Chinook Salmon Monitoring in the Lower Cowlitz River

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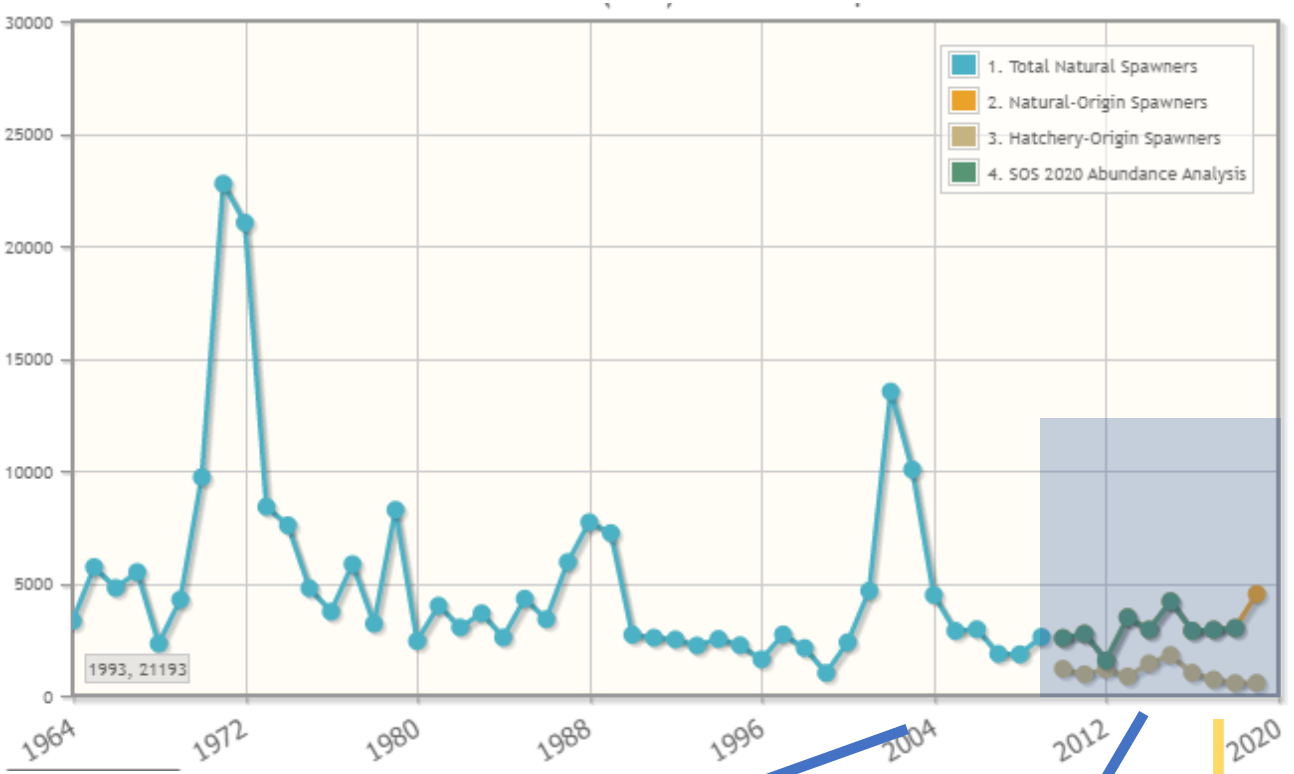
Background

- Estimates of fall Chinook abundance in the lower Cowlitz R. have been generated since the 1960s. Prior to 2011 there was higher harvest and no mass marking.
- Since 2010, Chinook have been monitored with aerial redd counts and carcass surveys to estimate abundance & composition
- In 2021, 2022 and 2023, mark-recapture (M-R) carcass surveys were implemented in the lower river



Objectives

- Conduct carcass surveys w/ M-R
  - Obtain accurate abundance estimates
  - Estimate precisions
- Conduct aerial flights
  - Continue existing time series of abundance
  - Data for bias-correction

Methods

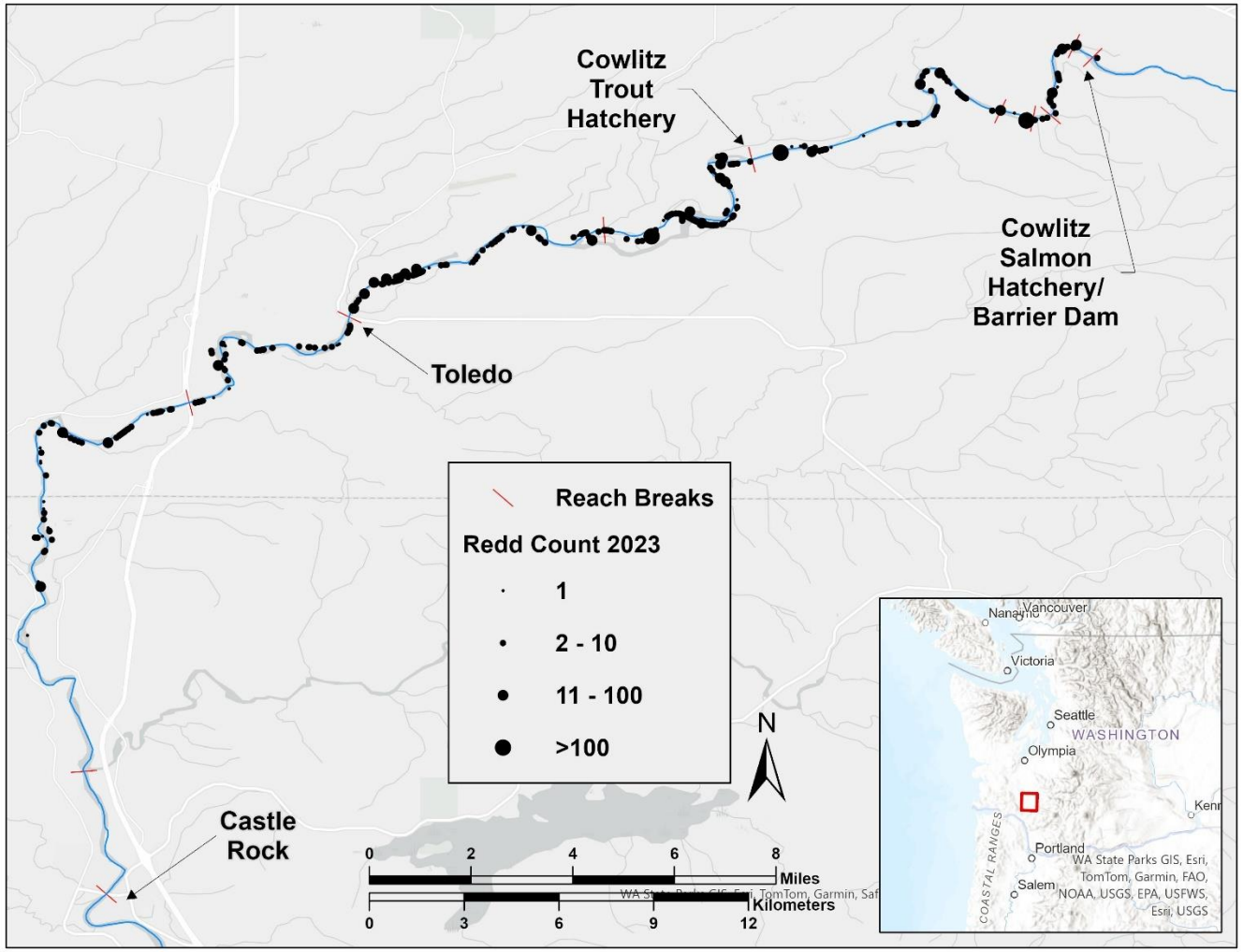
- Aerial flights for redds
  - Timing: bi-weekly (scheduled late Sept. – early Dec.)
  - Space: Castle Rock to Barrier Dam (~33 miles)
  - Approach: Count & GPS all redds via helicopter
- Carcass surveys
  - Timing: Weekly (Sept. – Dec.); 4 – 5 days/week
  - Space: Olequa Ck to Barrier Dam (~26 miles)
  - Approach:
    - Jet boat + gaffes + CWT wand
    - 2 people & 1 boat
    - Recover all carcasses
    - Sample & tag representatively

Results: Aerial flights for redds

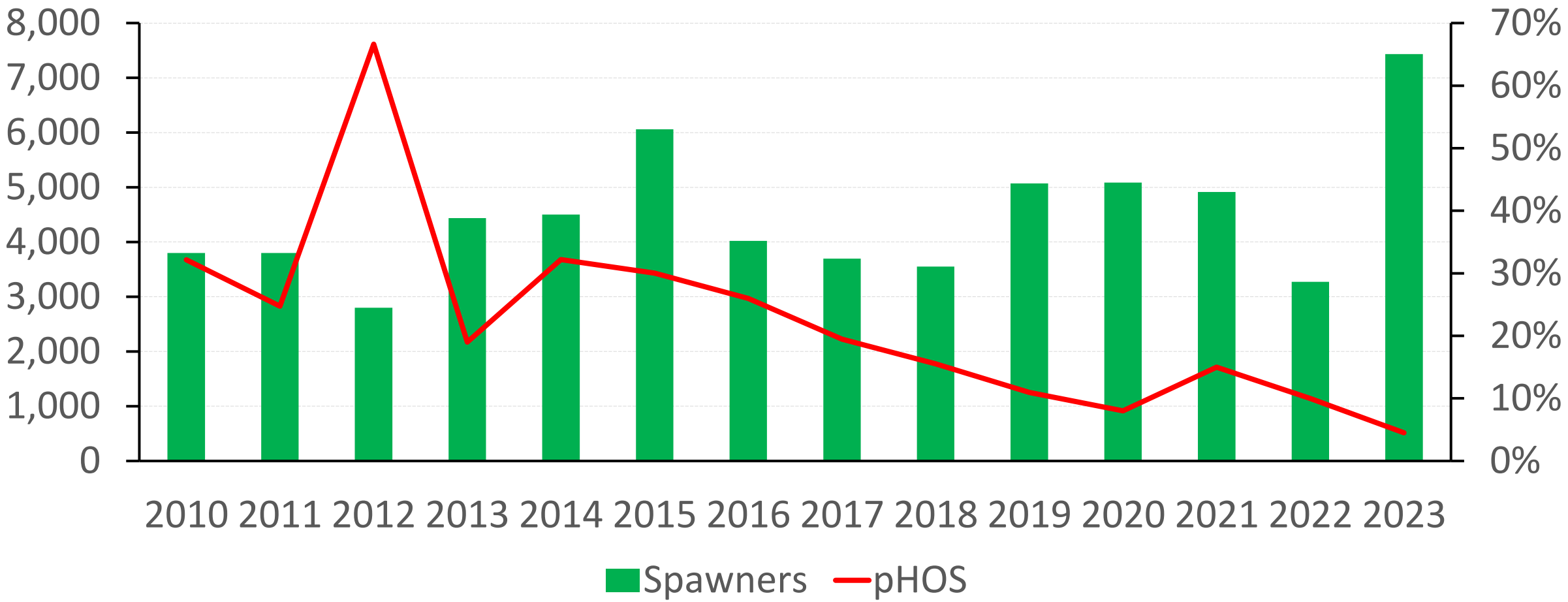
- Total Redds by Date

Date	Redds
12-Sep	-
26-Sep	-
10-Oct	2,556
11-Nov	2,617
17-Nov	1,362
20-Nov	-

- Abundance
  - Spring-run
    - No Flight
    - pHOS = 31% from Carcasses
  - Fall-run
    - Spawners: **7,432** (2,617 redds x 2.84 fish/redd)
    - pHOS = 4% (193/4,102 carcasses)
  - Total Spawners[a]: **7,432**



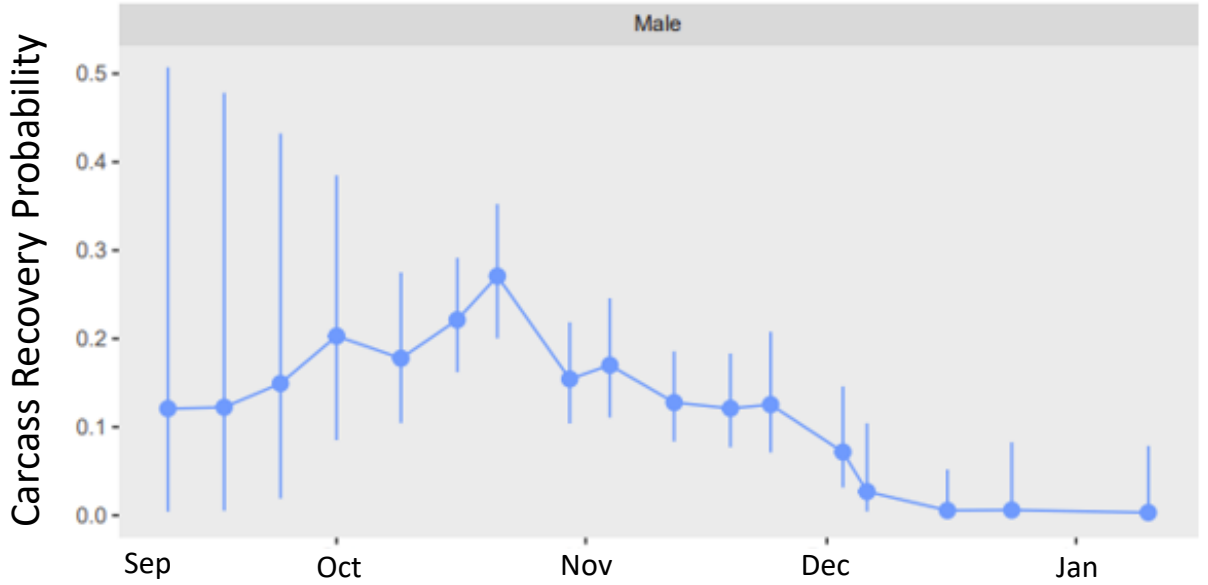
Lower Cowlitz River Fall Chinook Abundance Peak Count Expansion Estimates

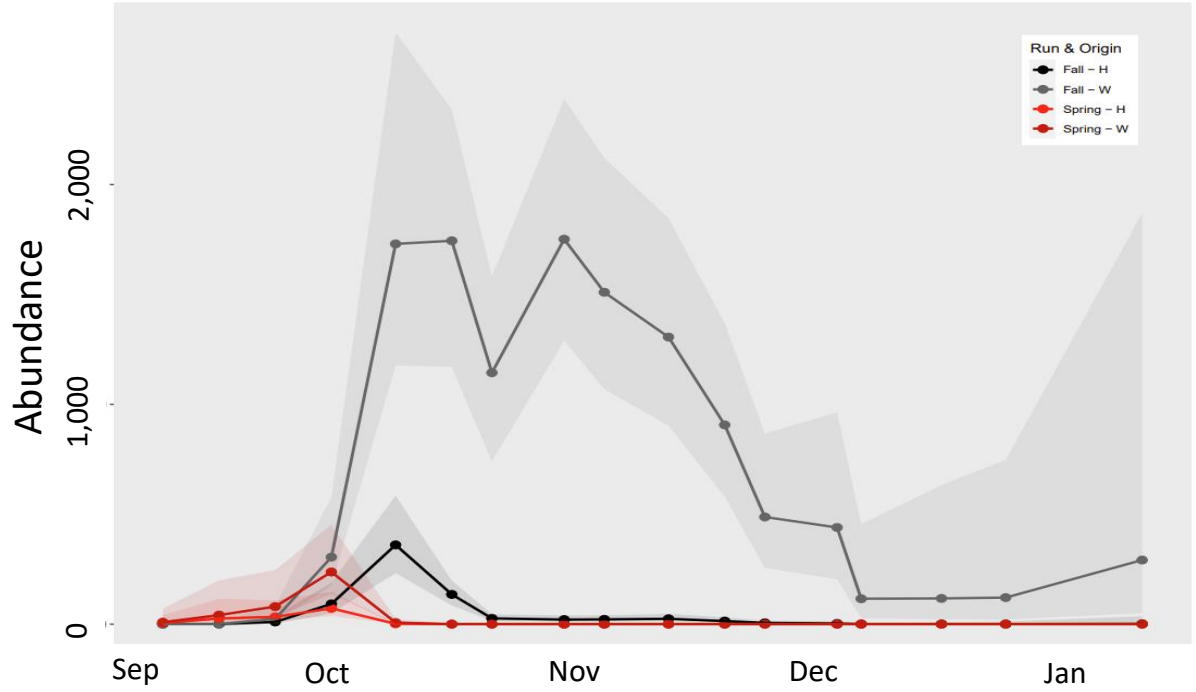


Results: M-R surveys

- Surveys
  - ~60 days across (late August – early January)
  - No missed survey weeks!
- Carcasses
  - Maiden (unique) = 4,439
  - Tagged = 1,538
  - Recaptured = 333

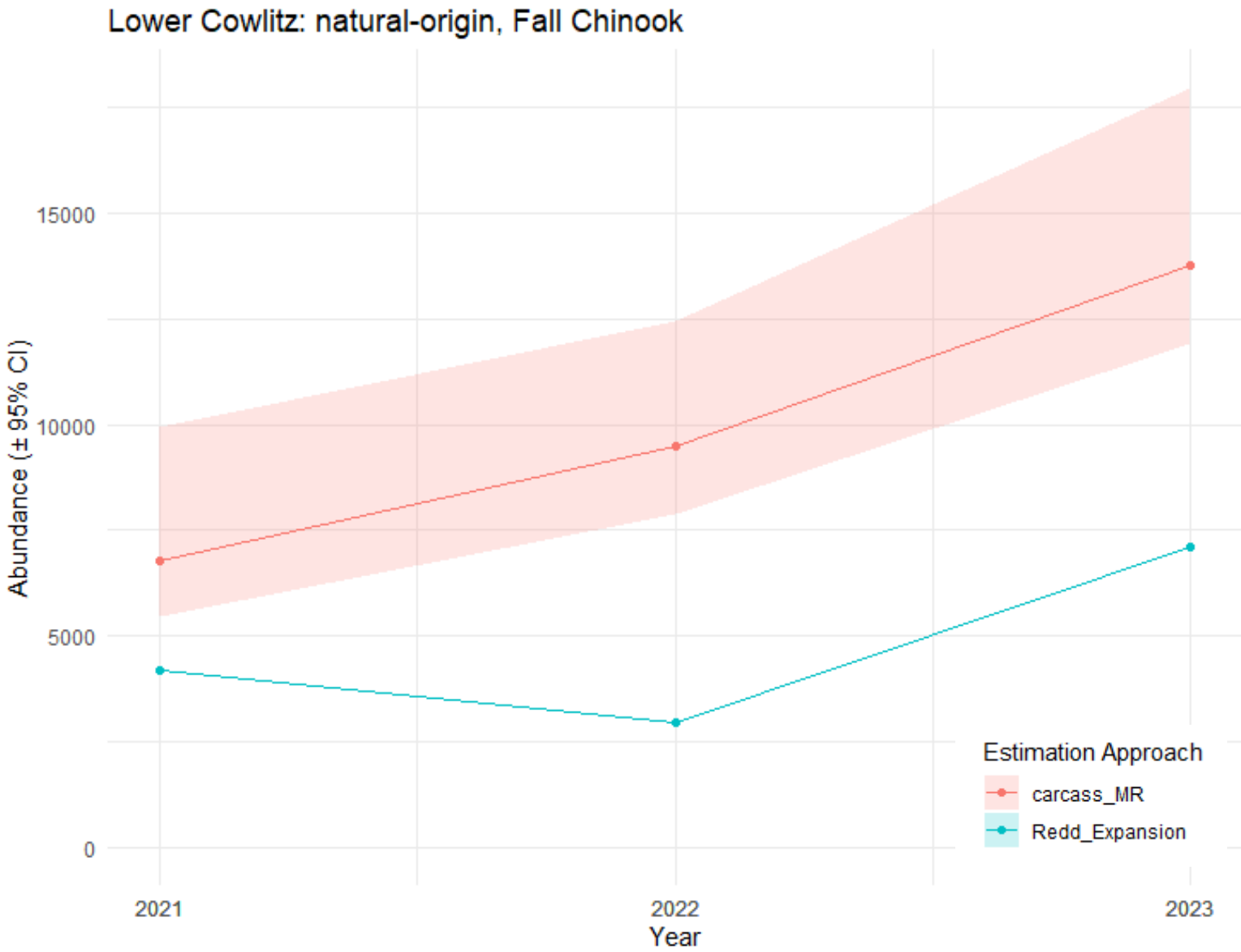
  Overall recovery probability ~28%
- Abundance (including jacks)
  - Total = **15,303** (median: 95% CI 13,229 – 19,911)
  - Spring-run
    - Spawners: **683** (median: 95% CI 363 – 1,811)
    - pHOS: 76%
  - Fall-run
    - Spawners: **14,547** (median: 95% CI 12,618 – 18,771)
    - pHOS: 5%



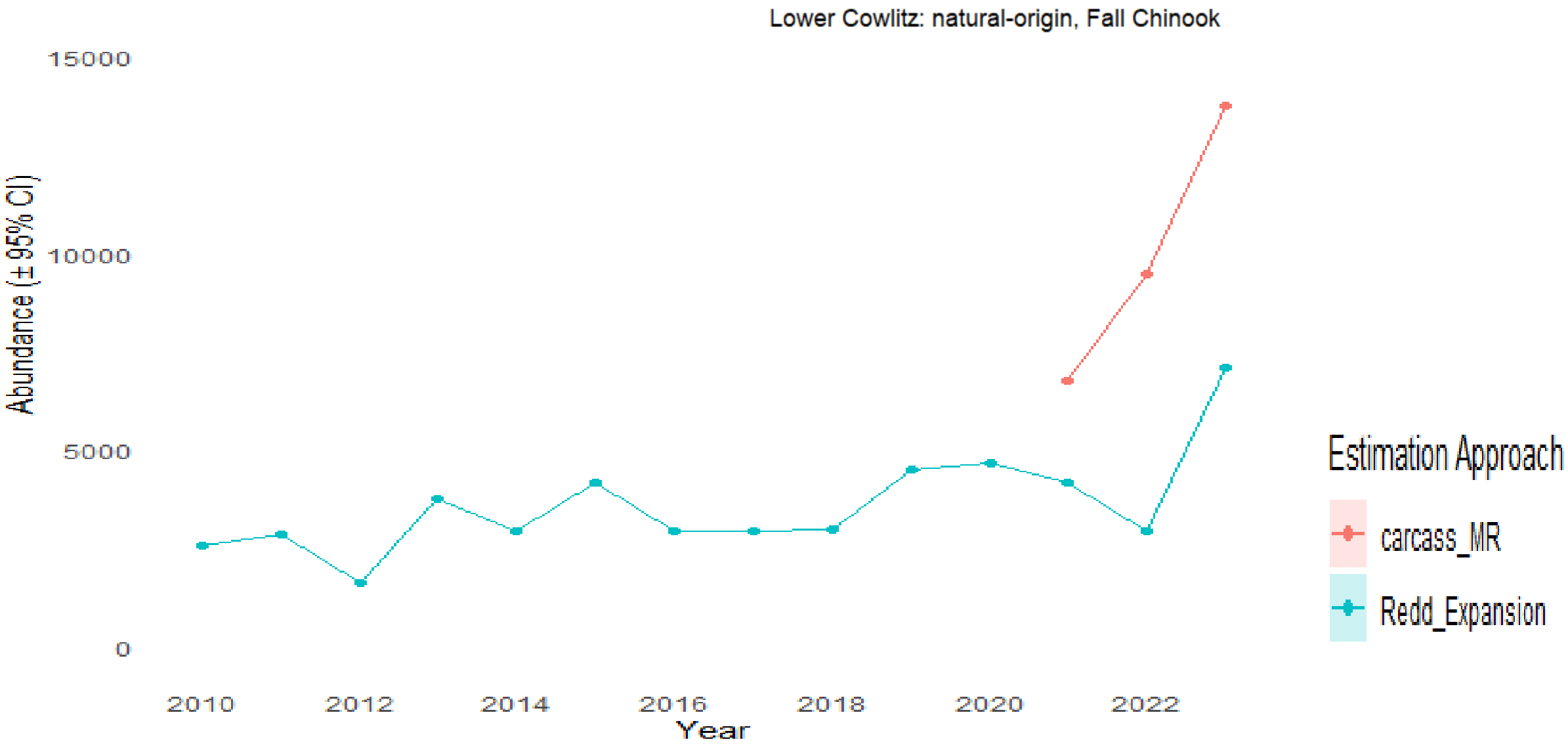


Results: M-R vs. redd-expansion, 2021-23

- In the past three years, the Carcass Mark-Recapture method has estimated a greater spawner abundance than peak Aerial Redd expansion.
- Both methods have limitations.

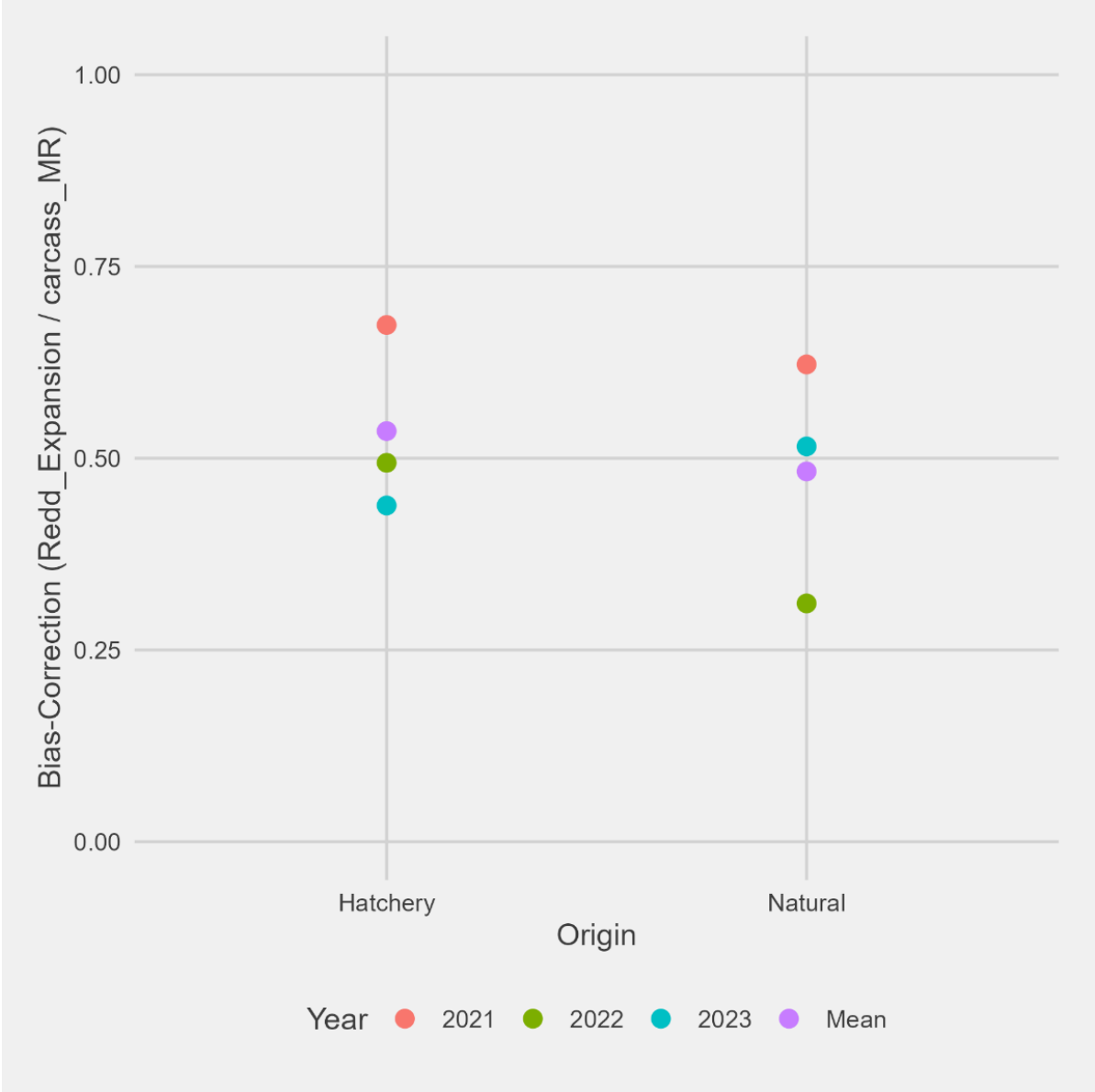


Results: M-R vs. redd-expansion, 2021-23

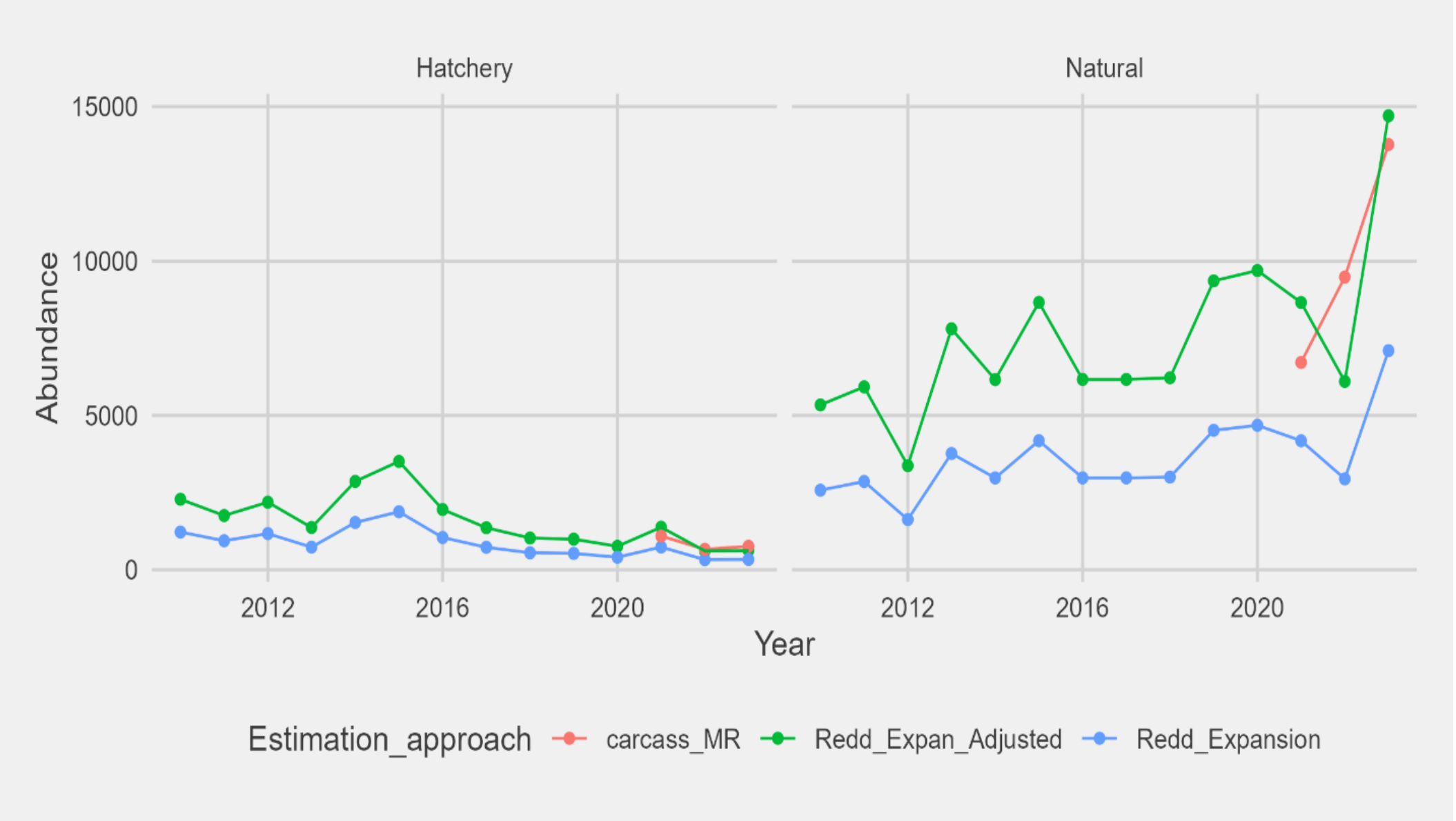


Results: Bias-correction factor for redd estimates

- Annual correction factor generated by dividing estimates.
- Average of three year's estimates.

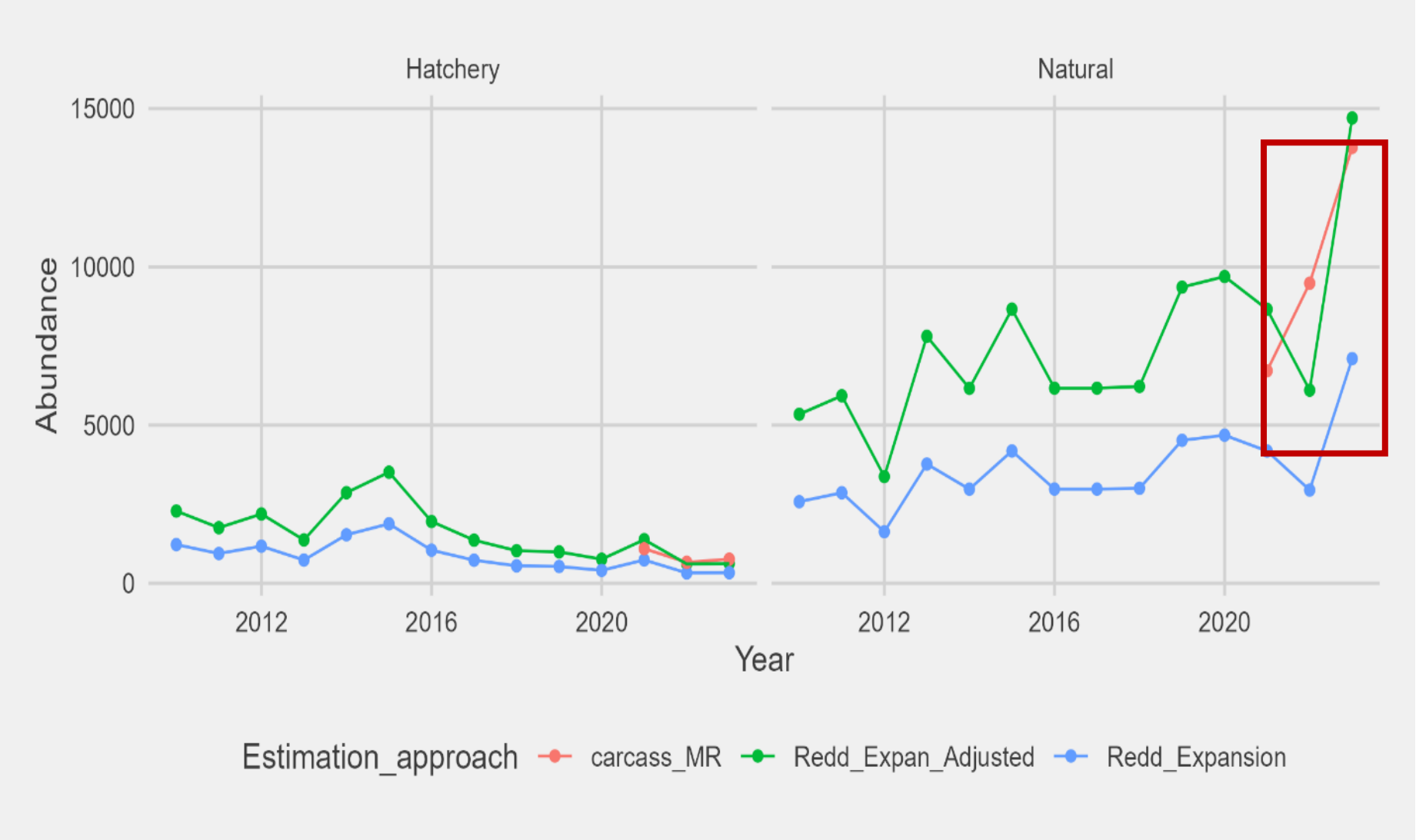


Results: Bias-corrected (aka adjusted) estimates

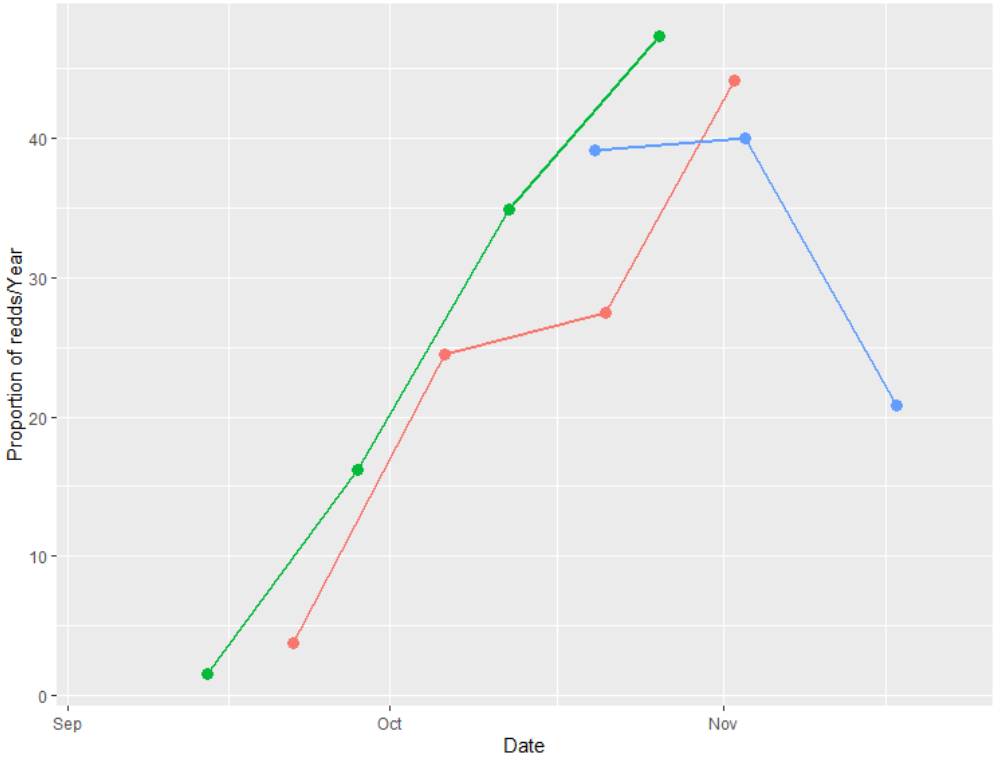


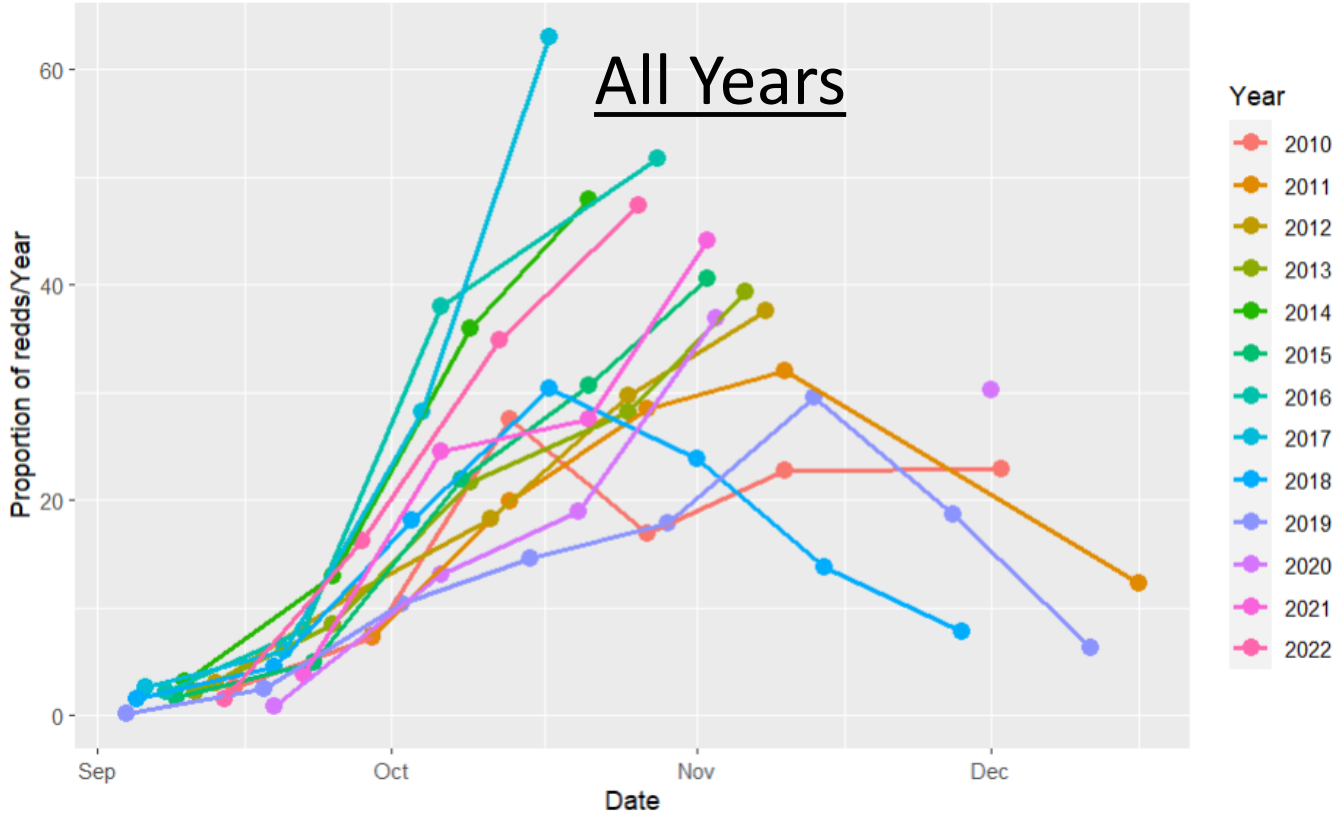
Results: Bias-corrected (aka adjusted) estimates

- The bias-corrected peak redd count estimates do not perfectly align with M-R estimates.



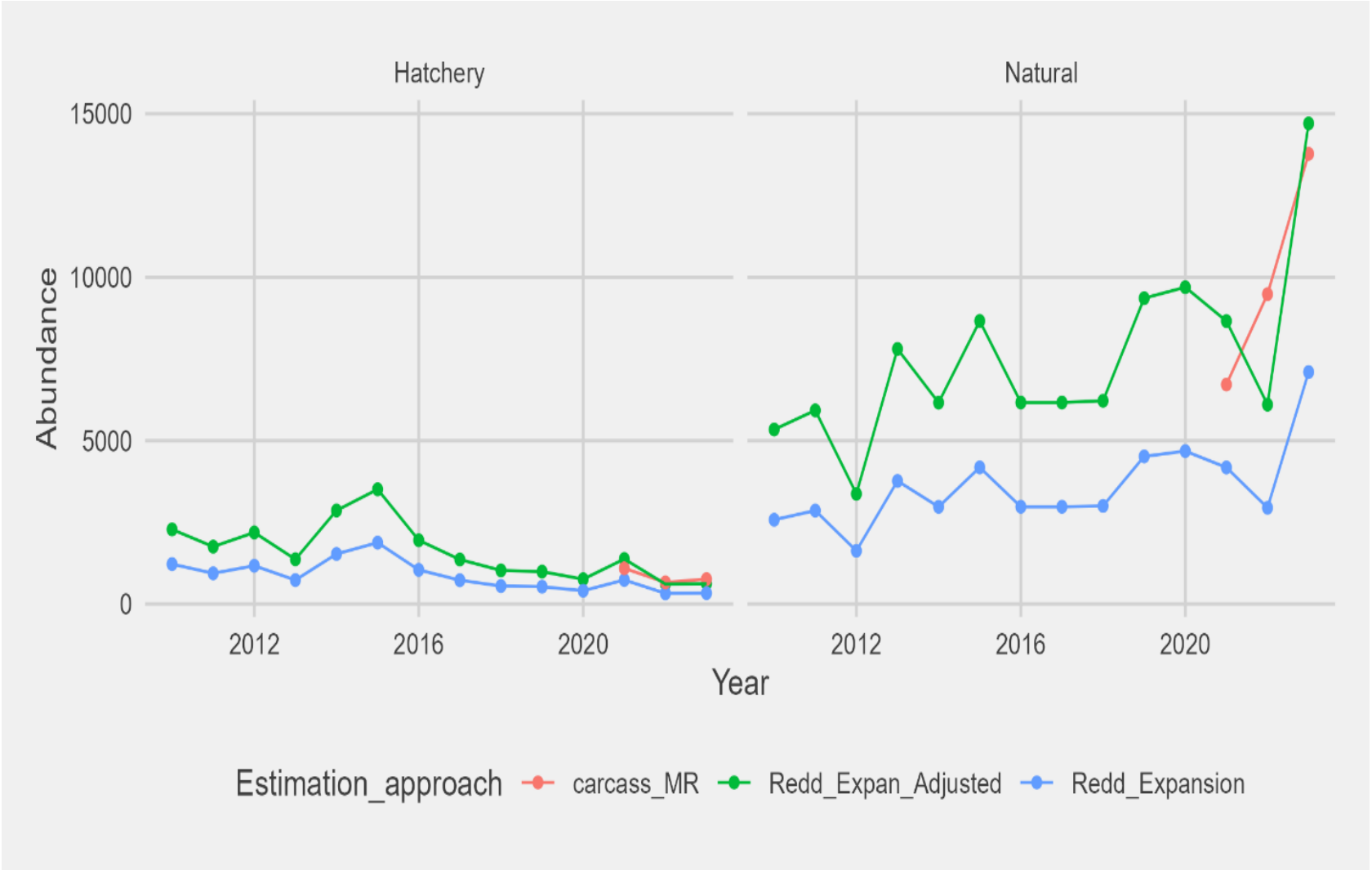
Results: Redd Counts by Year





Results: Bias-corrected (aka adjusted) estimates

- First attempt to correct peak redd count expansion abundance estimates.
- The adjusted estimates should be unbiased in the long term.
- More sophisticated statistical techniques may be applied in the future.



Conclusions

- Meeting objectives of the project
  - Obtain accurate estimates via M-R carcass surveys
  - Maintaining redd-based estimates for bias-correction later
- Next steps:
  - Short term → continue concurrent surveys
  - Long term → carcass tagging or updated expansion

Acknowledgments

- Survey crew
  - Erick Rockwood
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- Study Design & Analysis
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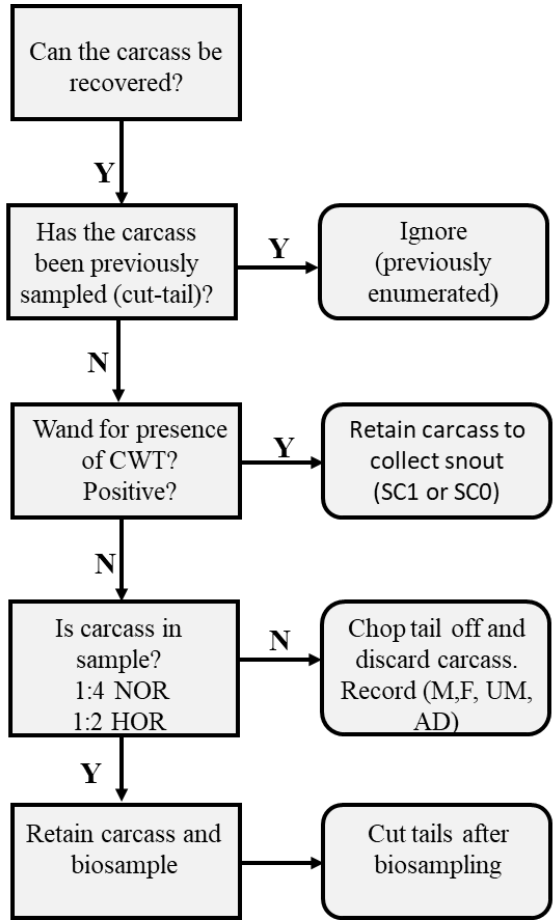
  - Kale Bentley
- Data Management
  - Danny Warren

Questions?

Supplemental slides

Mark-Recapture: Data Collection & Analysis

Carcass Survey Flow Diagram



Abundance and composition of adult Chinook escapement is estimated using an ***"open" population Jolly-Seber (JS) model*** (Seber 1982, Pollock et al. 1990).

- "super population" JS model was developed by Schwarz et al. (1993, 1996) specifically for estimating salmon spawning escapement using mark-capture methods
- Has been successfully implemented to estimate spawner escapement for other salmon populations within the Lower Columbia River (Rawding et al. 2014) and other Washington state watersheds (Ashcraft et al. 2017).

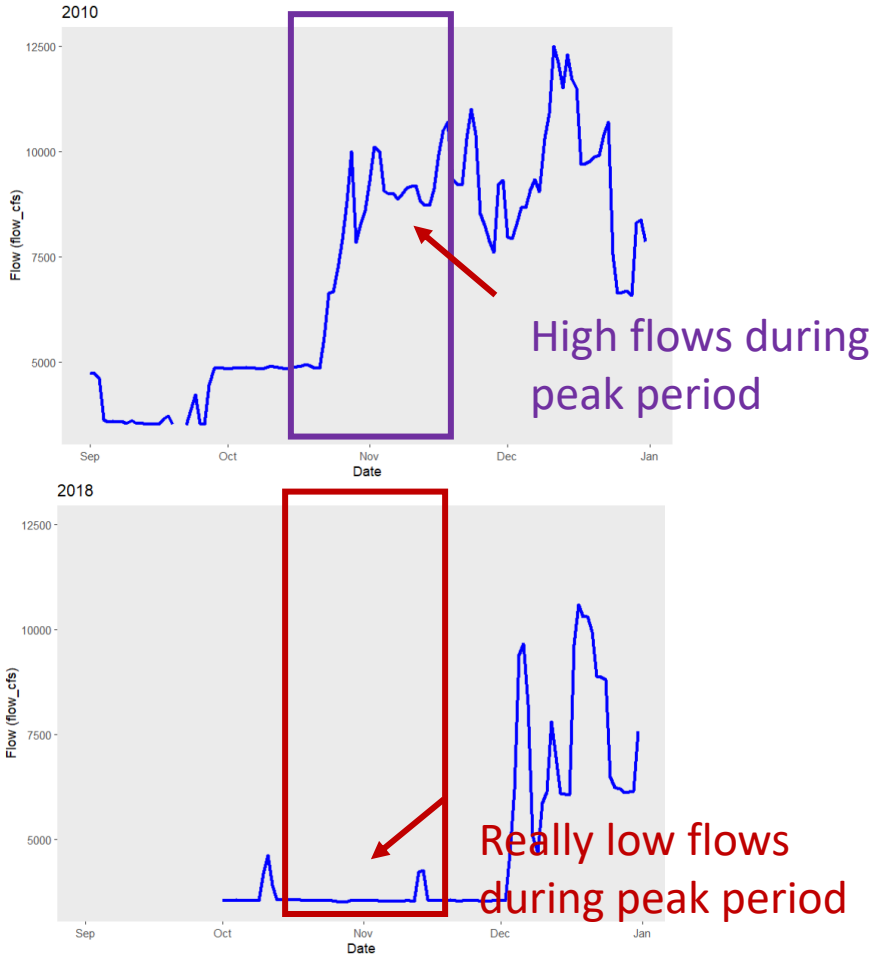
Assumptions of Jolly-Seber Mark-Recapture

- ***Spatial and temporal coverage***: Carcasses are sampled and marked throughout the entire spawning run and encompass the entire spawning distribution.
- ***Equal Catchability***: Each carcass that is present in the study system during a specific sample event, whether tagged or untagged, has the same probability of being sampled.
- ***Equal Persistence***: Each carcass that is present in the study system during a specific sample event, whether tagged or untagged, has the same probability of survival (i.e., persisting in the study area to the following sample period).
- ***Tag Loss and Recovery***: Tagged carcasses do not lose their tags and all tags are recognized and read properly on recovery.
- ***Instantaneous Sampling***: All samples are instantaneous, i.e., the sampling time is negligible and each release is made immediately after the sample.

Flows in the lower Cowlitz for 4 years of redd-counts with “descending limb”

2018 doesn’t match the pattern of high flows in early Nov. that could have resulted in an artificially earlier timed peak count

Earlier observed peak in redds



Later observed peak in redds