Survey data update

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Crab Plan Team

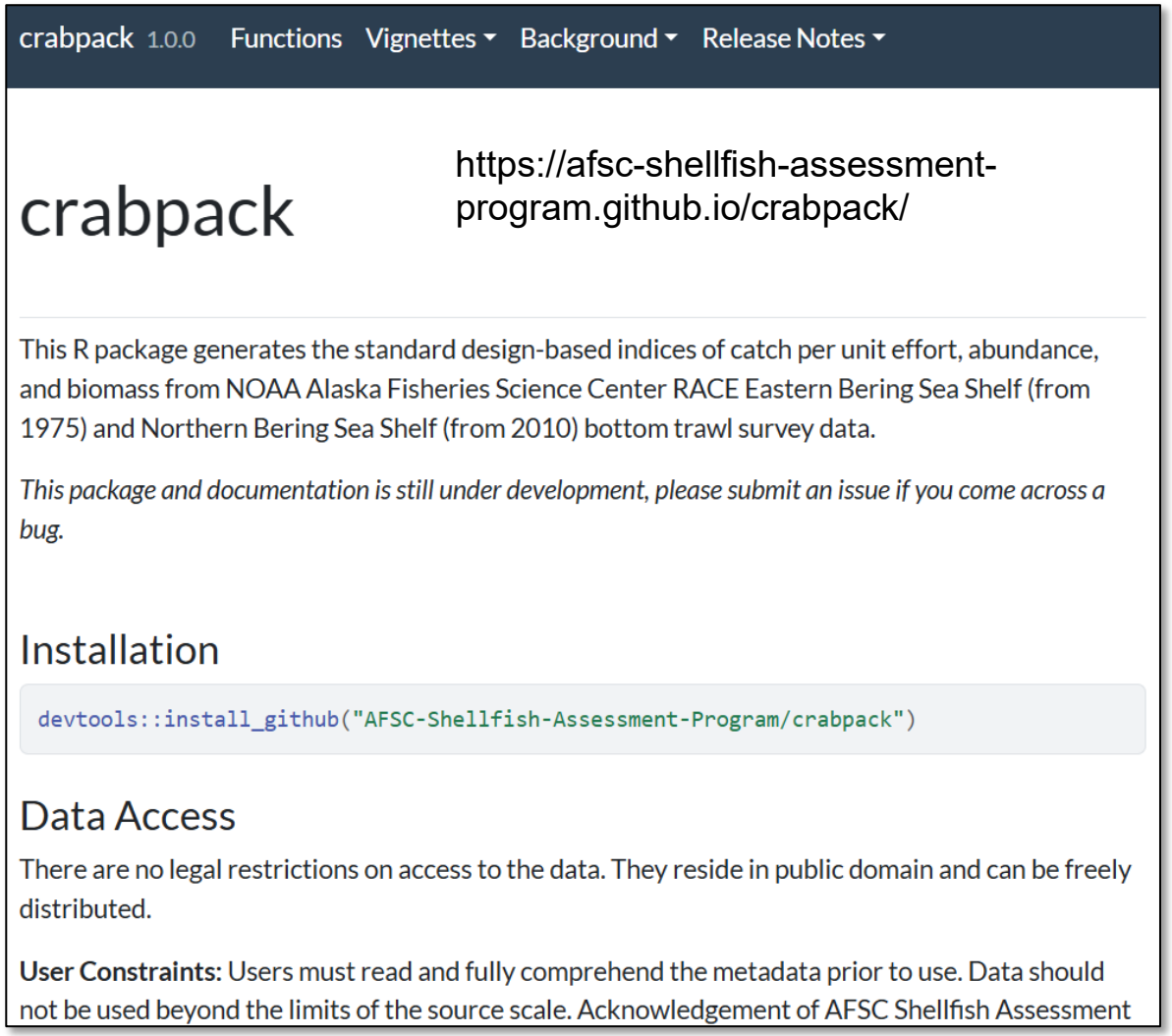
May 2025

Topics

Simple

Less simple

- New survey data platform - crabpack
- Survey footprint & gear history
- Post-corner station calculations - 1 stratum vs. 2 strata
- Carapace measurement precision
- Weight-length data
- *Chionoecetes* maturity data

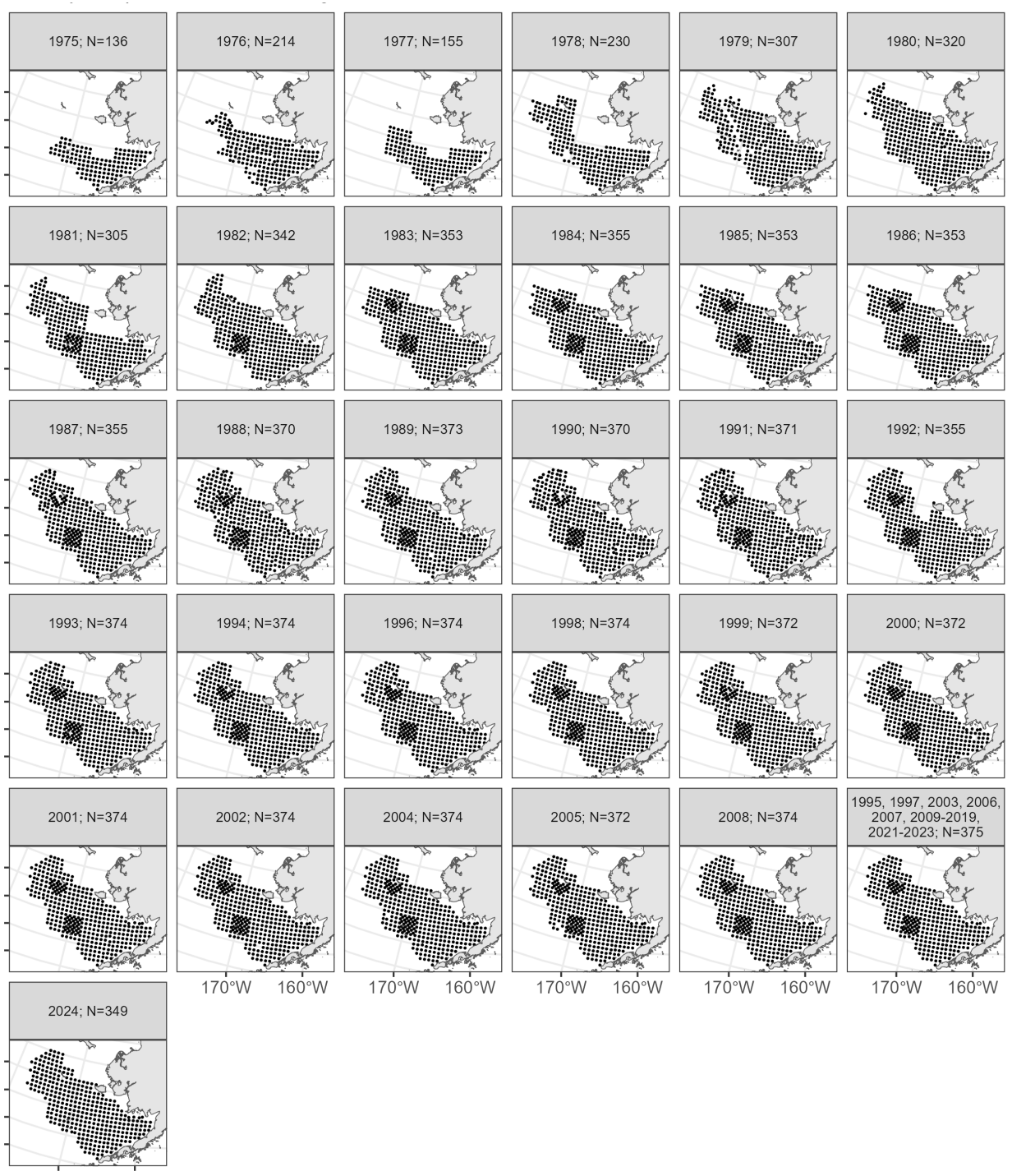


- Goal: data product that is standardized, transparent, reproducible, version-controlled, and that reduces effort for survey group & data users while increasing data availability
- Publicly available via API key
- **Platform for all data dissemination in 2025**
- Fallback option: .rds objects provided directly from survey group
- **Please reach out if your workflow is not already updated!**
  - Create issue on repository - https://github.com/AFSC-Shellfish-Assessment-Program/crabpack
  - Email - shannon.hennessey@noaa.gov (data contact for survey group)

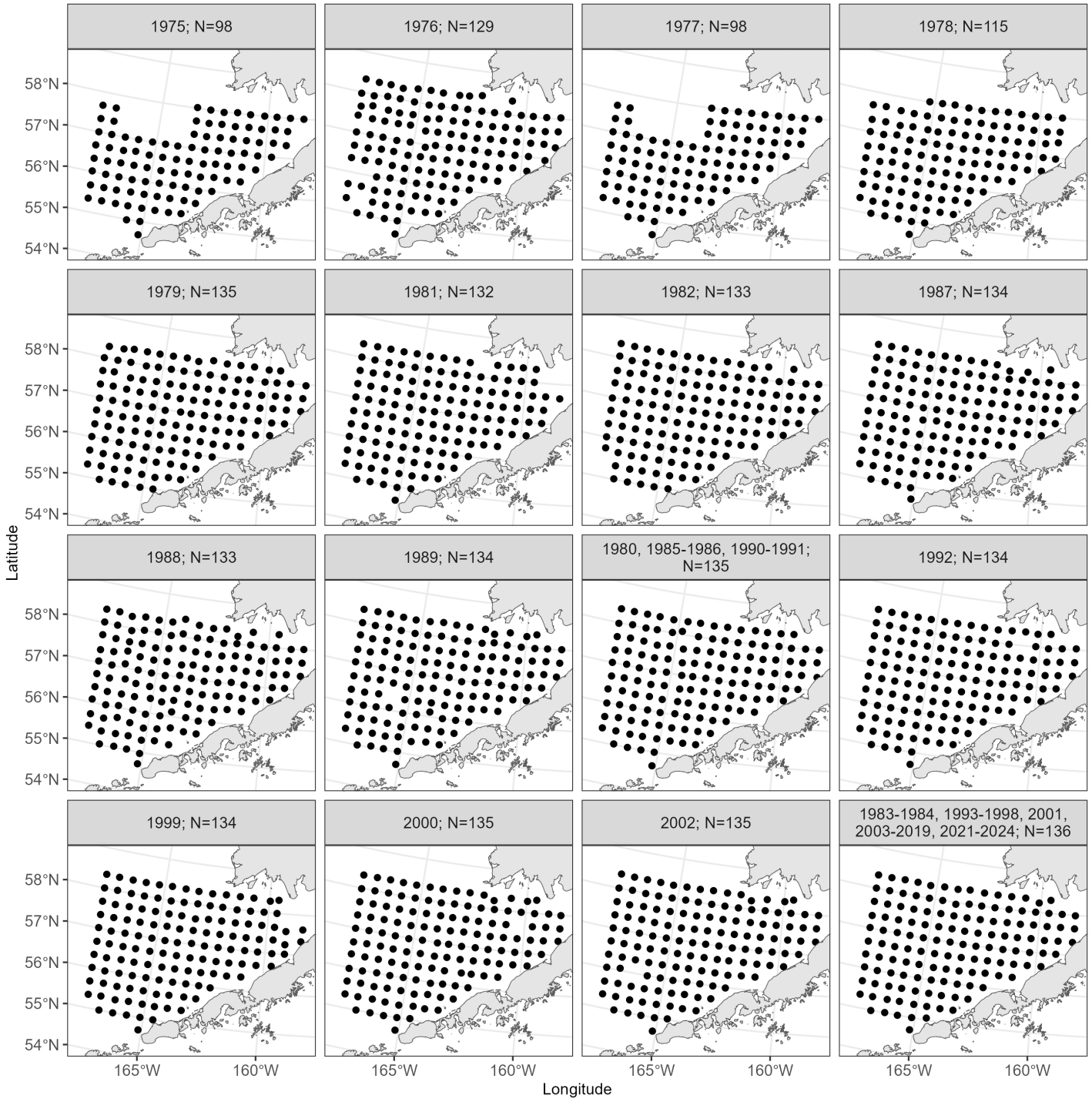
Survey history

- October 2024 report: "*The SSC requests that the survey authors provide a clear overview of the survey's historical standardization and a summary of the years used by any of the stock assessments*."
- Survey history and assessment time series presented to CPT in January 2023
- Assessment time series use presented to SSC in February 2023.
- General approach of survey group:
  - Provide data from 1975 - present to assessment authors and other users
  - For annual tech memo describing survey results, present time series with comparable survey footprint
    - BBRKC: 1979 - present
    - PIBKC / PIRKC: 1981 - present
    - SMBKC: 1983 - present
    - Snow / Tanner crab: 1988 - present
    - All stocks combined: 1988 - present

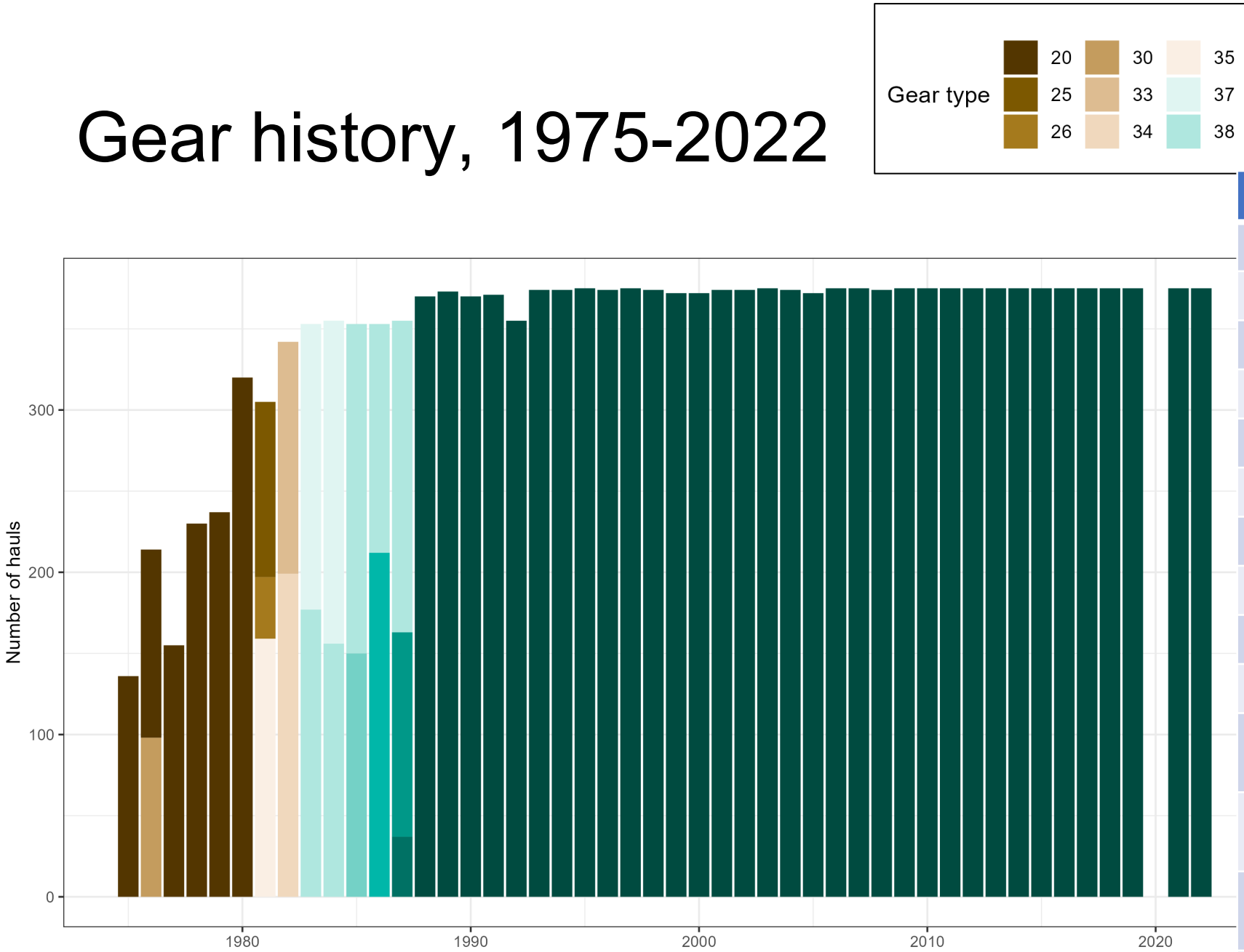
Shelf coverage 1975 - 2024



Bristol Bay coverage 1975 - 2024



Gear history, 1975-2022



Code	Description
20	71-94 Eastern, 12.19m width
25	71-94 Eastern, 13.41m width
26	71-94 Eastern, 14.33m width
30	83-112 Eastern, 17m width
33	83-112 Eastern, 16.65m width
34	83-112 Eastern, 16.26m width
35	83-112 Eastern, 17.98m width
37	83-112 Eastern, 16.54m width
38	83-112 Eastern, 16.41m width
39	83-112 Eastern, 18m width
40	83-112 Eastern, 16.65m width, 3m height
42	83-112 Eastern, 16.67m width in depth < 100m
43	83-112 Eastern, 17.8m width in depth < 100m
44	83-112 Eastern, 17m width, mensuration gear

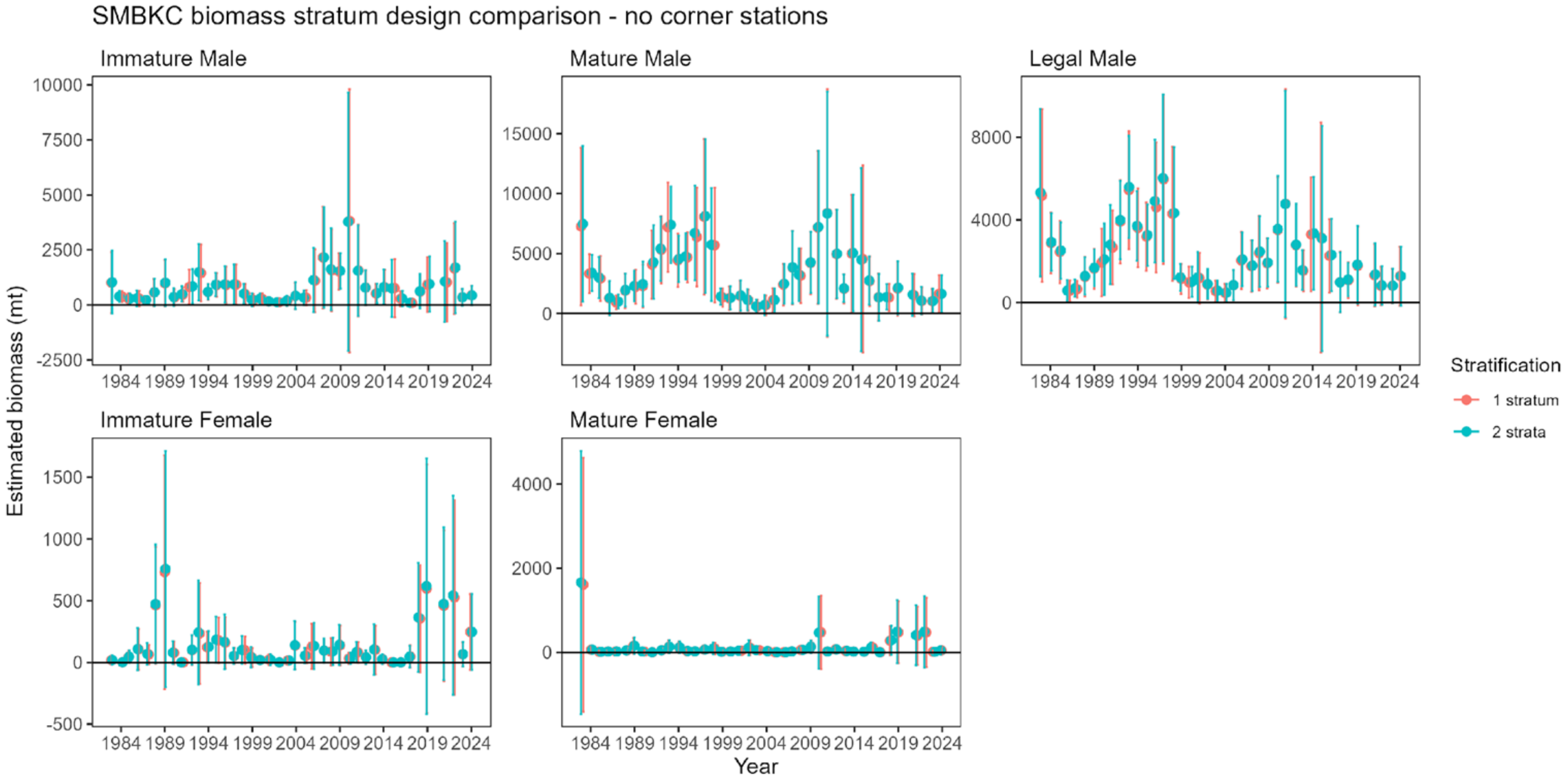
Assessments - survey time series

- Default should be to use all the data available – long history of CPT recommendations
- Moving the start date if:
  - Early data are suspect and this leads to convergence issues or divergent trajectories for the stock
  - Changes in population dynamics present difficulties in modeling periods of very different M, R, etc.
- Models estimate different catchability / selectivity to account for differences in coverage and gear
- Time series used in most recent SAFEs:
    - BBRKC: 1975 - present
    - PIBKC 1976 - present
    - PIRKC: 1975 - present
    - SMBKC: 1978 - present
    - Snow crab: 1982 - present
    - Tanner crab: 1975 - present

SMBKC corner station removal

October 2024: "*The SSC recommends that the producers of the crab trawl survey estimates should explore showing both high and low-density strata estimates without the corner stations, alongside the one-stratum estimate seen in this assessment, to better understand potential biases*."

Stratification with no corners: 1 stratum or 2 strata?



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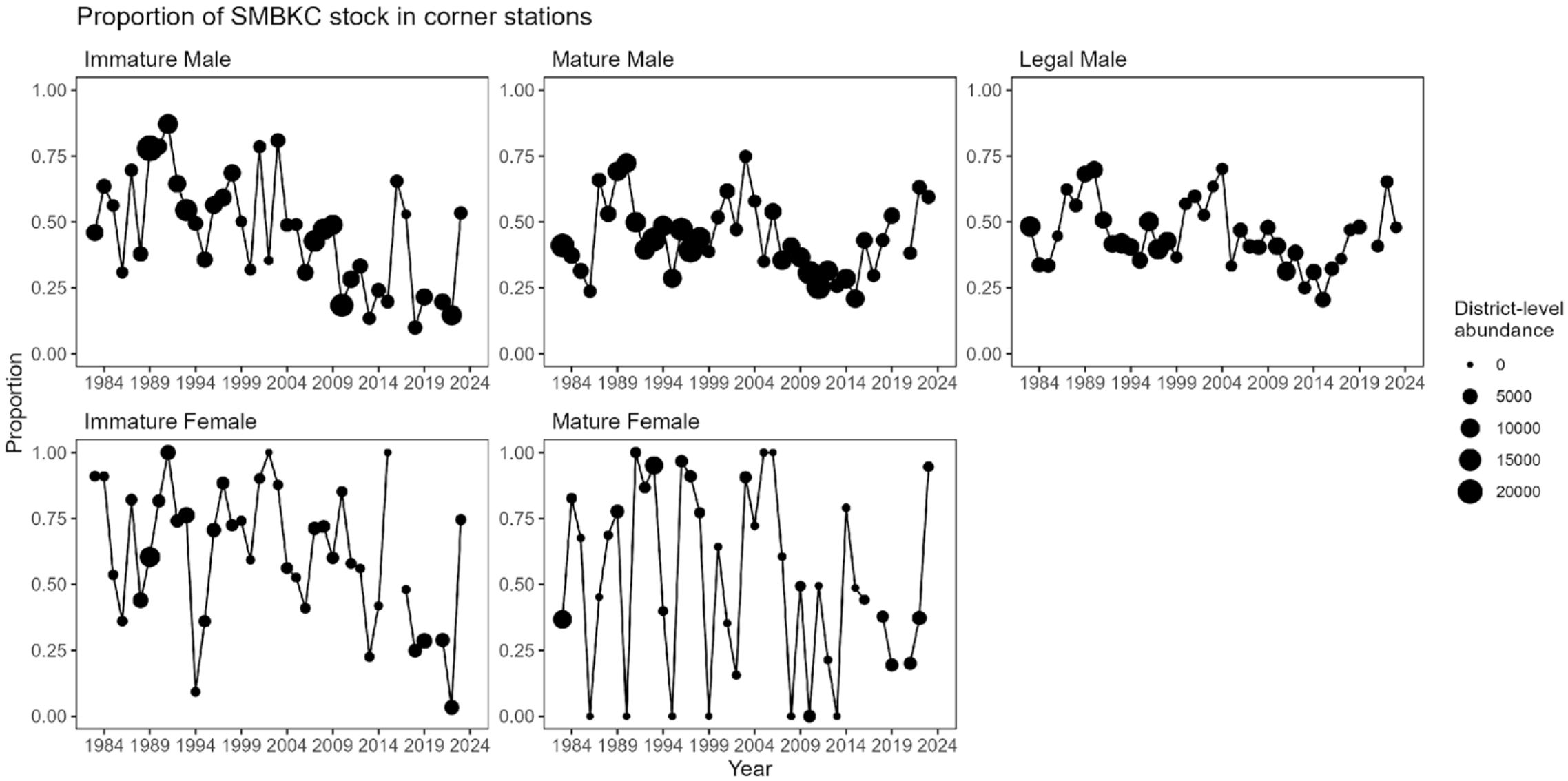
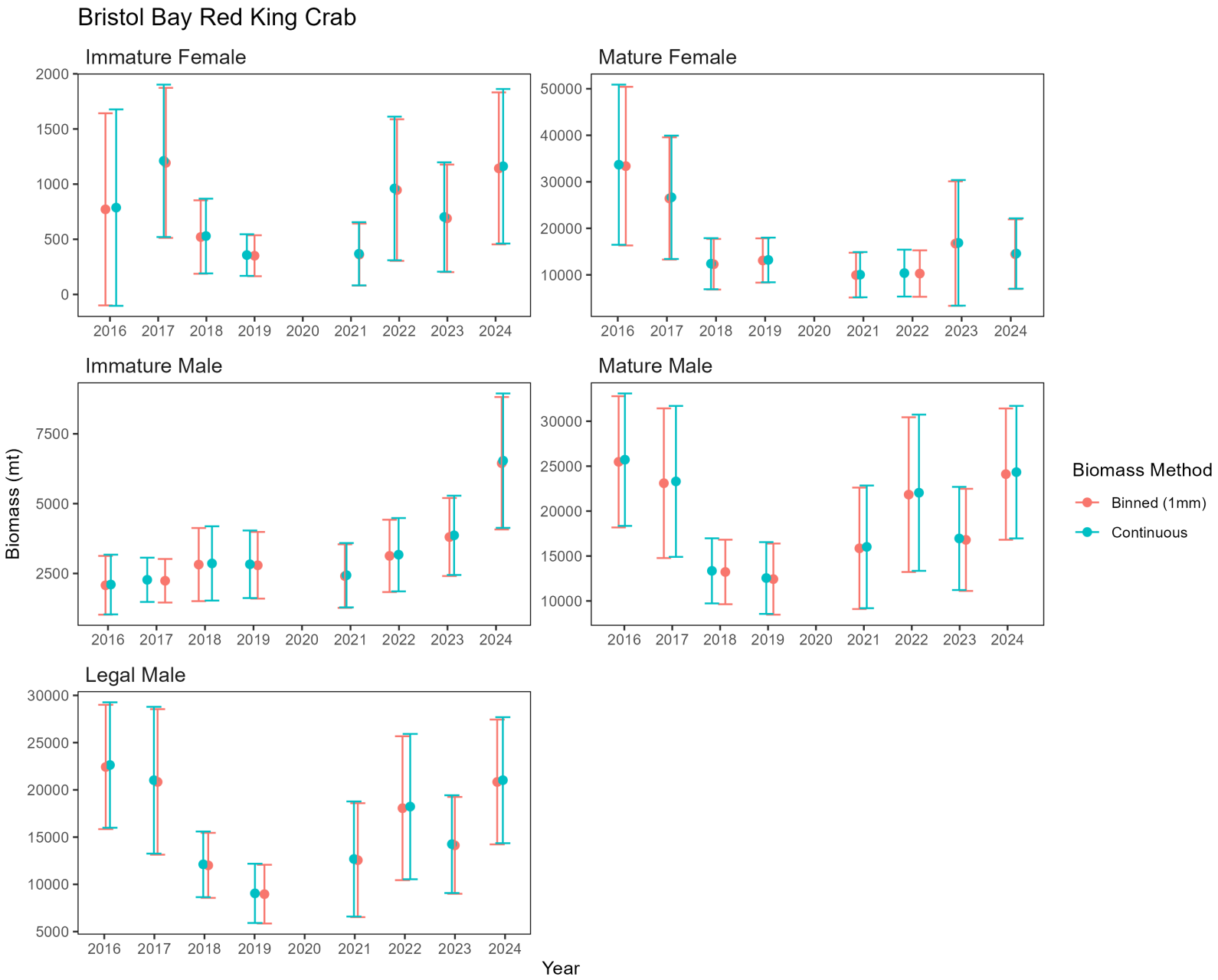


1mm-binned vs. 0.1mm size biomass estimates

- Moved from 1mm precision to 0.1mm precision for carapace measurements in 2016
- Bug in legacy workflow - all measurements are rounded down to the nearest whole mm before fitting length-weight regressions to estimate biomass
- Propose changing to using actual measurements for regressions
- Results in a very slight upward adjustment in biomass estimates

Biomass comparison:
1mm-bin vs. 0.1mm



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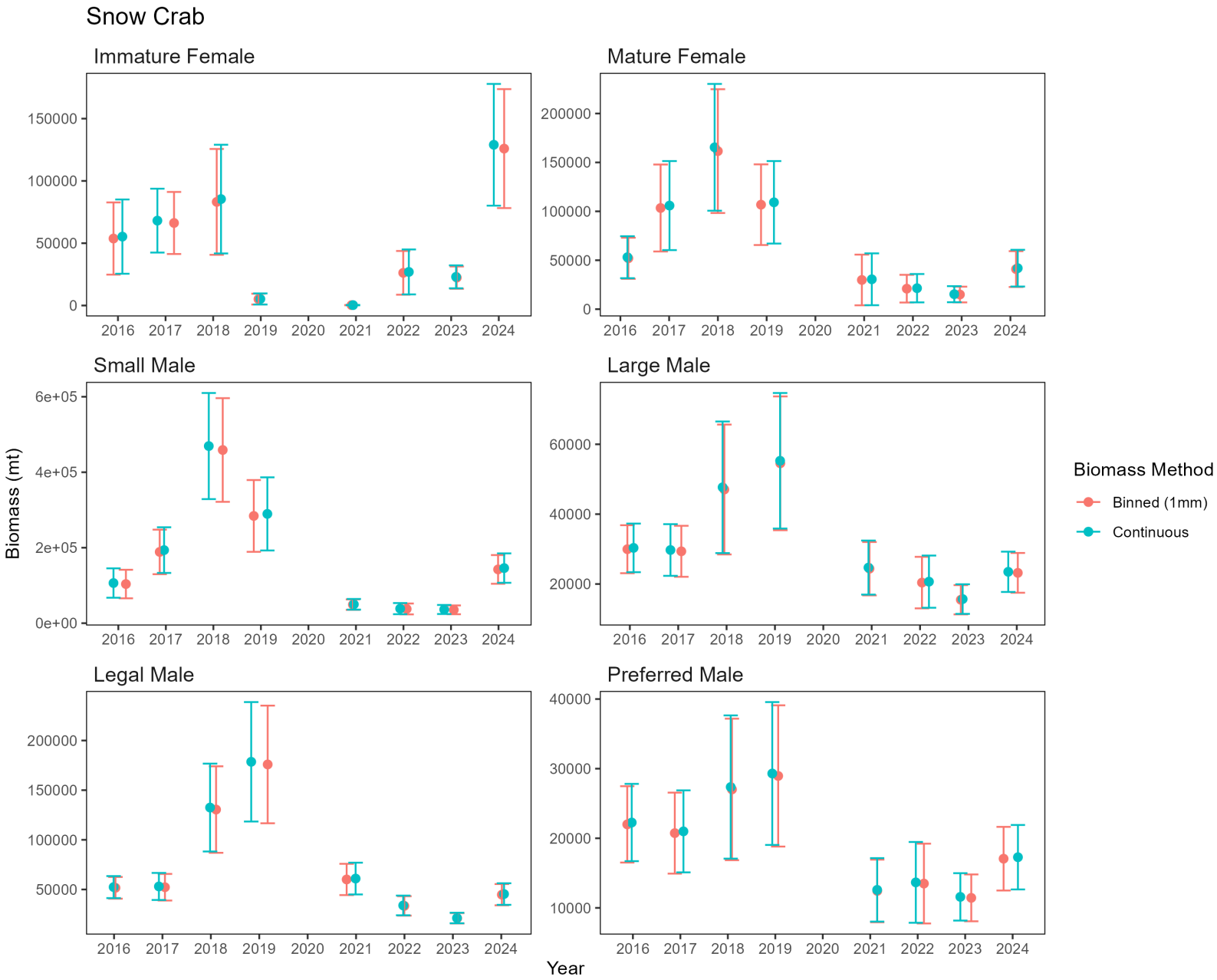

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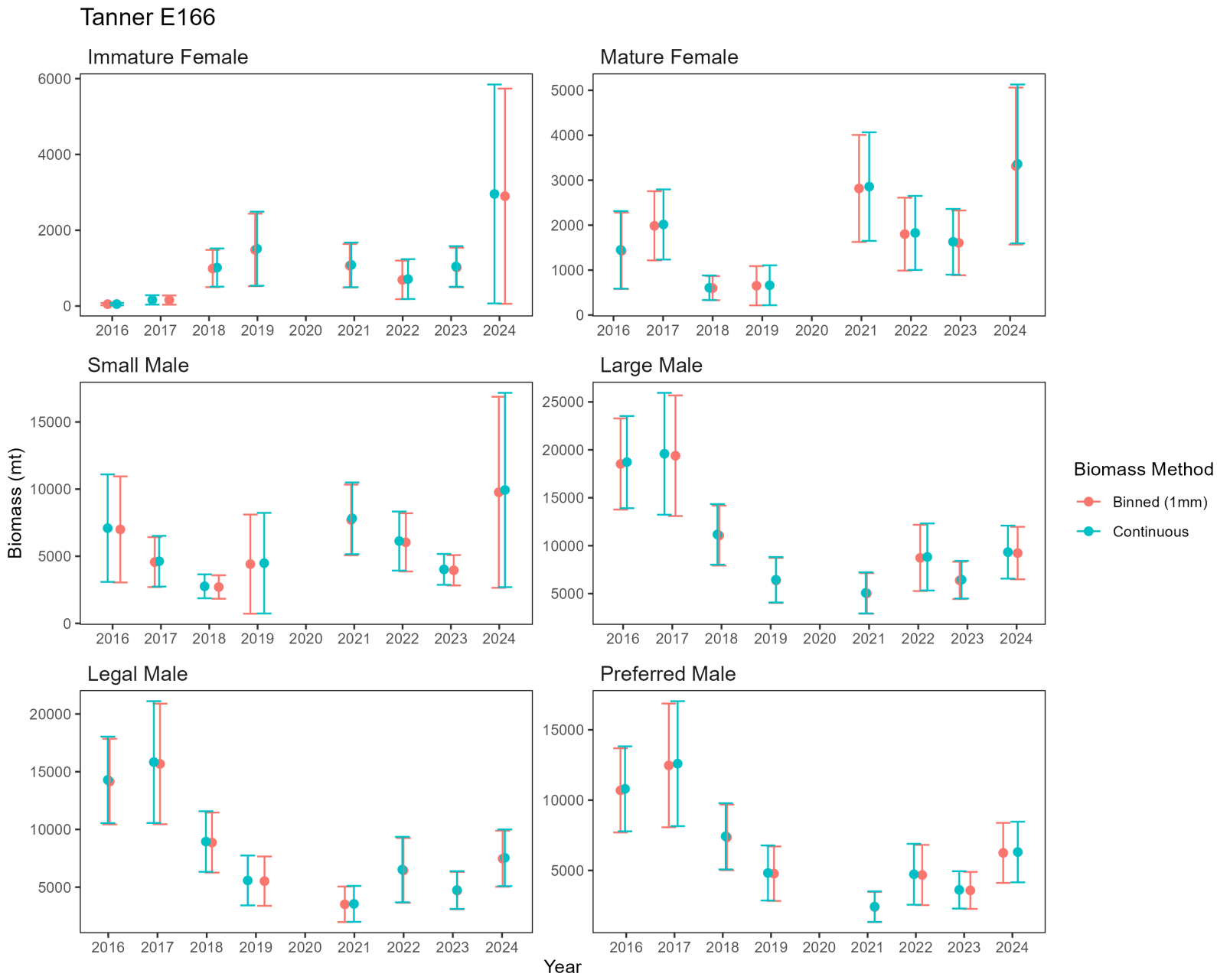

Biomass comparison:
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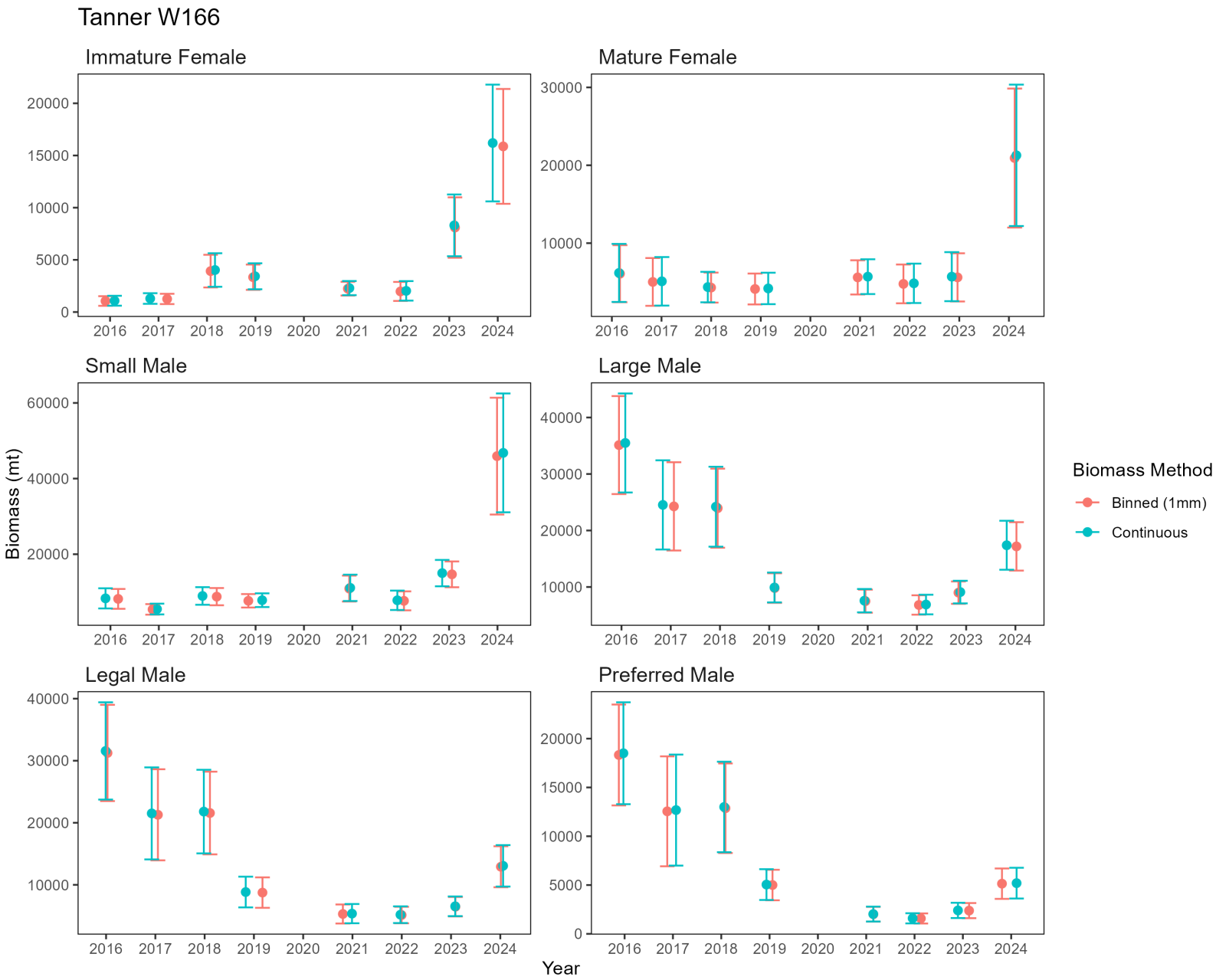


Length-weight regression update

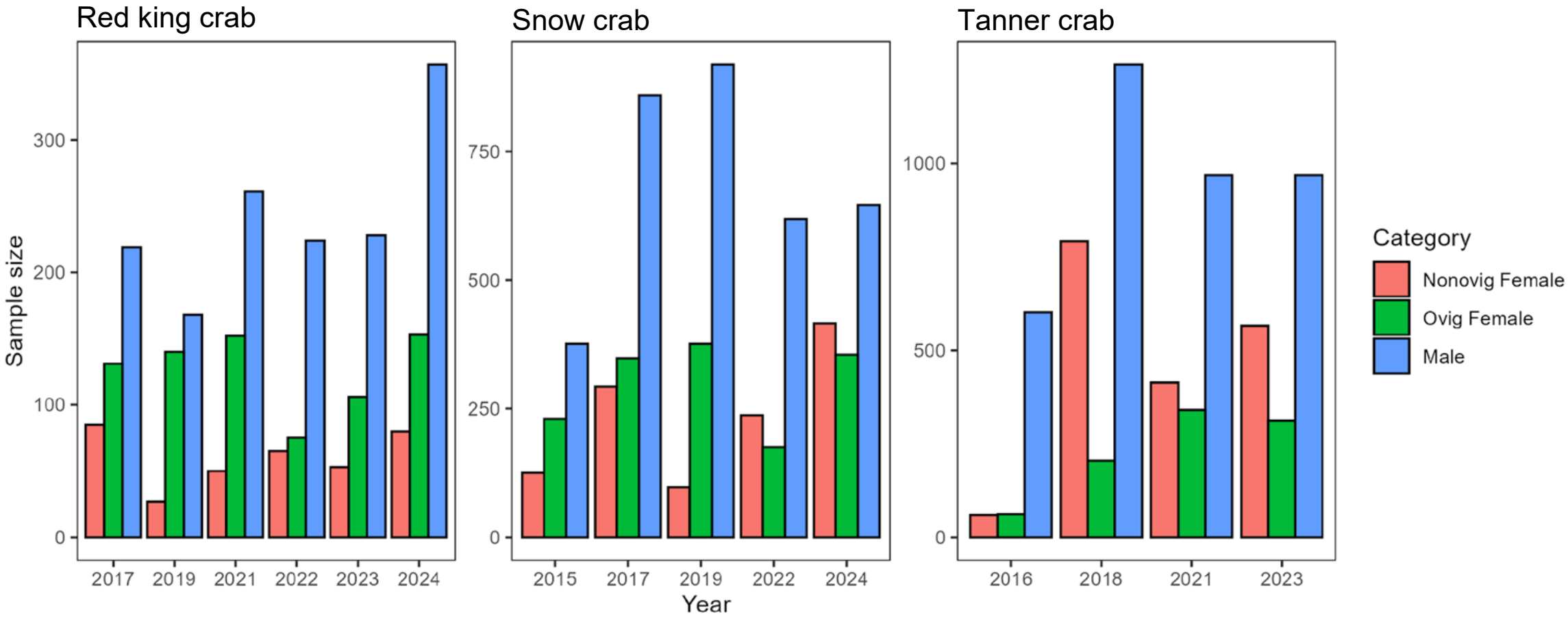
Purpose

- Currently use weight-length data from fixed 2000-2009 window to translate abundance and size to biomass estimates
- Currently collect individual RKC weights every year, and *Chionoecetes* weights in alternate years
- Moving towards taking both *Chionoecetes* spp. weights every year, to allow annual length-weight regressions to estimate biomass (CPT recommendation January 2024)
- In order to assess impact of transition to annual regressions, we need to:
    1. Evaluate annual variation in parameter estimates
    2. Evaluate the effects of decreasing sampling effort (not feasible to sample both species annually at current effort levels)
    3. Compare changes in estimated biomass with yearly length-weight regression vs. legacy parameters

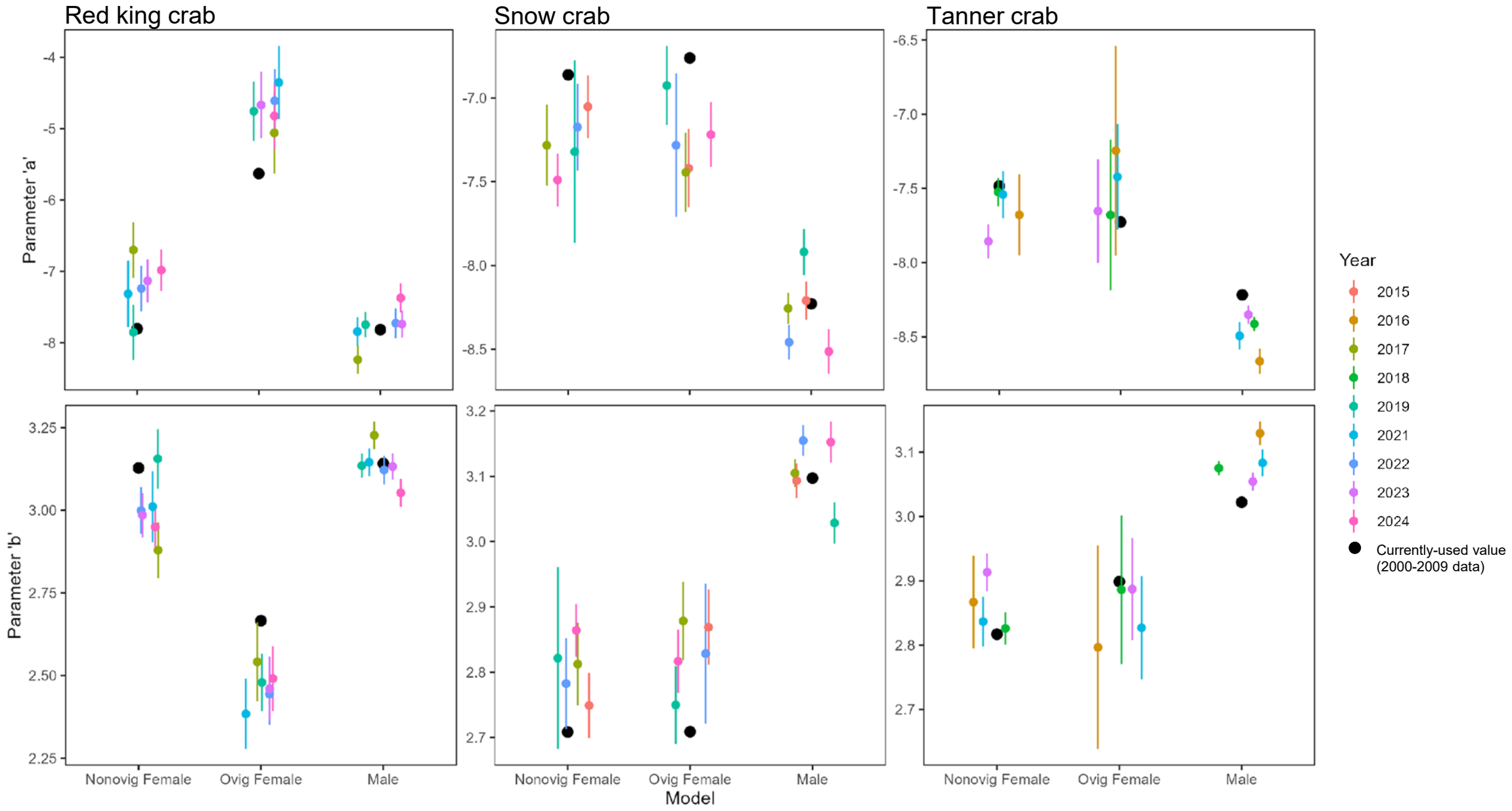
Annual variation in parameter estimates

- 3 models per species:
  - Males
  - Nonovigerous females
  - Ovigerous females
- Fitted linear regression model: log(weight) ~ a + b*log(size)
- Removed extreme outlier observations
  - Retained observations with Cook's distance < 32/n
- Evaluated parameter point estimates and 95% CI

Sample sizes



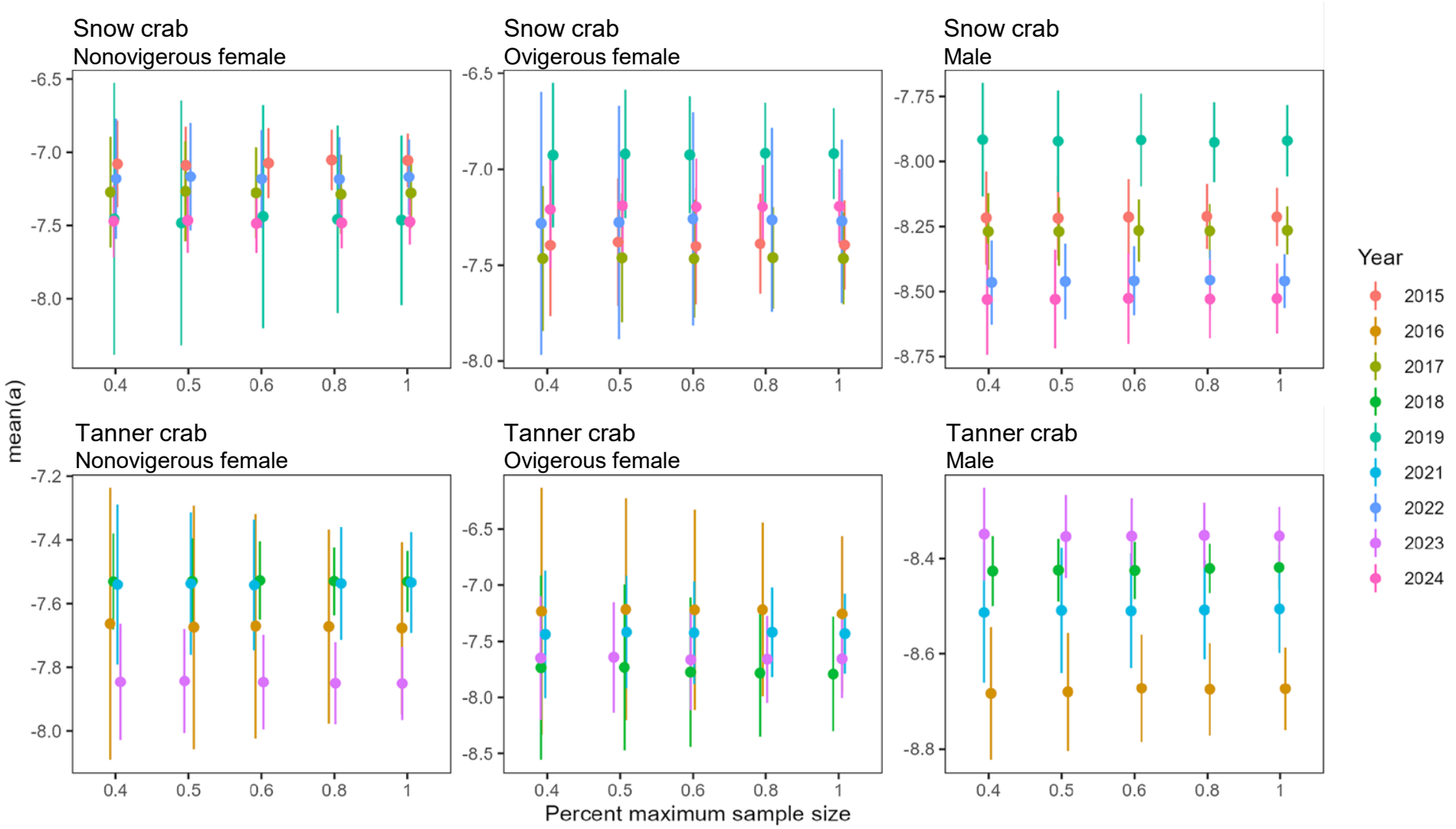
Annual parameter estimates



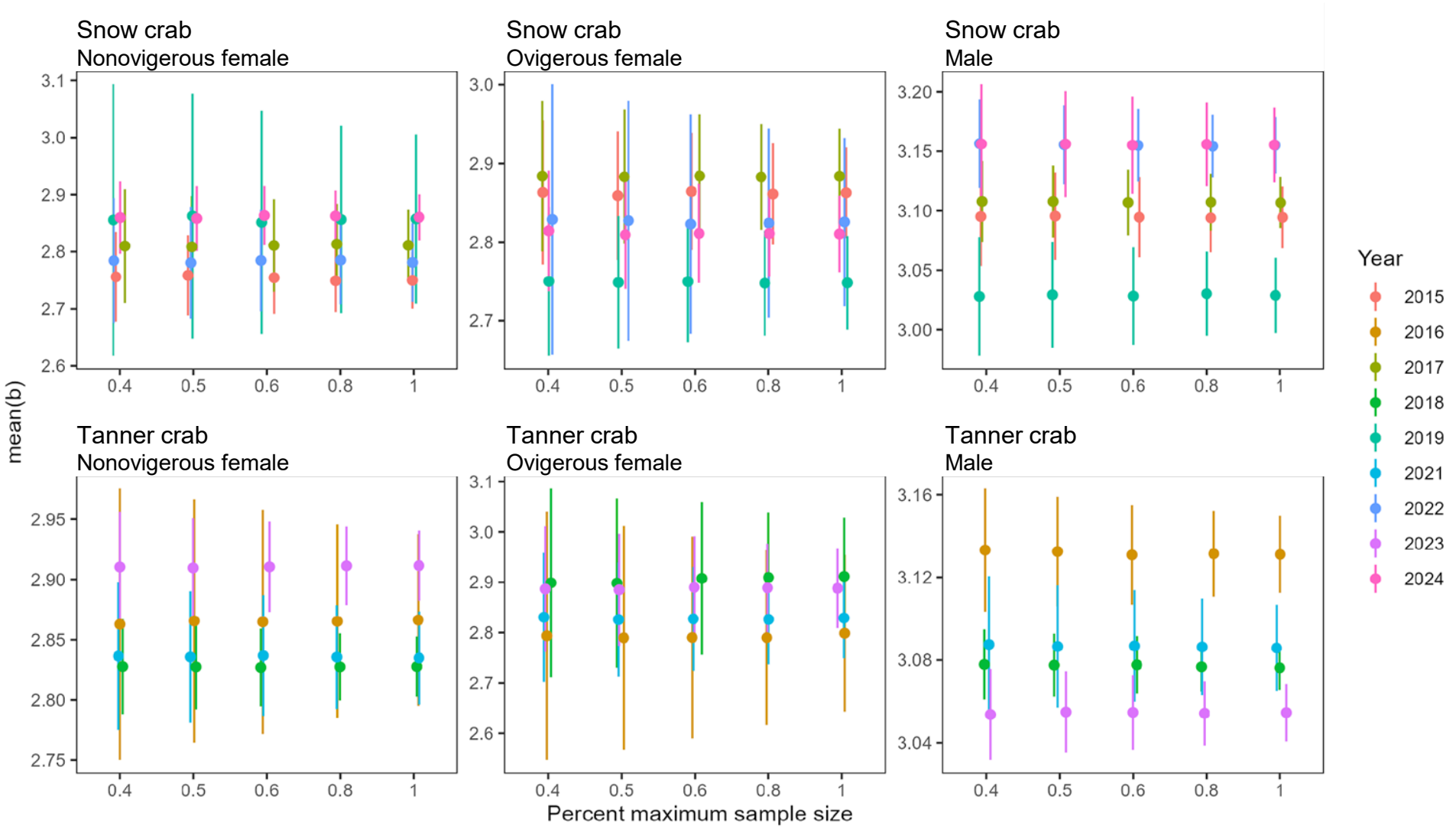
Effect of reducing sampling effort

- Same model-fitting protocol as with annual estimates
- Bootstrapped regression using 40, 50, 60, 80, and 100% of annual sample size
- Compared estimated parameters across years and sampling effort
  - mean(a), mean(b), mean(CI) across 1000 iterations

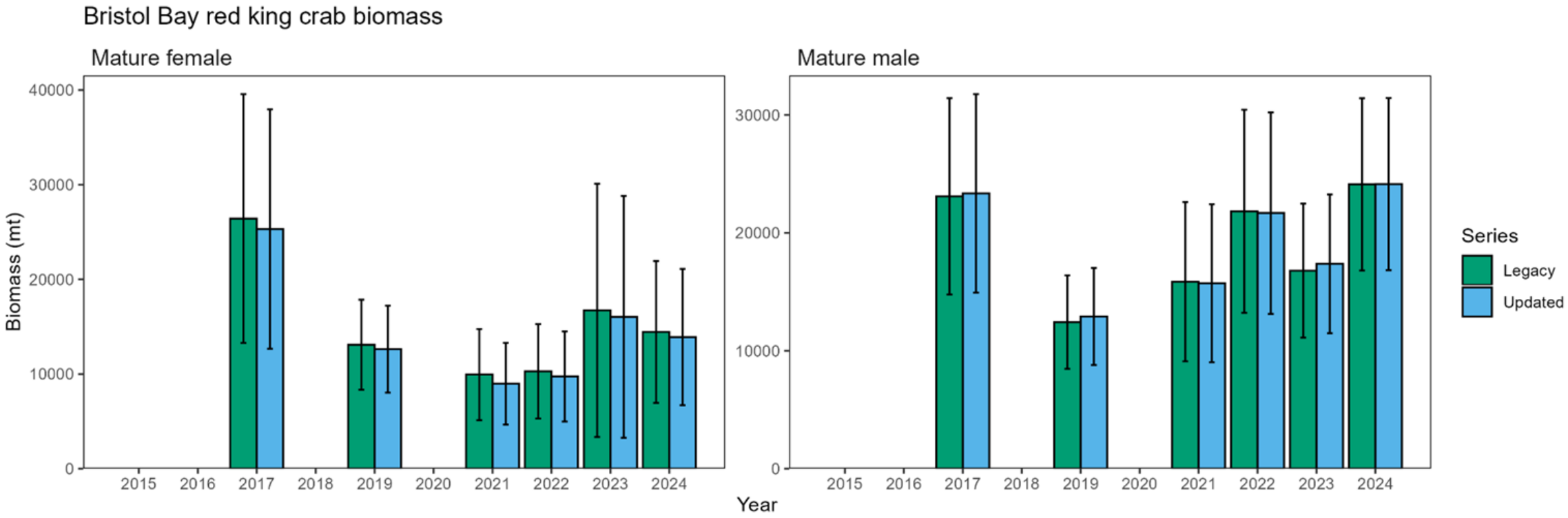
Bootstrapping results: intercept



Bootstrapping results: slope

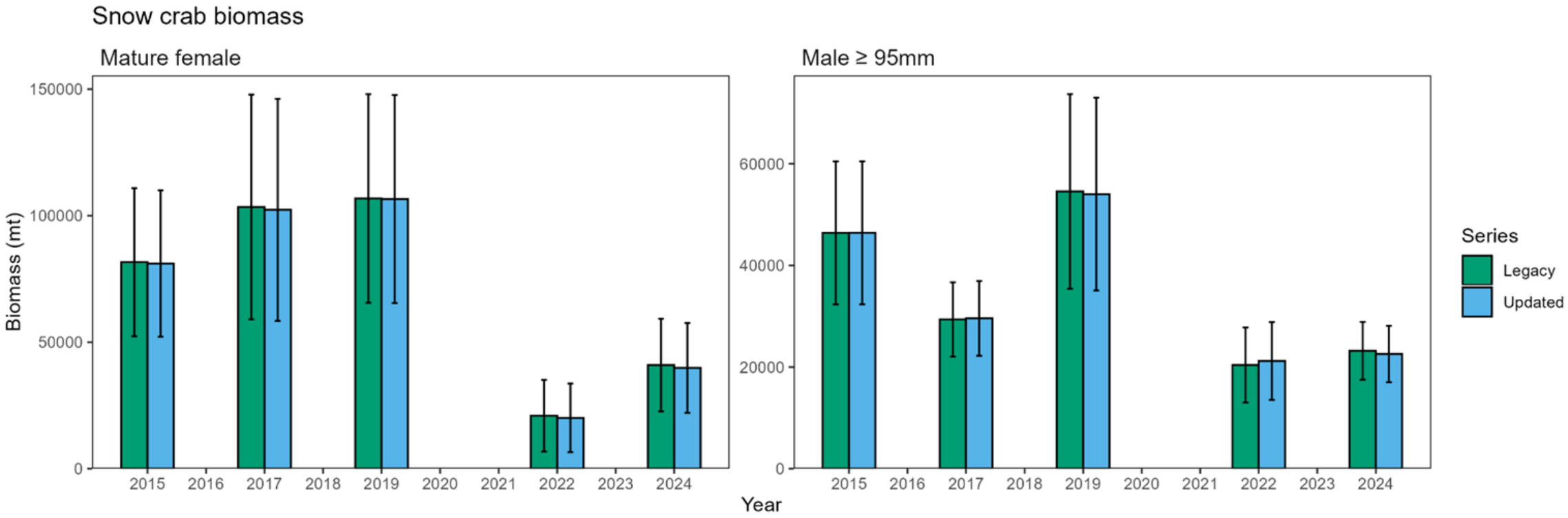


Biomass comparison: annual vs. legacy regression



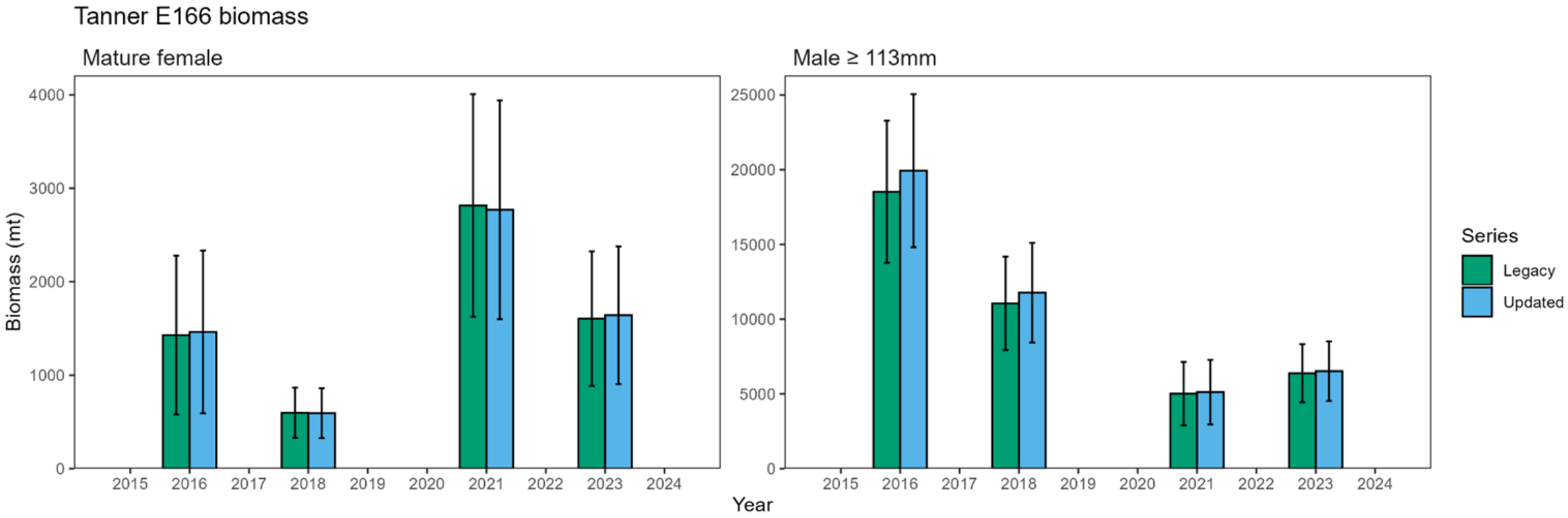
Maximum difference: 2019 mature males ~3.7%

Biomass comparison: annual vs. legacy regression



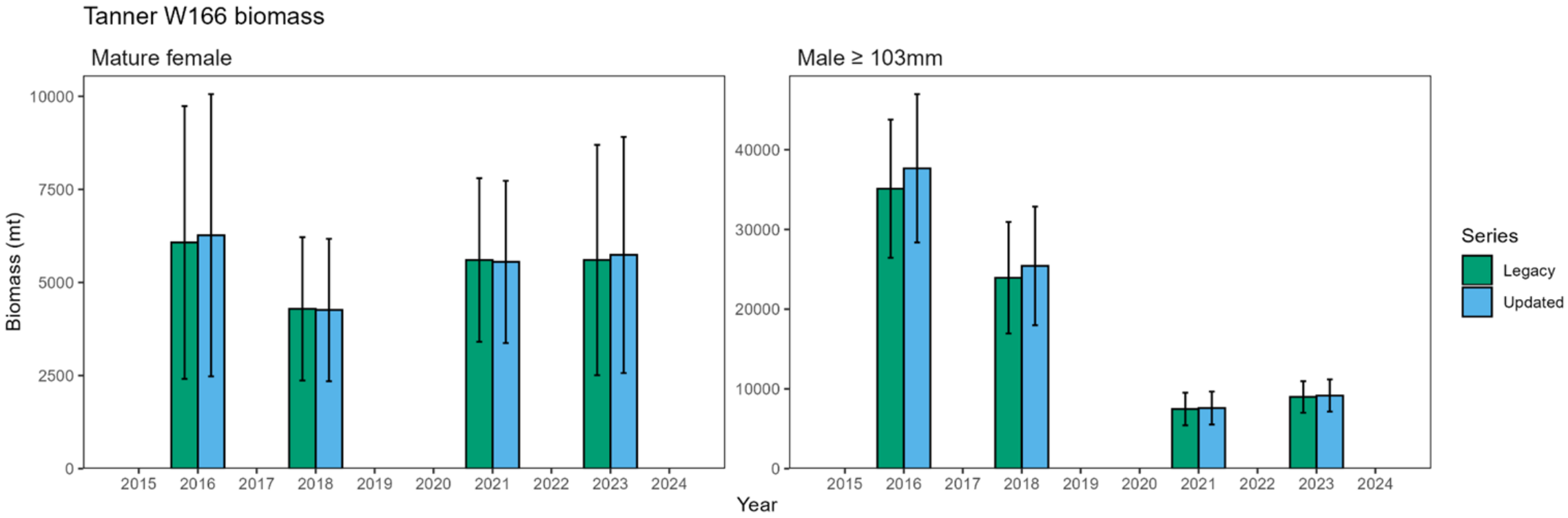
Maximum difference: 2022 large males ~3.7%

Biomass comparison: annual vs. legacy regression



Maximum difference: 2016 large males ~7.1%

Biomass comparison: annual vs. legacy regression



Maximum difference: 2016 large males ~6.8%

Takeaways

- Significant variation in annual parameter estimates
- Decreasing sampling effort to even 50% of current sample size has low impact on point estimates
- Using annual length-weight regression results in minor changes in estimated biomass (max ~ 10%)
- CPT recommendation - change to annual weight-length data, or continue to use 2000-2009 data? (Change would not happen until 2025)

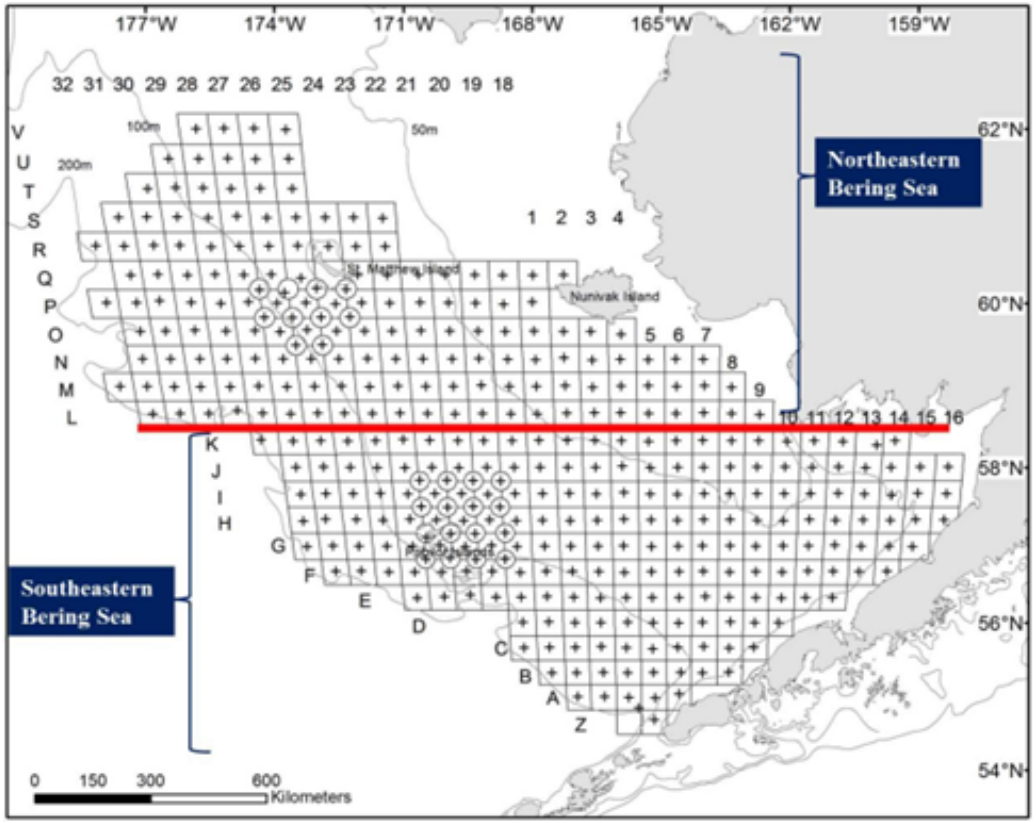
Chionoecetes morphometric maturity

October 2023: *The SSC would like to better understand the sampling design for molt data and is concerned about the weighting of the spatial samples in the analysis; weighting should be based on abundance if the sampling rate differs by area (which it would, unless abundance were uniform and/or the targets were in direct proportion to abundance).*

October 2024: *The SSC would also like to better understand the sampling design for the molt data and is concerned about the weighting of the spatial samples in the analysis; weighting should be based on abundance if the sampling rate differs by area (which it would, unless abundance were uniform and/or the targets were in direct proportion to abundance).*

Survey protocol

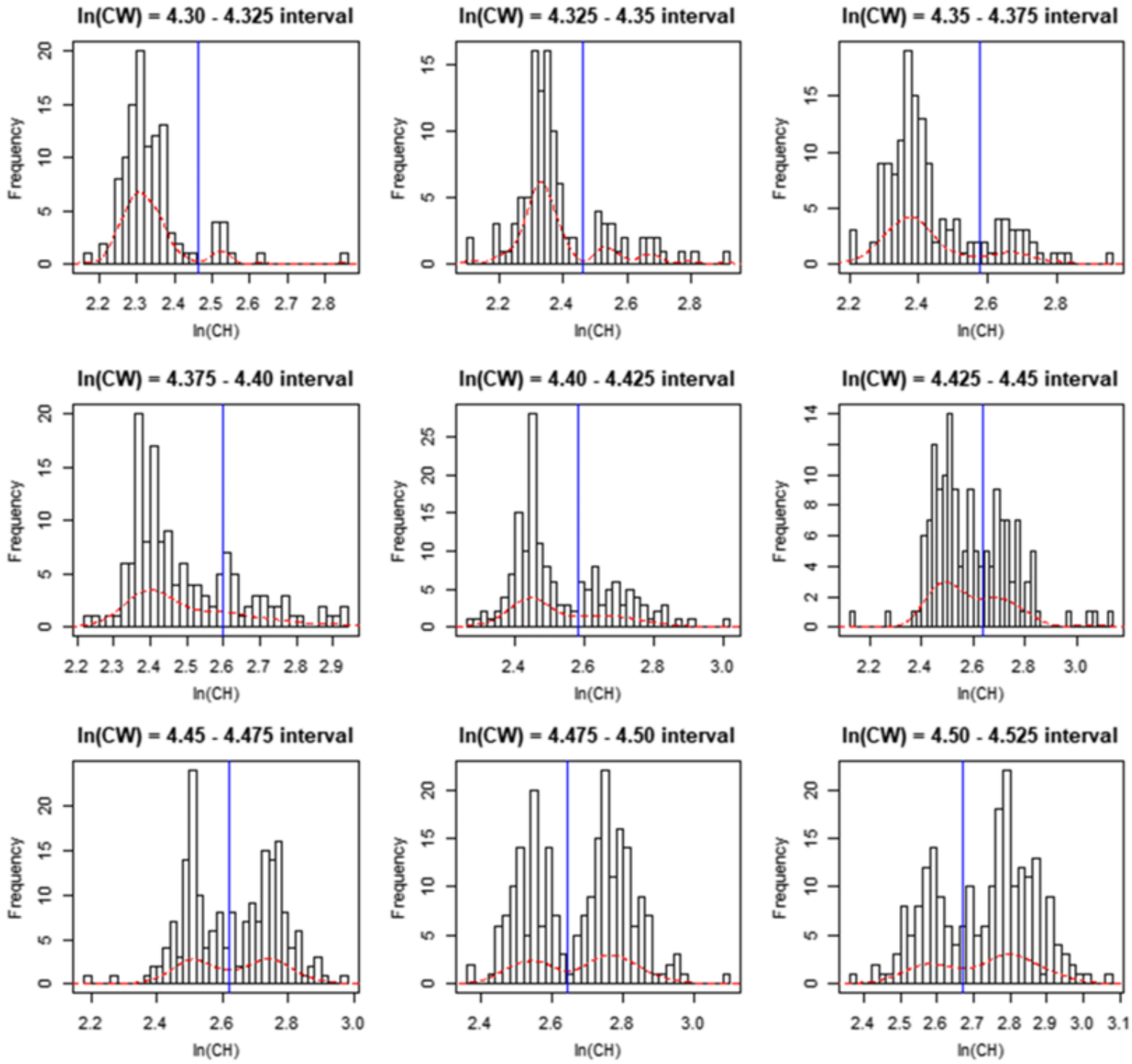
- Tanner
  - Each tow: 5 measurements each for three size classes (< 85 mm CW, 85-124 mm CW, > 124 mm CW)
  - Entire survey: at least 10 measurements per 5mm bin (50-165 mm range) in southern and northern areas of EBS grid
- Snow
  - Each tow: 5 measurements each for three size classes (40-59 mm CW, 60-99 mm CW, 100-119 mm CW)
  - Entire survey: at least 10 measurements per 5mm bin (40-119 mm range) in southern and northern areas of EBS grid



Deep dive into maturity data processing

Step 1) Bin carapace widths in log space and identify break between two modes of chela heights (smaller mode = immature, larger mode = mature)

(Note: the breakpoints were formerly hardcoded into workflow, now identified iteratively as each year of data comes in.)

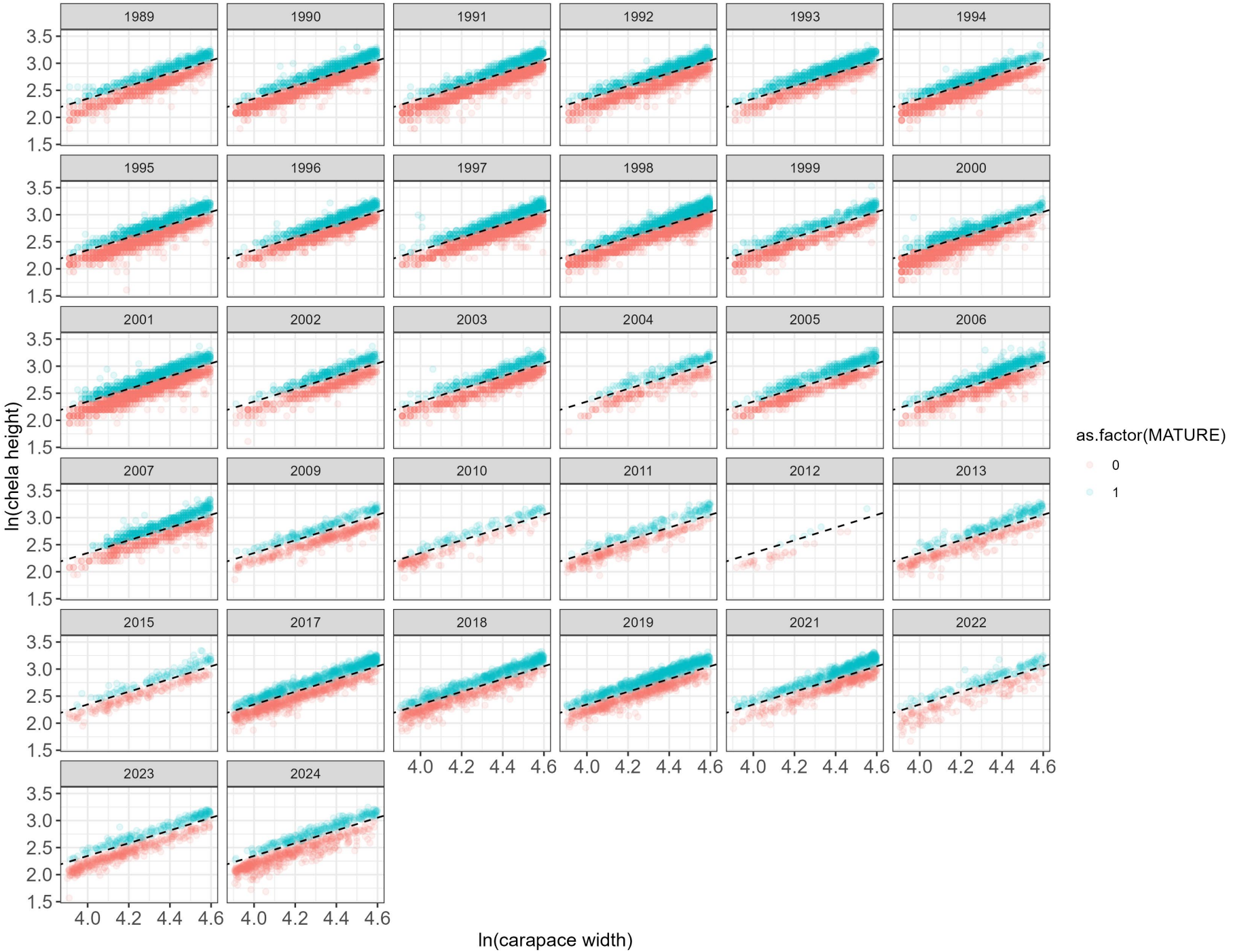


Snow crab example

Deep dive into maturity data processing

Step 2) Fit a linear model to the resulting set of points for chela height breakpoint vs. carapace width for all bins (the fit is perfect!)

Step 3) Use the line to divide all measured crab into mature / immature categories



Snow crab example

Deep dive into maturity data processing

Step 2) Fit a linear model to the resulting set of points for chela height breakpoint vs. carapace width for all bins (the fit is perfect!)

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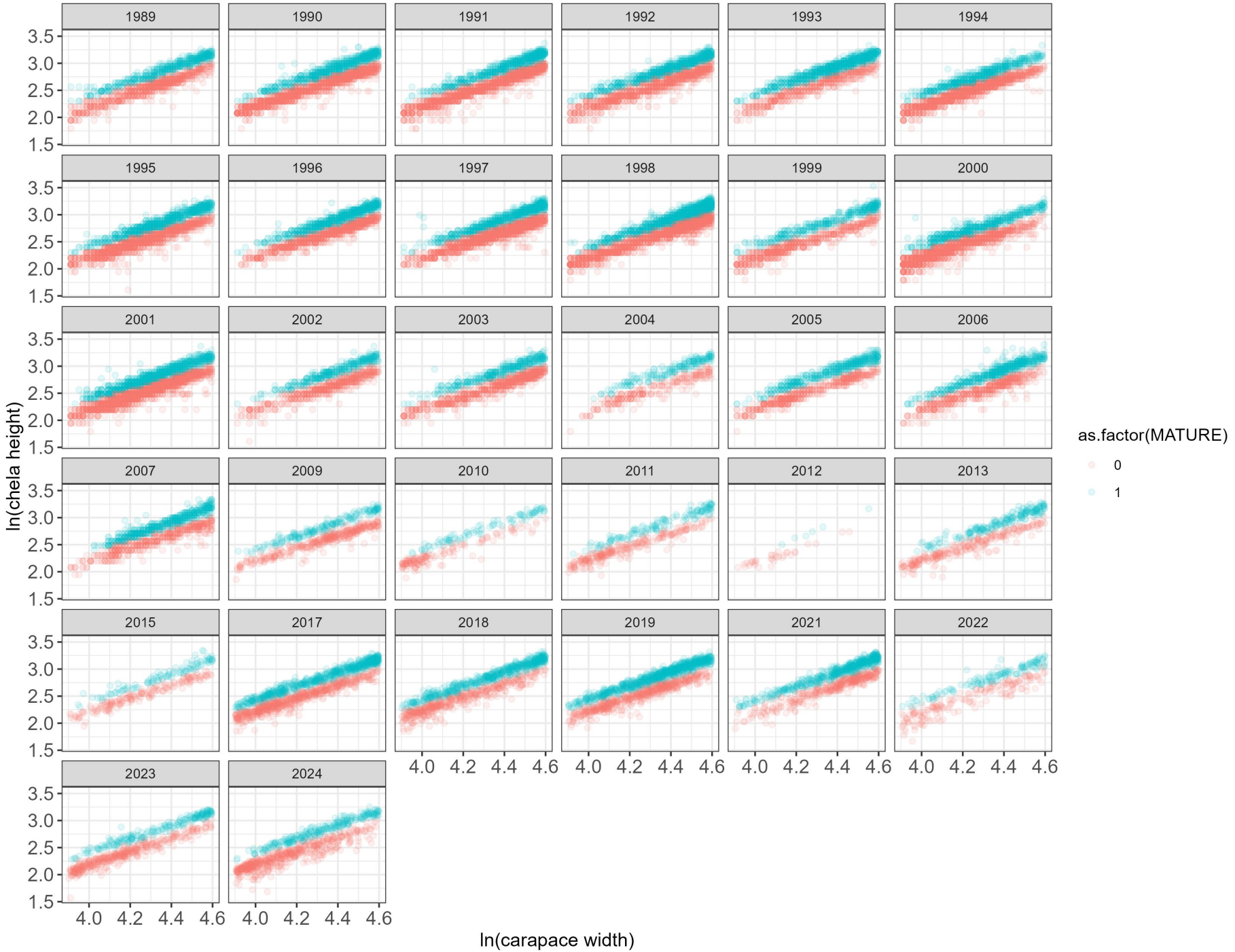
The distinction between the mature & immature clouds is very good!

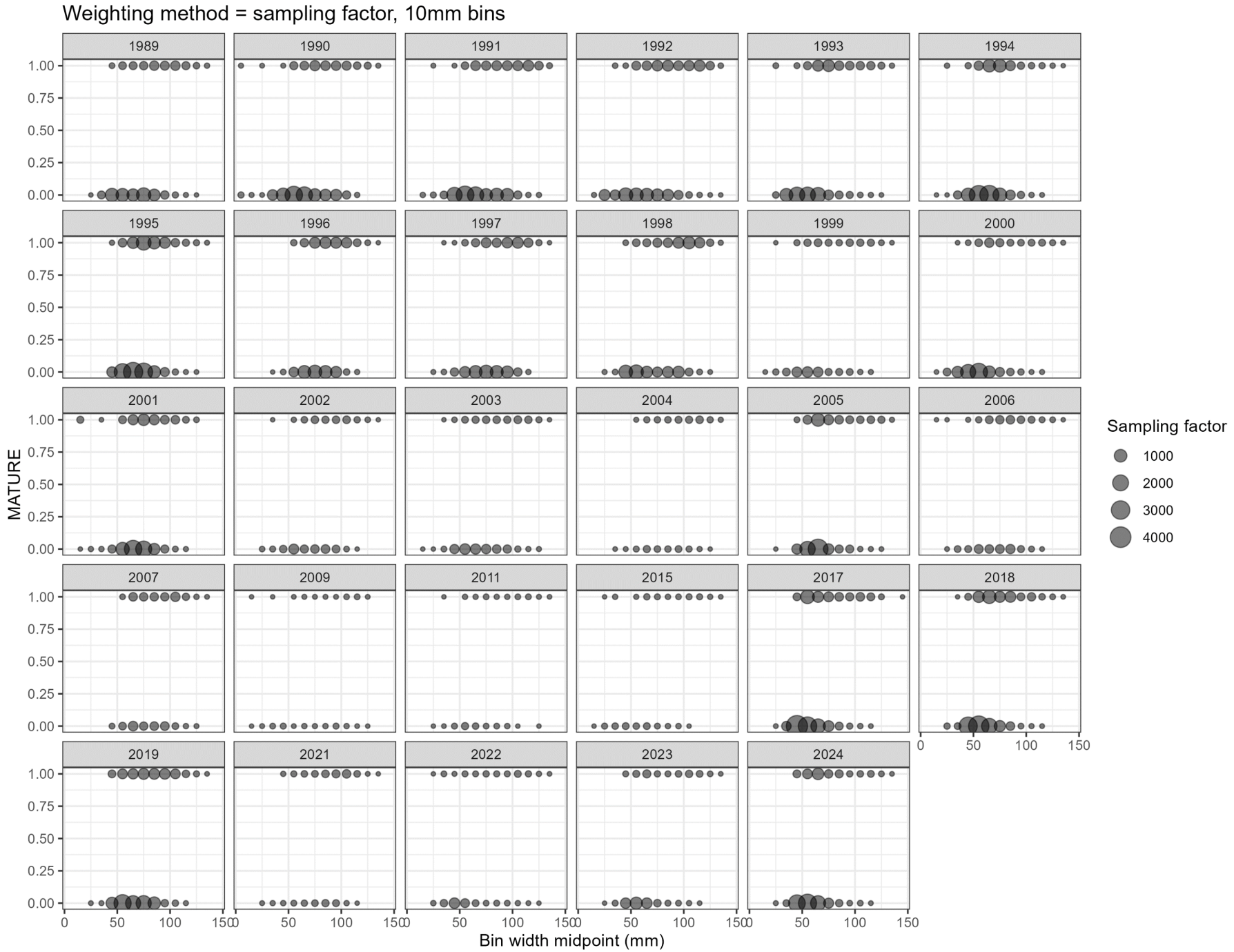


Snow crab example

Deep dive into maturity data processing

Step 4) Weight each observation by its corresponding sampling factor.

We're confident this is incorrect.

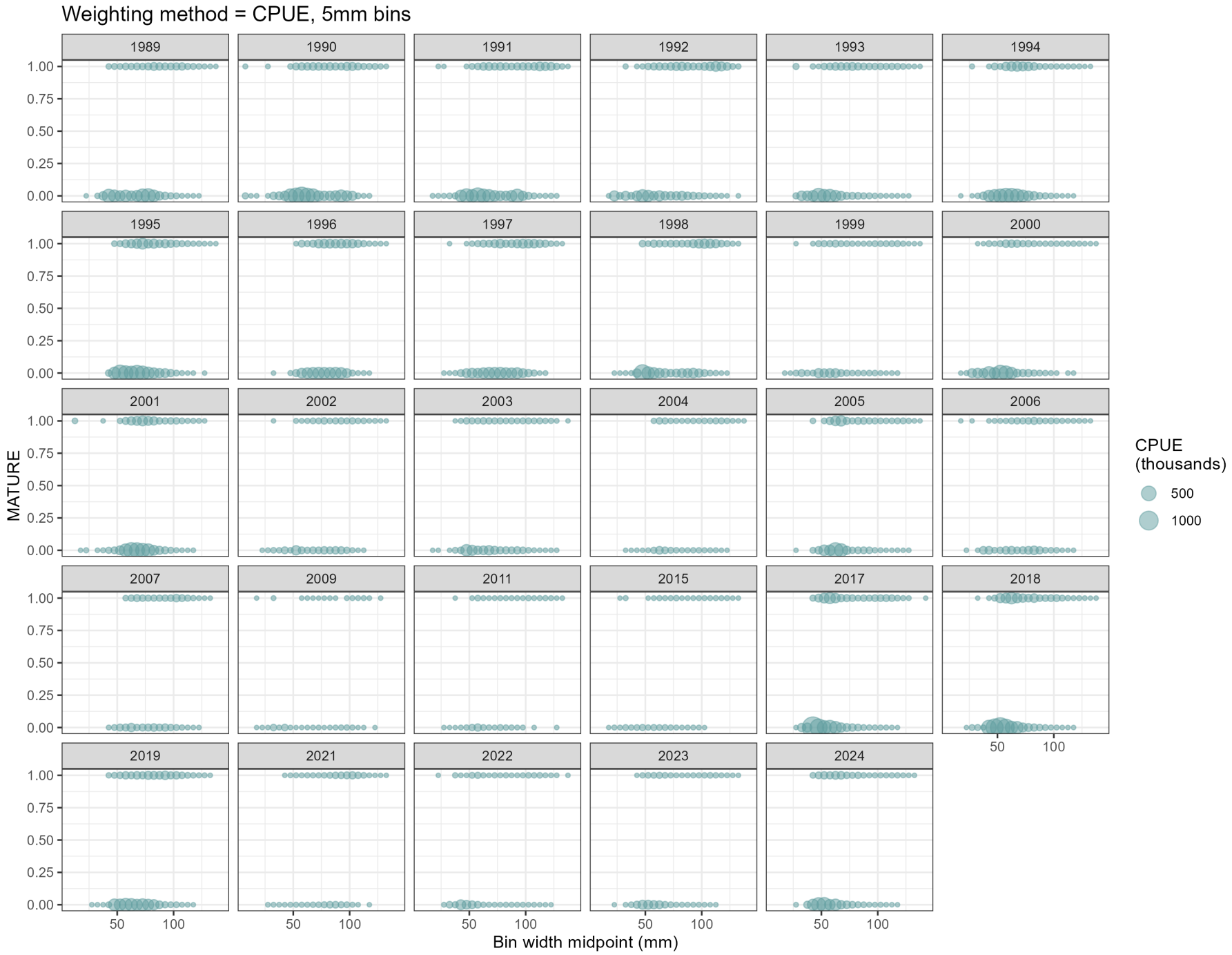


Snow crab example

Deep dive into maturity data processing

Step 4) Weight each observation by its corresponding ~~sampling factor~~ CPUE.

We are (I am) confident this is a better approach for weighting by abundance. In line with SSC recommendation, still debate in our group over this approach.



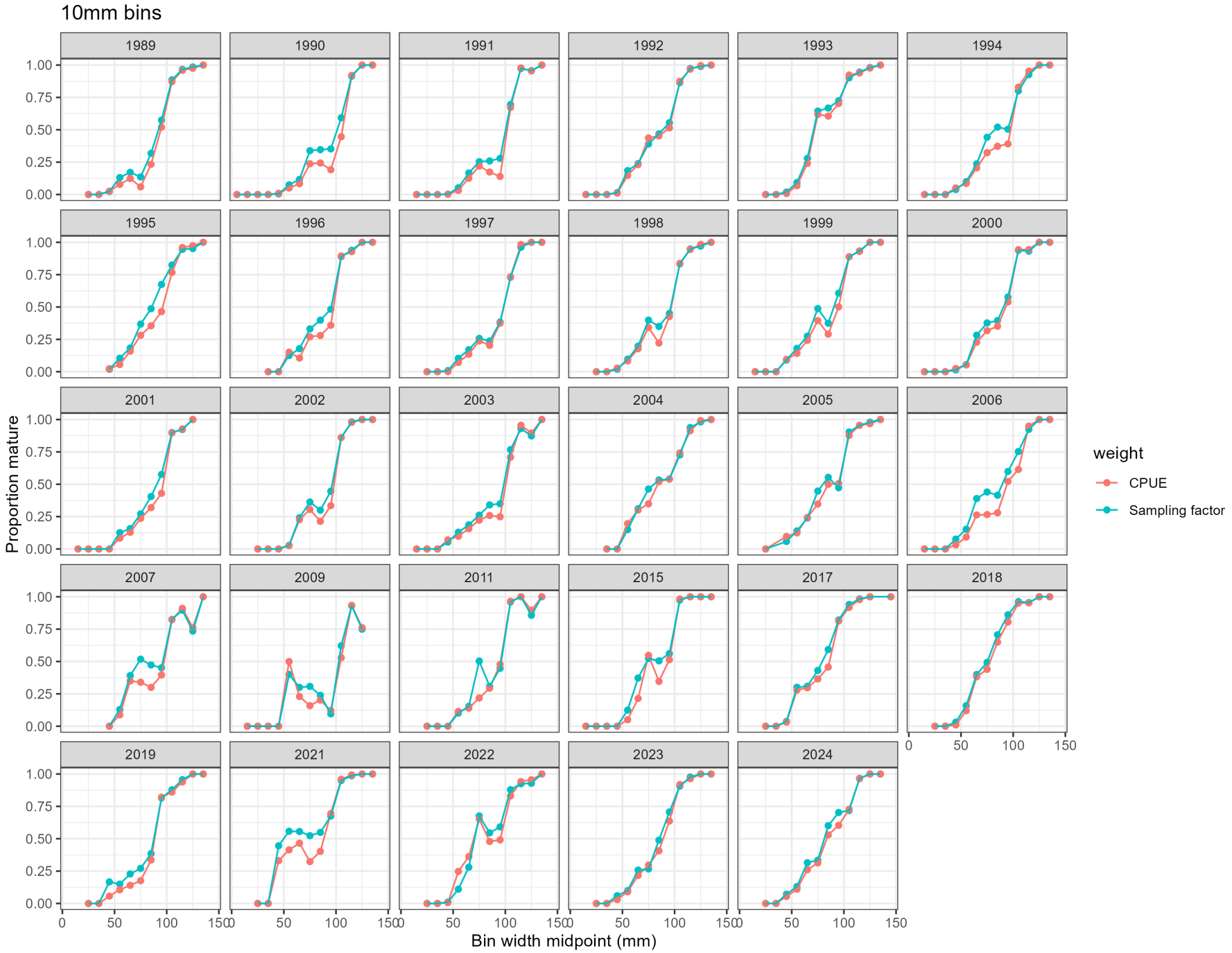
Snow crab example

Deep dive into maturity data processing

Step 5) For each 10 mm bin of carapace width, calculate proportion mature.

Step 6) Hand these data to assessment authors, who interpolate to 5 mm bins.

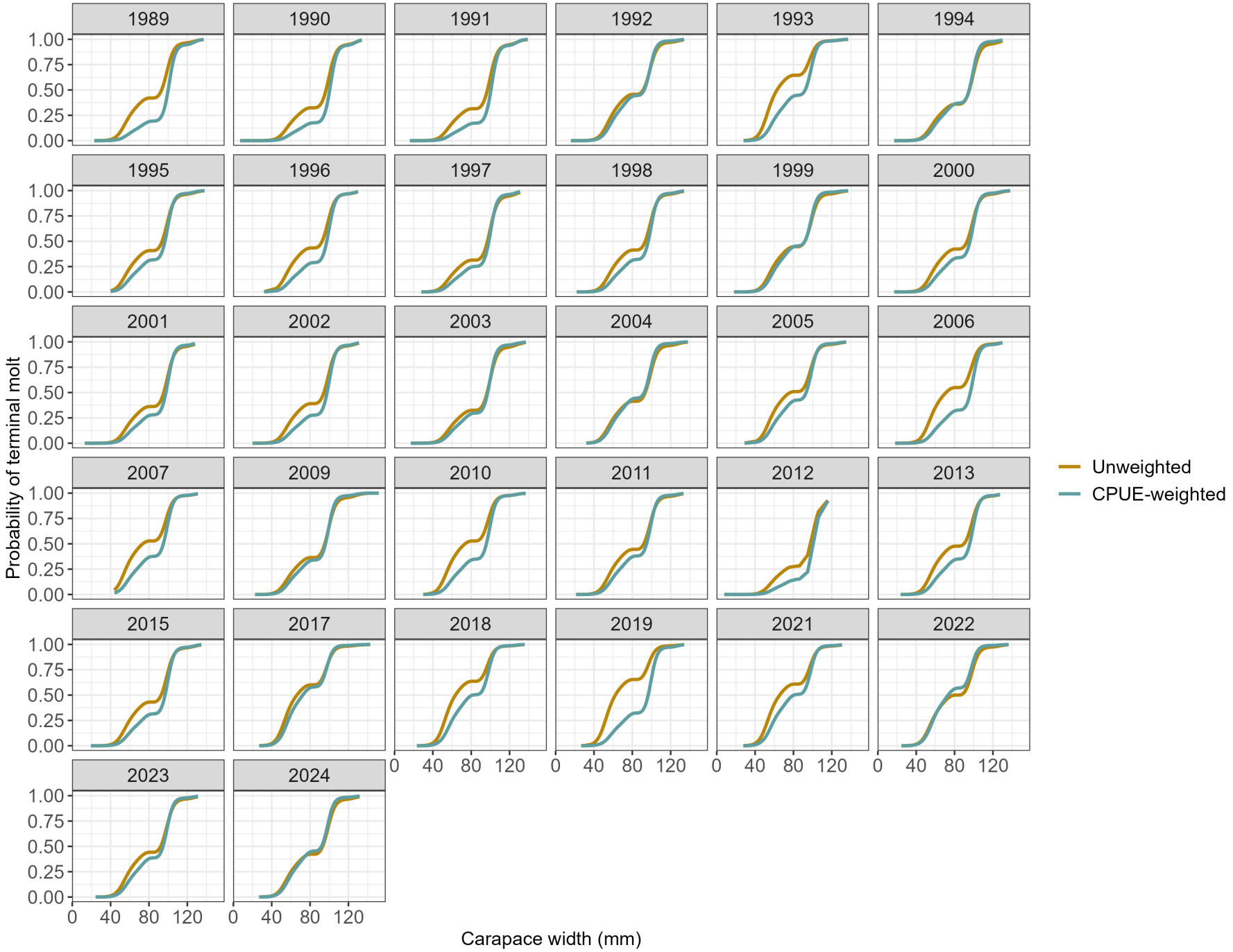
Note different results for sampling factor vs CPUE weighting.



Snow crab example

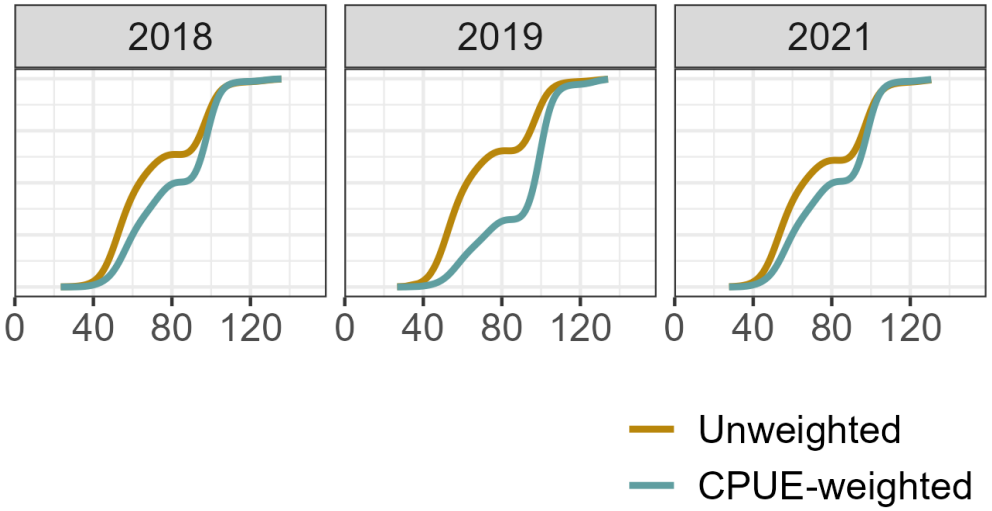
Deep dive into maturity data processing

Proposed new step 5) Instead of binning and calculate proportion mature, fit binomial GAM to data

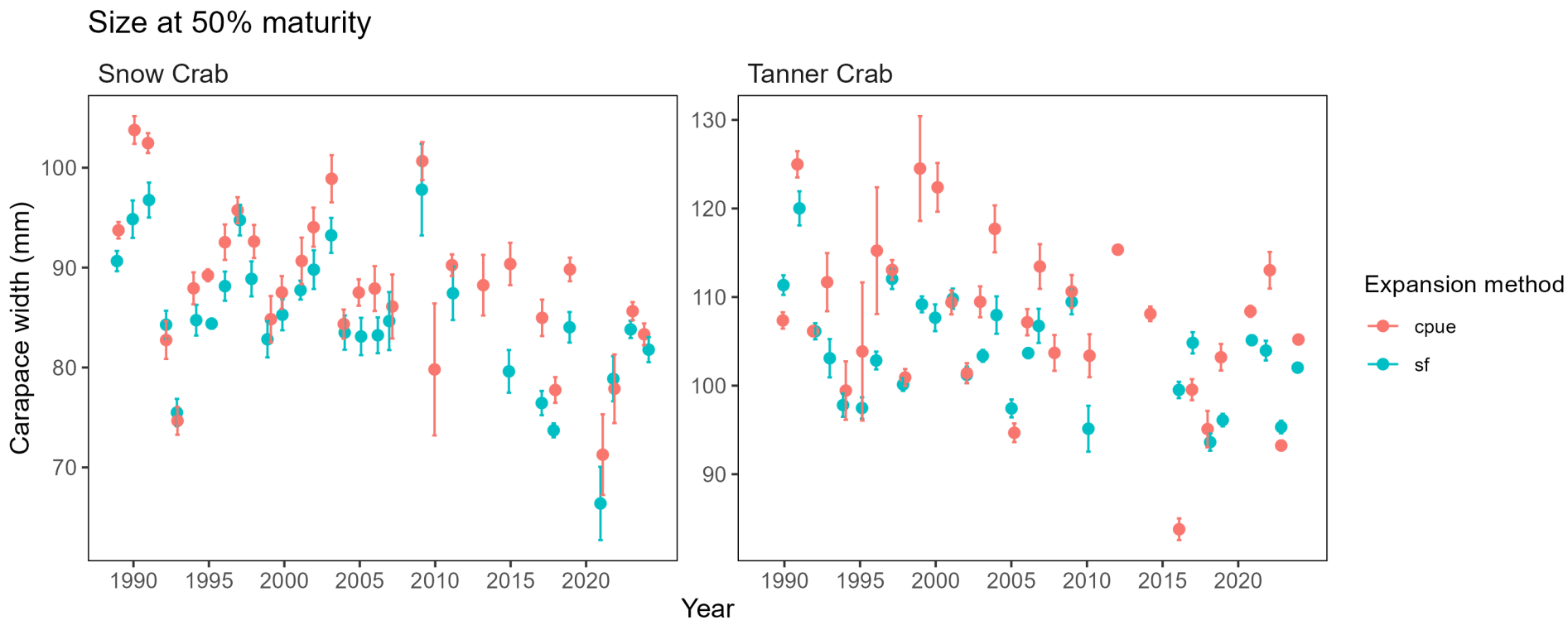


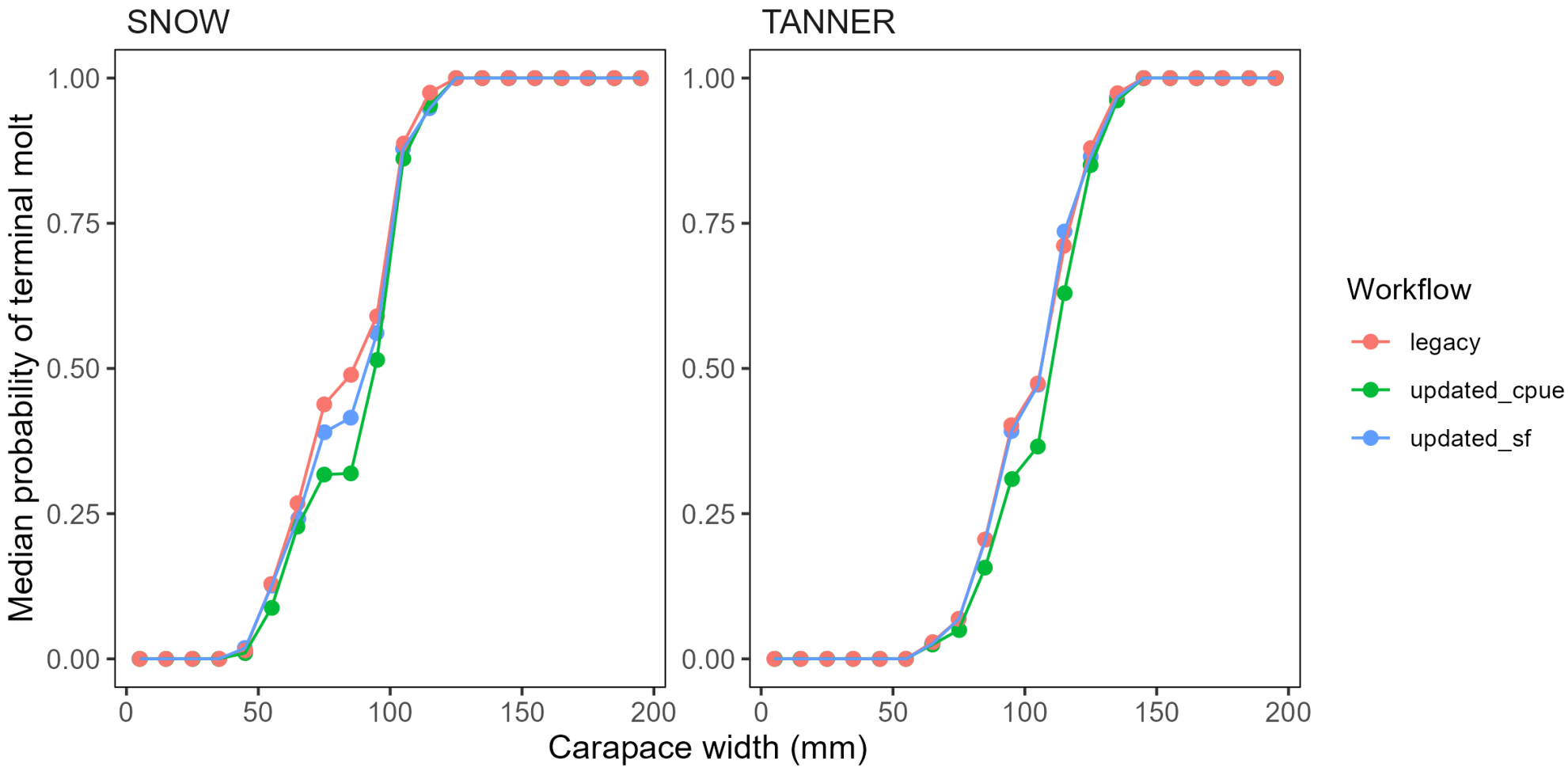
Snow crab example

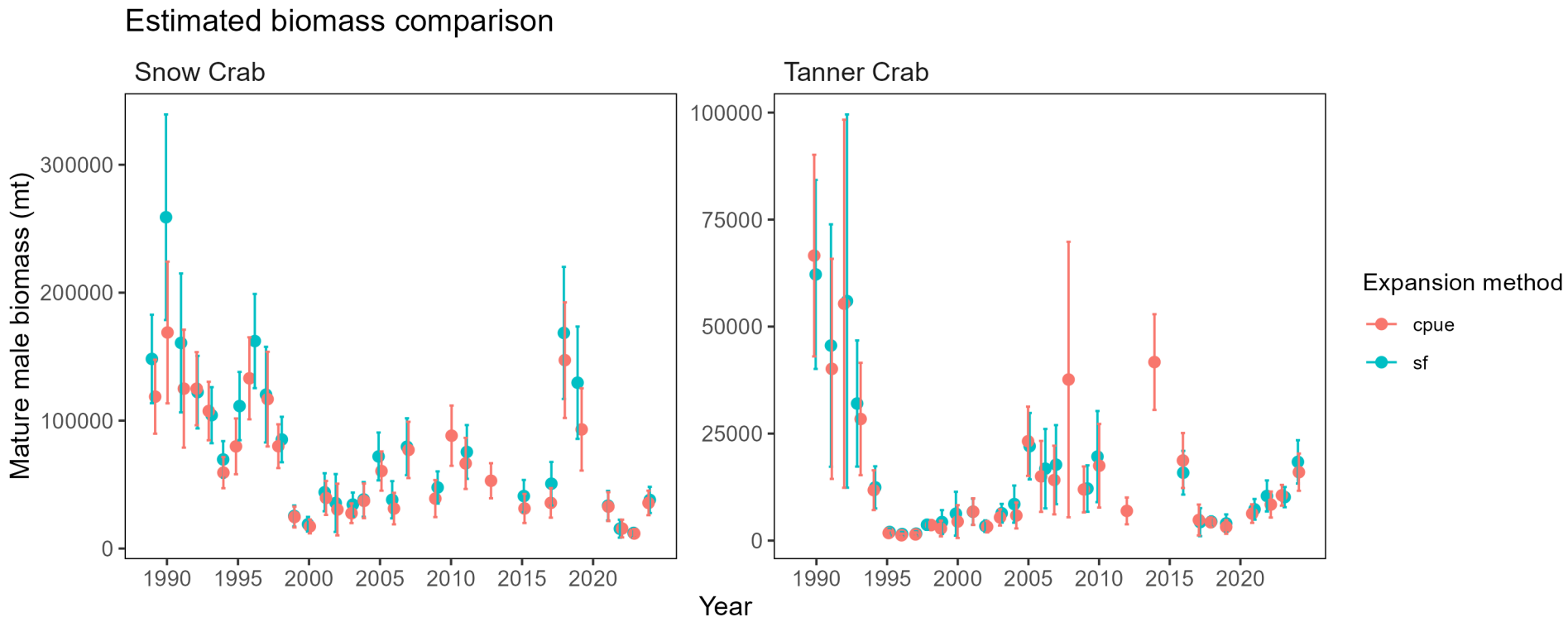
- Bimodal pattern in maturity: one group @ ~ 60-80mm, asymptote ~ 100mm
- Not an artefact of processing: pattern persists with all weighting approaches, with binned and continuous data
- Propose moving to binomial fits
  - Avoids possible artefacts with binning
  - Allows error estimation
- Weighting?
  - CPUE weighting in line with SSC comments, better than sampling factor
  - Simulation study?

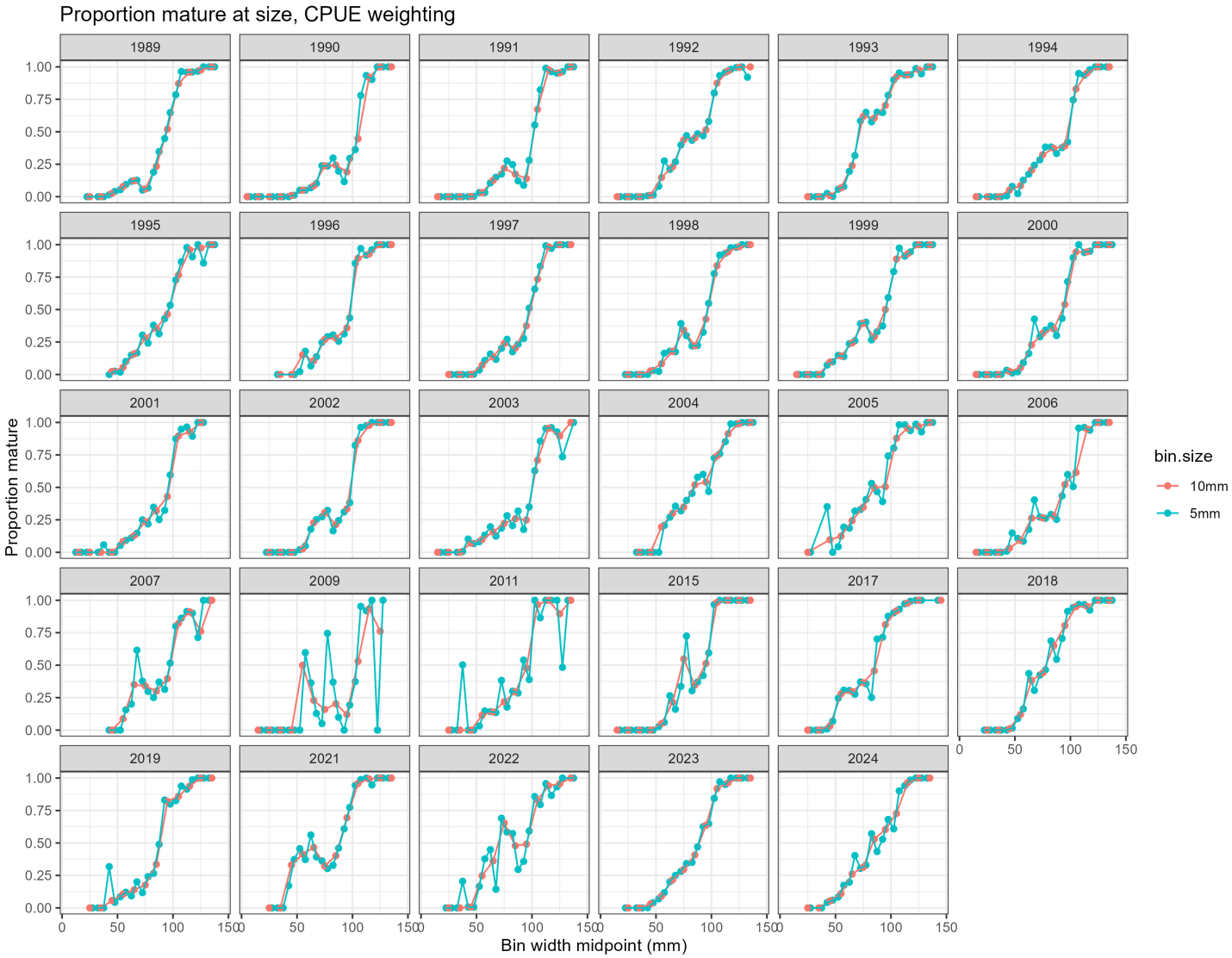


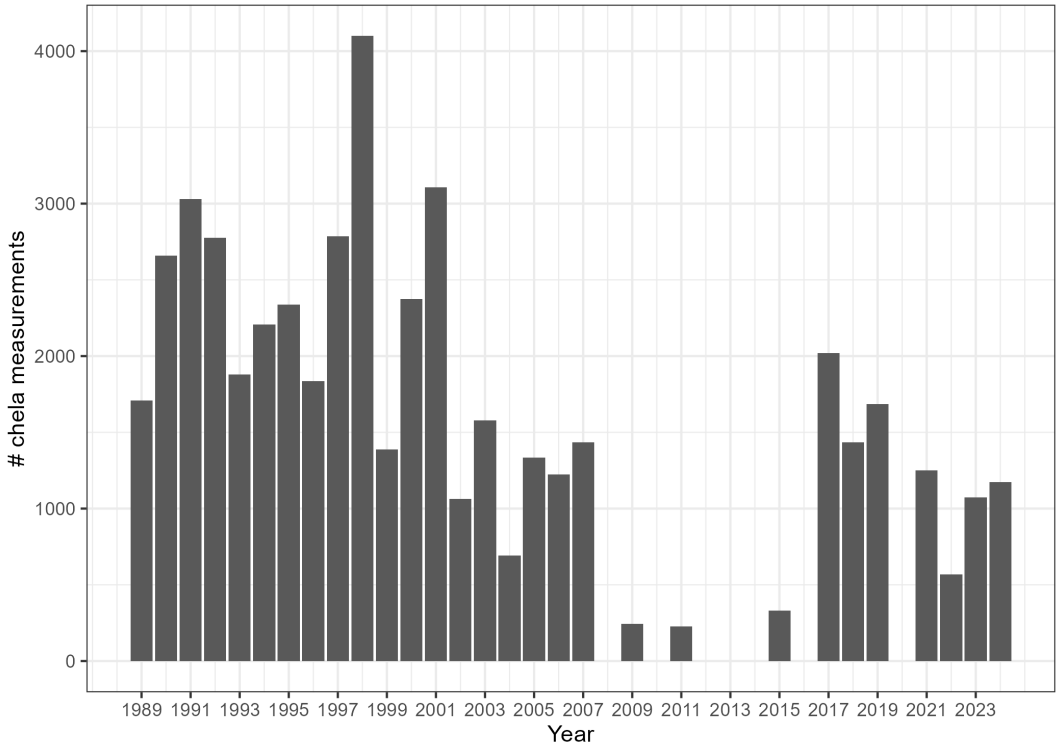
Extra slides


Size at 50% maturity
Snow Crab
Tanner Crab
Carapace width (mm)
100
90
80
70
130
120
110
100
90
1990
1995
2000
2005
2010
2015
2020
Year
Expansion method
cpue
sf

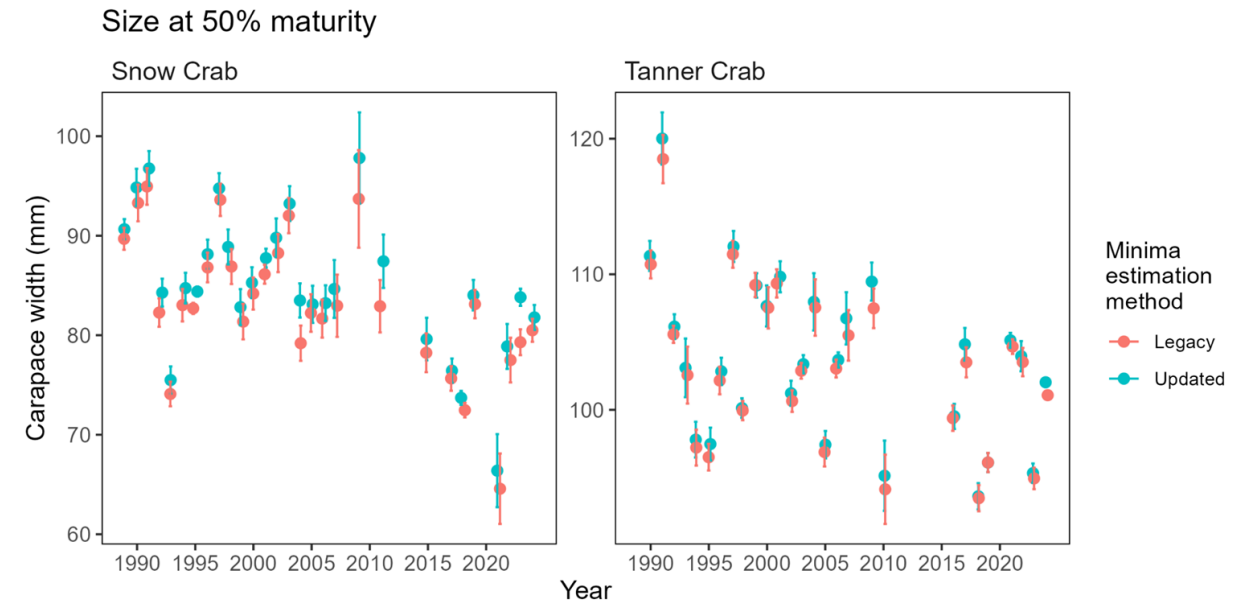

SNOW
TANNER
Median probability of terminal molt
1.00
0.75
0.50
0.25
0.00
0
50
100
150
200
Carapace width (mm)
Workflow
legacy
updated_cpue
updated_sf

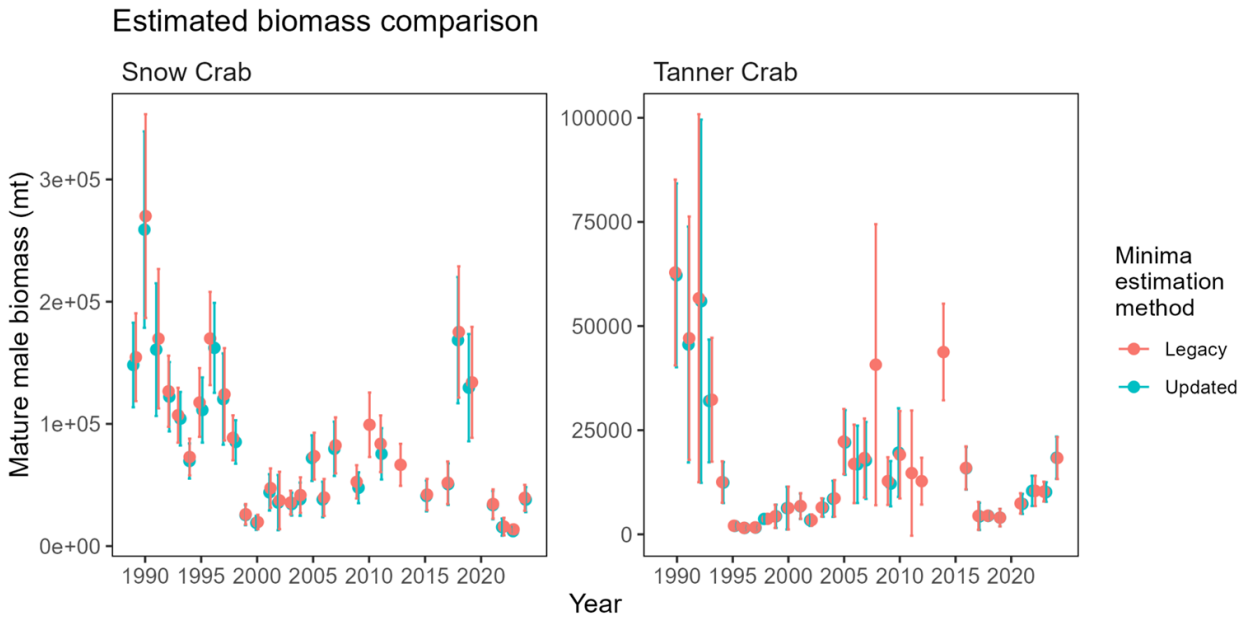

Estimated biomass comparison
Snow Crab
Tanner Crab
Mature male biomass (mt)
300000
200000
100000
0
100000
75000
50000
25000
0
1990
1995
2000
2005
2010
2015
2020
Year
Expansion method
cpue
sf


Proportion mature at size, CPUE weighting
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2009
2011
2015
2017
2018
2019
2021
2022
2023
2024
Proportion mature
Bin width midpoint (mm)
bin.size
10mm
5mm


chela measurements
Year

Updated chela cutline estimation methodology





Weighting by CPUE instead of sampling factor