Fish modelling to support management decisions

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H.4 Salmonid modelling

Using data collected by AZGF and TRGD as part of project H

Thanks to Josh Korman, Michael Yard, Mariah Giardina, Jan Boyer and Kim Dibble

Linking water management decisions with fish populations

Funded primarily by USGS, non-AMP

Thanks to Lindsey Bruckerhoff, Drew Eppehimer, Kevin Bestgen, Jian Wang, Kim Dibble, Bryce Mihalevich, and Jack Schmidt

Resource Goals: Invasive Species

Annual Reporting

January 10, 2022

U.S. Department of the Interior
U.S. Geological Survey

Outline

- **Brown trout model update.**
- **Coupled outflow and smallmouth bass model.**

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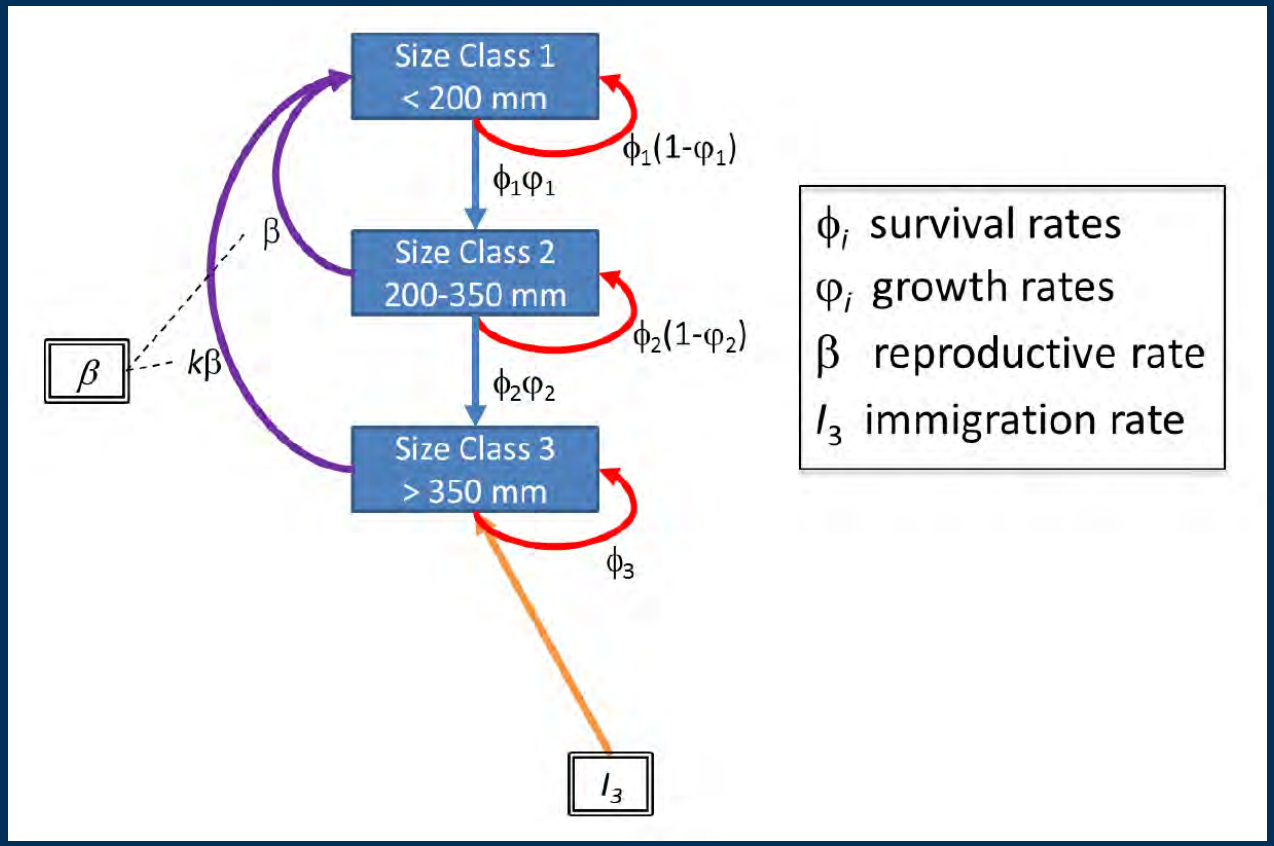
Basic modelling framework



- Fit to cpe data (2000 – present) and mark-recapture data (2012-present)
- 1 mark-recapture site (2012-2016), 3 sites (2017-2020), 2 sites (2021).
- Gap in mark-recapture data when culling required.

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Modelling assumptions

- Seasonal time step.
- Size and seasonal variation in growth and survival (but not among years).
- Survival informed by a Lorenzen relationship.
- Capture probability allowed to vary by trip and size class (random effect).
- Immigration for large adults allowed to vary for each interval (random effect).
- Recruitment varies between years (random effect).

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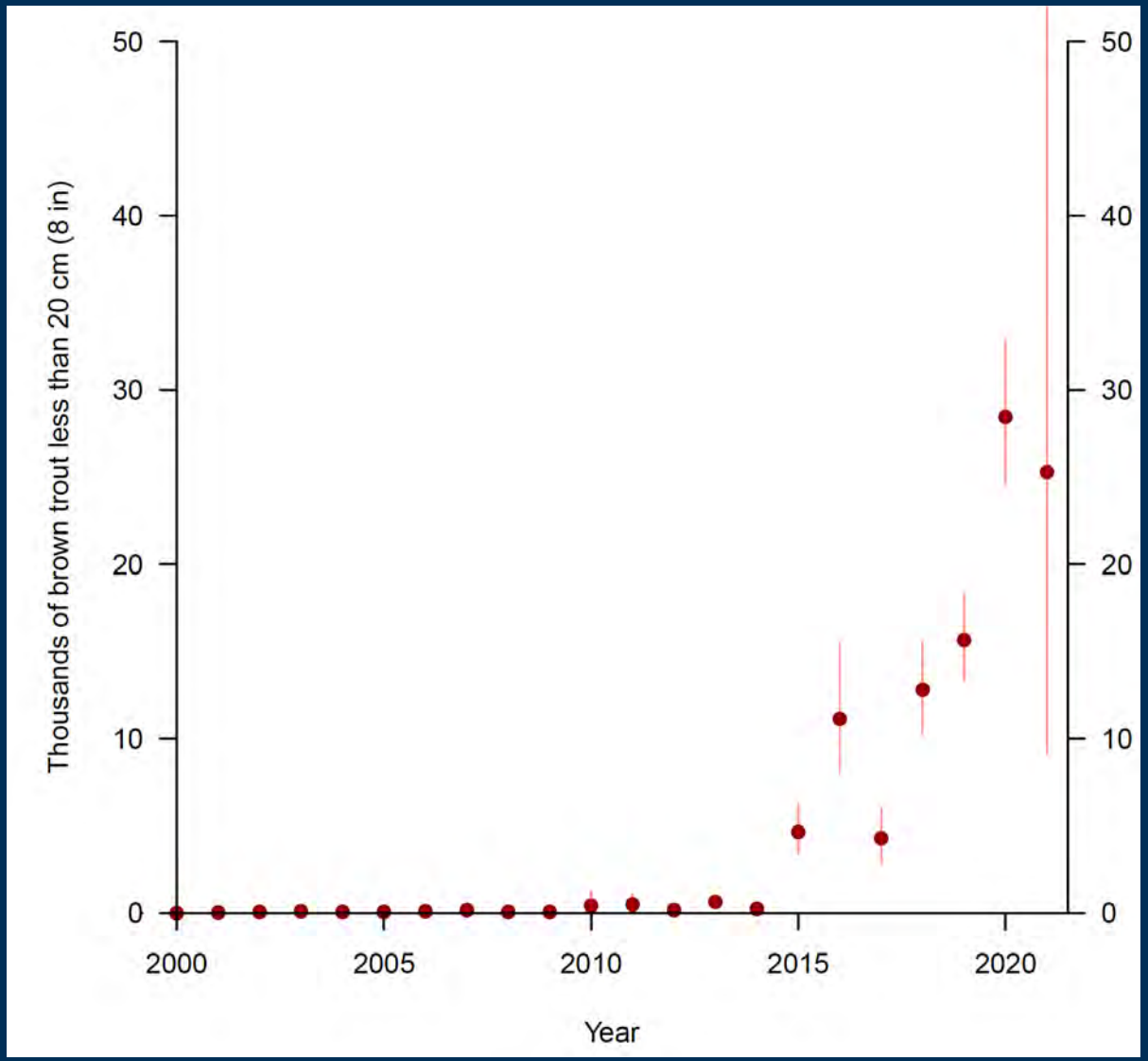
Recruitment this year similar to last year



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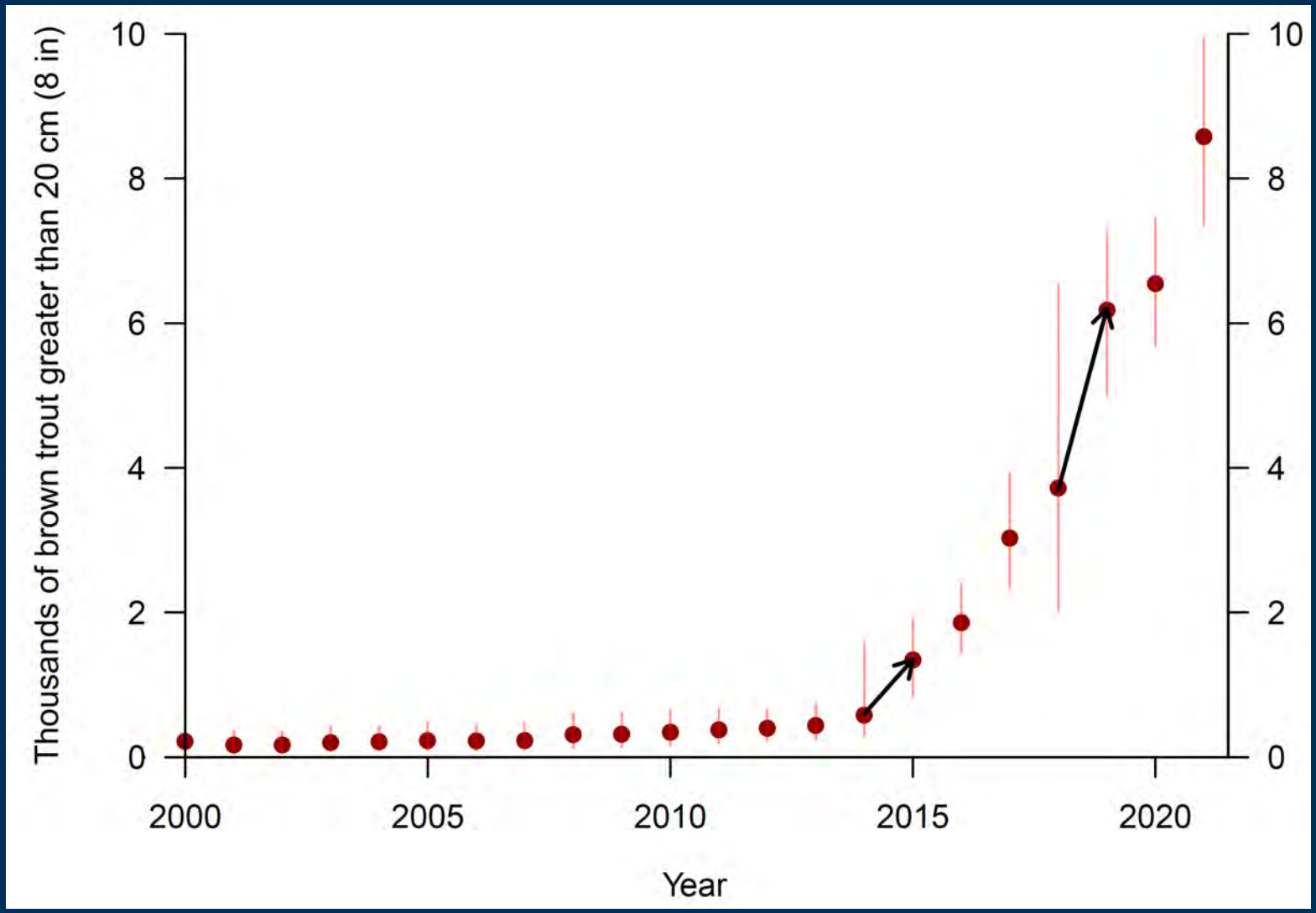
(Preliminary, do not cite)

Brown trout adult abundances continue to increase



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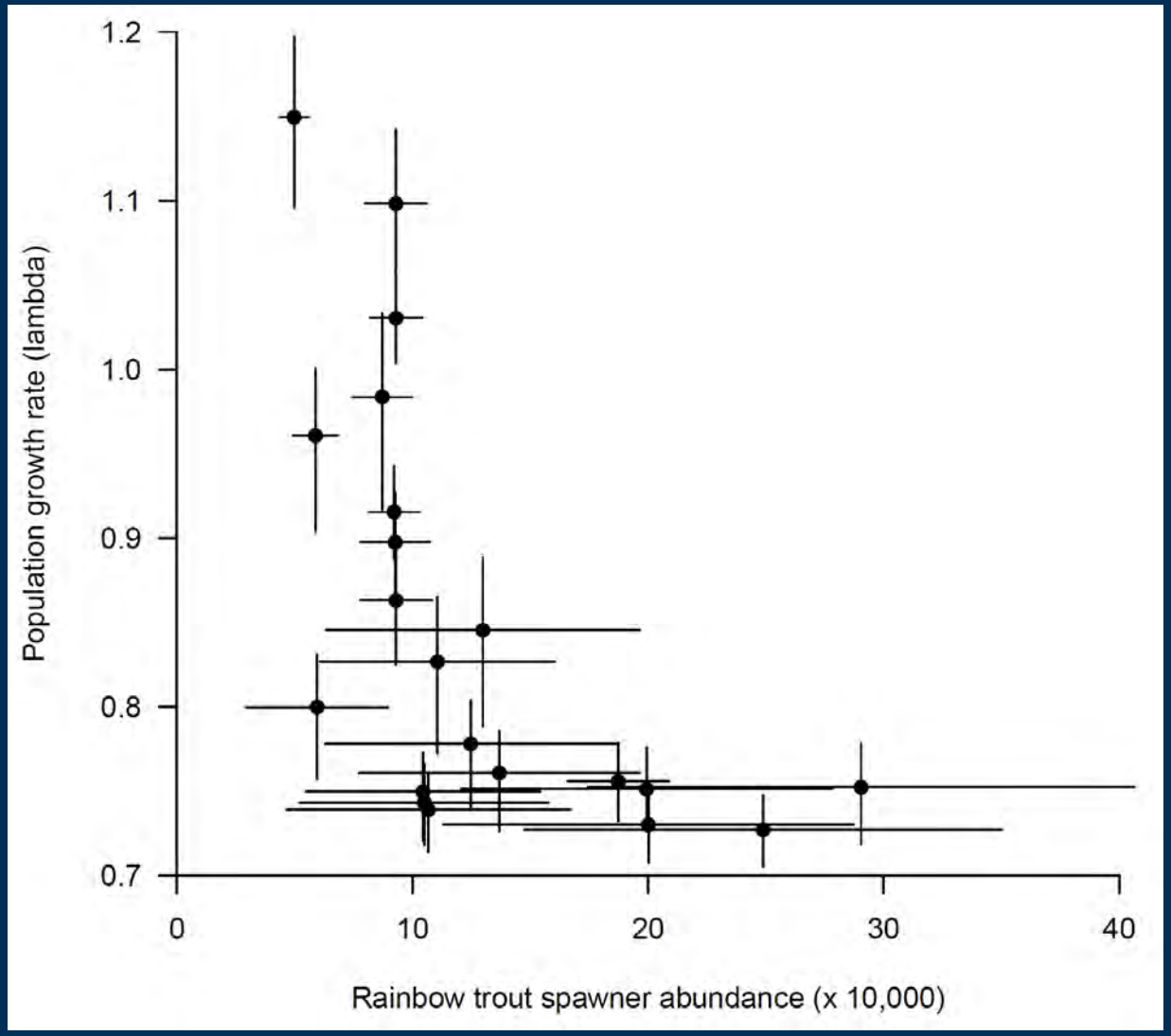
Brown trout recruitment, and by extension population growth rate (not including immigration), negatively correlated to rainbow trout spawner abundance



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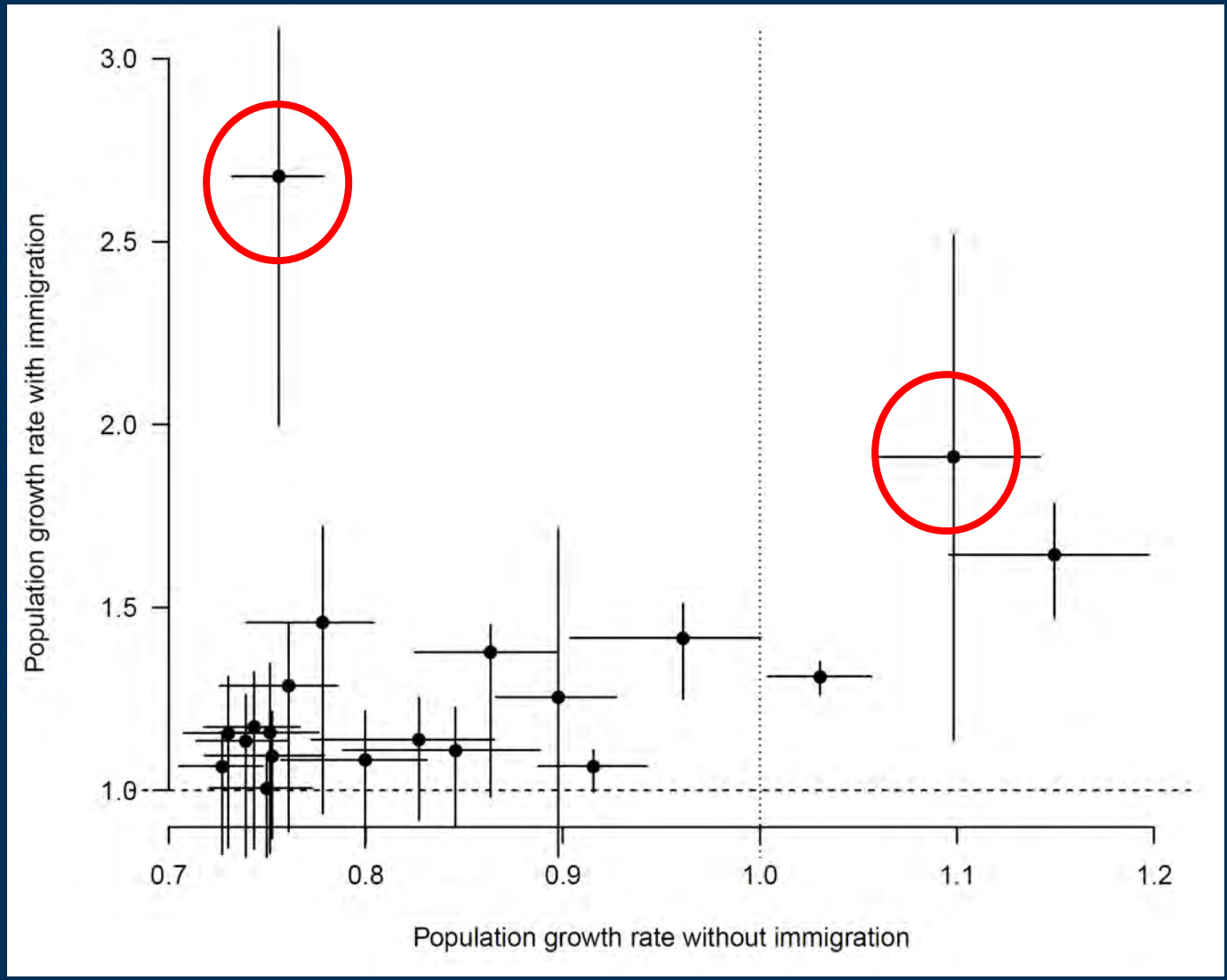
(Preliminary, do not cite)

Recruitment variation drives most, but not all variation in brown trout lambdas.



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Outline

- Brown trout model update.
- **Coupled outflow and smallmouth bass model.**

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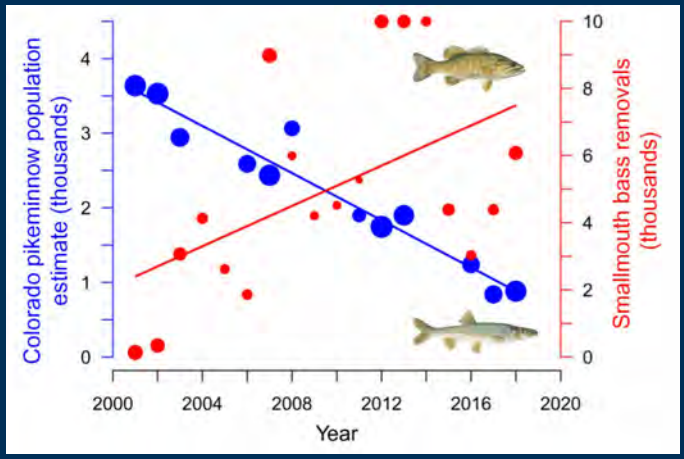
Background

- Smallmouth bass (and other warmwater nonnatives) are a huge issue in the upper basin.
- Project focused on developing coupled smallmouth bass and Colorado pikeminnow population models.
- Provides some opportunity for learning that is relevant to Grand Canyon.



(Dibble et al., 2021)

Questions driving development of tool for Grand Canyon

- What thermal regimes are suitable for smallmouth bass to increase (assuming they are present in sufficient numbers to reproduce)?

- To what extent do changes in monthly volumes and/or use of jet tubes alter predicted thermal regime?

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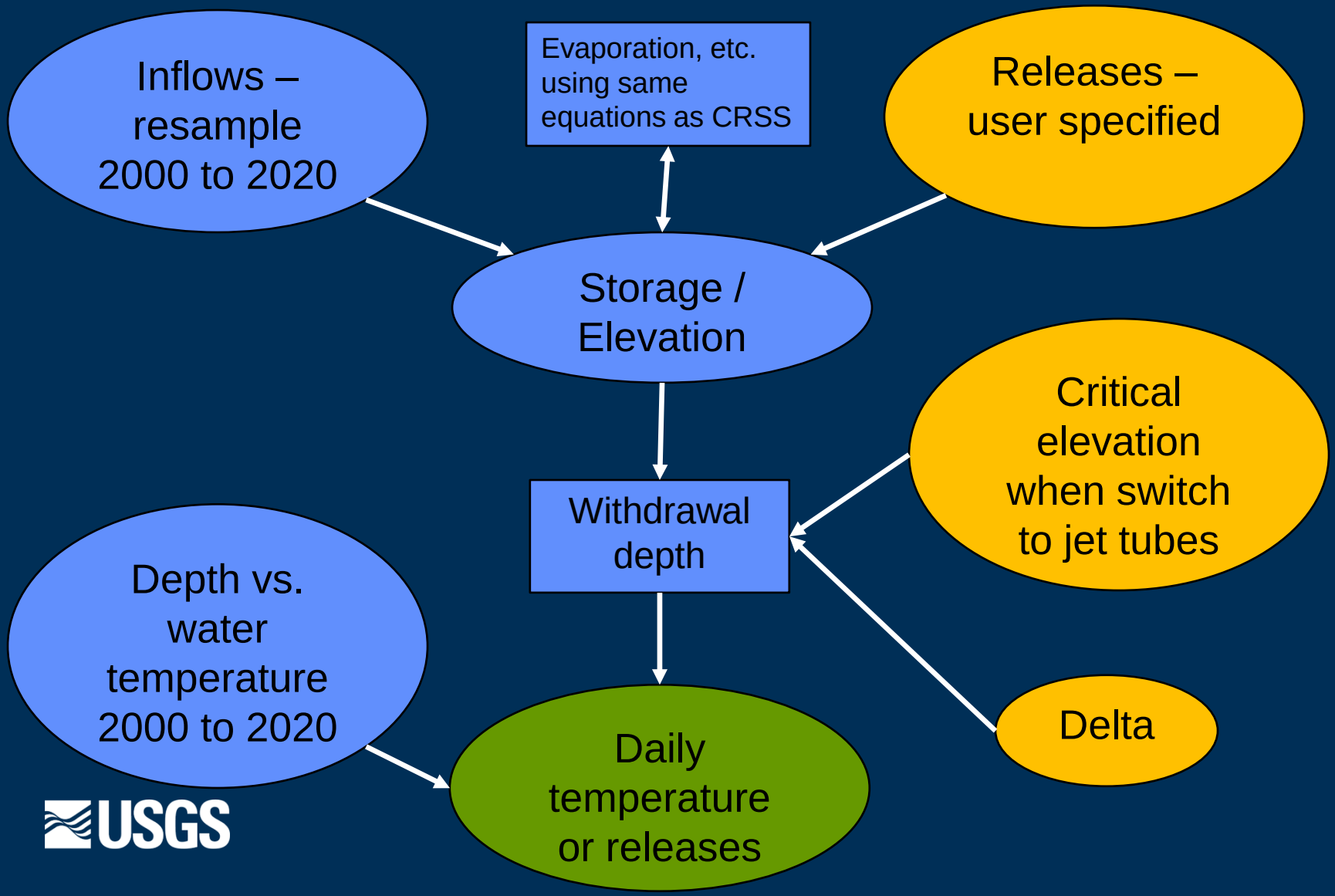
Model framework: Part 1



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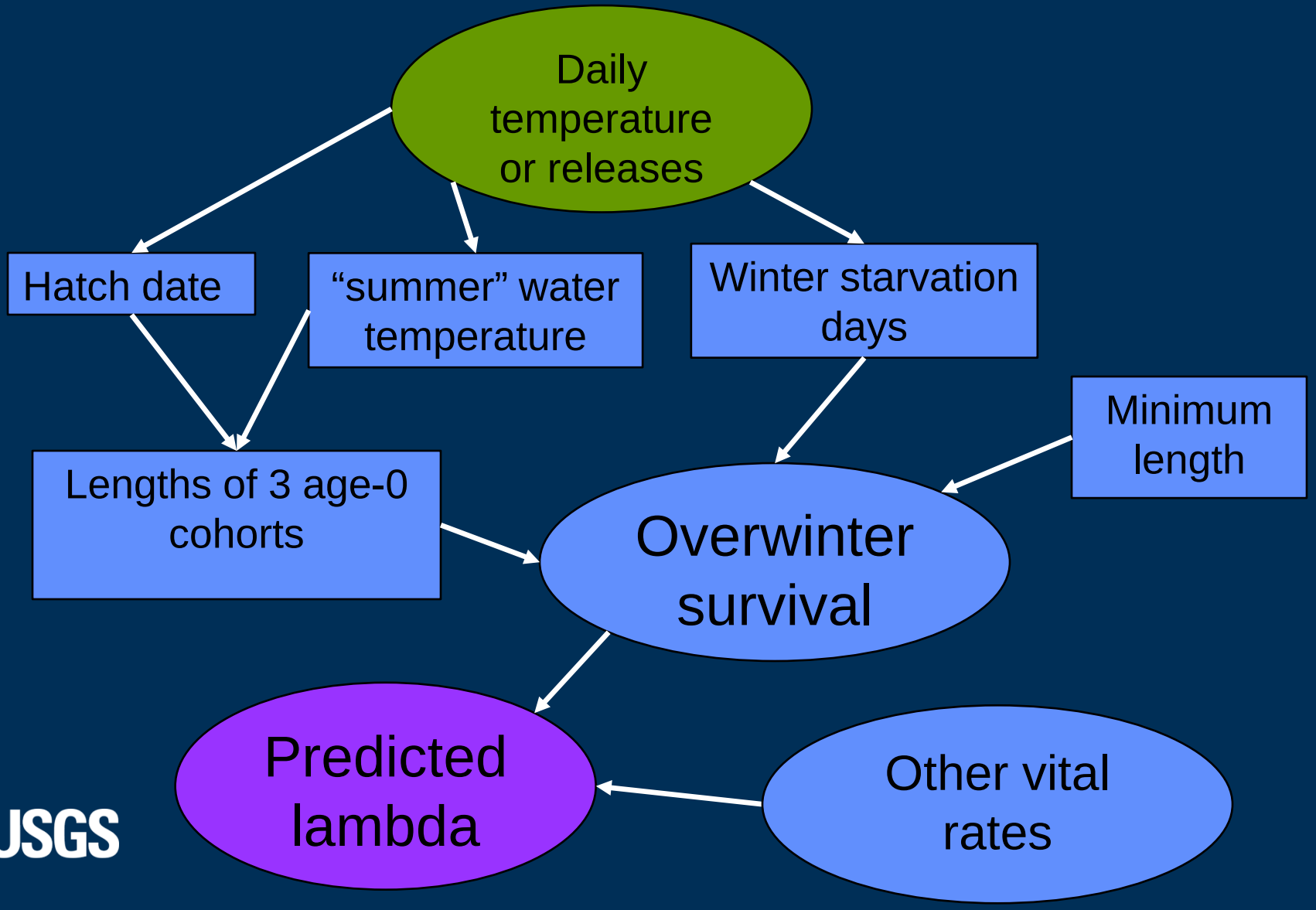
Model framework: Part 2



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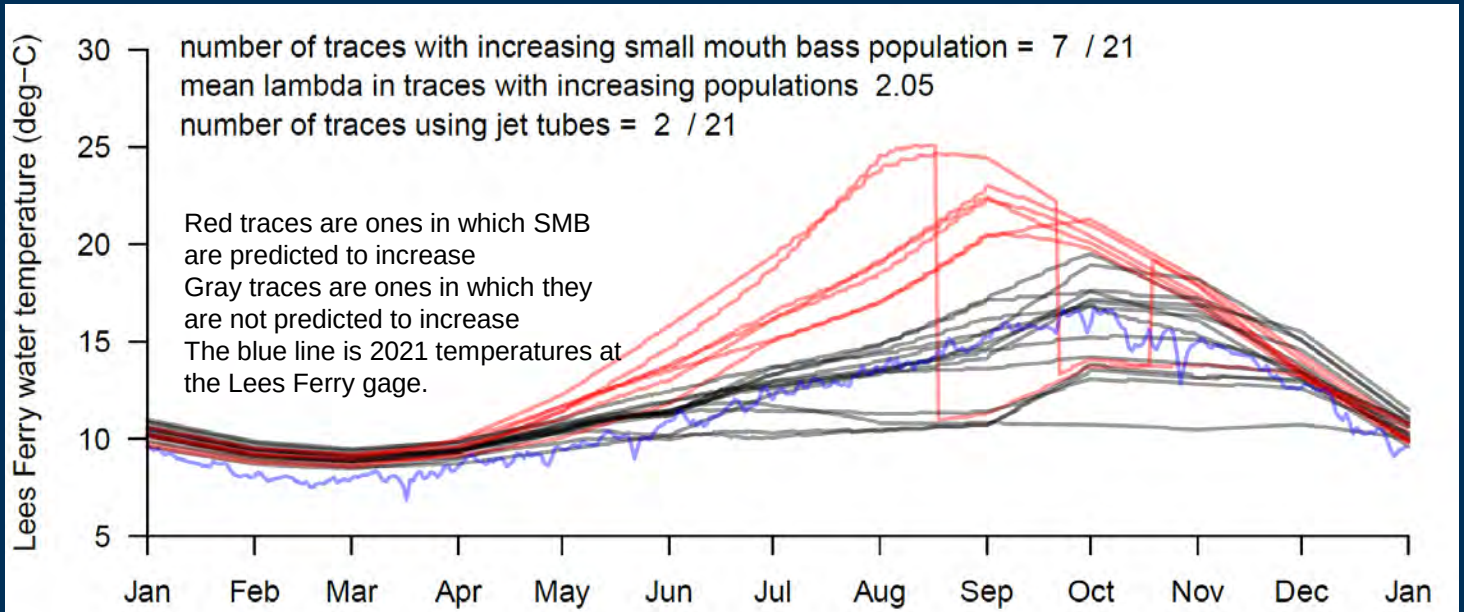
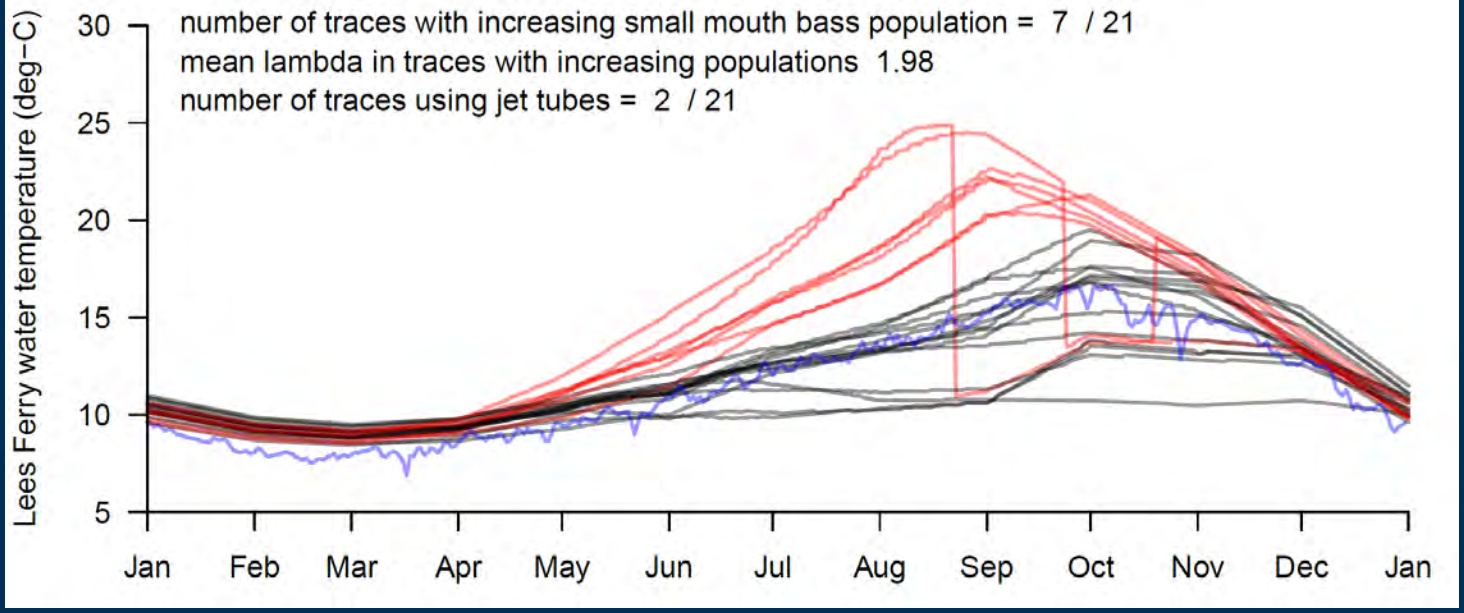
Baseline





3b

(Preliminary, do not cite)

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(Preliminary, do not cite)

Baseline

Change critical elevation from 3490 to 3510

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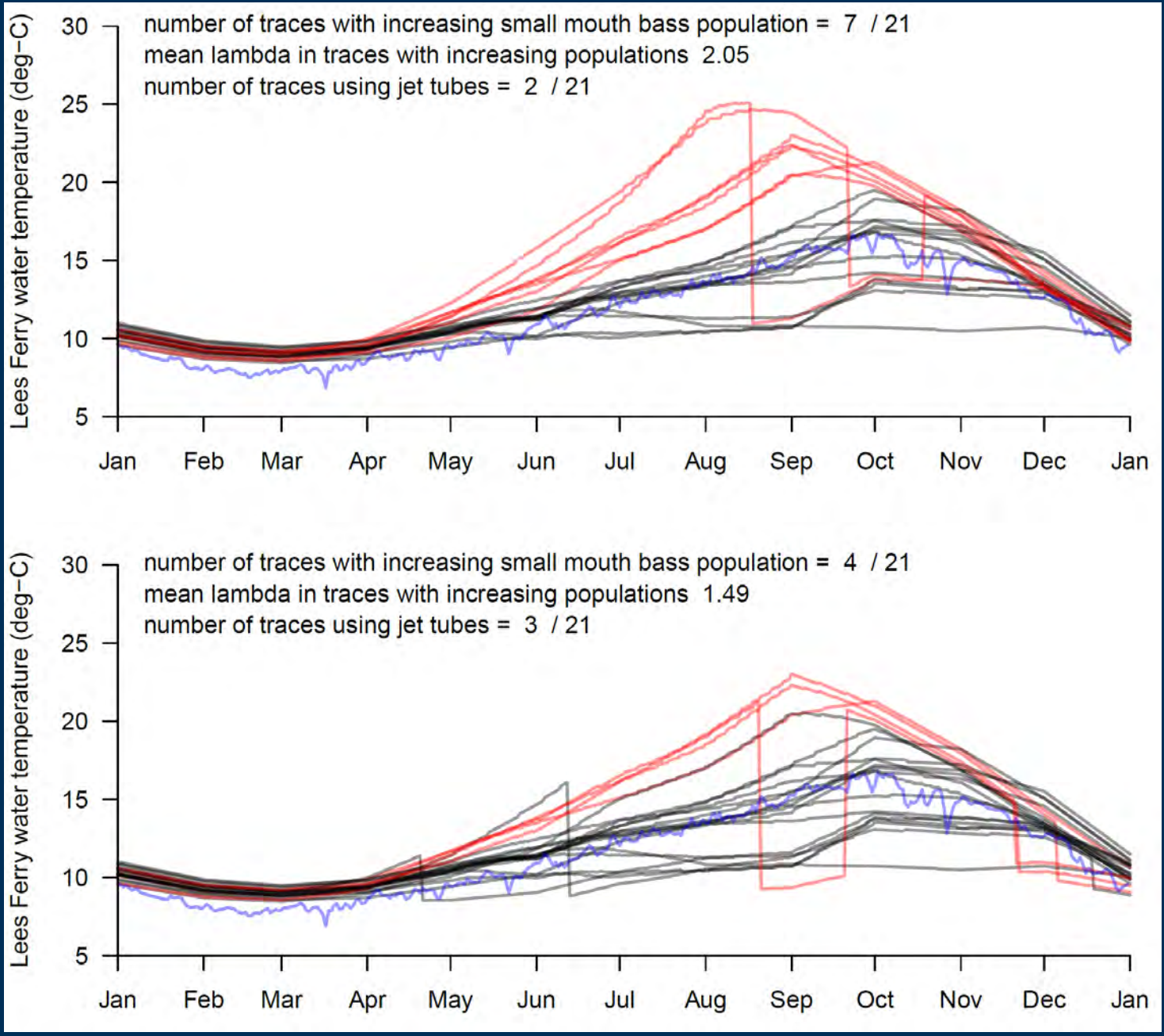

One important uncertainty

- **Translating water temperature in depth profiles to outflow water temperature as lake elevation approaches penstocks.**

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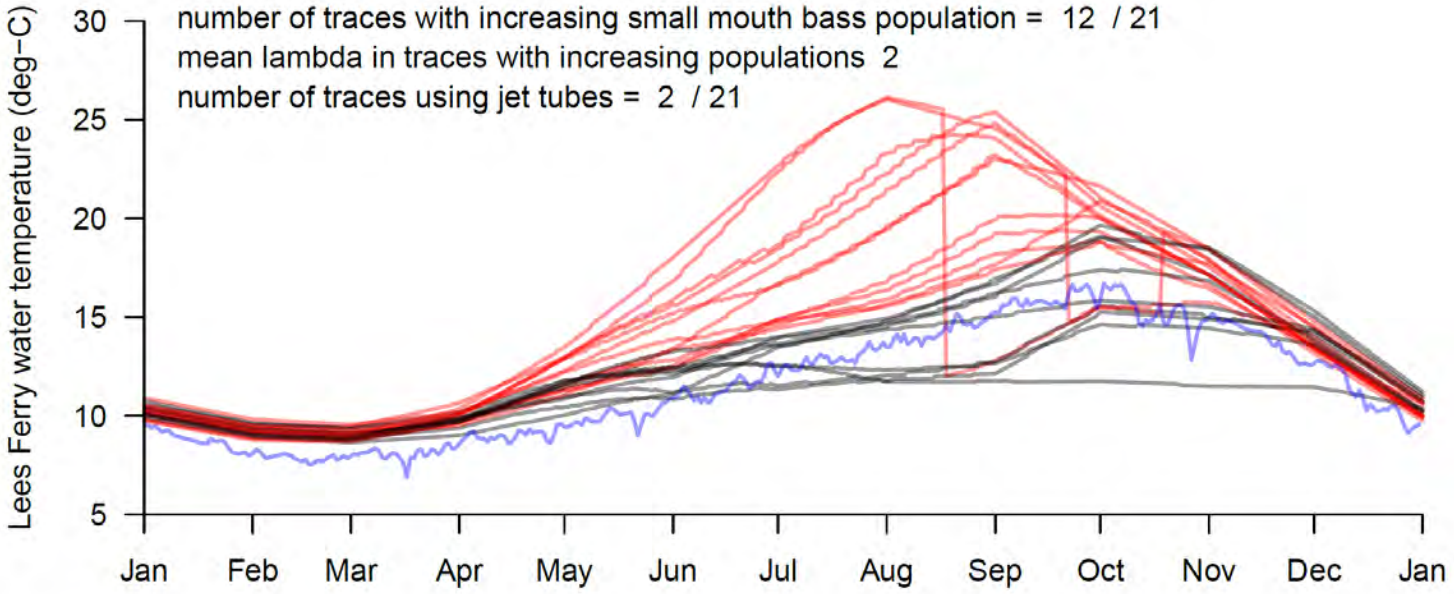
Baseline
Delta = -15



3b
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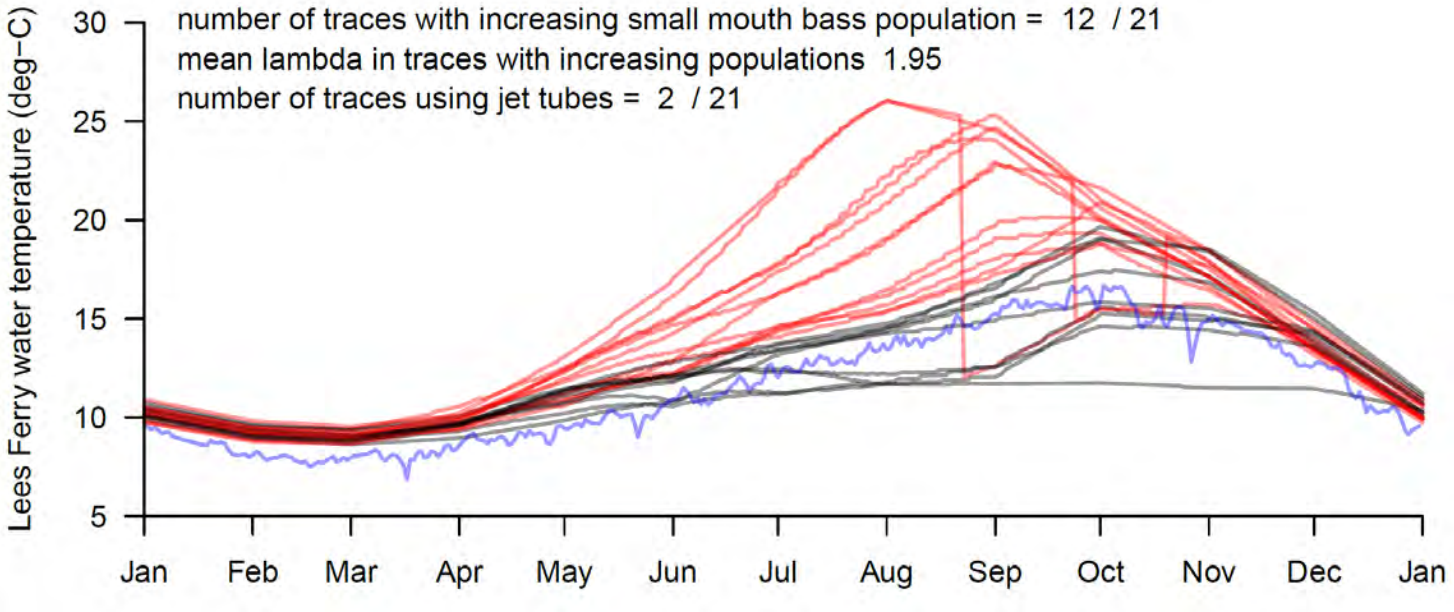

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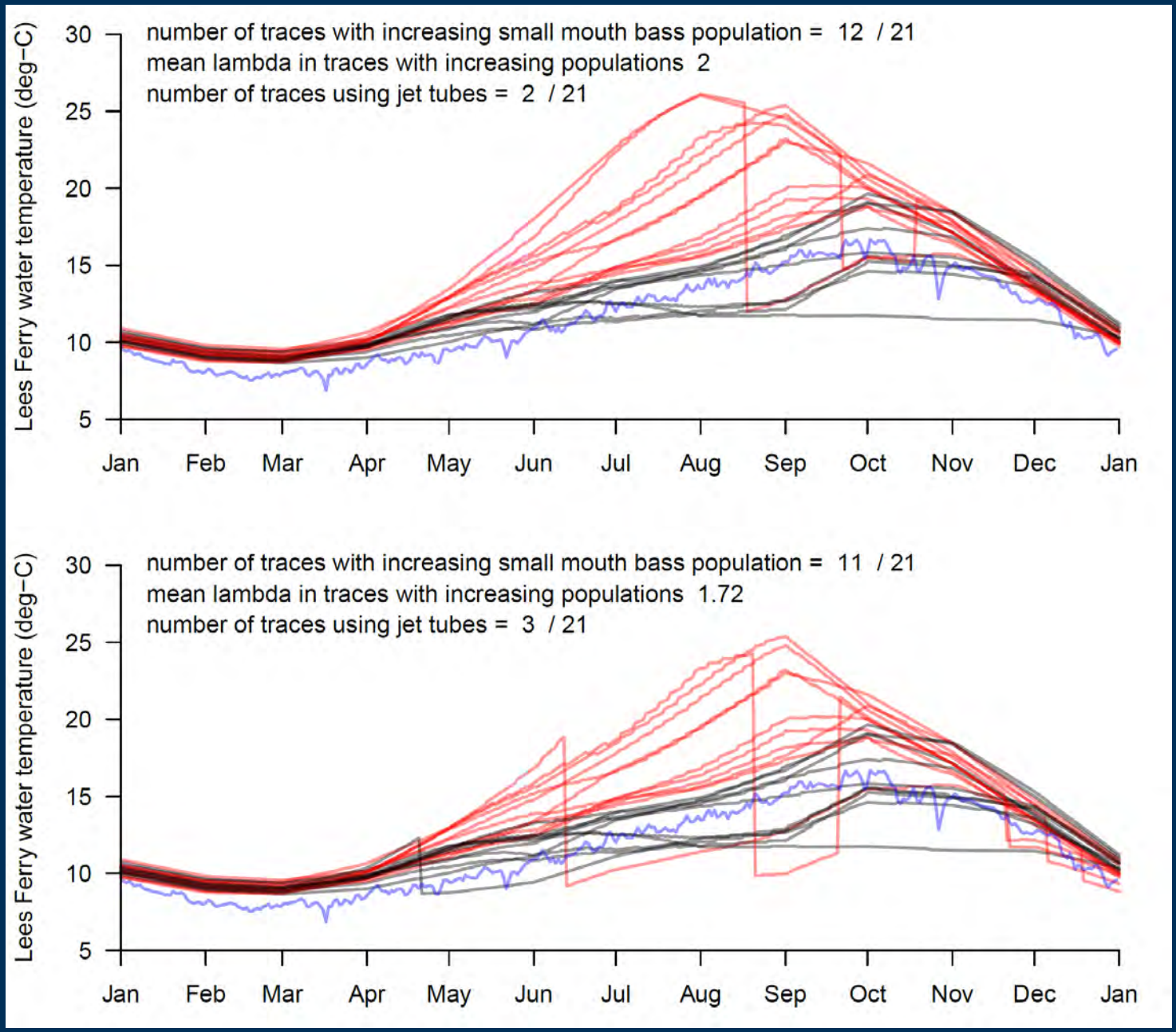
Baseline Delta=-15

Change critical elevation from 3490 to 3510 Delta=-15



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Future work

- Extend predictions downstream.
- Consider improvements to depth to release water temperature component.
- Could explore other scenarios.
- Canyon wide model.
- But near term plan is to shift focus back to upper basin.

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Questions
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