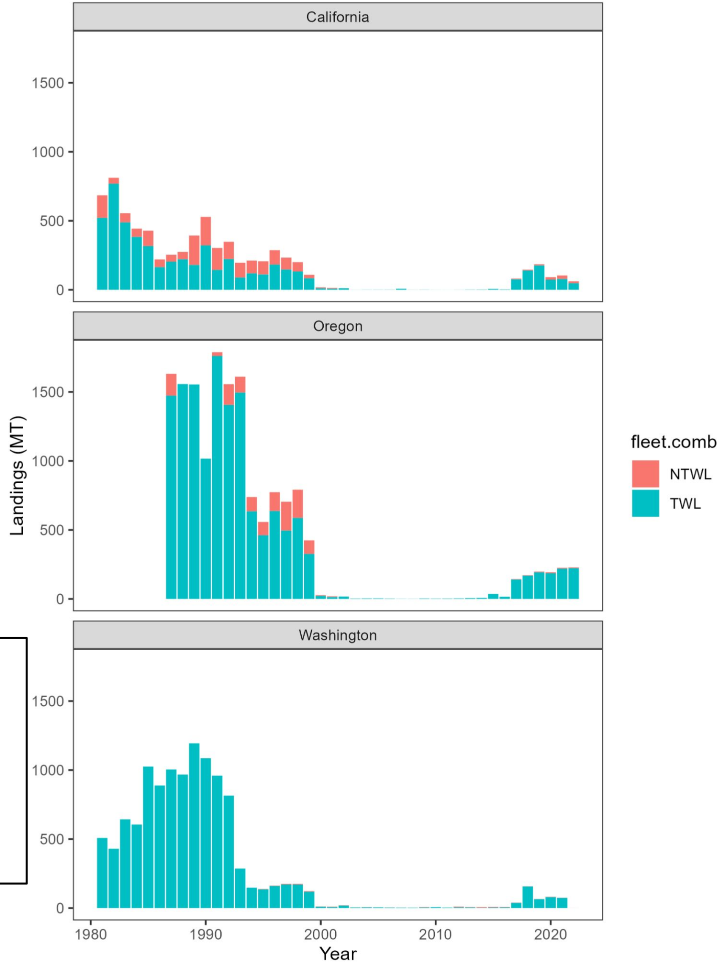
Majority of landings are bottom trawl

Do not yet have historical estimates, but these will be included in model

1916-1980 California
1892-1986 Oregon
1934-1980 Washington

Are these going to differ from last assessments? Was shrimp trawl a large component in past?

*Note shrimp trawl was assumed as NTWL in last assessment



Commercial Discards

- Plan to model removals as landings + mortality from discards as was done in last assessment

- Recent (2002-2022): Estimates from West Coast Groundfish Observer Program (WCGOP).
    - Data broken down by gear and area provided but not yet analyzed

- Historical: Assumed rates from last assessment for each state were:

  2000-2001 (77% TWL, 210% NTWL),
  1995-1999 (20%), 1981-1994* (5%), <=1980 (1%)

  Any additional data to inform or changes these?

*1981-1994 estimates based on Pikitch study

Recreational CA Removals

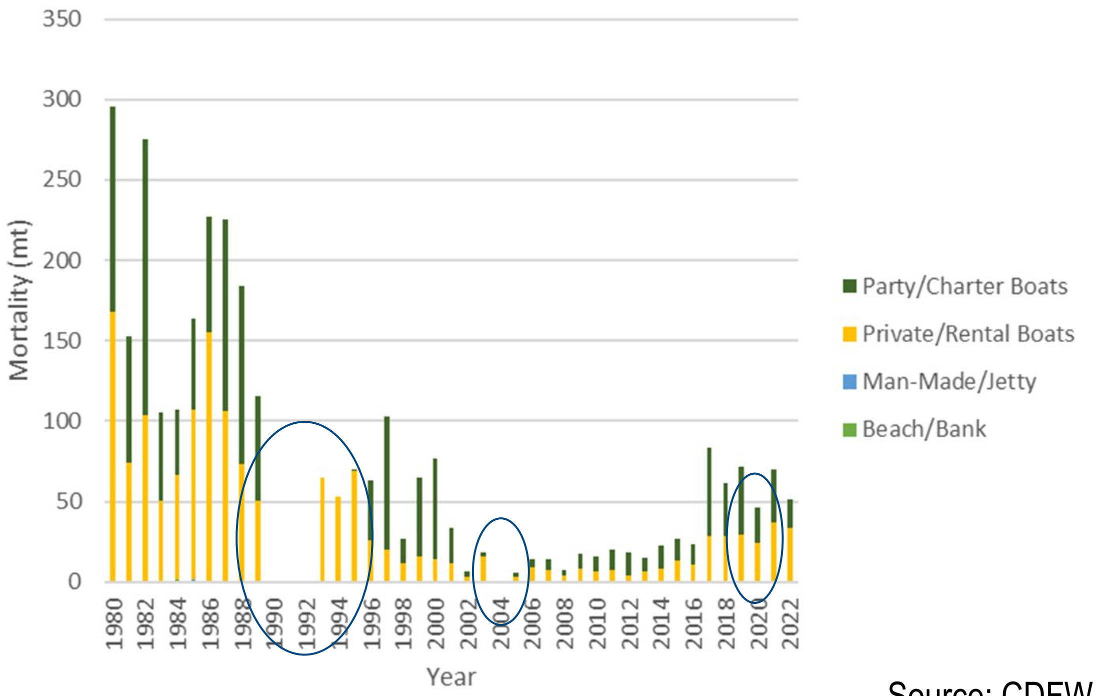
Discard and landings estimates

From RecFIN: 2005-2022

From MRFSS: 1980-2003

- Will fill in 2004 and 1990-1992 gaps, PC 1993-1995, and address potential undercount in 2020 due to Covid-19 impacts

Will combine private/rental (PR) and party/charter (PC) modes

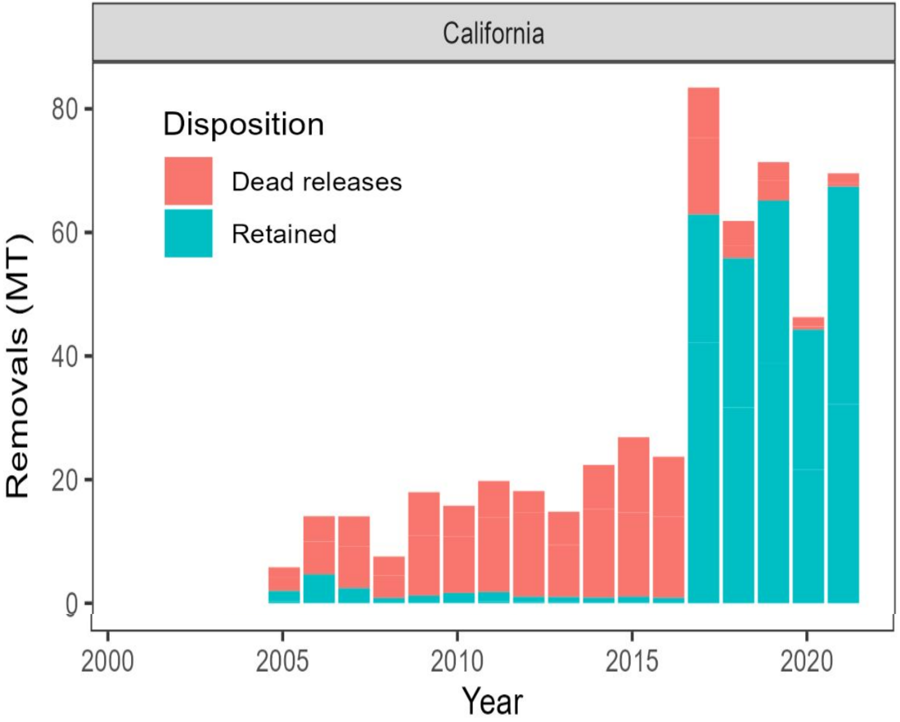


Source: CDFW

Recreational CA Removals: from RecFIN

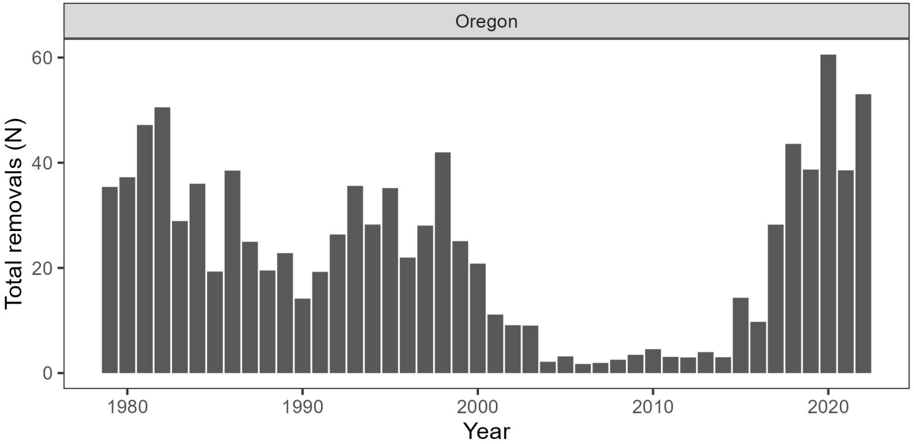
Discard higher during period of no retention

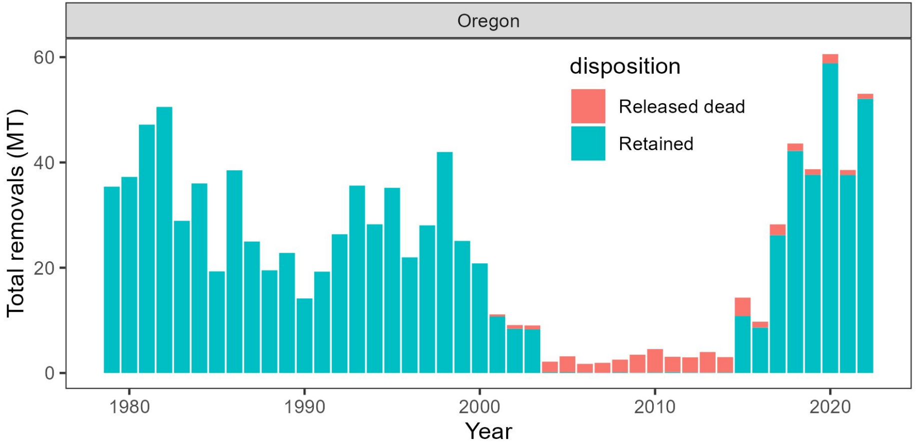
Note: Breakdown of MRFSS data not yet analyzed



Recreational OR Removals

From RecFIN: 2001-2022
Reconstruction: 1979-2000

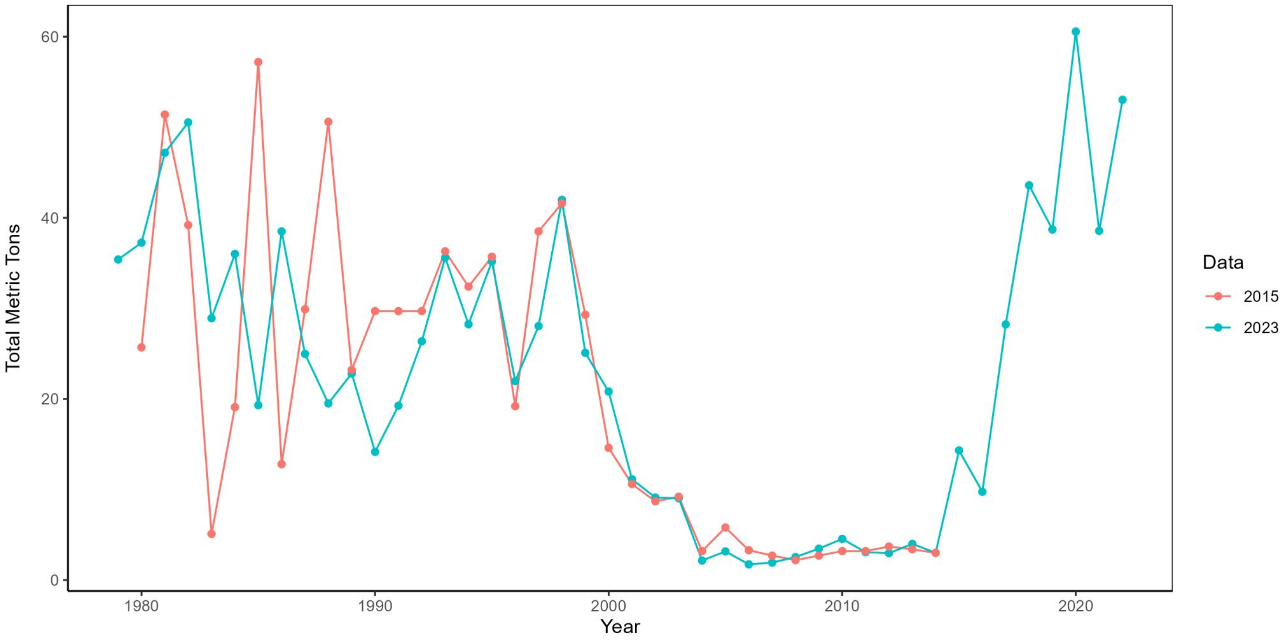




How do we handle removals prior to 1979? Presumably there were some removals.
Previous assessment assumed 0

Differences in Oregon removals from last assessment

Differences from previous assessment in historical period



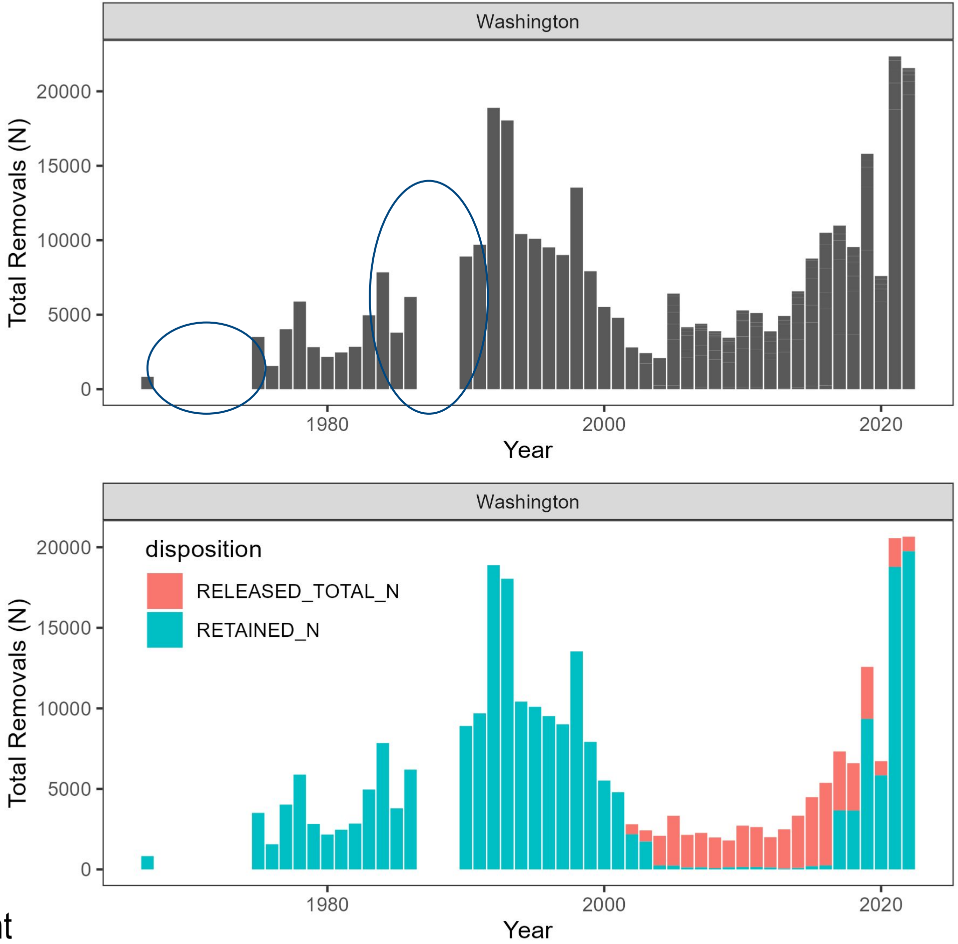
Recreational WA Removals for Model

From State: all years (in numbers)

Will fill in 1968-1974 and 1987-1989 gaps

Previous assessment used MT, so difficult to compare to last assessment*

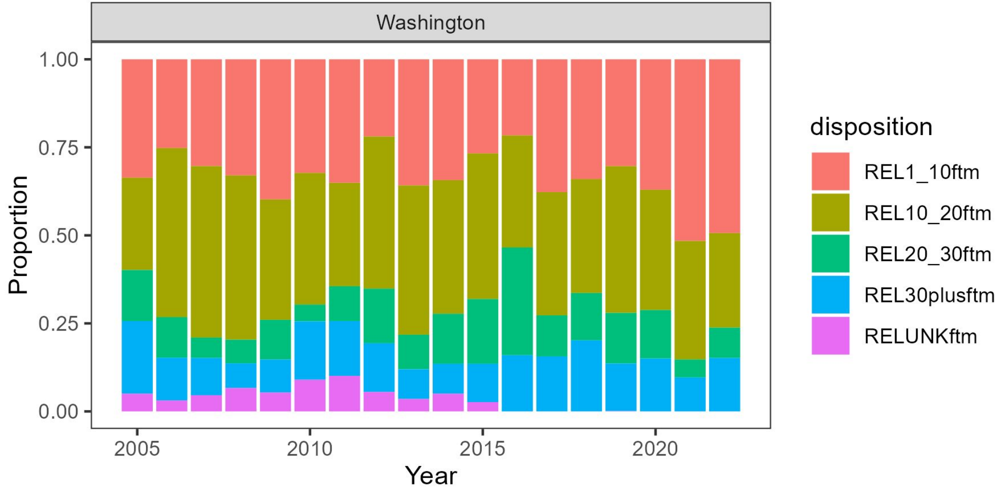
Were there any discards before 2001?



*numbers have also been reworked since last assessment

Washington release mortality

- Releases do not yet have release mortality applied. What is best way to obtain release mortality?



- Ways to obtain are:

    1. Pull release mortality from RecFIN (2004-2022)
    2. Use discard estimates from previous assessment (in MT)
    3. Estimate using release by depth values provided by WDFW, but need mortality rates by depth! **Are these available?**
    4. Borrow mortality rate from other areas (e.g. Oregon)?

Do the OR and WA recreational fisheries operate similarly?

Recreational Discards

- Plan to model removals as landings + mortality from discards as was done in last assessment

- State provided discards for OR
- Estimated from RecFIN (2005-2022) or MRFSS (1980-2003) for CA
- State provided releases for WA

Questions about landings and discards

1. Are historical commercial estimates going to be different from previous assessment values? Shrimp trawl now TWL
2. Are historical commercial discard rates still appropriate for all states: 1995-2001 (20%), 1981-1994 (5%), <=1980 (1%)?
   How desirable were canary rockfish historically?
3. What is magnitude of recreational landings prior to period we have data available for OR?
4. a. What is magnitude of discards prior to 2001 for WA?
   b. Are mortality rates by depth available for released data from 2005-2022?

Outline

1. Basic overview
2. Landings
3. **Fishery Length and Age compositions**
4. Indices
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Length and Ages Overview

Support proposed fleet structure

- Trawl (TWL) and Non-trawl (NTWL) groupings for commercial
- Combined Private/Rental and Private/Charter modes for recreational

Majority of samples come from commercial bottom trawl gear. Many are from Oregon

Reading of recent age samples may result in added age comps for non-trawl commercial and recreational fleets

Plan to use only break and burn reads for age compositions

Commercial Length and Age Samples

PacFIN: Showing “market” sampling that is sampled randomly

-2189 Commercial onboard samples in WA (1880 with ages) excluded

-199 purposive sampling method in WA (163 with ages) excluded

-8827 samples outside US waters (507 with ages) excluded

-1057 special project samples in OR (34 with ages) starting in 1999 excluded

OR special projects samples <= 1986 (5859 with 4641 ages) kept

-Designated SP after collection based on lacking full documentation on sampling procedures

-Sampled randomly

Commercial: Sample sizes

Majority of samples come from bottom trawl gear

Few non-trawl ages and lengths (other than CA)

Previous assessment did not include NTWL age comps.

Commercial: Sample sizes

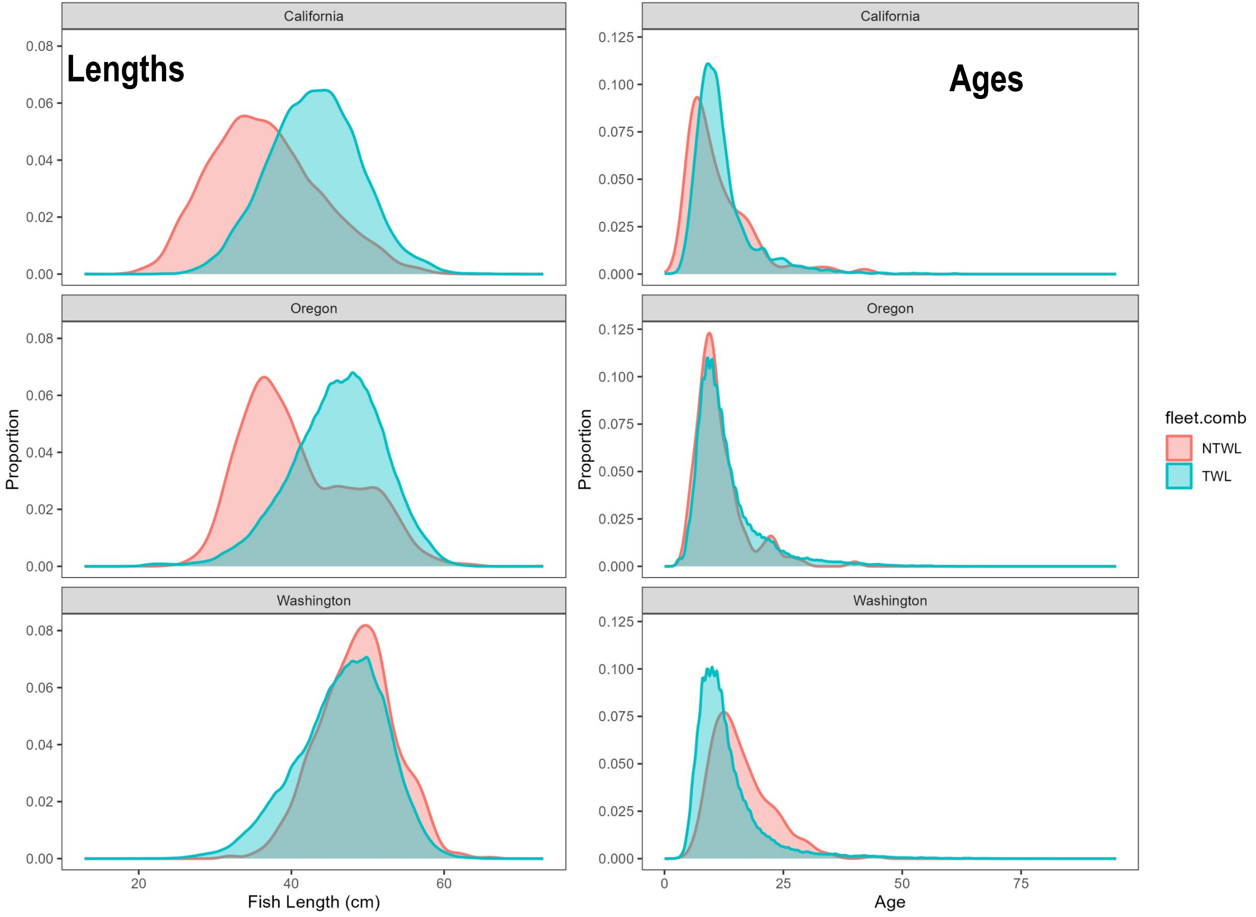
Majority of samples come from bottom trawl gear

Few non-trawl ages and lengths (other than CA)

Previous assessment did not include NTWL age comps. **Will explore for this assessment**

Commercial: Distributions

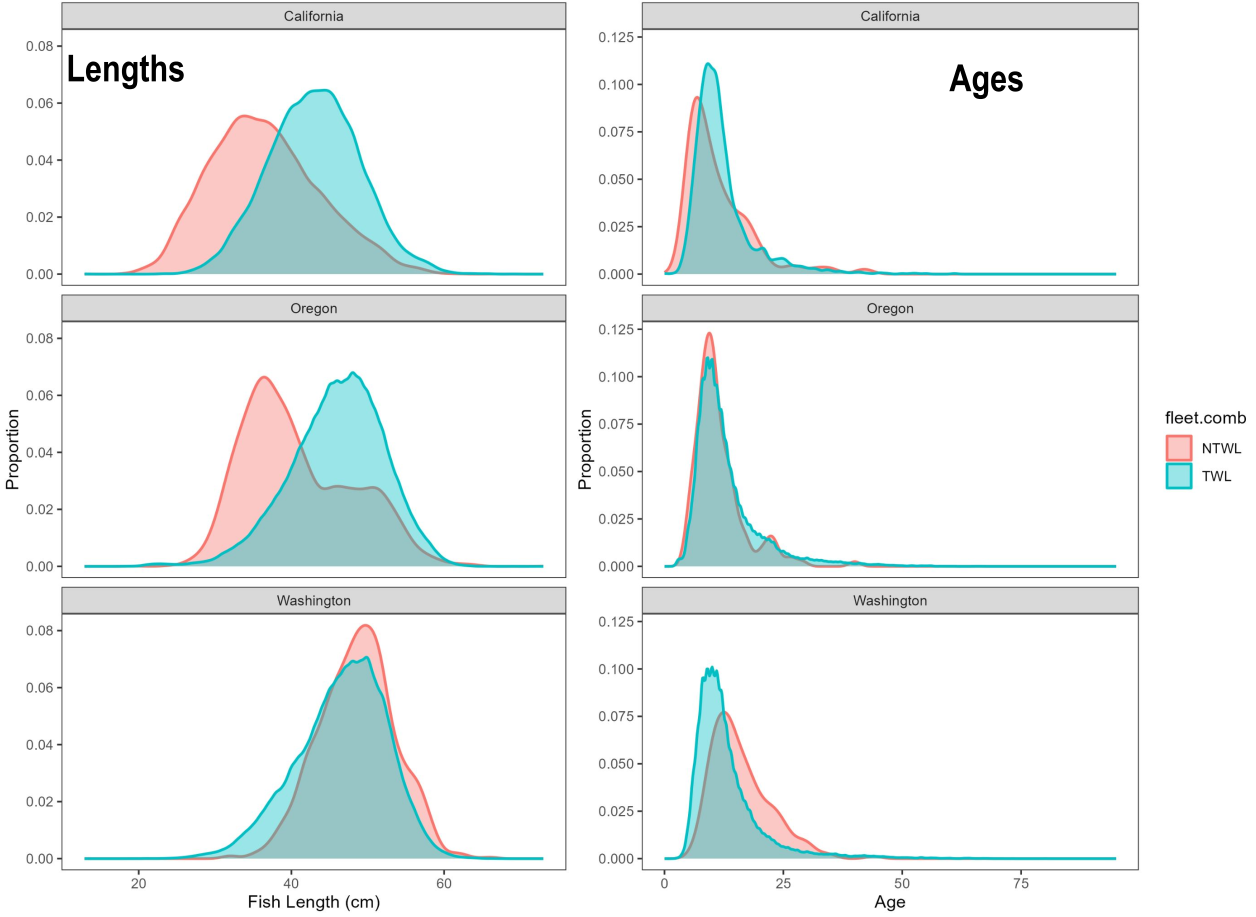
Differences between TWL and NTWL lengths for CA and OR, ages for CA and WA



Commercial: Distributions

Differences between TWL and NTWL lengths for CA and OR, ages for CA and WA

Does it make sense to combine WA NTWL and WA TWL?



Commercial age reads: Surface reads vs. Break and Burn

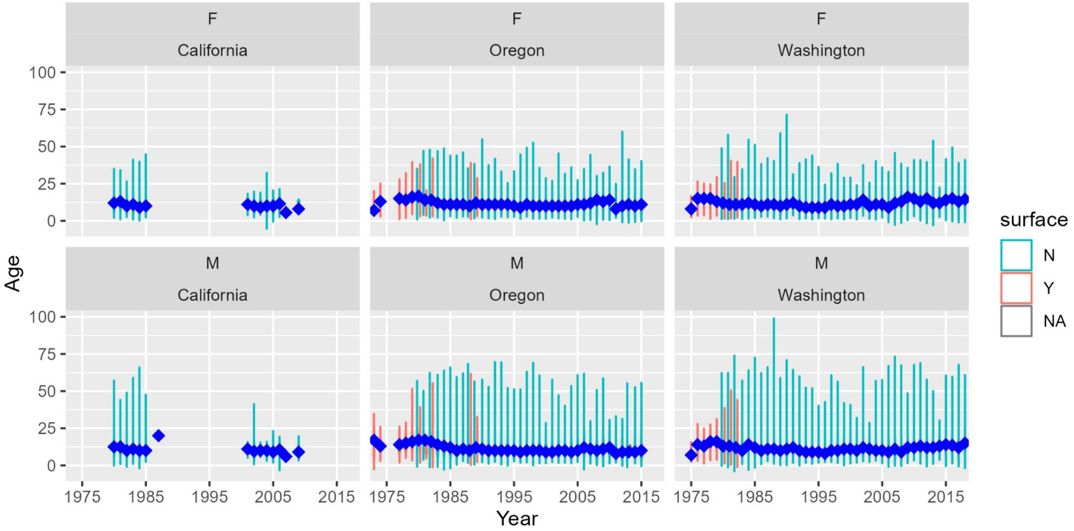
Previous assessment used two age comp types with unique error matrices

-Comps from surface reads (red)

-Comps from break & burn reads (cyan)

-Use of surface did not change results

Plan to exclude surface read comps for base model



blue diamonds are median ages within a year

Explored in 2005 and 2007 benchmarks and not included in base

Recreational Length and Age Samples

RecFIN: Showing “retained” fish only

-6135 released length samples from CA (3880) and OR (2255) not shown

OR data includes RecFIN and MRFSS era years

California MRFSS data available but are not yet analyzed. Will add to what is shown here

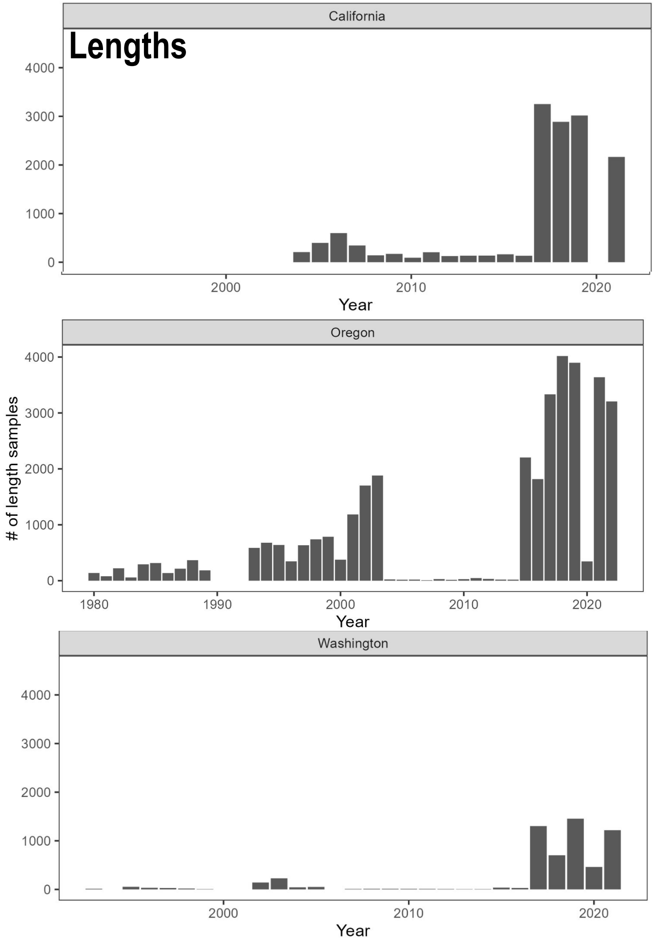
WA sport biodata available but not yet analyzed. Will be used in model in place of RecFIN data. Showing RecFIN data here to explore initial patterns

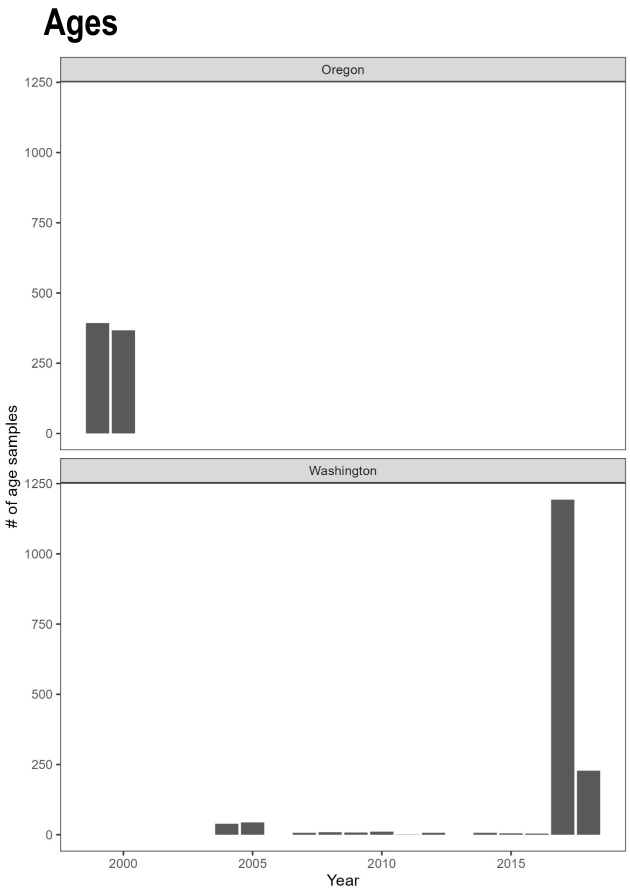
Recreational: Sample sizes

Combining PC & PR modes

Majority of length samples are unsexed

Previous assessment did not include rec age comps





Recreational: Sample sizes

Combining PC & PR modes

Majority of length samples are unsexed

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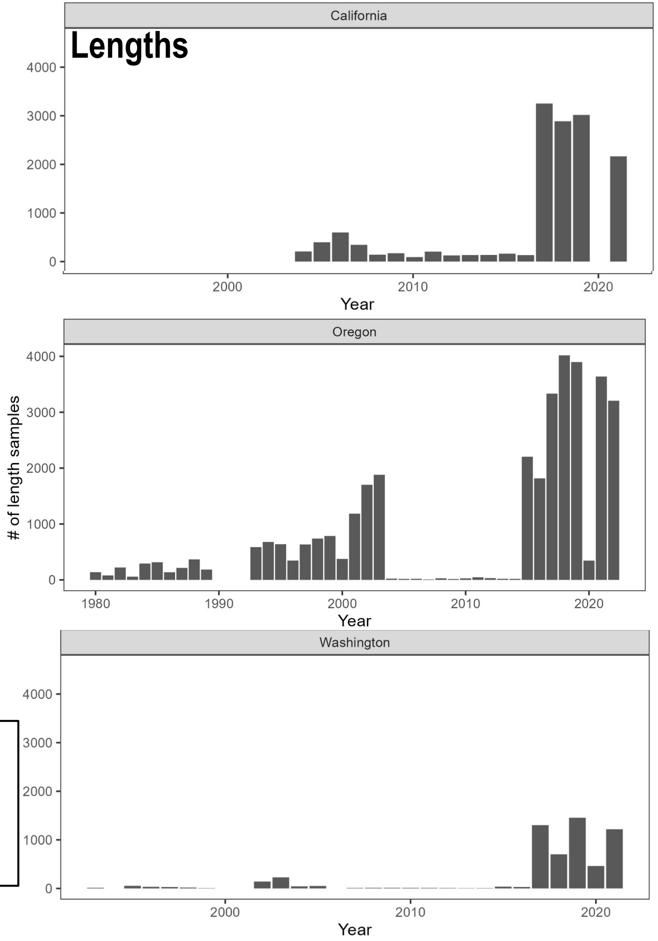
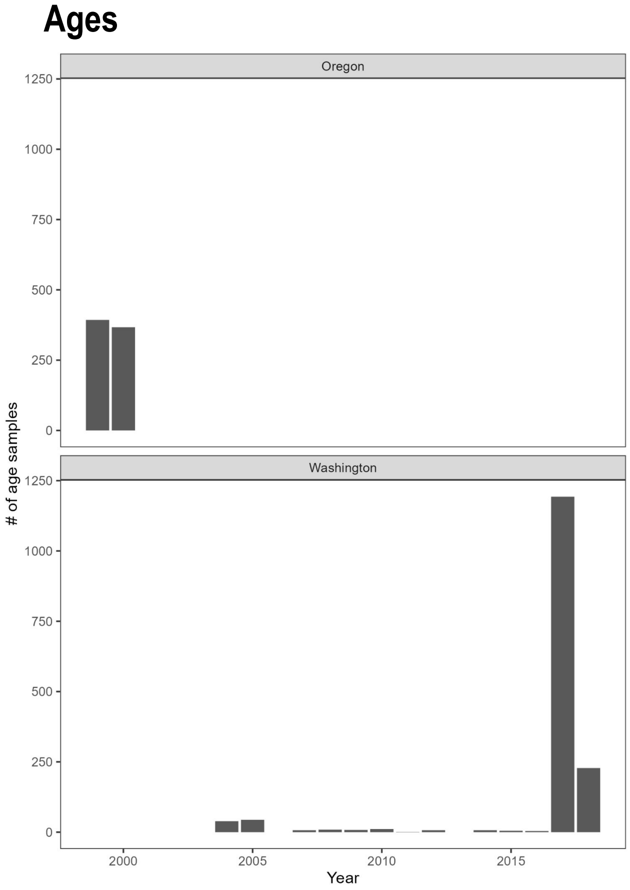
Plan to explore age comps
-Planning to age WA structures 2018-2022
-Planning to age OR structures 2015-2022

ultimately based on what is aged





Recreational: Length Distributions

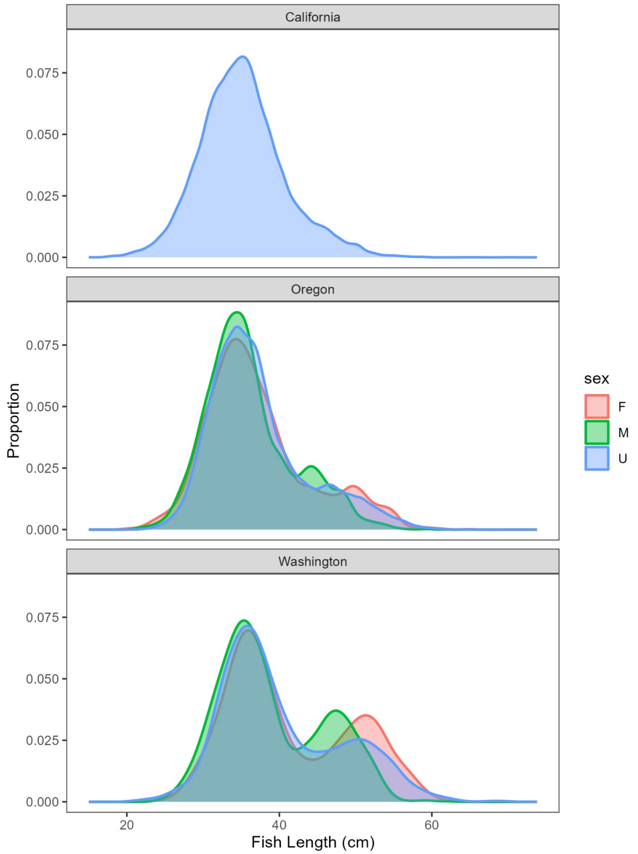
Previous assessment used single unsexed length comp for OR but not for WA

majority since 2015

Sample sizes in RecFIN	California	Oregon	Washington
Female	0	2804	2717
Male	0	2115	1752
Unsexed	14179	23945	1505

Will explore using sex specific comps

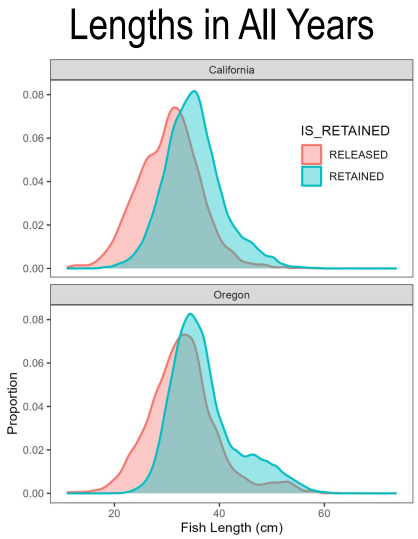
Lengths by sex from RecFIN



Questions about length and age data: RecFIN data

1. Are we missing important information by excluding released fish in compositions?

a. Tend to be smaller



Washington did not have any released fish

Questions about length and age data: RecFIN data

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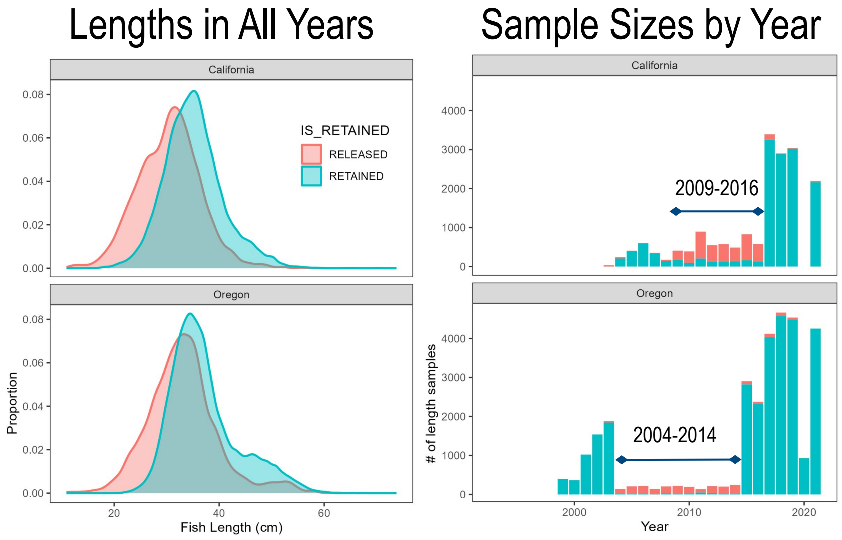
b. Higher proportion during period of non-retention



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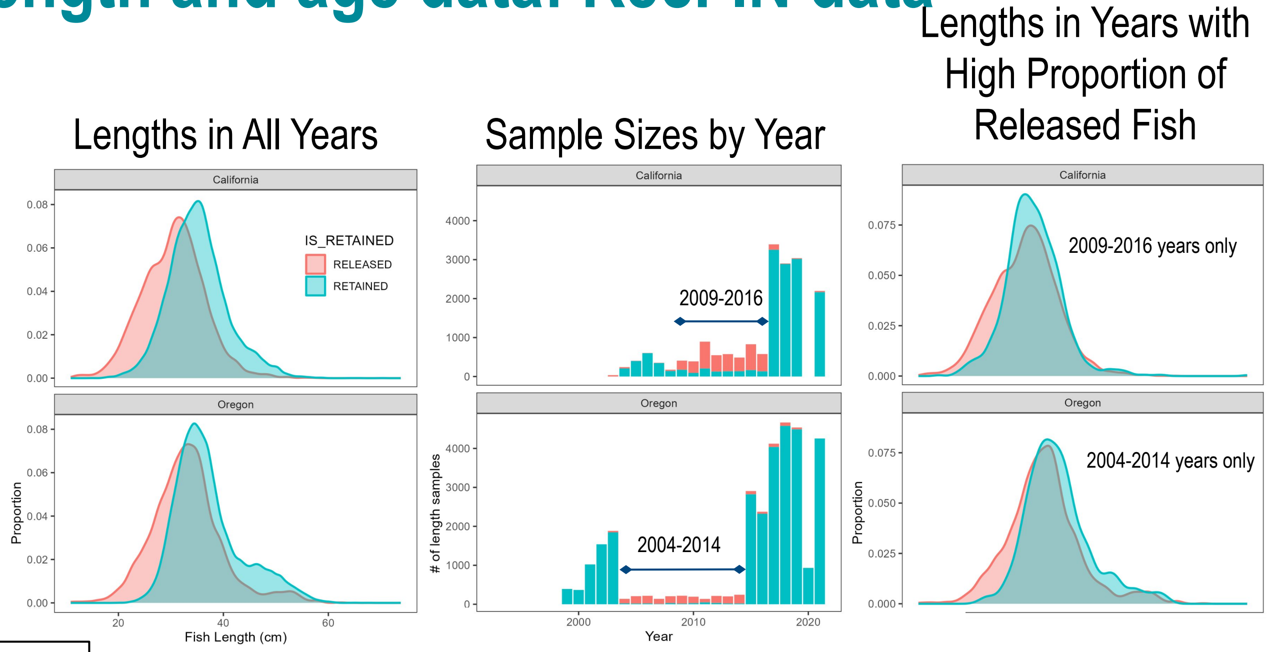

Including released fish likely to have limited effect

Washington did not have any released fish

Questions about length and age data

2. Any updates to selectivity blocking? What years did major changes occur in how the fisheries operated?

Previous assessment

- Commercial fleets: break at overfished declaration (‘99-‘00)
- Trawl fleets: break at start of ITQs (‘10-‘11)
- No selectivity block in recreational fleet
- Selectivity was mirrored across states for each fleet

All questions about length and age data

1. Does combining WA NTWL and TWL make sense? Are they expected to catch similarly sized fish?
2. Are we missing important information by excluding released fish in length compositions?
3. What years did major changes occur in how the fisheries operated?

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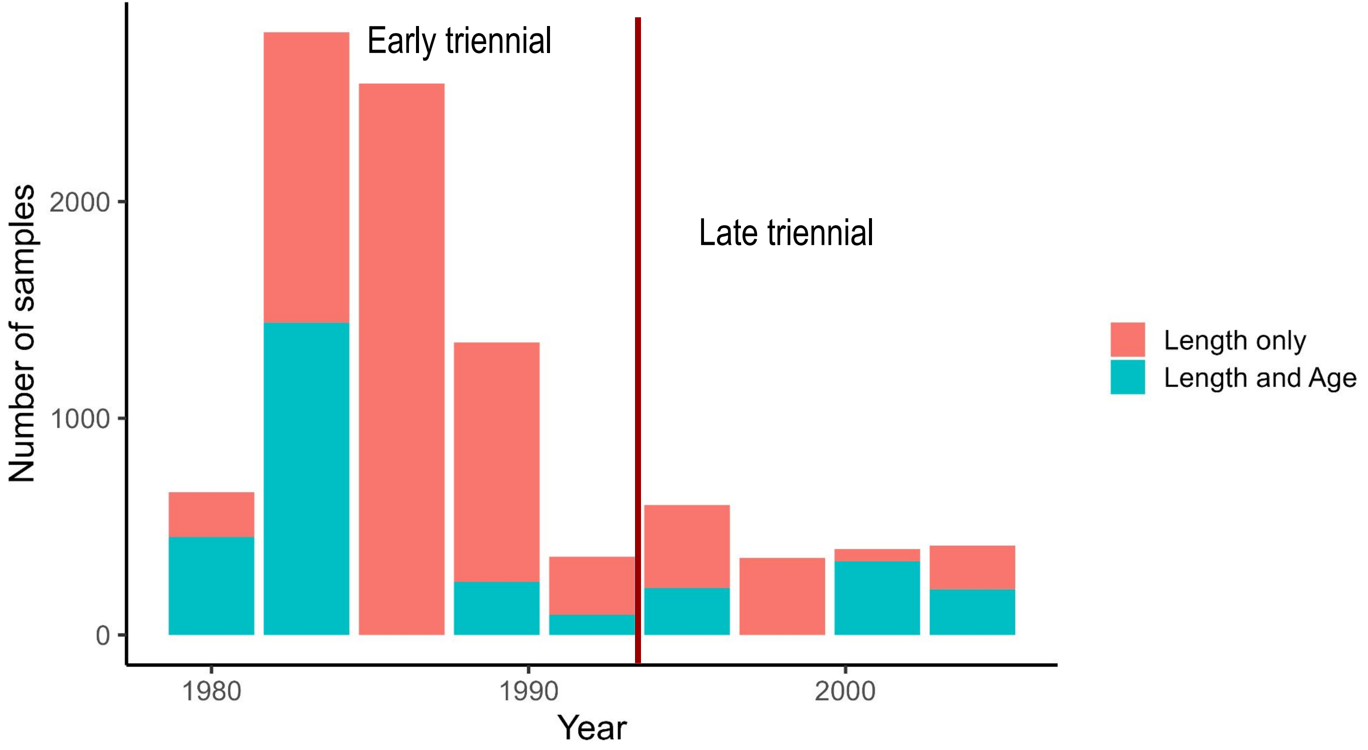
NOAA Surveys Overview

19 years of WCGBTS data

9 years of triennial survey data. Given it is usually split in two periods, impact likely limited.

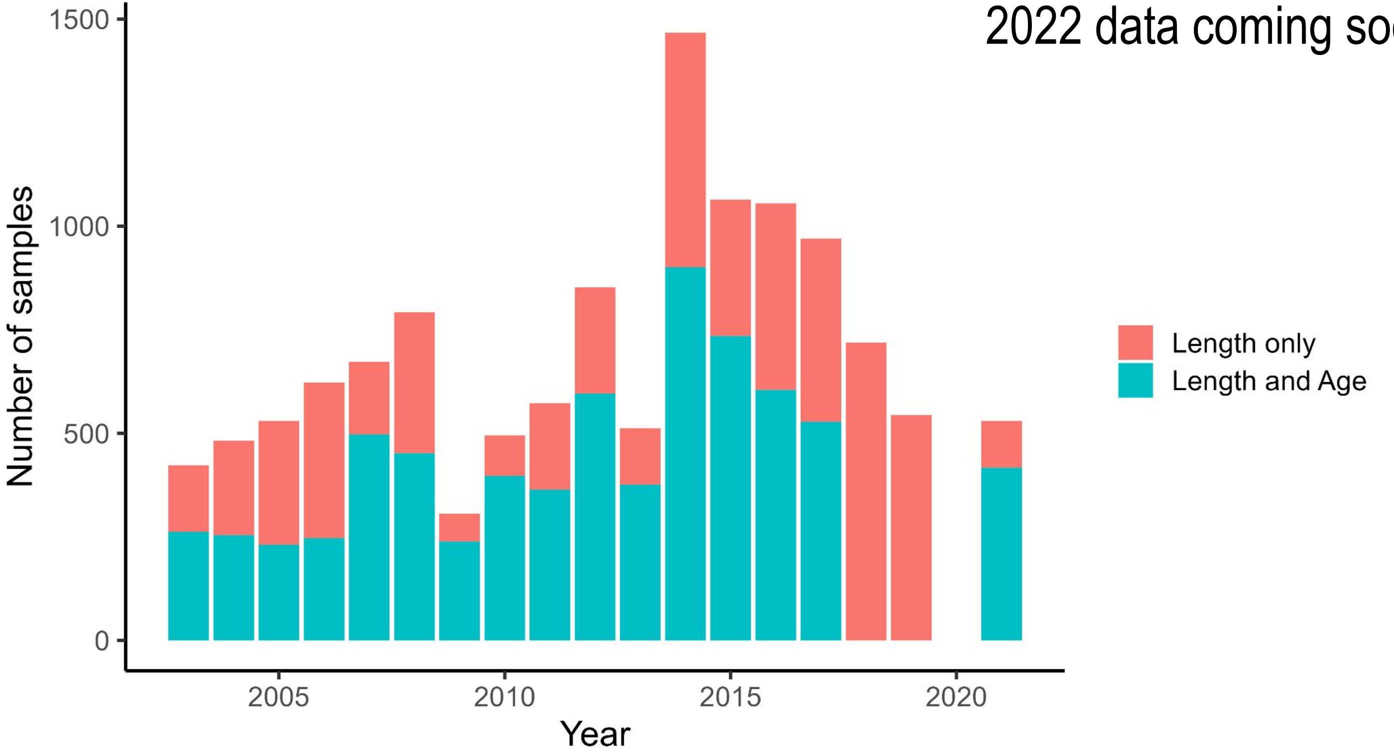
Also include coastwide years for juvenile rockfish survey (RREAS) as recruitment index

Triennial survey composition sample sizes



WCGBTS composition sample sizes

2018, 2019 ages, all 2022 data coming soon

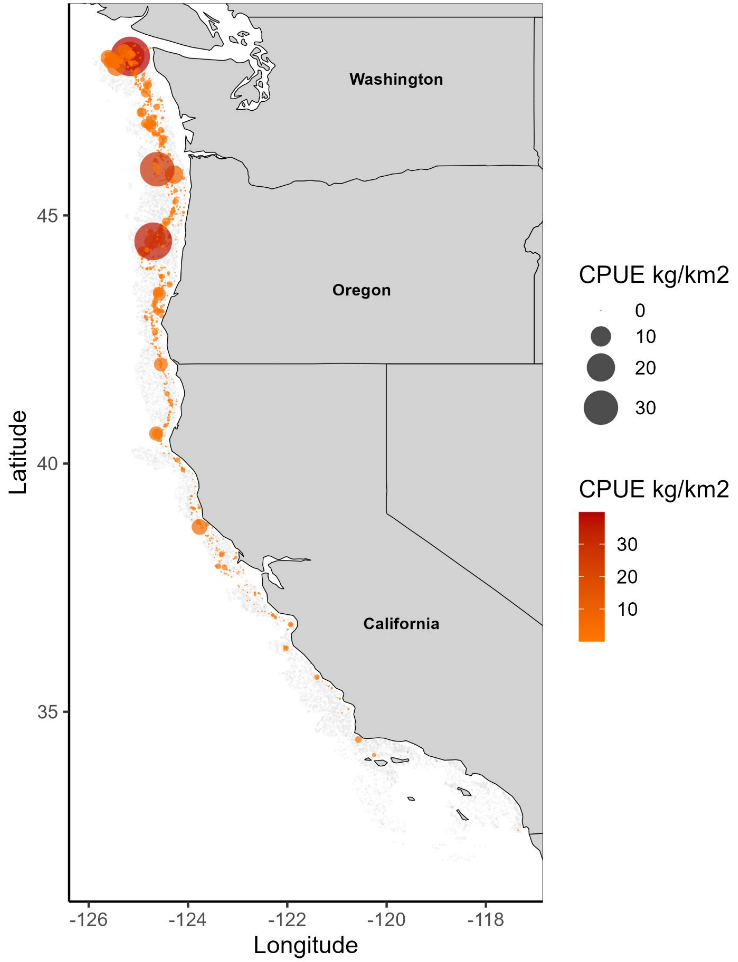


WCGBTS catches

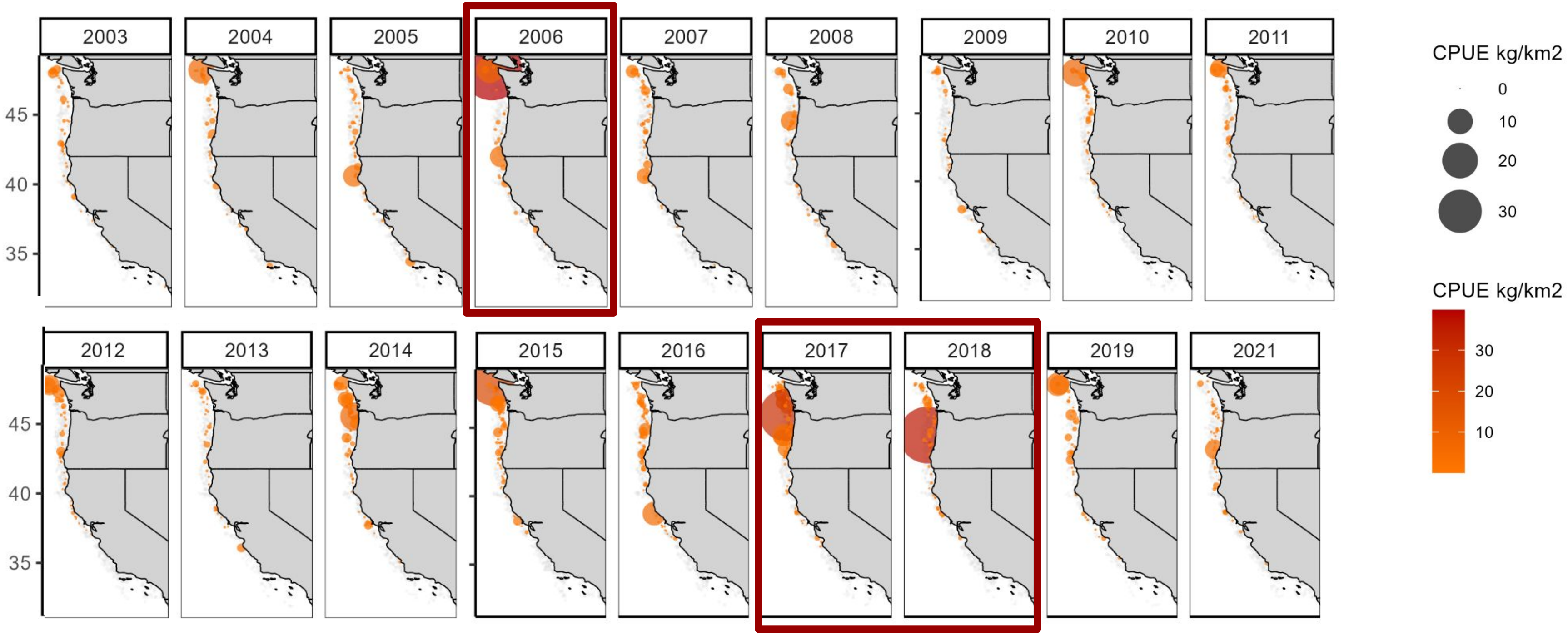
Most observations north of San Francisco Bay

Density increases with latitude

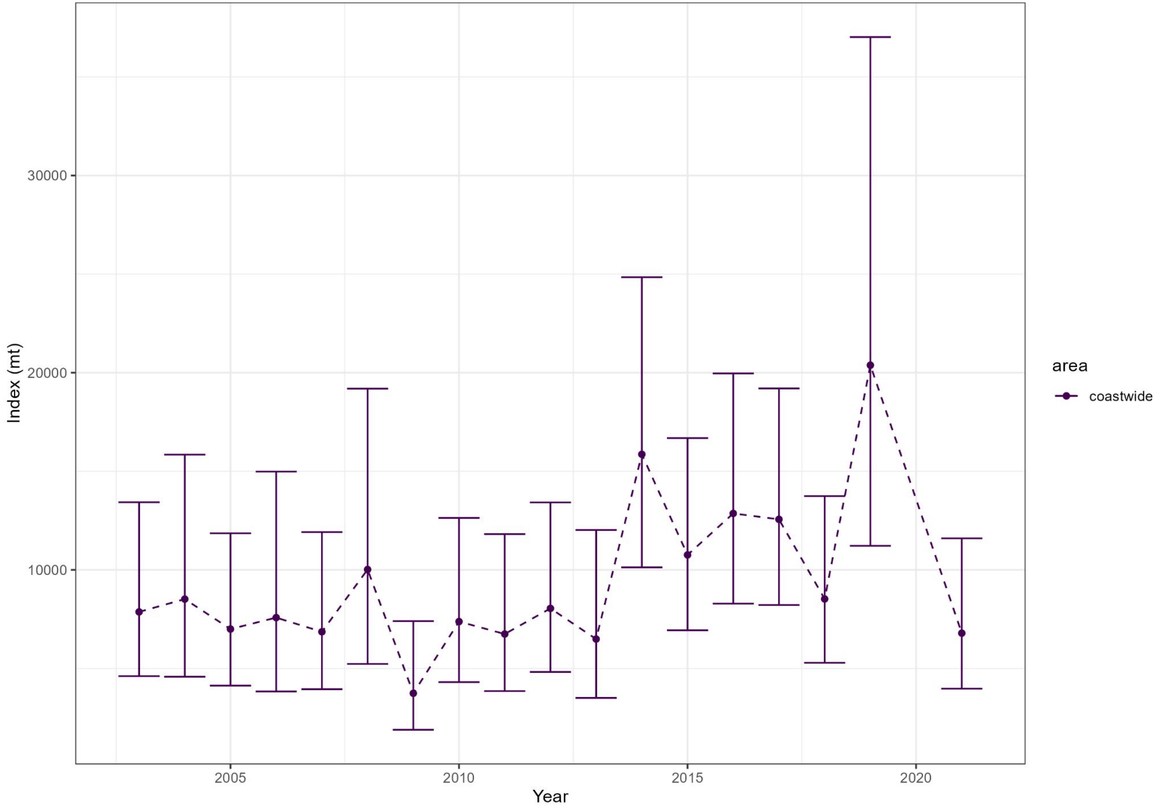
Caught in 15% of tows <350m



Trawl survey catches: issues with extreme catch events



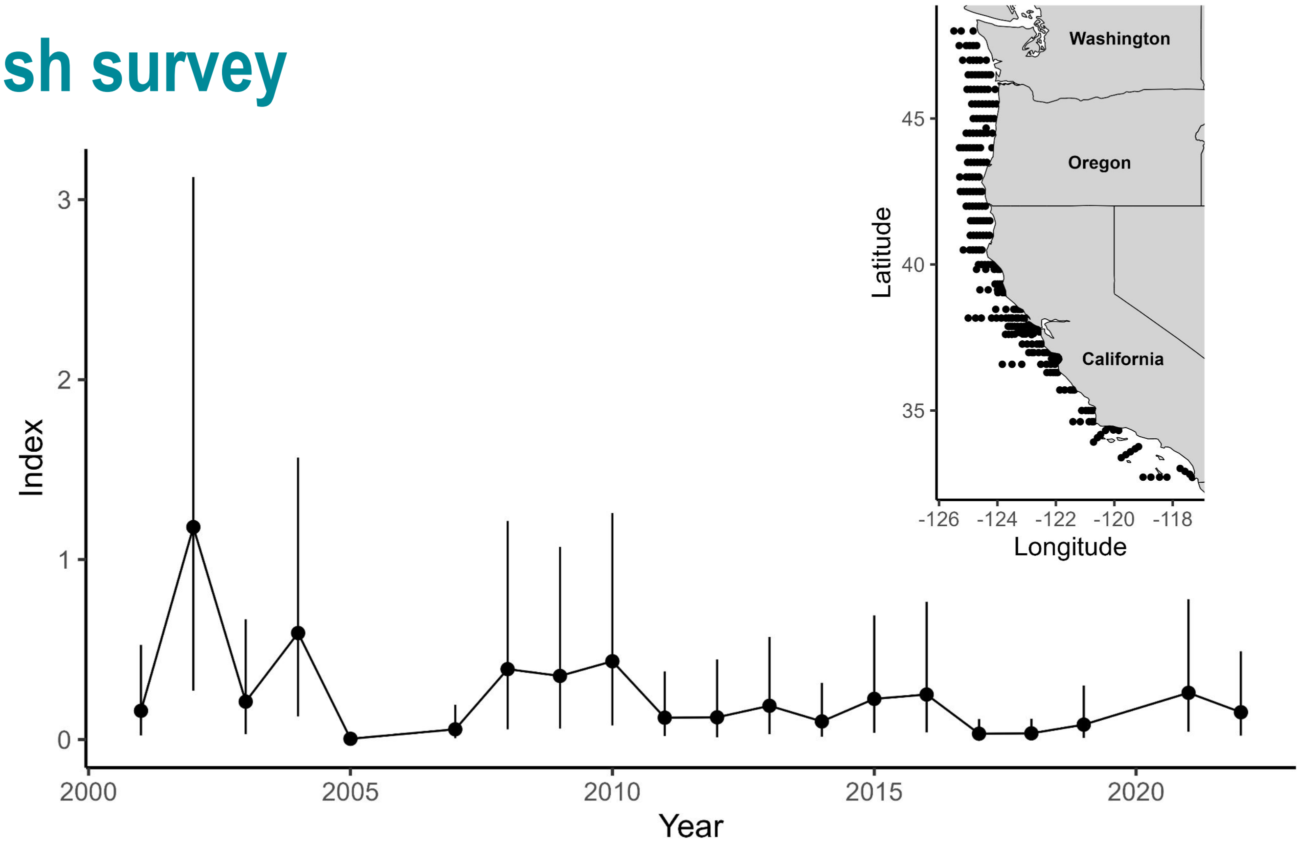
Coastwide index



Juvenile rockfish survey

Still exploring methodology for generating index

2020 will be excluded, not sure why 2006 missing



Additional indices to explore

- Recreational fishery-dependent index
  - CA: dockside PR/PC, onboard PC
  - OR: rec at sea observers
  - WA: dockside interview
- WA hook & line
- CA ROV
- OR marine reserve hook and line
- OR video lander

Surveys likely not going to include

- IPHC
- WA Olympic Coast YOY survey
- OR marine reserves longline
- OR ROV
- OR SMURF

Questions about survey data

1. Any other sources for indices of abundance or surveys we have missed?
2. Triennial survey: what information will it add given it is usually split, generally caught larger fish than WCGBTS?
   - It covers the period of most significant depletion, but does it actually help to quantify that?

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Biological data sources

Type	Source
Growth	WCGBTS survey conditional age at length (CAAL) compositions
Length-weight	WCGBTS survey data
Fecundity/Maturity	Existing relationship from last assessment
Mortality	Hamel prior based on longevity for male and females separately. Updated since 2015

Biological Data Overview

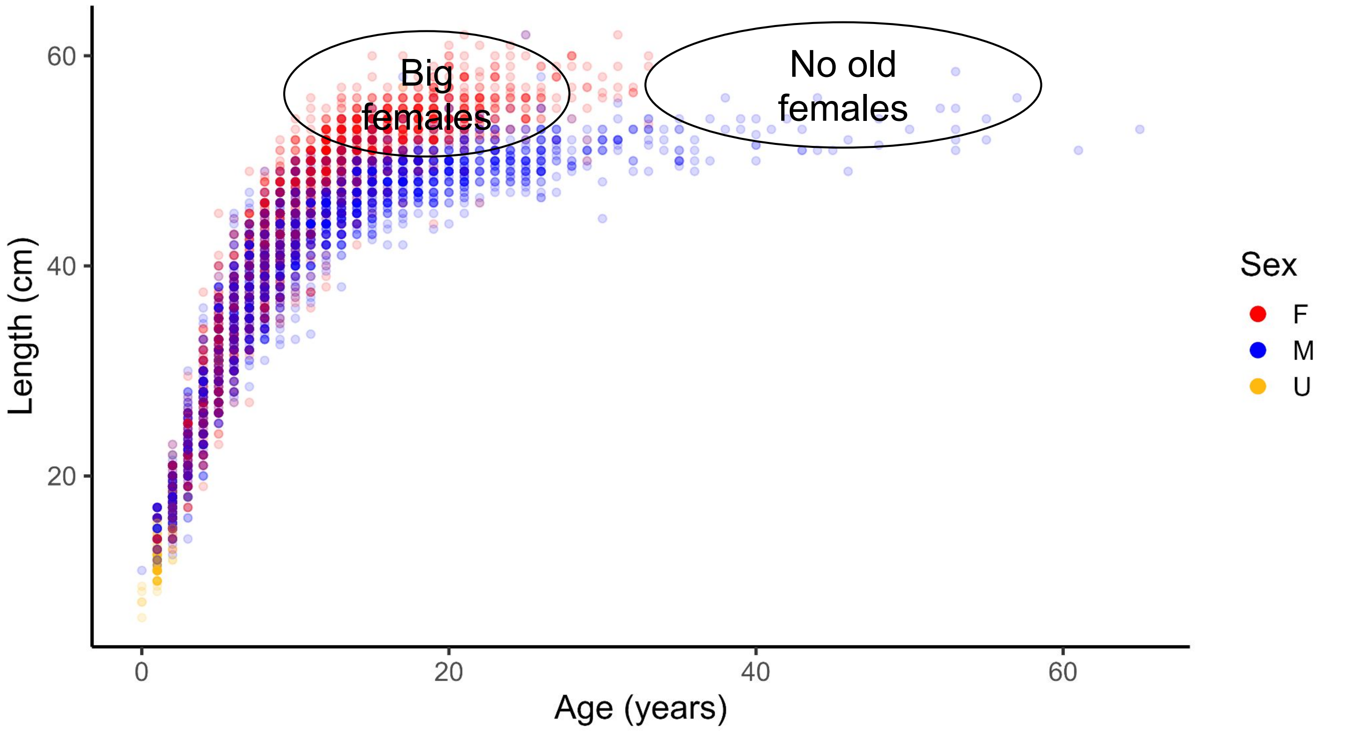
Sexually dimorphic growth so we will model sex separately

There is a lack of old females across all data sources

MS thesis (Brooks 2021) indicated latitudinal break in life history around Coos Bay, but we did not see evidence in WCGBTS growth data

No major changes to maturity or fecundity information. Previous assessment accounted for skip-spawning.

Lack of old females in survey data

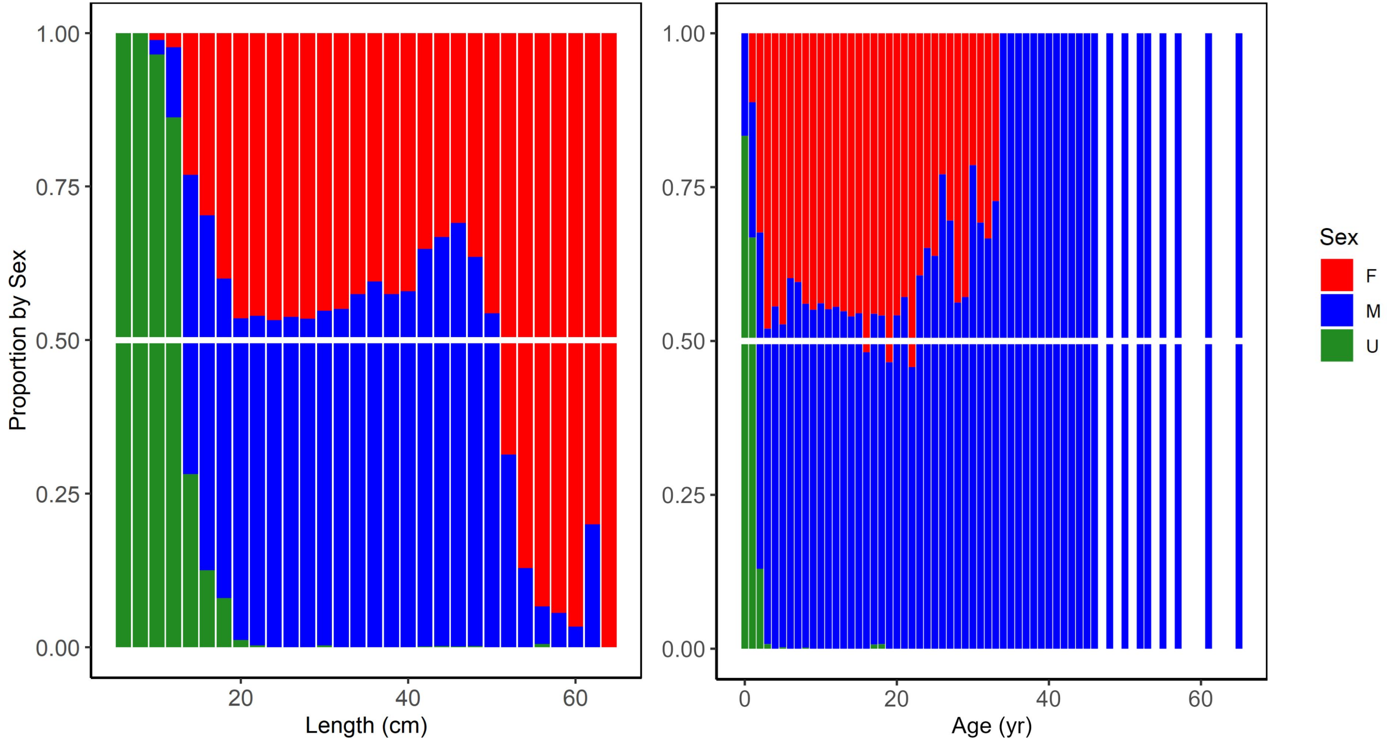


Lack of old females

Most big fish are female

Most old fish are male

Pattern seen across all data sources



Sex-specific natural mortality

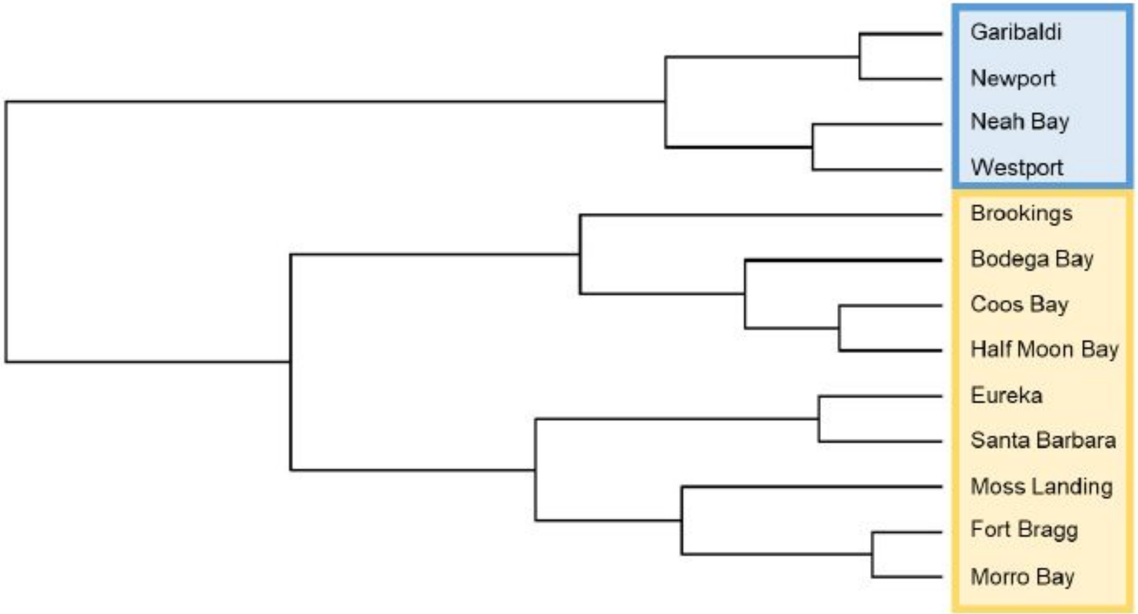
Previous assessment: fixed M for males and young females at Hamel prior (0.052), estimated ramp for females from age 6-14

Based on same longevity would now be 0.064

Our approach: coordinated with black rockfish, use step function instead of ramp (parsimony)

- Explore sensitivity to this assumption vs. dome-shaped selectivity

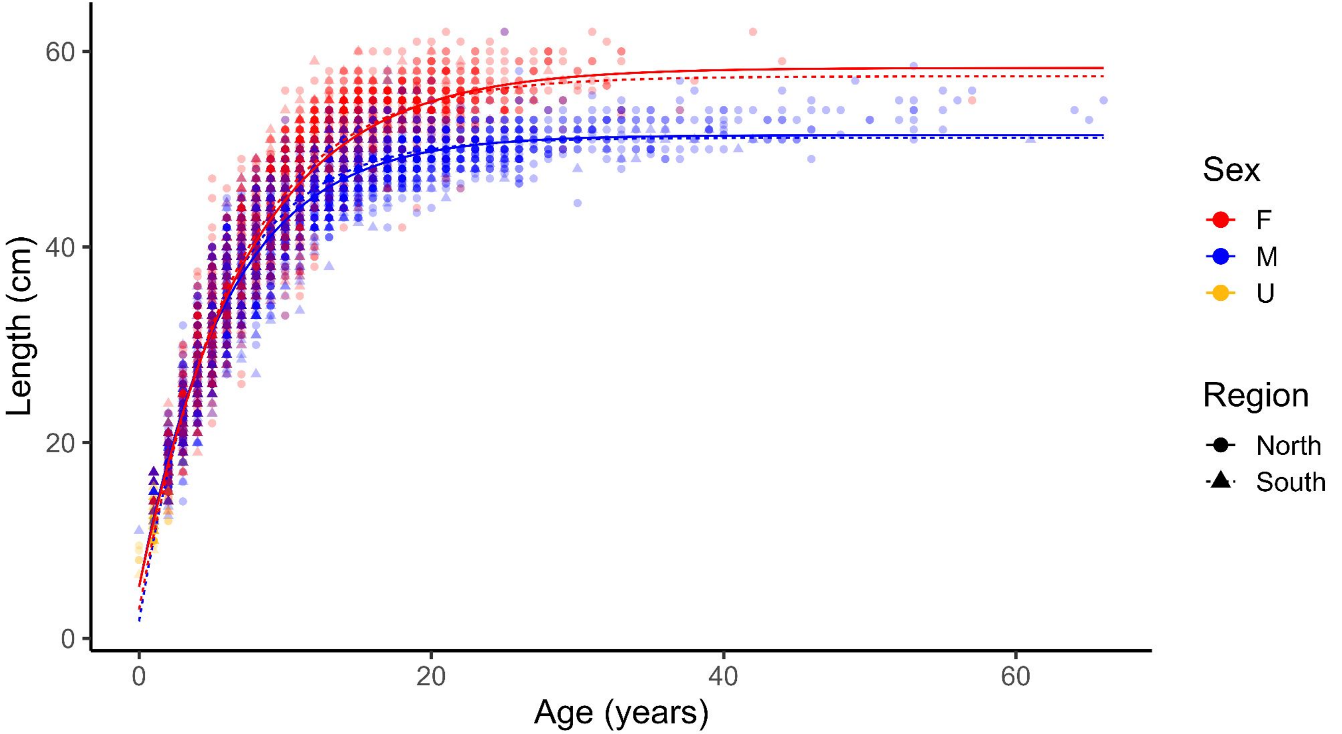
Life history differences



Brooks 2021

*note these are not ordered geographically

Growth curves split at Coos Bay, only minor differences



Questions about biological data

1. Have you seen *old* females?

2. What approaches should we take towards modeling the lack of old females?

3. Is there other evidence to suggest latitudinal differences in growth, or lack thereof?

Thank you! Please reach out to us if you have questions

Brian Langseth - brian.langseth@noaa.gov   Kiva Oken - kiva.oken@noaa.gov

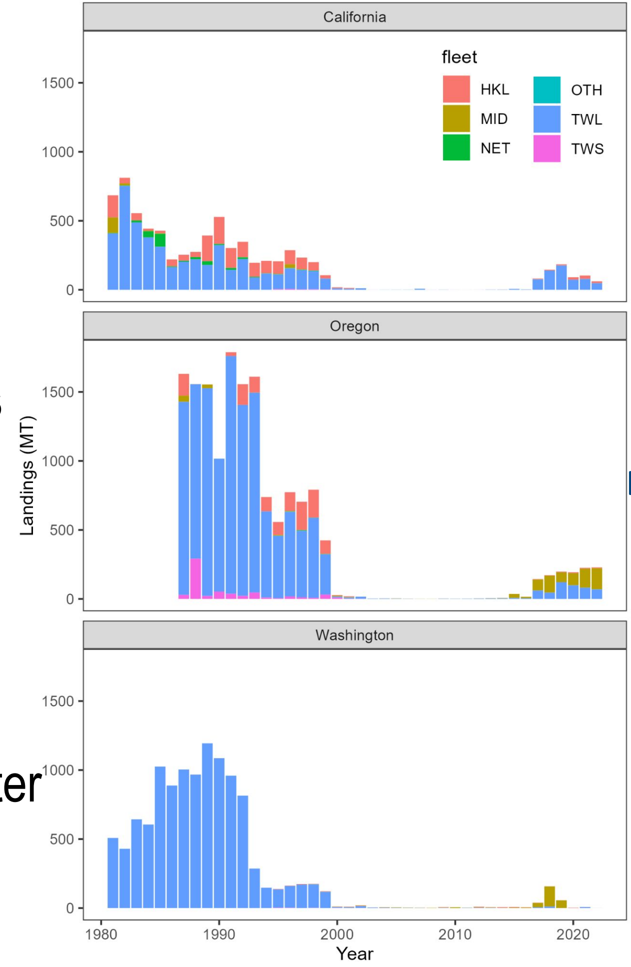
Extra slides

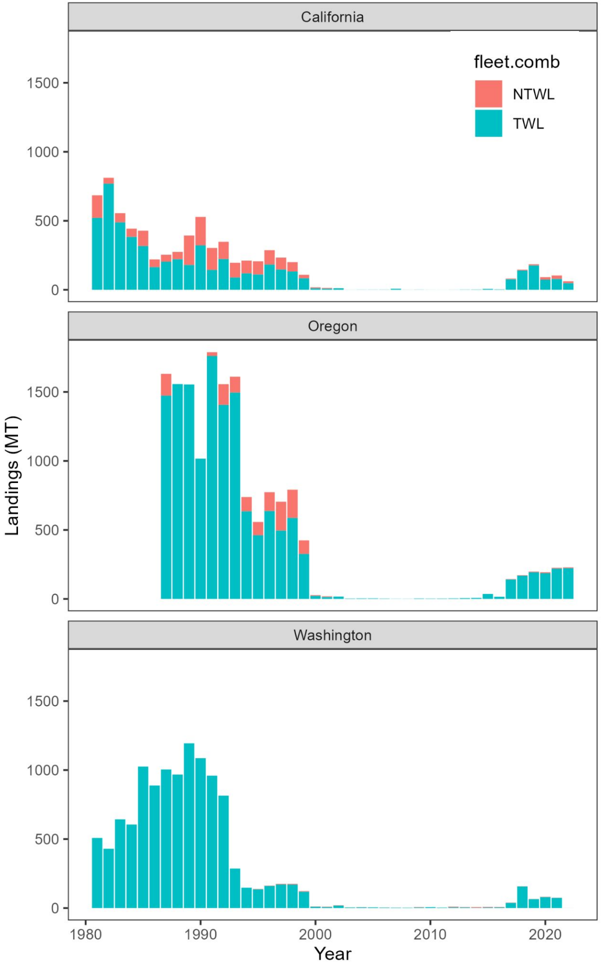
Commercial Landings by Gear

Model will include discards

Don't yet have historical estimates

Primarily trawl (TWL) with recent increases in midwater trawl (MID)

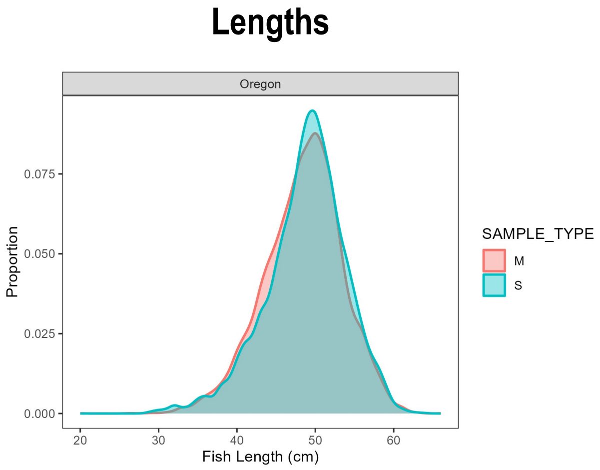


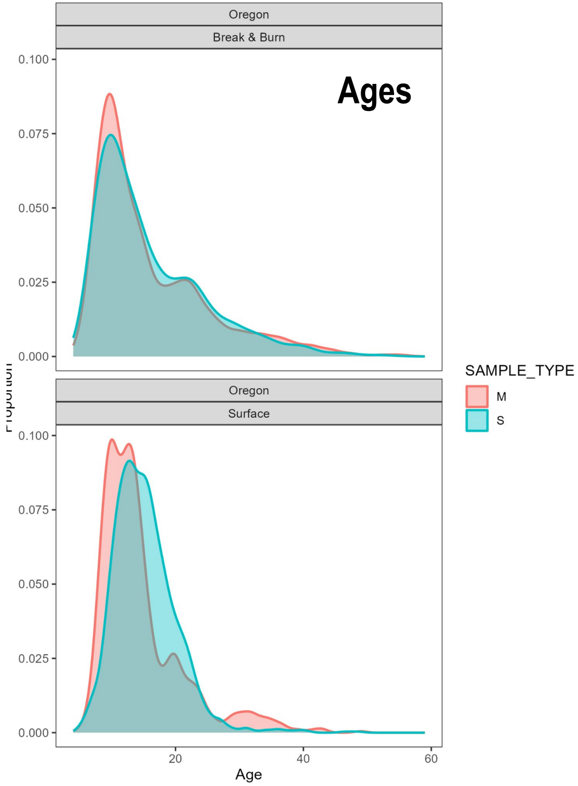


Commercial: Oregon Special Projects

Data are for years where both market (M) and special (S) SAMPLE_TYPE exist

Oregon special projects data are similar to Market data. Reason for inclusion



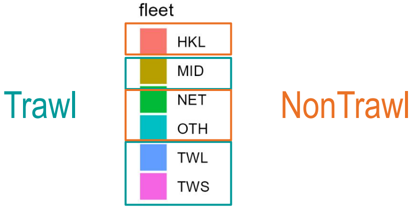


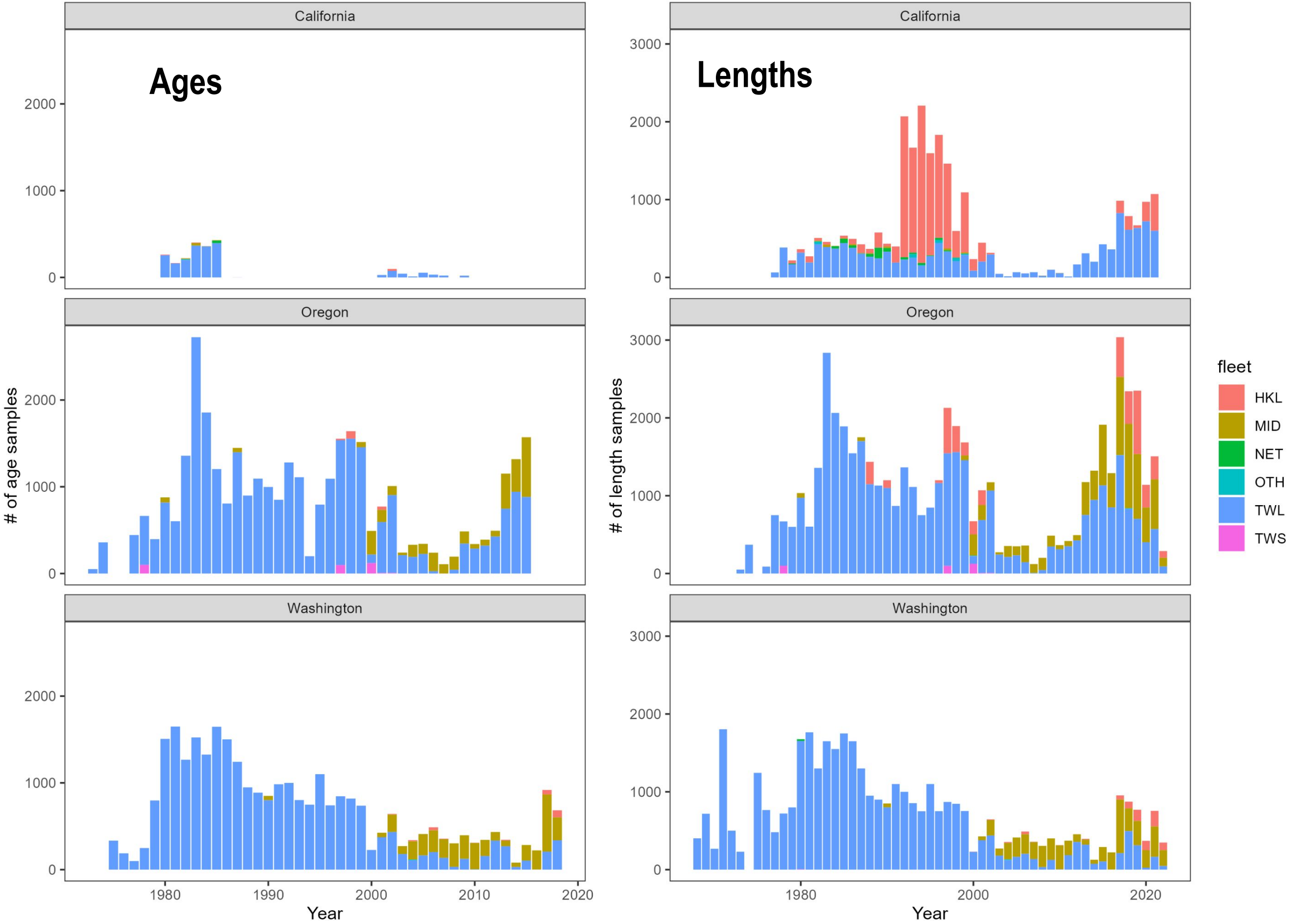
Commercial: Sample sizes

Majority of samples come from trawl (twl) gear

Very few non-trawl ages (other than twl and mid)

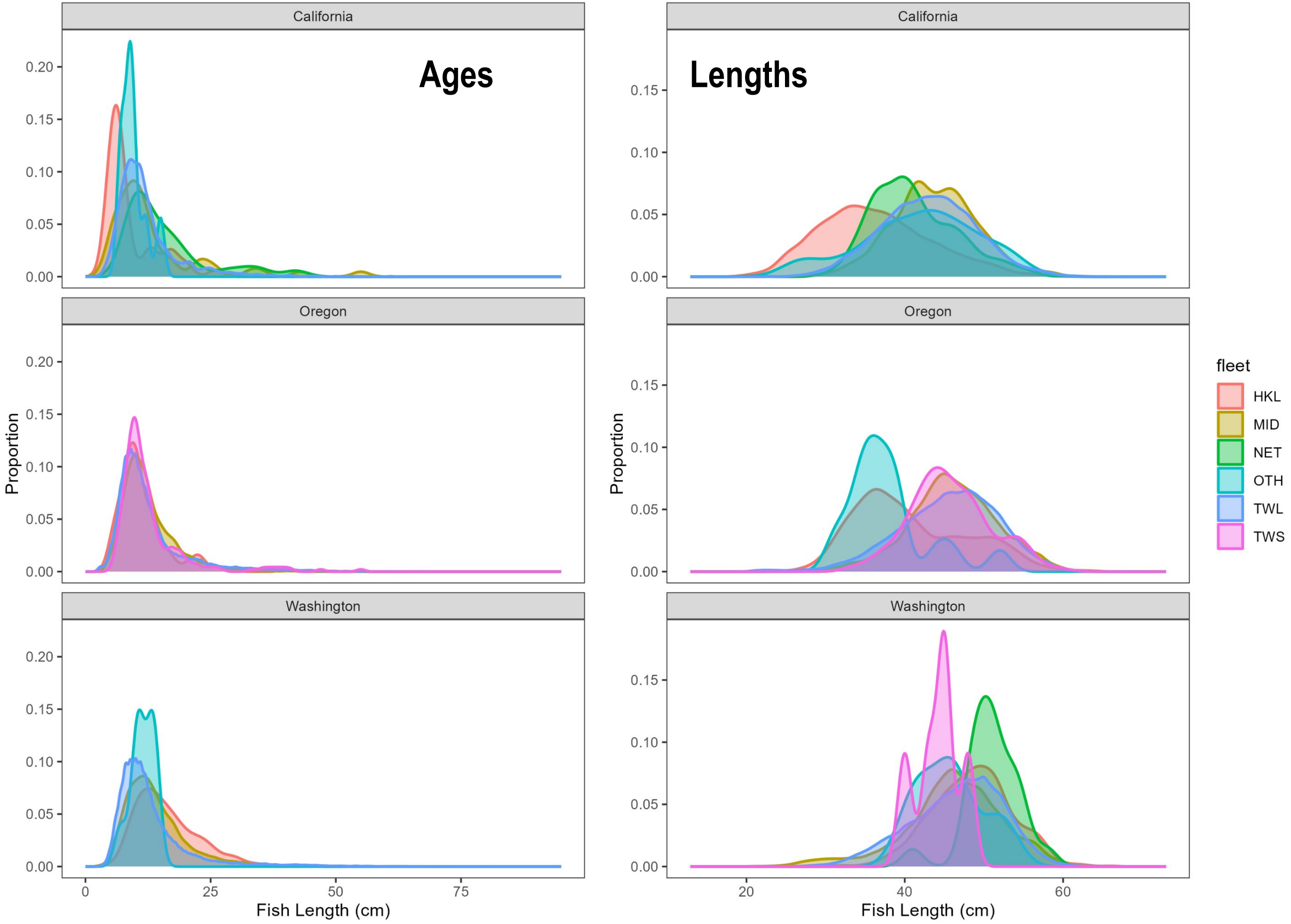
Few WA non-trawl lengths





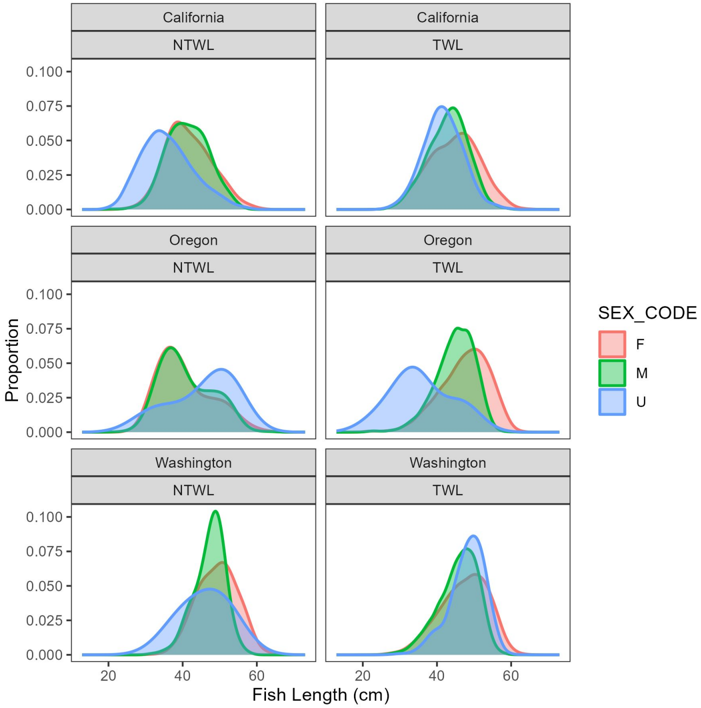
Commercial: Raw distributions

Supports proposed structure
Trawl (**twl**, mid, tws)
NonTrawl (**hkl**, net, oth)

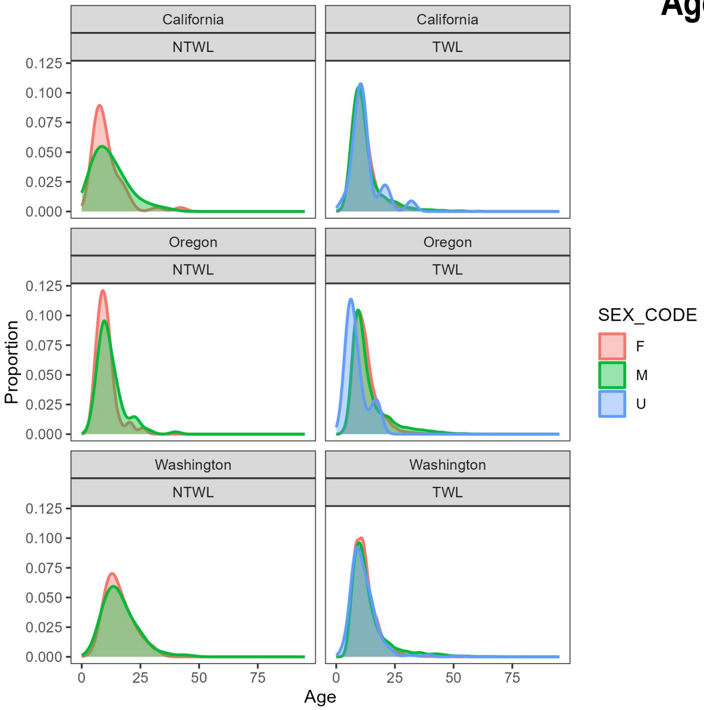


Commercial: Raw distributions by sex

Lengths



Ages

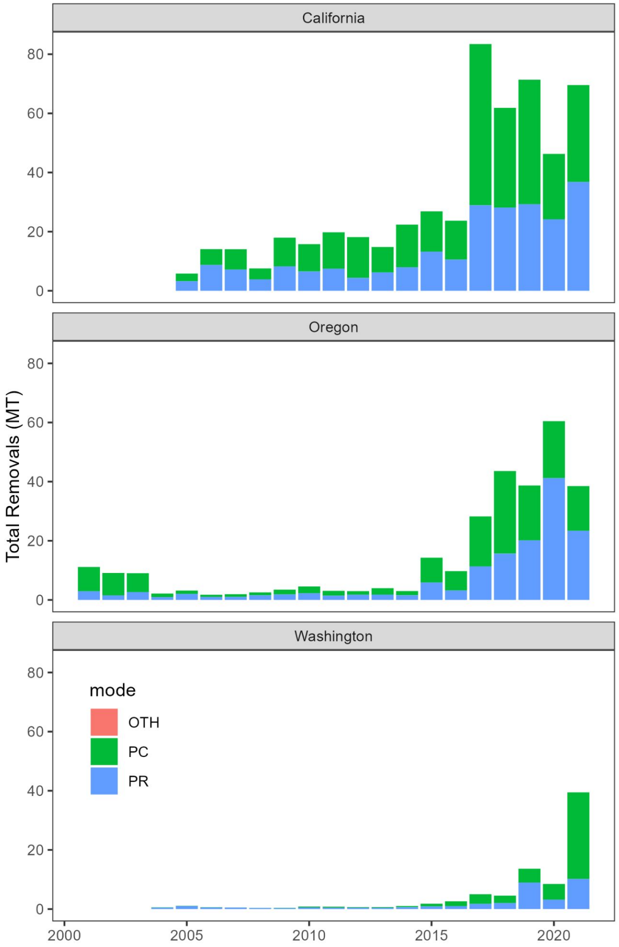


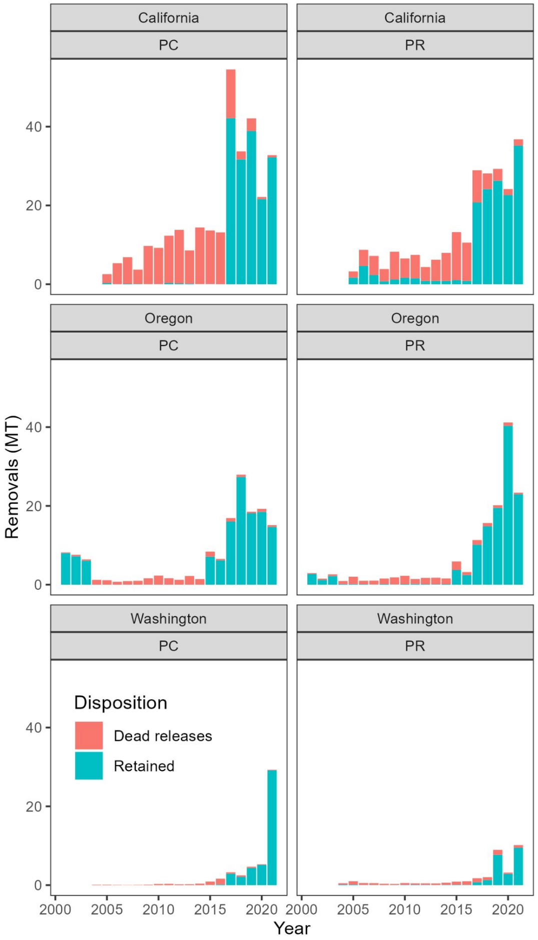
Recreational Removals by mode: Recfin

Used for CA and OR
Not used for WA

Private/Charter and Private/Rental have similar magnitude

Obvious period of no retention

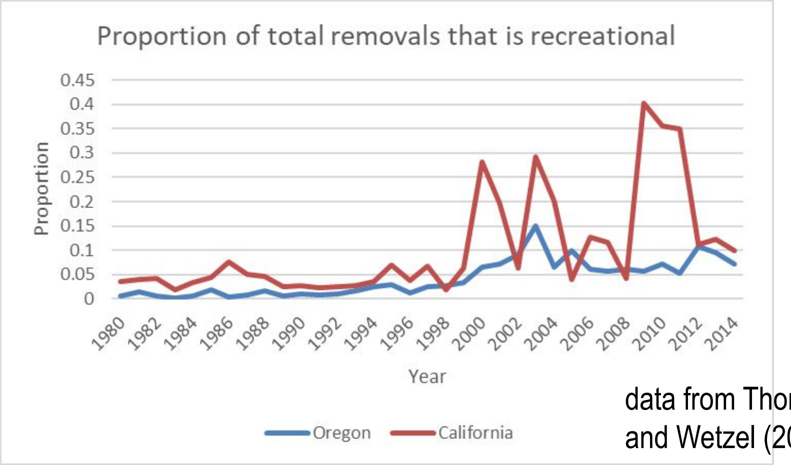




Contributions of recreational removals to total removals

Contribution of recreational removals higher during period of no retention…

…which is period of reduced fishing mortality



data from Thorson and Wetzel (2016)

Figure f. Time-series of estimated summary harvest rate (total catch divided by age-5 and older biomass) for the base case model (round points) with approximate 95% asymptotic confidence intervals (grey lines).

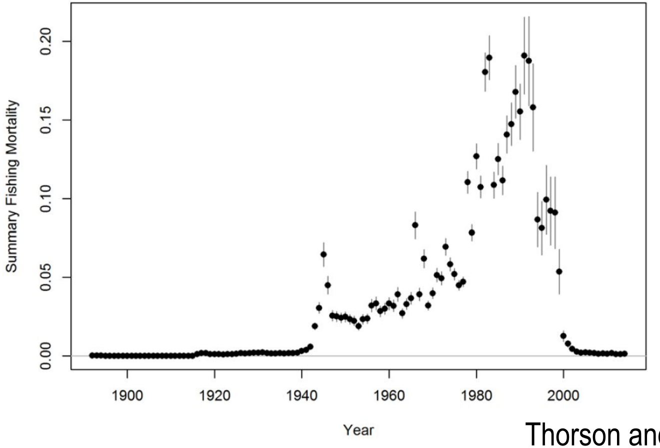


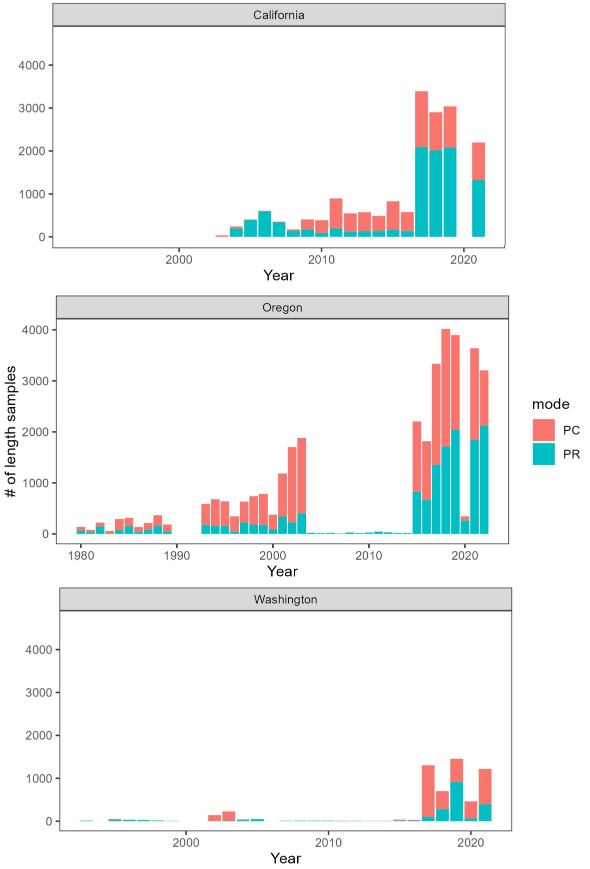
Figure f in Thorson and Wetzel (2016)

Recreational: Sample sizes

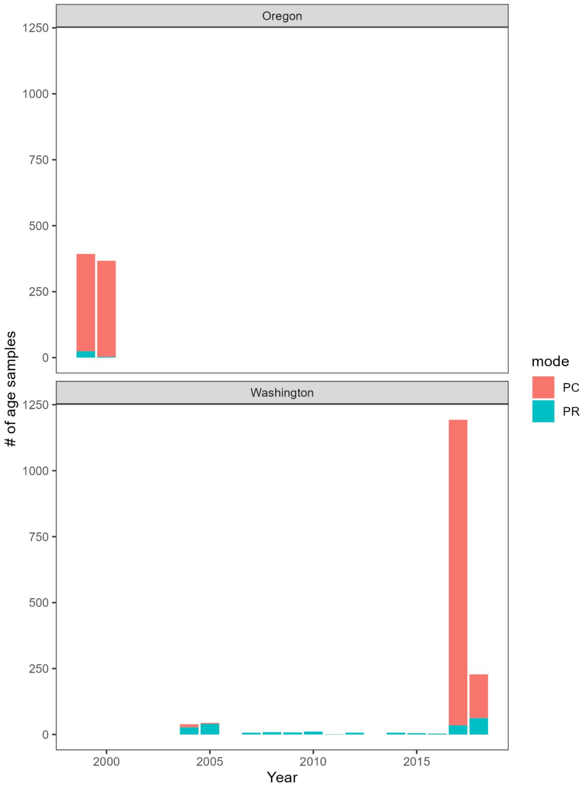
Majority of length samples are unsexed

Previous assessment did not include rec age comps

Lengths by mode



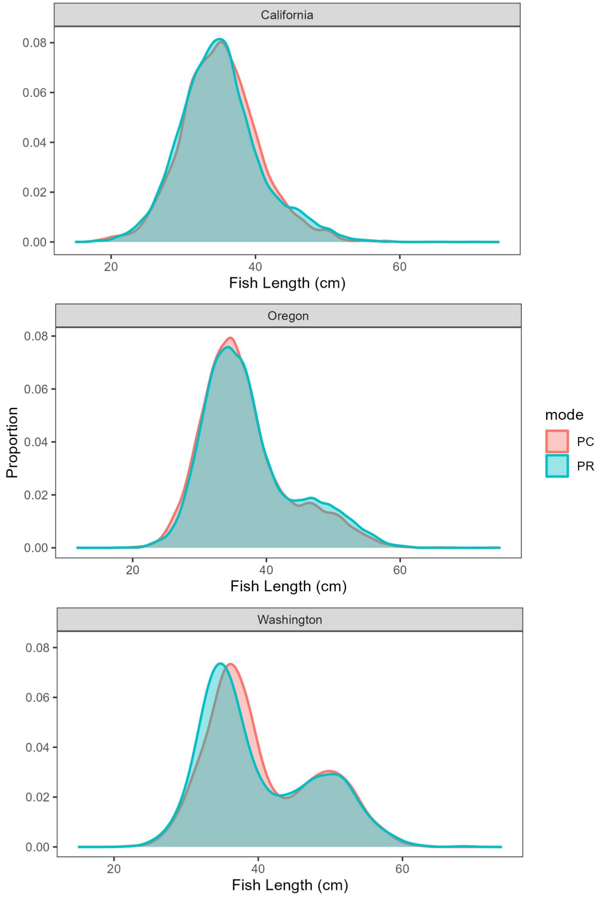
Ages by mode



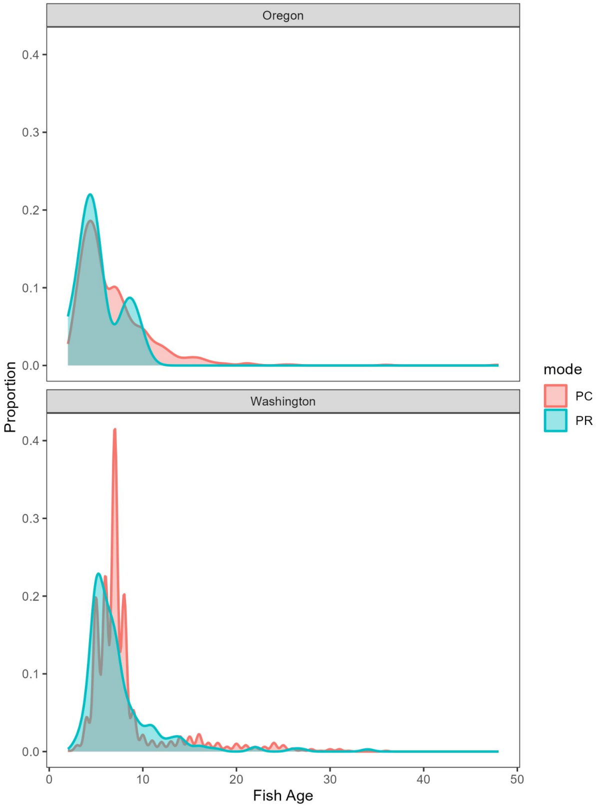
Recreational: Distributions

Plan to combine PR and PC modes

Lengths by mode without released fish



Ages by mode

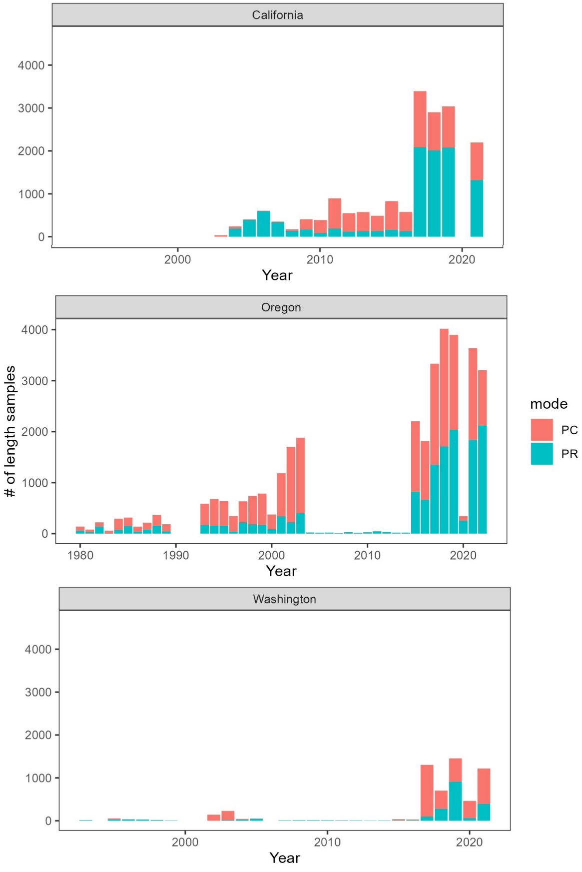


Recreational: Sample sizes

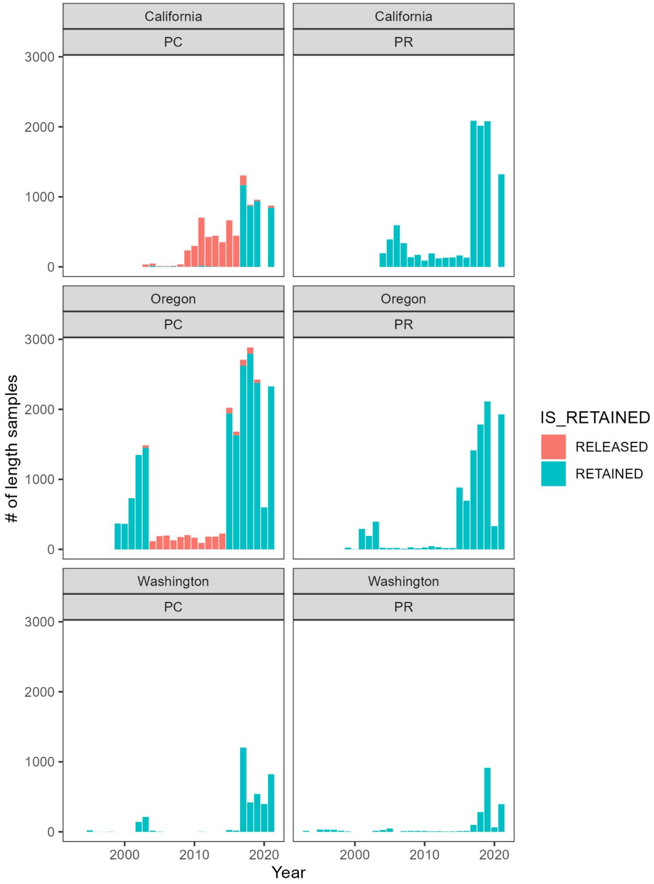
Majority of length samples are unsexed

Previous assessment did not include rec age comps

Lengths by mode



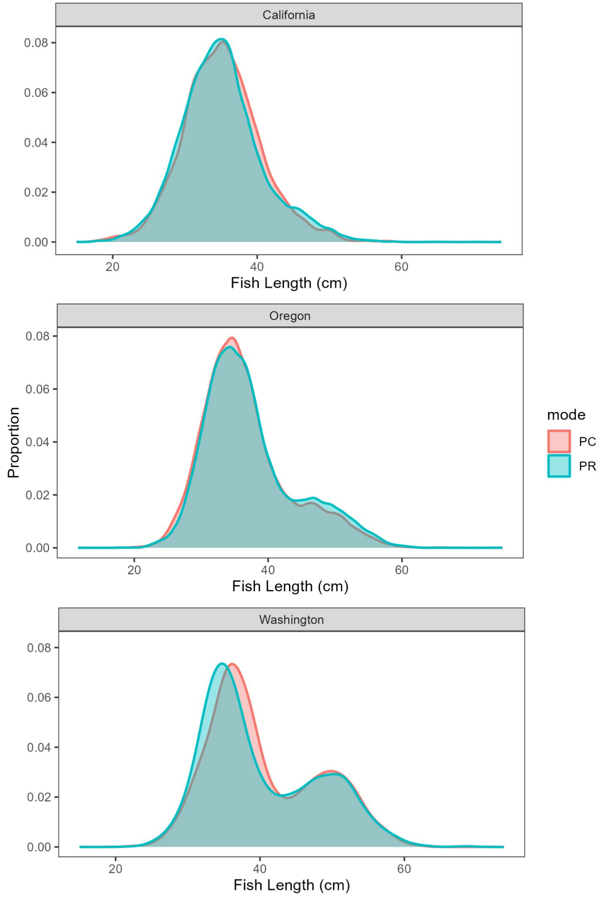
Lengths by mode and disposition



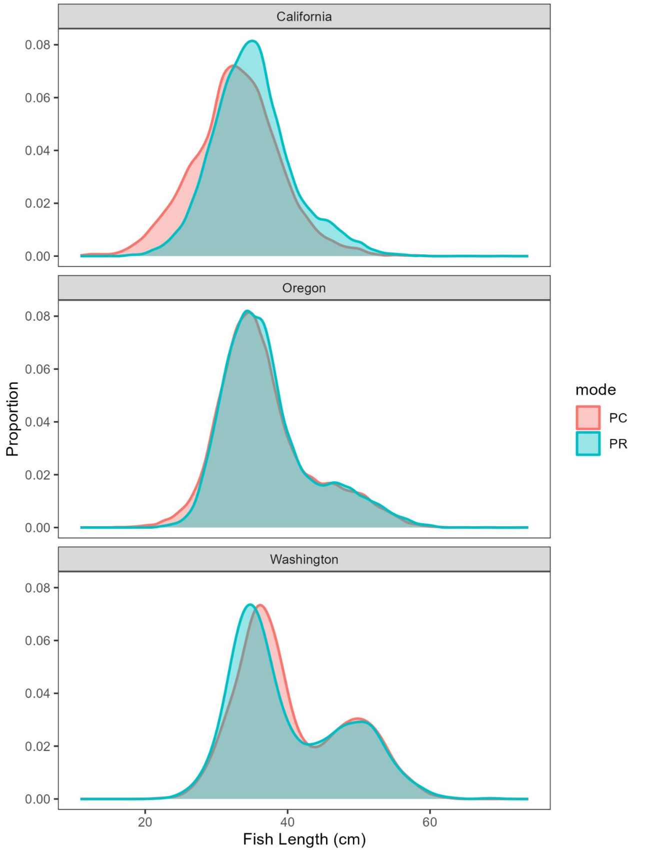
Recreational: Distributions

Plan to combine PR and PC modes

Lengths by mode without released fish



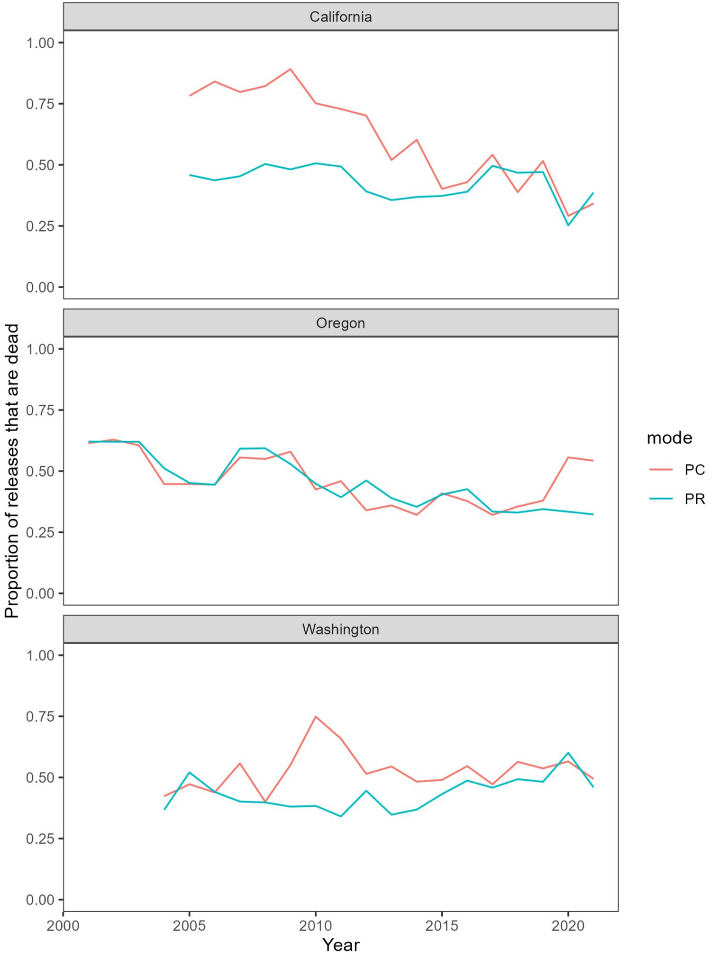
Lengths by mode with released fish



Recreational Mortality Rates

From RecFIN

$$\frac{\text{released dead}}{\text{released dead + released alive}}$$



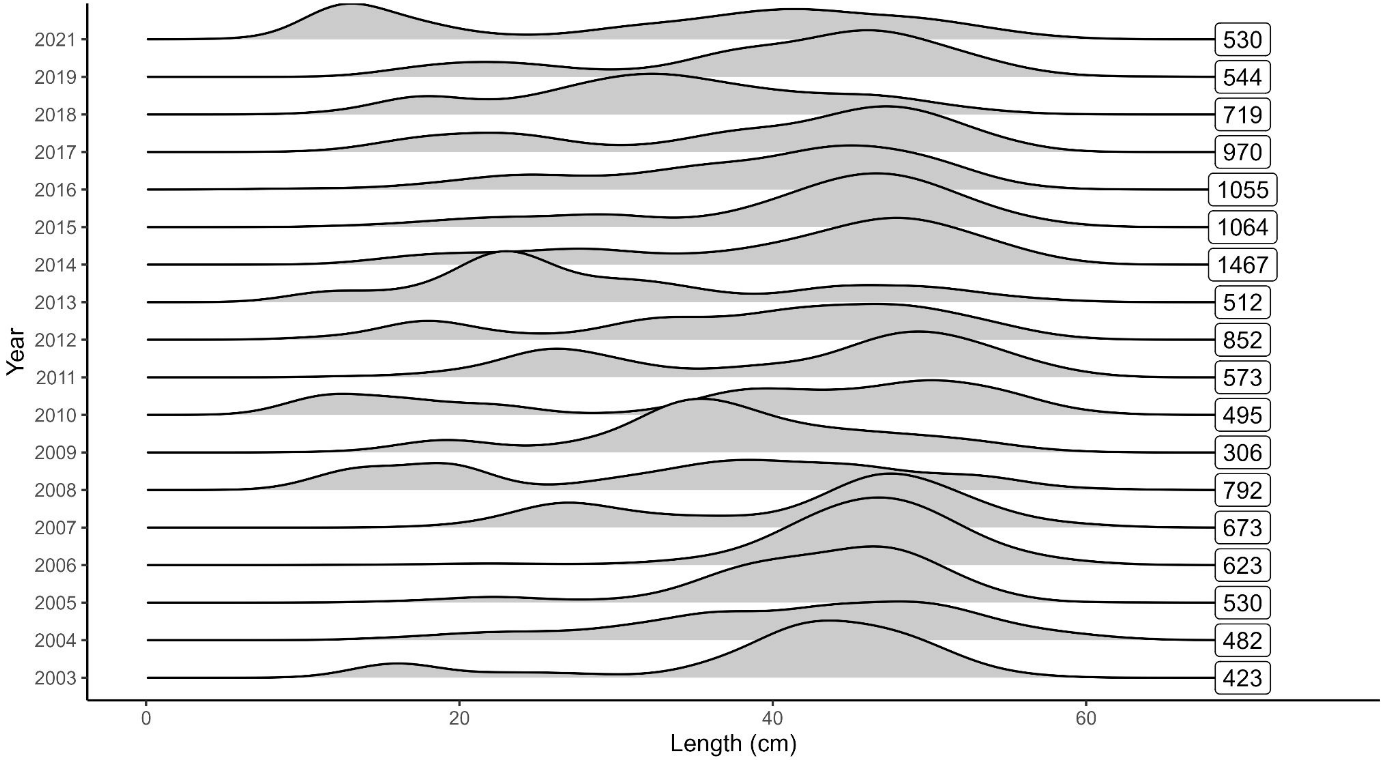
Choice of modeling of discards

Plan to model as landings + discards as done in 2015 assessment

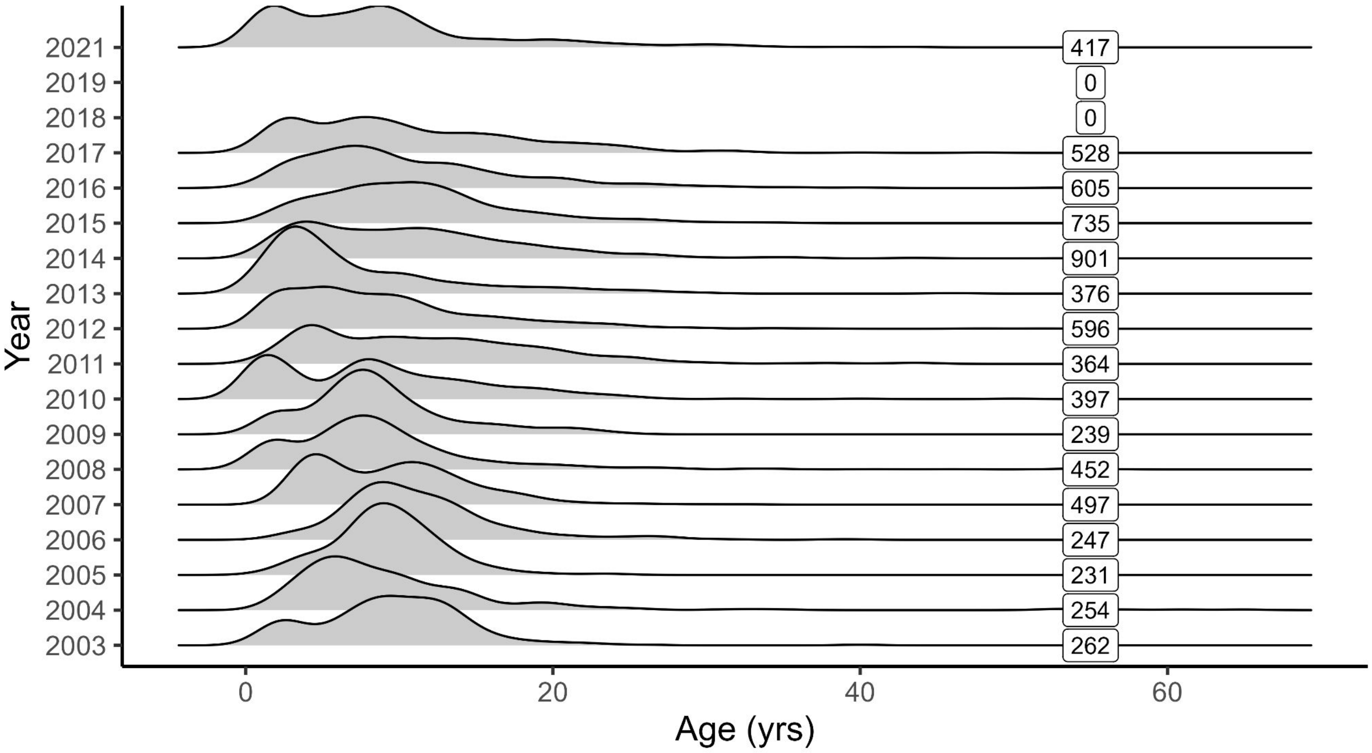
Alternatives include:

a. Model as a discard fleet, possibly with comps and selectivity
b. Model discards within the model using a retention curve (fit to discard rate or magnitude data)

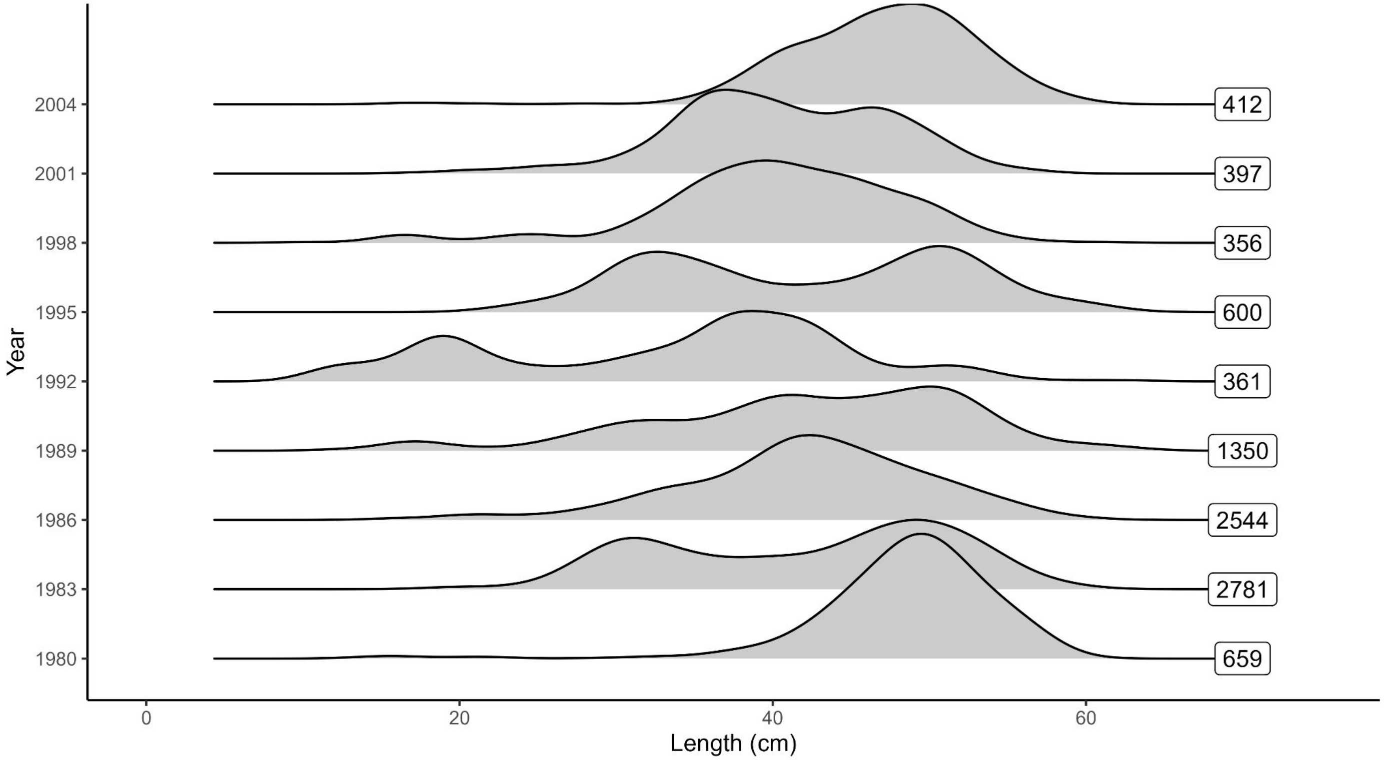
Length compositions: WCGBT survey



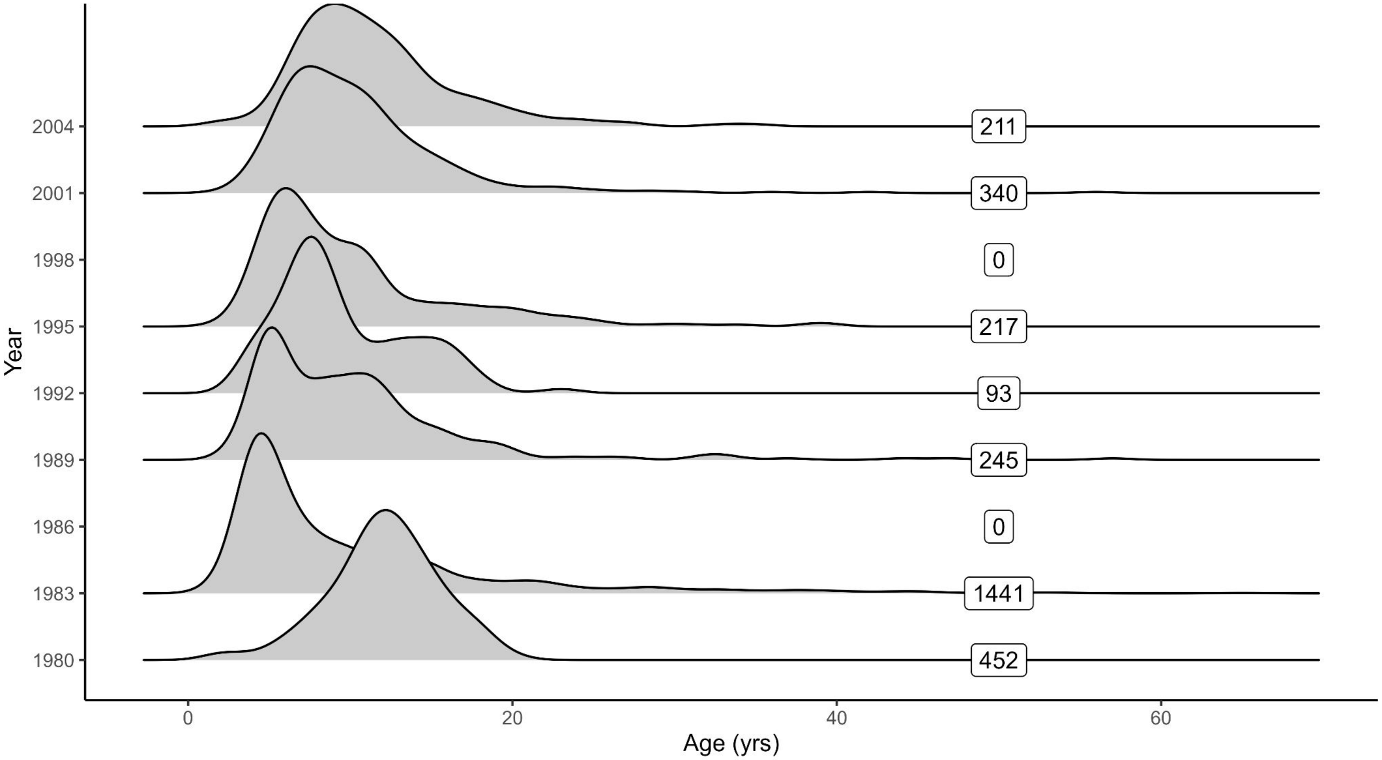
Age compositions: WCGBT survey



Length compositions: Triennial survey



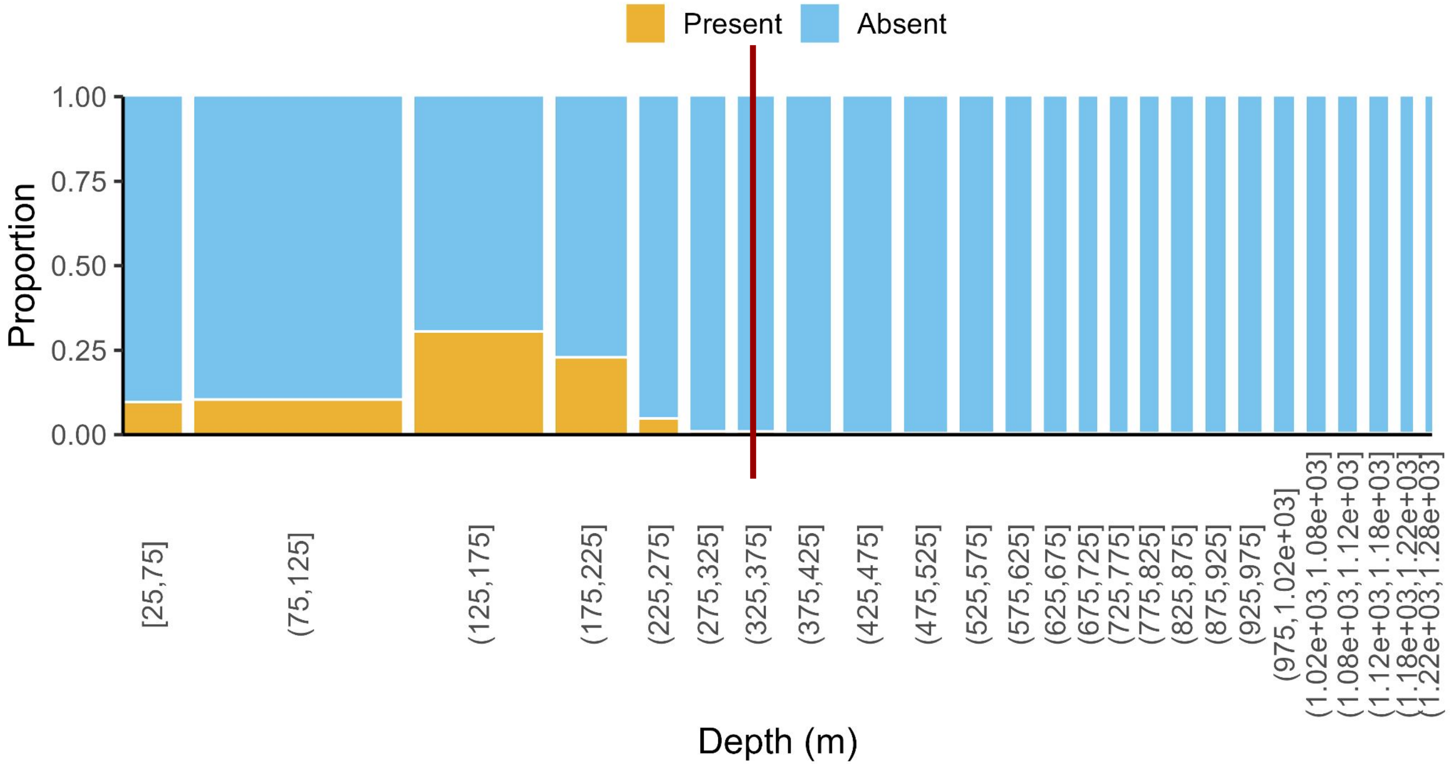
Age compositions: triennial survey



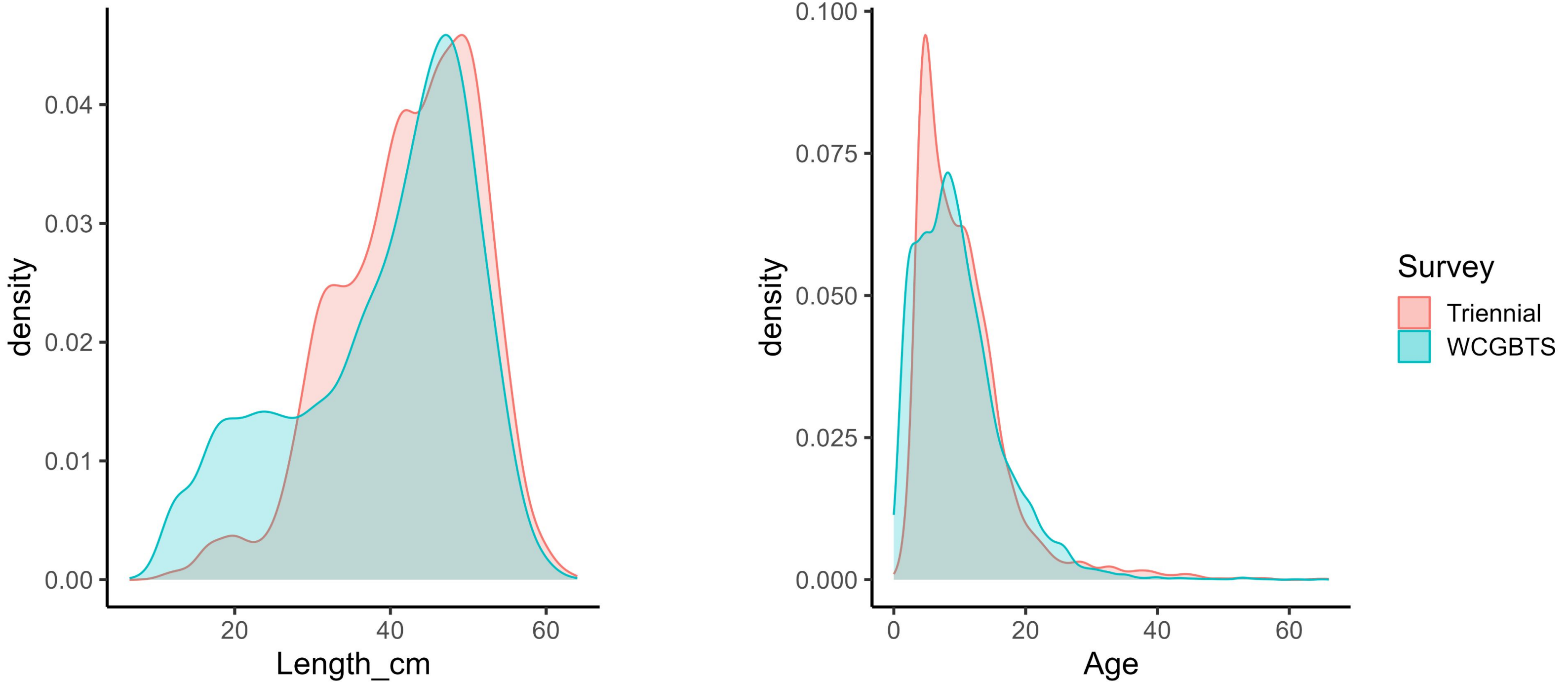
Presence in survey tows

Only present in ~⅓ of tows at optimum depths

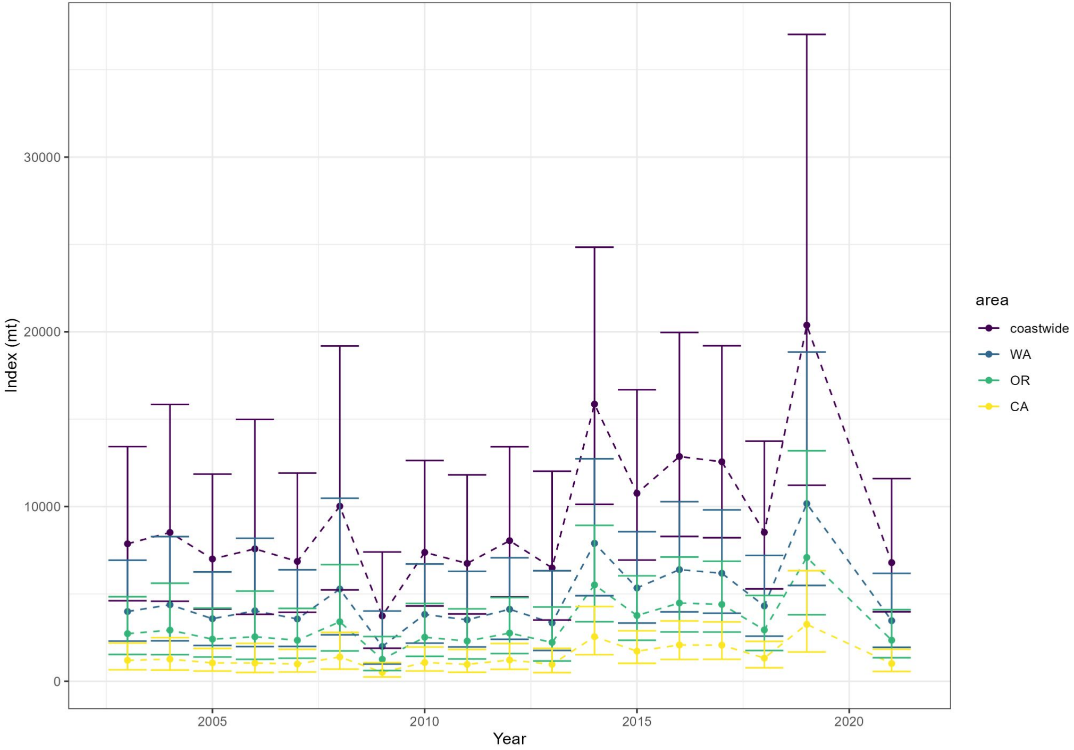
Cut off distribution at 350m



WCGBTS selects broader range of population than triennial



State indices mirror coastwide trends



History of female M

1996: one assessment, OR/WA only, female M ramp from 0.06 at age 9 to roughly 0.18 at age 25. (I think 25 was the plus group.)

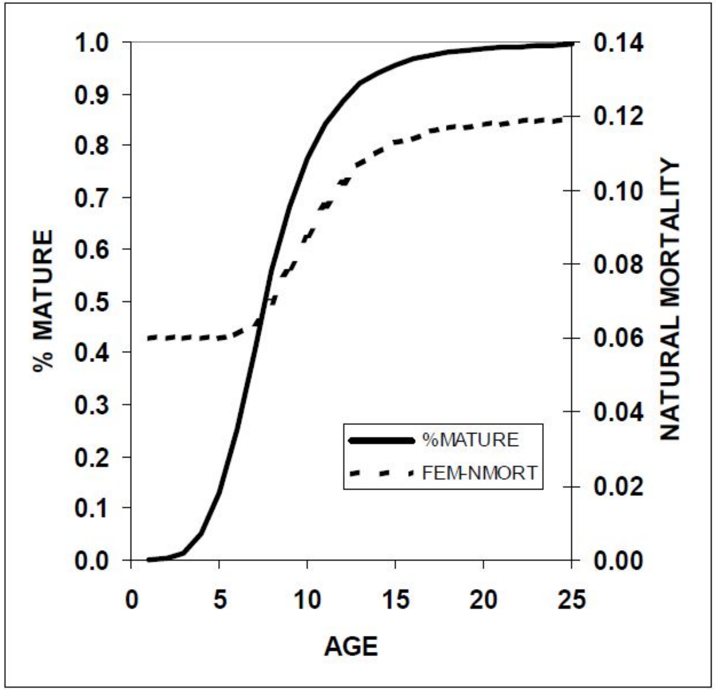
1999: two assessments. OR/WA had more data. 0.06 at age 11 increasing to 0.20 at age 25. Extensive research into life history theory.

2001: first to estimate the female M offset. used (%mature)^kappa*(M2-M1) as “slope” of ramp, so not linear w/age! Noted rationale for higher M is usually associated with stress of spawning.

2005: 2001 approach no longer possible in SS2, approximated it using linear ramp from age 6 to 14. This is the approach that has been used since.

M “ramp” from 2001

Maturity curve has changed since 2001!



Tentative Proposed Model Structure for 2023

- Explore simplifying structure from 2015 model
  1. Exclude recruitment apportionment spatial structure
  2. Exclude triennial survey data
  3. Exclude survey catches
     - low values and add complication for projections
  4. Fix some selectivity parameters
     - estimating all 6 probably over parameterized
  5. Exclude surface-read age comps
- Additions to 2015 model
  1. Add recreational (and commercial) age compositions
  2. More exploration of mechanisms explaining lack of older females
  3. More exploration of indices