Hydraulic and Habitat Modeling to Understand Habitat Overlap Between spring Chinook Salmon and Smallmouth Bass Along the Willamette River

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Willamette Fisheries Science Review

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Smallmouth Bass Predation: Juvenile Salmon

- First introduced in the Willamette River Basin in 1924
- Historical primary distribution: from mouth of Santiam River to Columbia River confluence
- Most abundant non-native fish species in Willamette River
  - Lavigne et al. 2008
  - Friesen et al. 2005

> "Considering their relative abundance (all size classes), diet, and ubiquity, smallmouth bass probably pose the most significant potential threat to juvenile salmonids in the lower Willamette River."

Photo from Toby Koch, USGS

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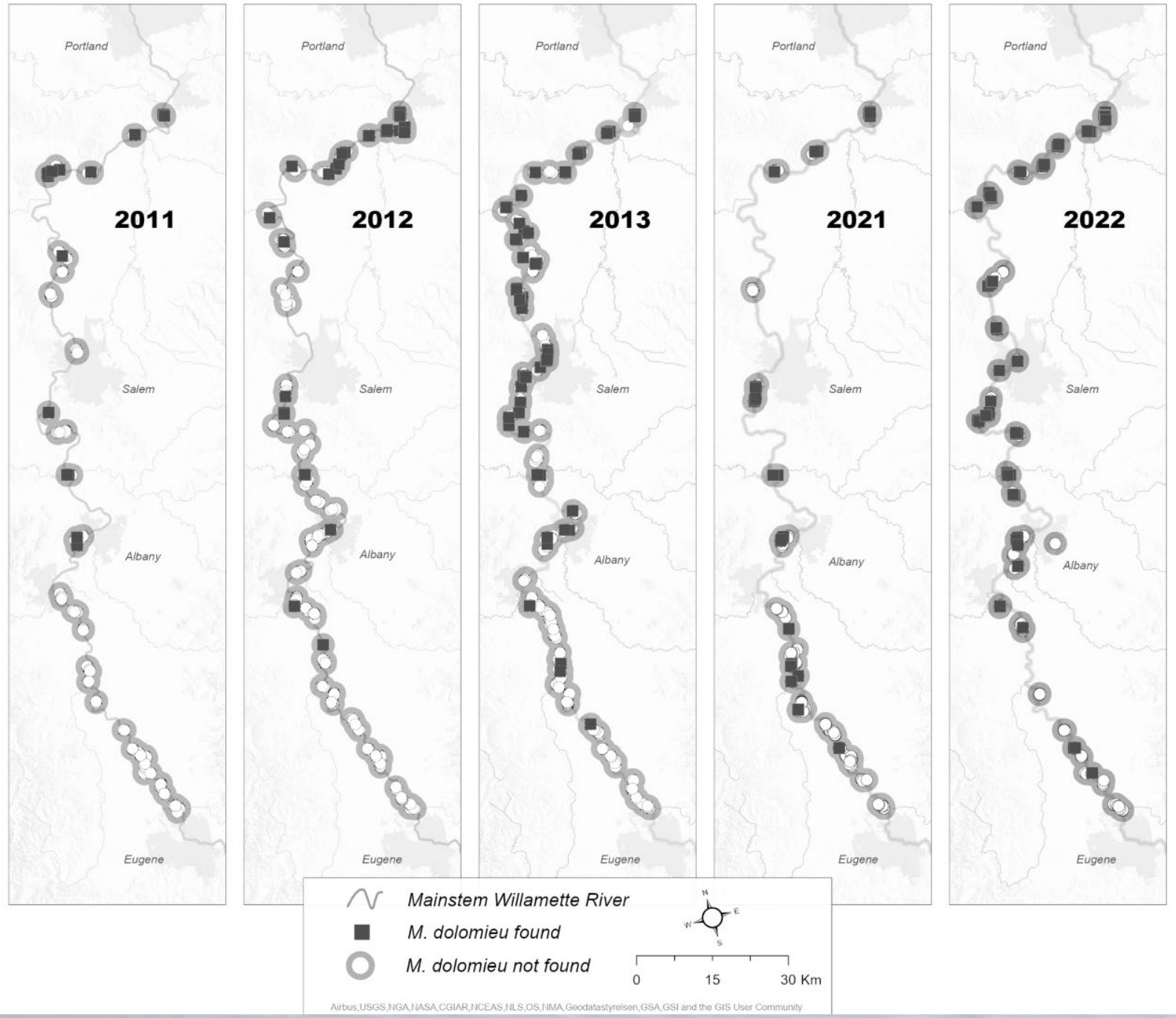
Distribution of Smallmouth Bass in the Willamette River 2011-2022, from OSU and USFS repeat sampling



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Preliminary data, do not cite

Smallmouth Bass Predation: Juvenile Salmon

What is the extent of overlap between juvenile Chinook and Smallmouth Bass habitat, and are there flow-management strategies that could reduce predation potential?

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Modeling Approach

- Use hydraulic models developed in White and Wallick (2022) to assess extent of useable hydraulic conditions from Eugene – Newberg
- Develop Smallmouth Bass habitat criteria by combining literature derived habitat suitability values with local expert opinion:
    - Smallmouth bass habitat criteria used in this study:
        - Velocity range: 0.0 – 0.5 m/s
        - Depth range: 0.5 – infinite m
        - Proximity to revetment: 3m
        - Water temperature ≥ 15 degrees Celsius

- Compare Smallmouth Bass habitat extents to juvenile Chinook habitat models produced in White et al. 2022 and Hansen et al., 2022

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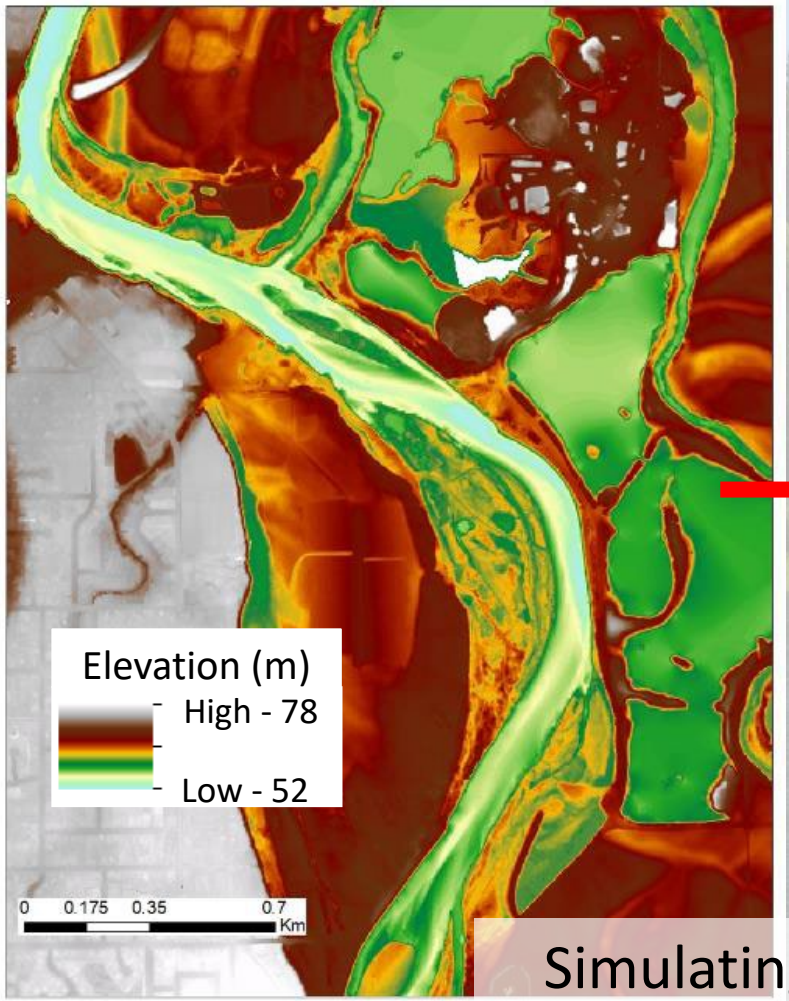
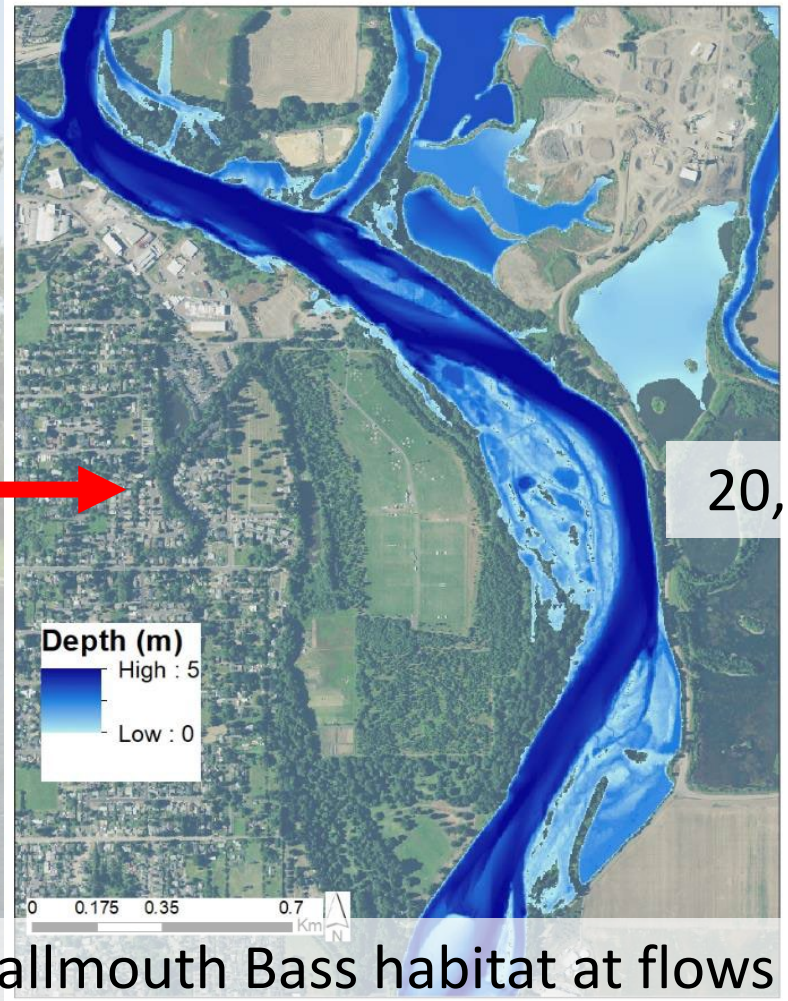
Hydraulic Model

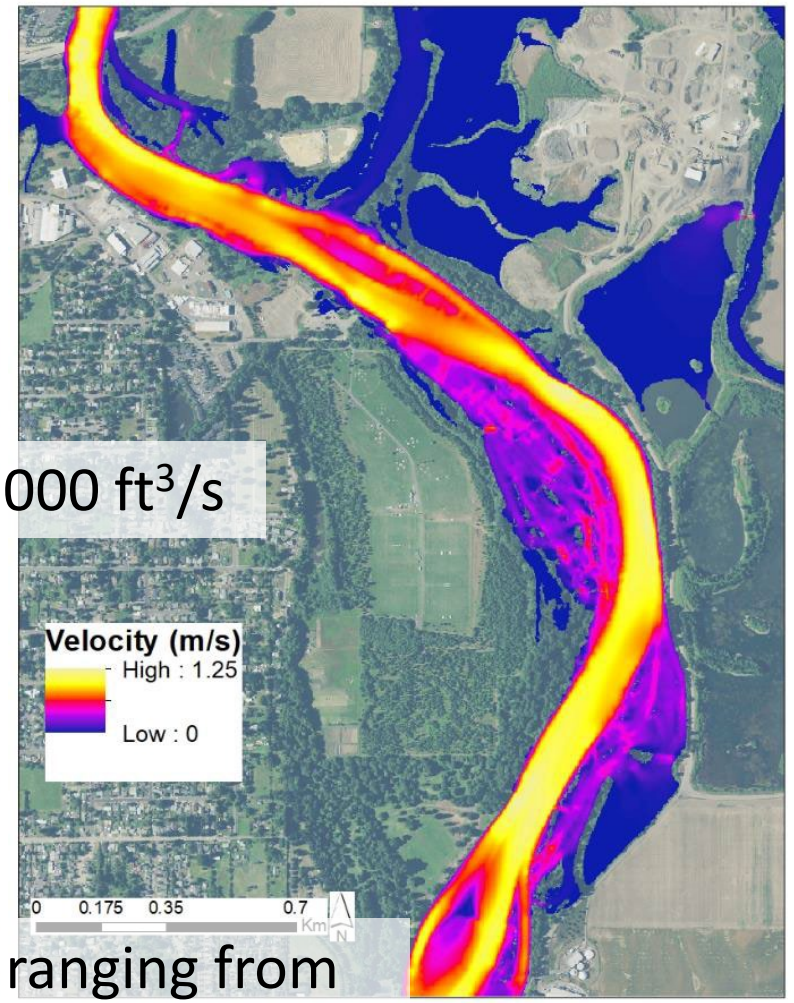
Bathymetry
(Bathymetric lidar + USGS sonar)



Continuous Depth



Continuous Velocity



20,000 ft^3/s

Simulating Smallmouth Bass habitat at flows ranging from summer low flow to average spring flows

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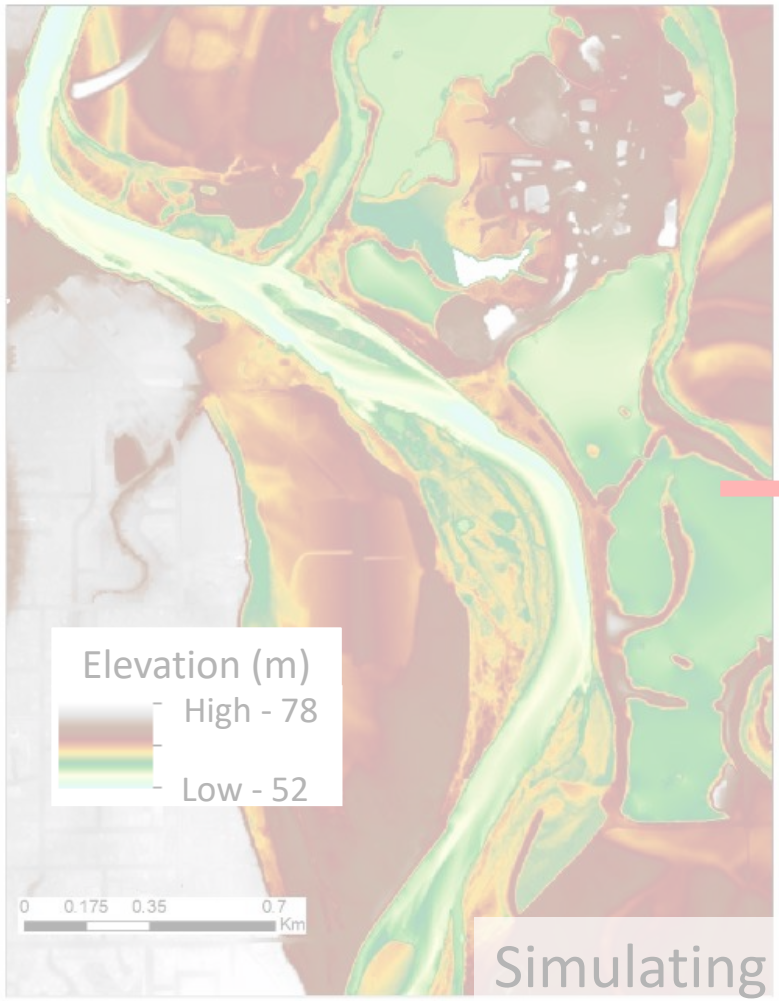
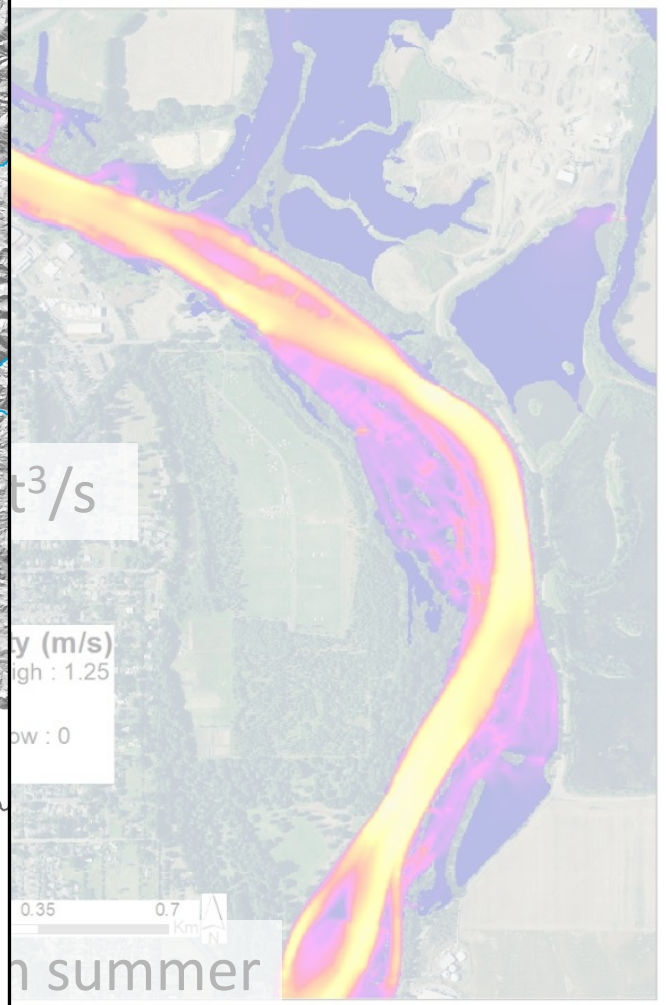
White and Wallick, 2022

Hydraulic Model

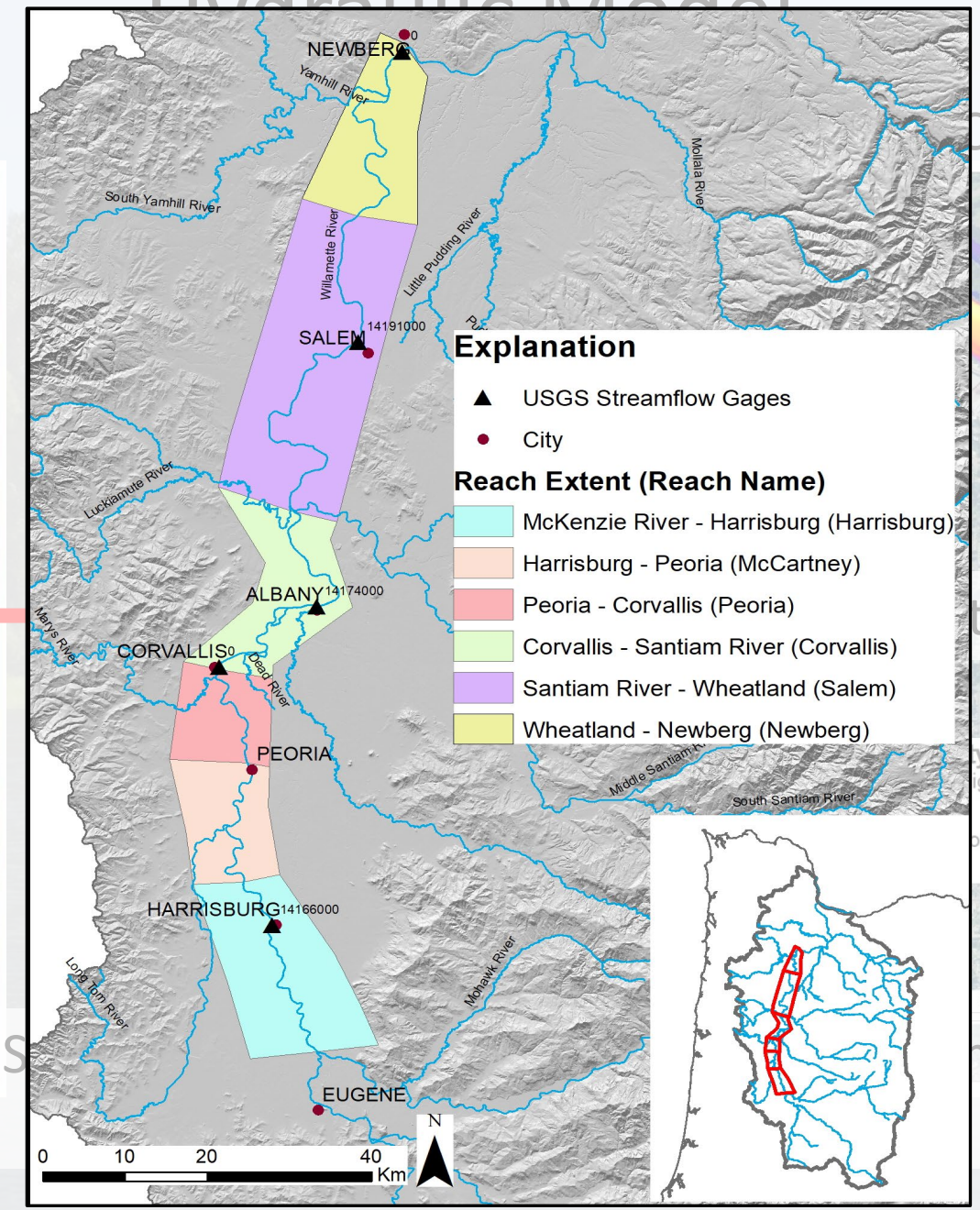
Bathymetry
(QSI TB lidar + USGS sonar)



Continuous Velocity



Simulating S… summer



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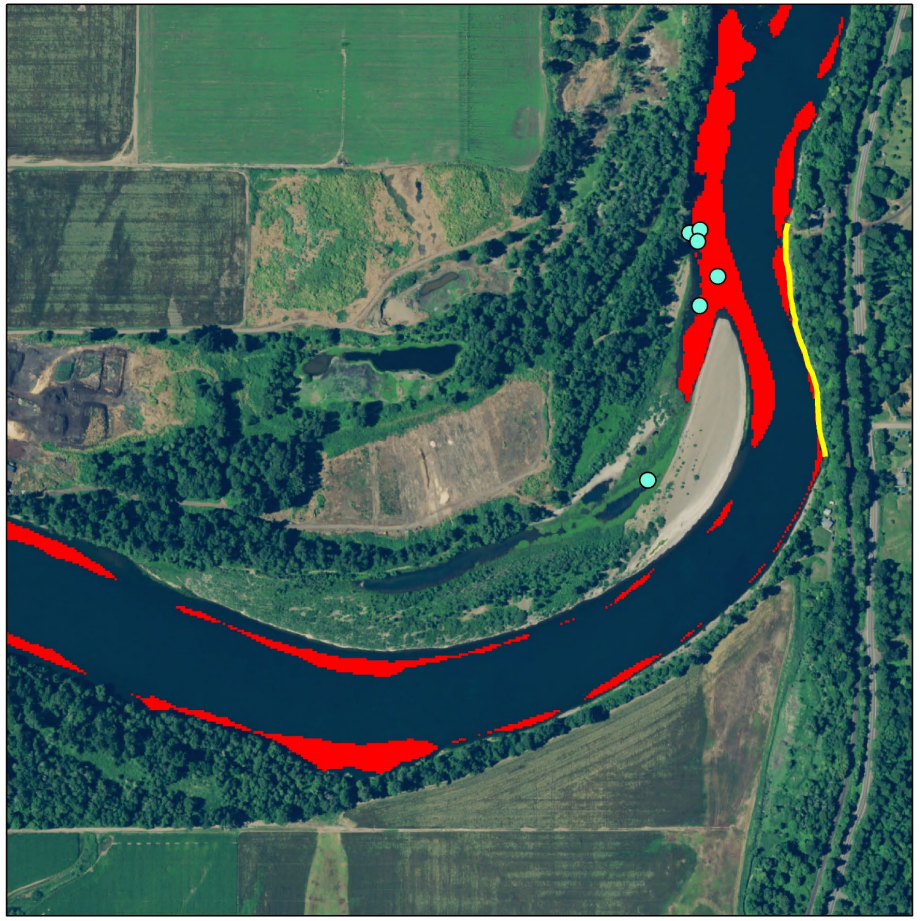
White and Wallick, 2022

Spatial Outputs of Smallmouth Bass Habitat Model



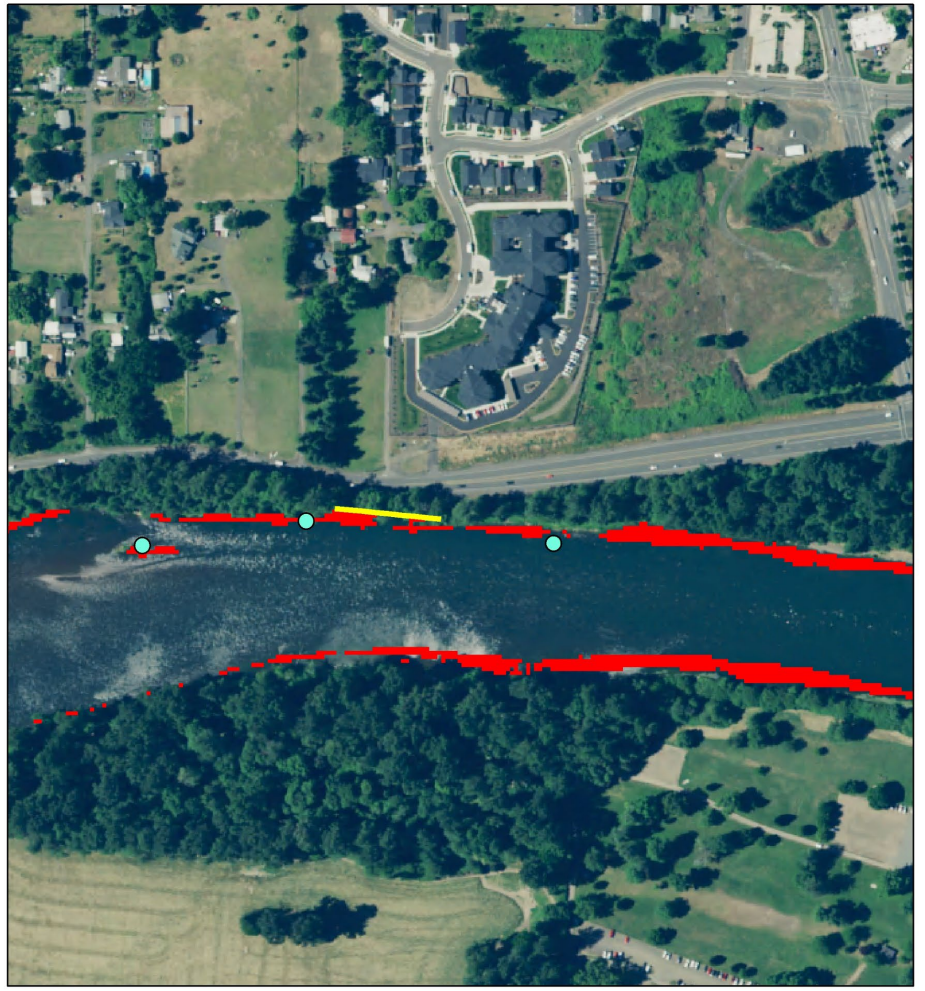
Salem – Santiam River Reach

0 0.1 0.2 0.4 Km

OSU Smallmouth Observation

Revetment

Modeled Smallmouth Habitat



Albany – Corvallis Reach

0 0.075 0.15 0.3 Km

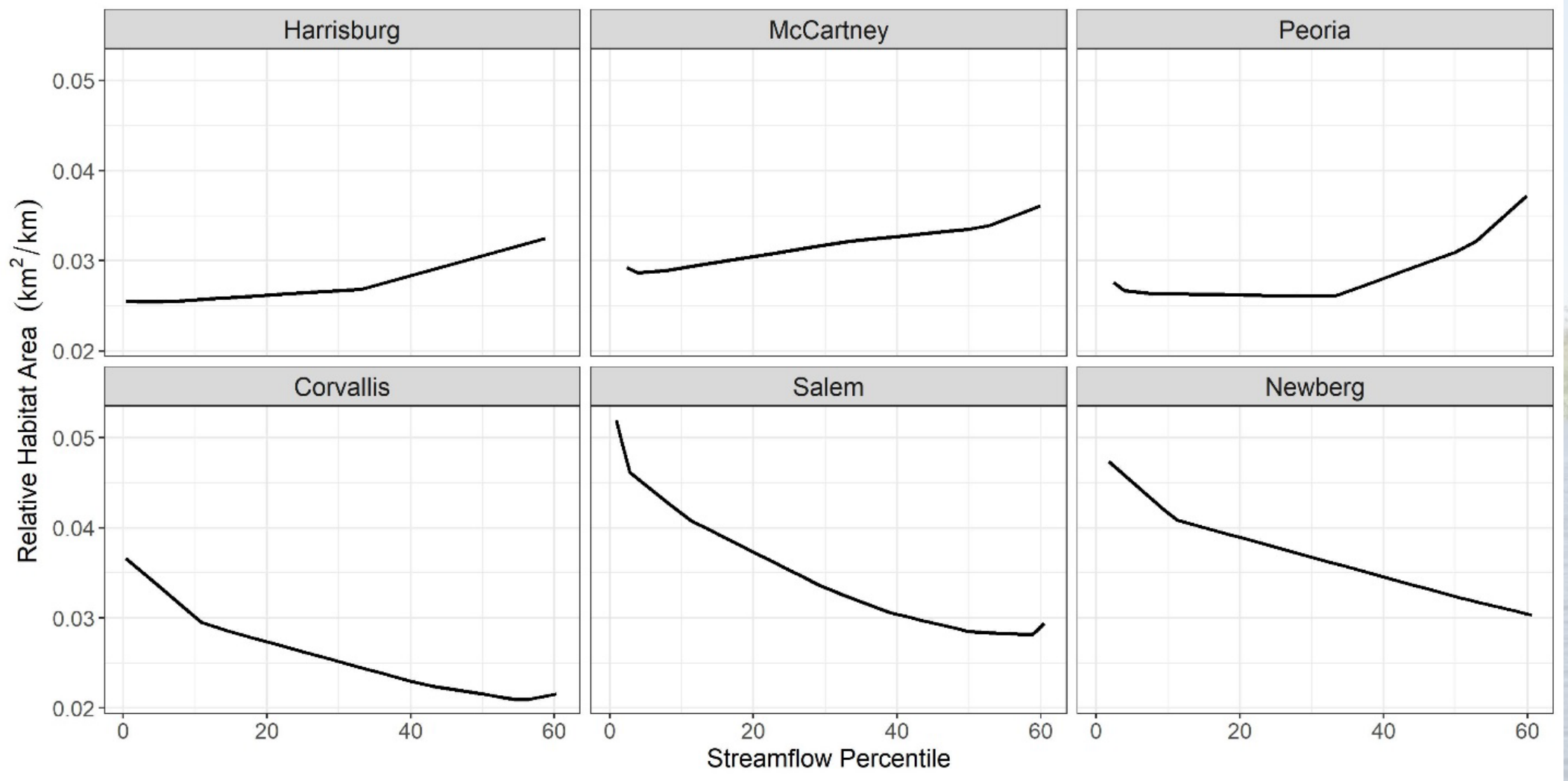
OSU Smallmouth Observation

Revetment

Modeled Smallmouth Habitat

Preliminary data, do not cite

Response of Smallmouth Bass habitat to changes in streamflow by model reach



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Assessing Smallmouth/Chinook habitat overlap

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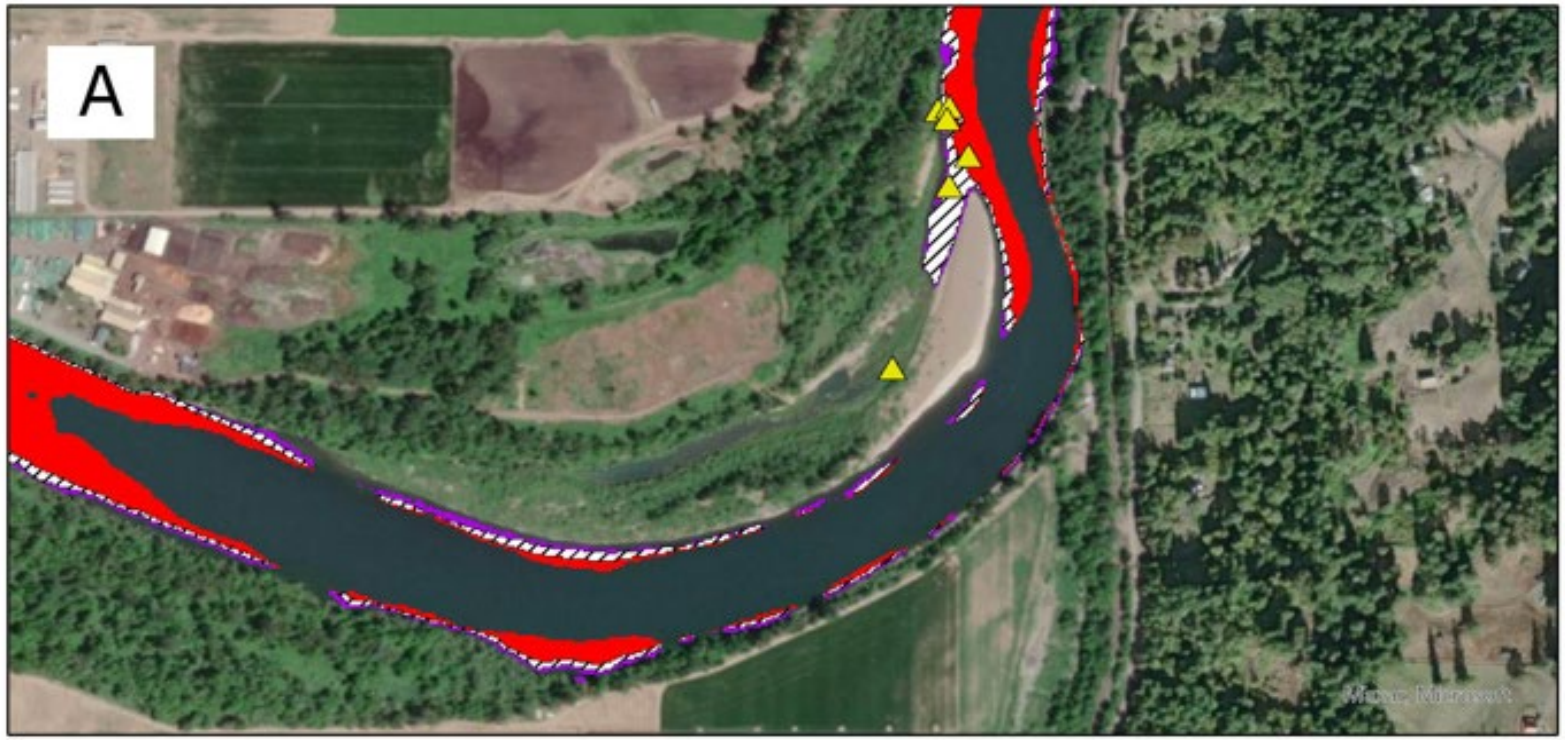
Assessing Smallmouth/Chinook habitat overlap



Explanation

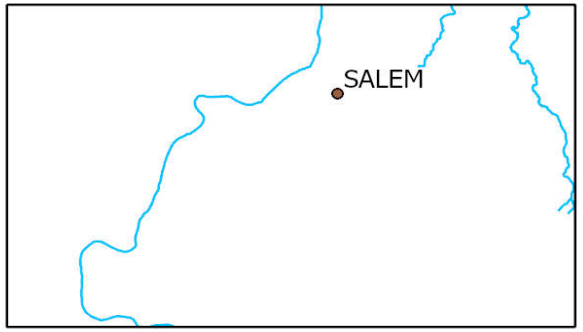
Observed Smallmouth Bass

Chinook Smallmouth Habitat Overlap

Chinook Fry Habitat

Smallmouth Bass Habitat

0 0.25 0.5 1 Km



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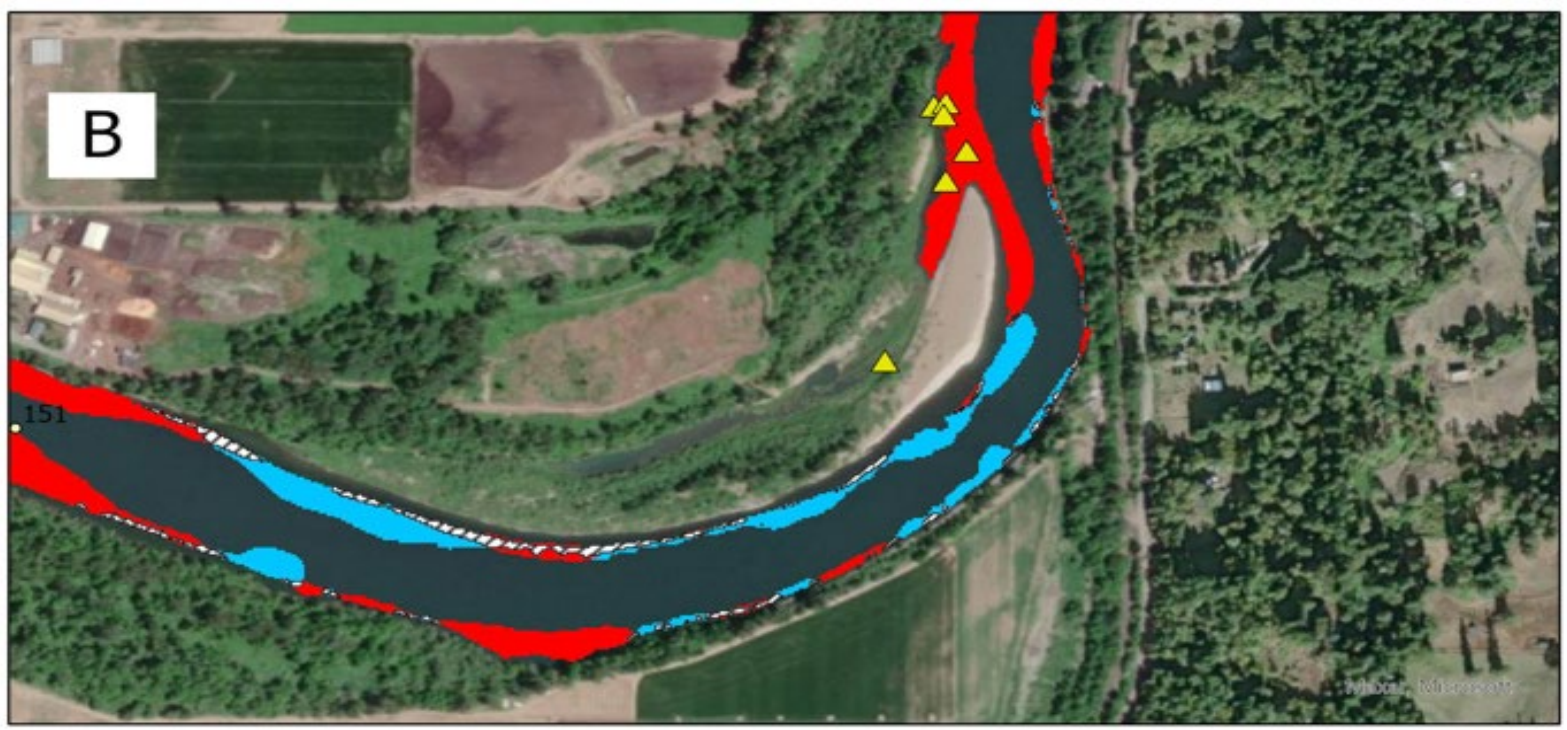
Assessing Smallmouth/Chinook habitat overlap



Explanation

Observed Smallmouth Bass

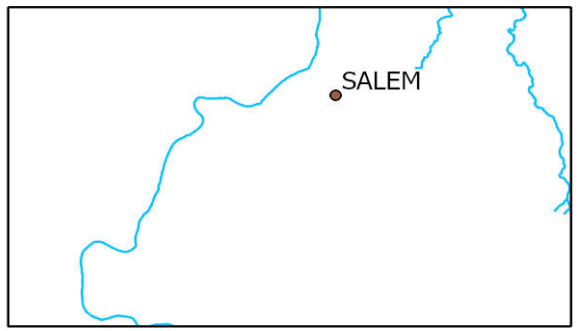
Chinook Smallmouth Habitat Overlap

Chinook Parr Habitat

Smallmouth Bass Habitat

0 0.25 0.5 1 Km

N



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Preliminary data, do not cite

Variation in overlap between Smallmouth Bass habitat and juvenile Chinook habitat with streamflow

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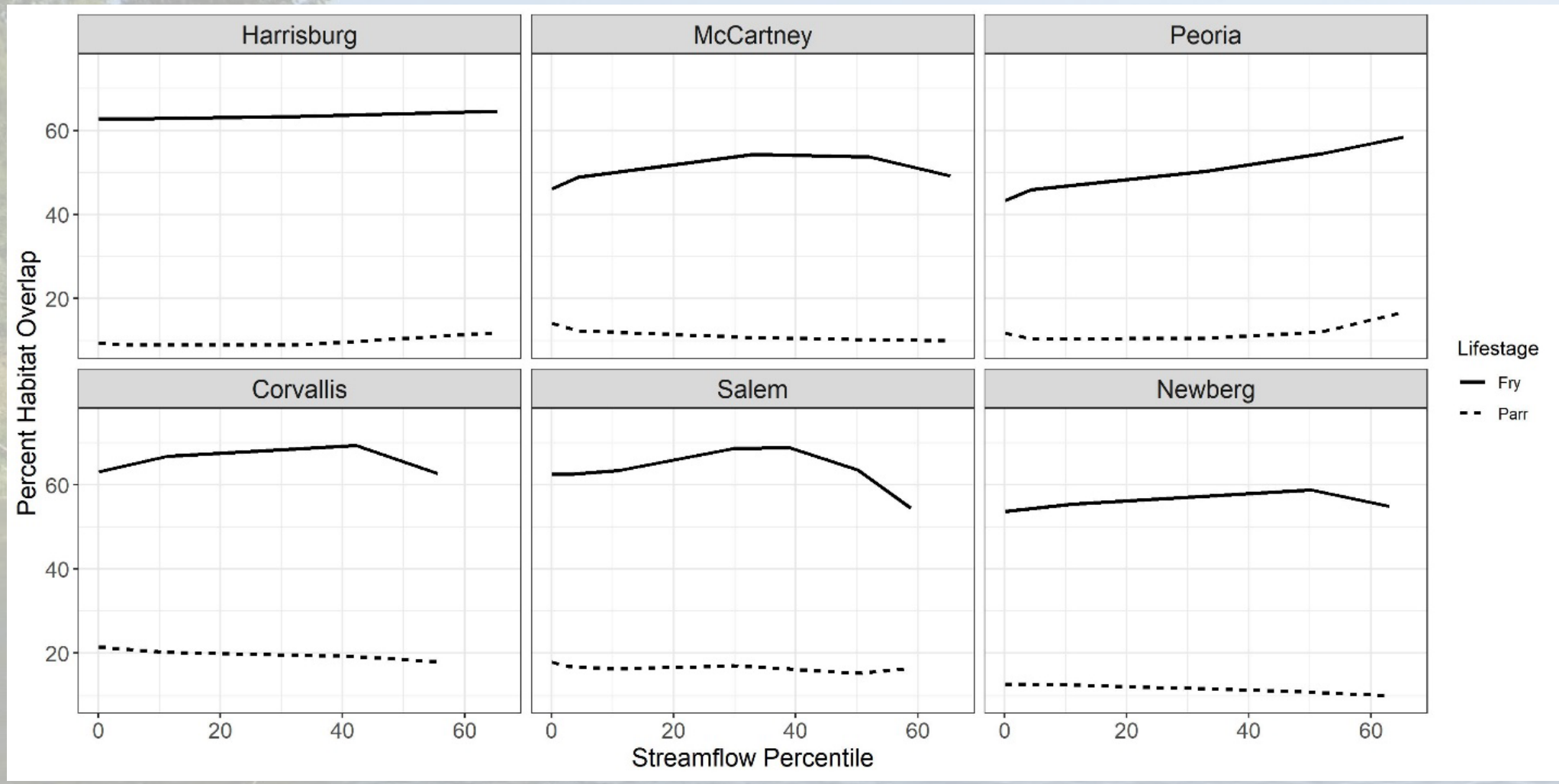
Variation in overlap between Smallmouth Bass habitat and juvenile Chinook habitat with streamflow



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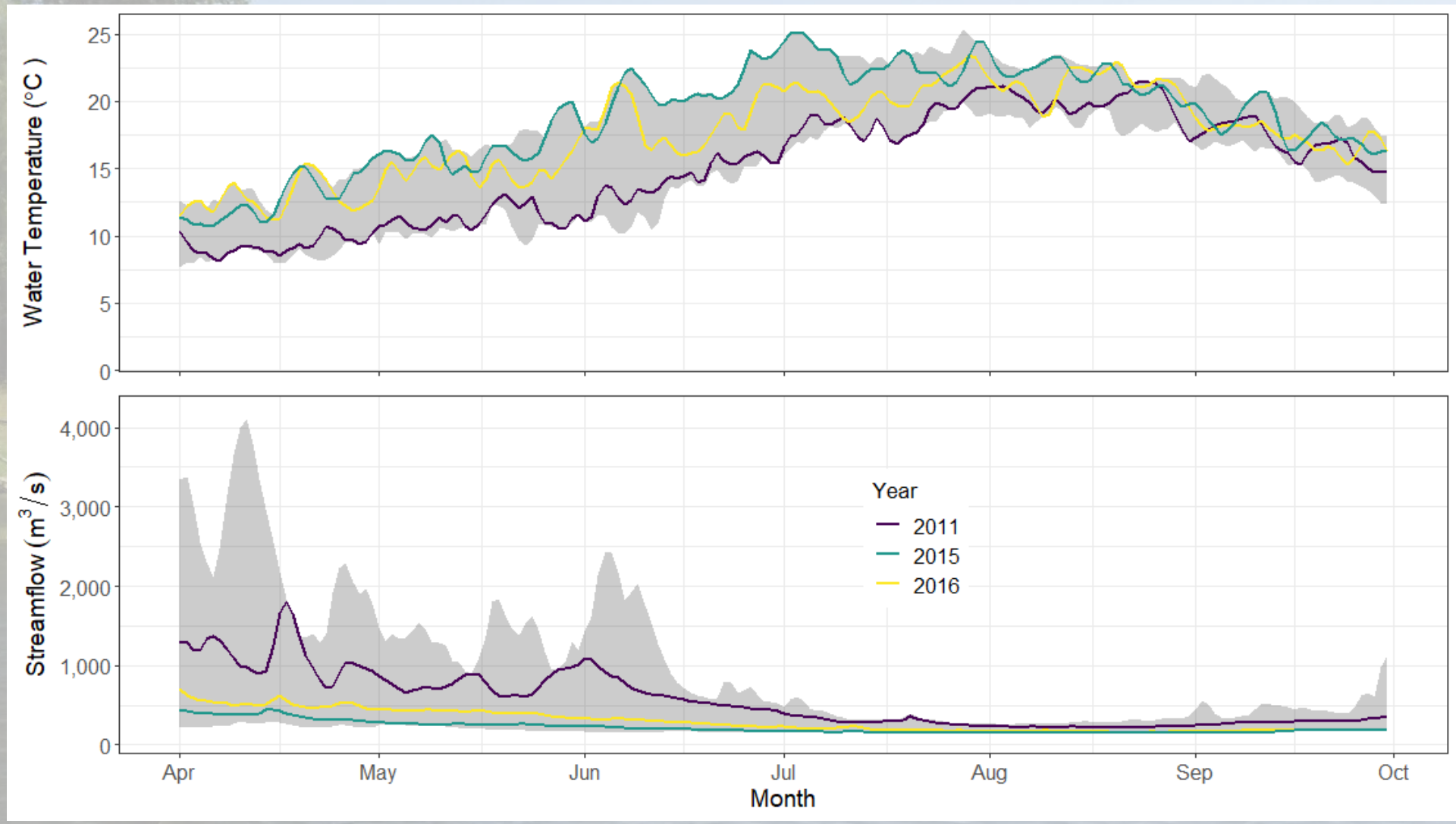
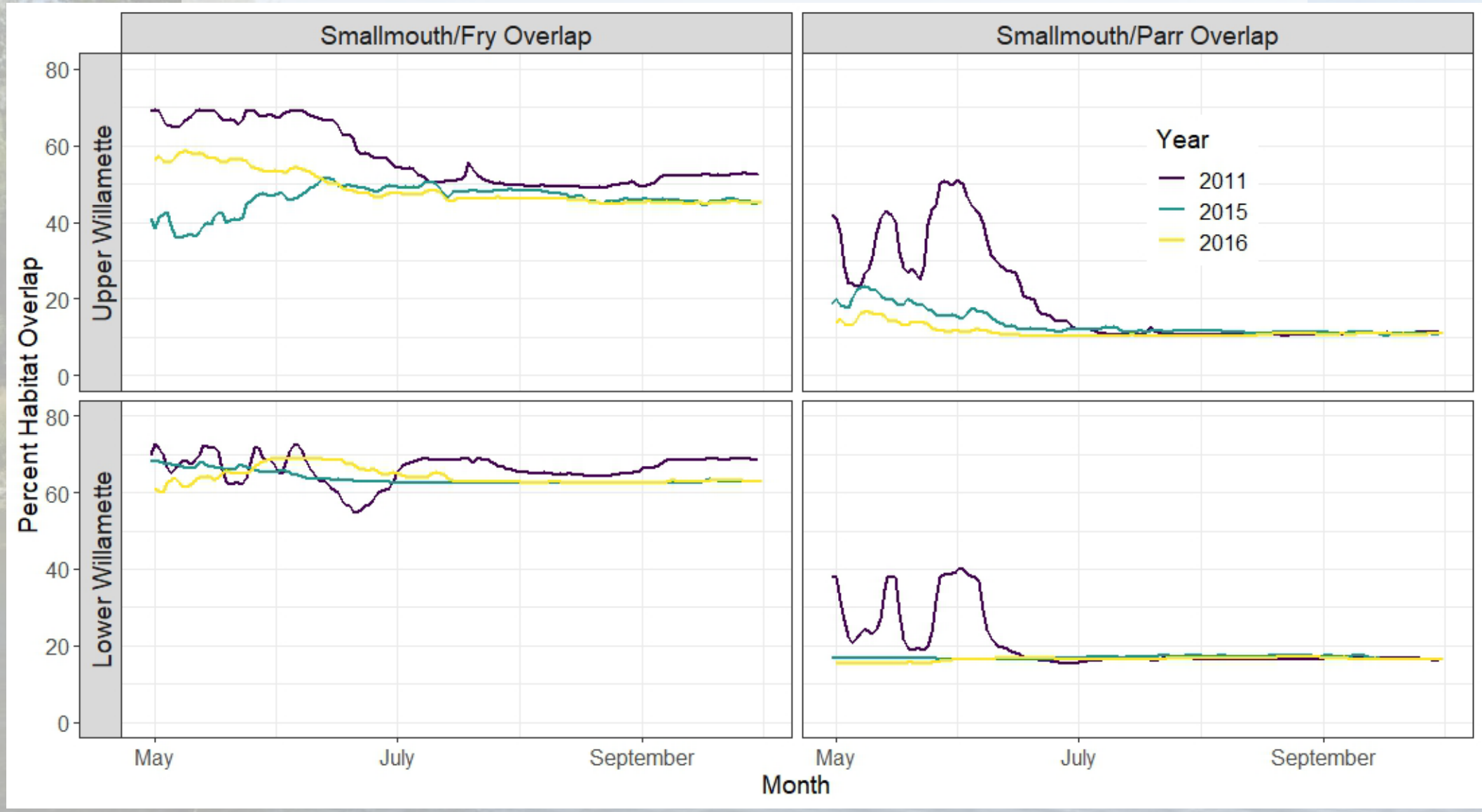
Preliminary data, do not cite

Willamette River Water streamflow and temperature near Salem for 2011, 2015, 2016



Willamette River streamflow at Salem is measured at USGS station 14191000 and water temperature at Keizer is measured at station 14192015. Data are available at https://waterdata.usgs.gov

Timeseries of habitat overlap between Smallmouth Bass and Chinook fry and parr for 2011, 2015, 2016 for Peoria and Salem reaches



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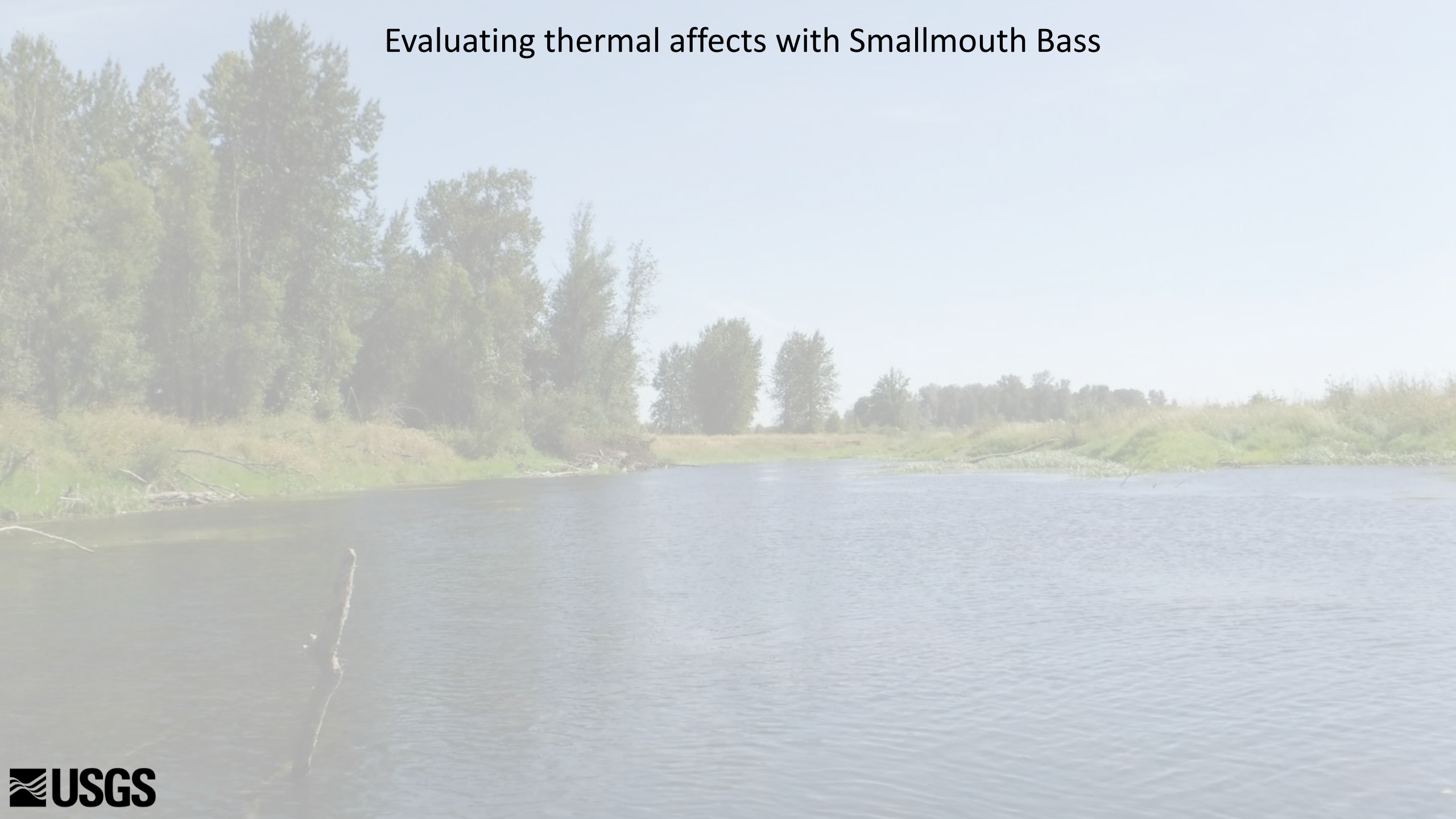
Preliminary data, do not cite

Evaluating thermal affects with Smallmouth Bass



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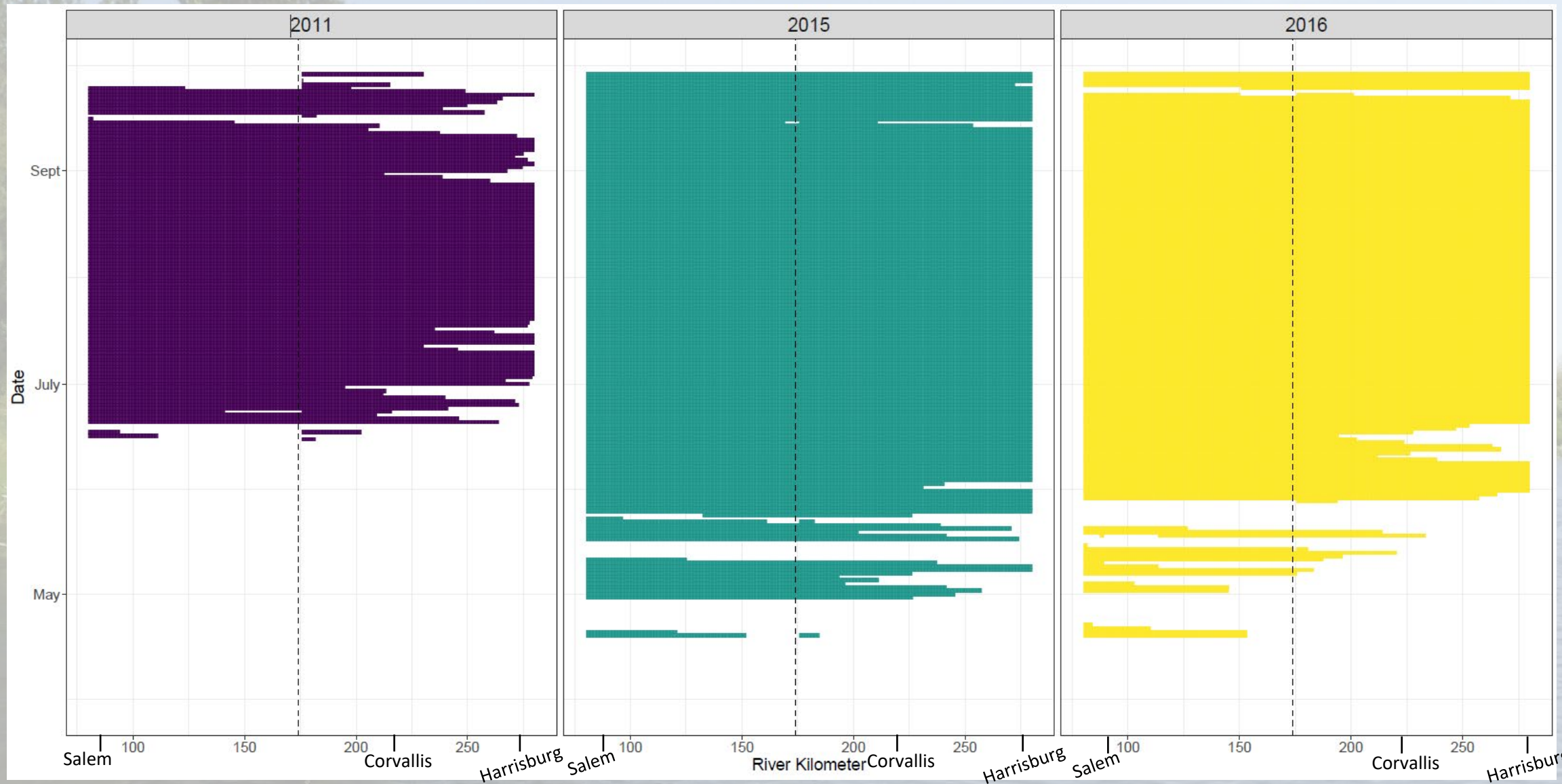
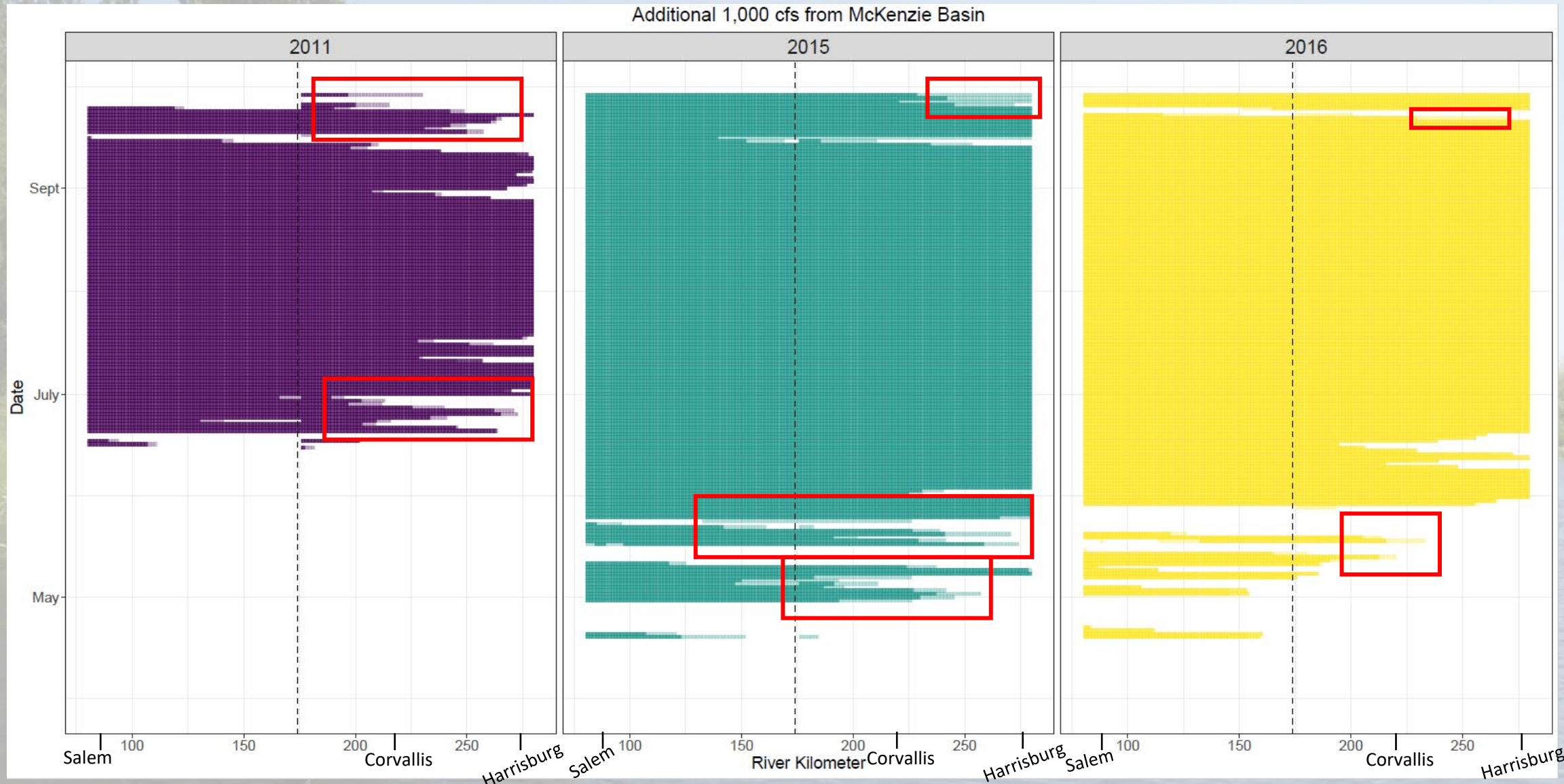
Evaluating thermal affects with Smallmouth Bass



Results using data from Stratton et al., 2022

Assessing sensitivity to additional streamflow



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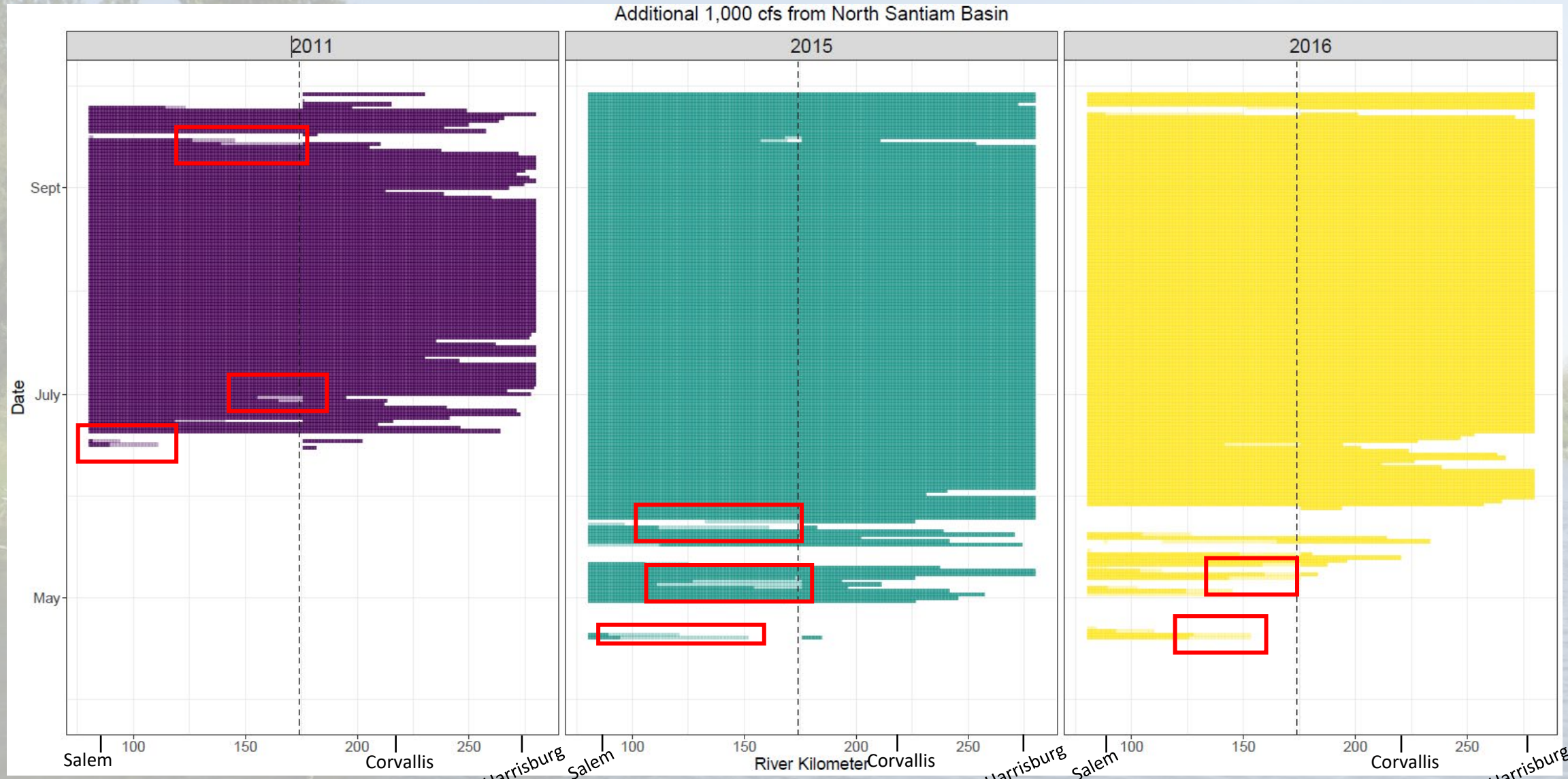
Assessing sensitivity to additional streamflow



Results using data from Stratton et al., 2022

Preliminary Conclusions

- Smallmouth Bass have been observed throughout the Willamette River.
- Preliminary modeling shows there is useable habitat throughout the Willamette River.
- Chinook salmon fry and parr habitats are often in close proximity.
- Habitat for both Smallmouth Bass and juvenile Chinook Salmon responds similarly to streamflow.
- Streamflow management has limited ability to reduce thermally suitable habitat for Smallmouth Bass; there is some ability to reduce stream temperatures for short periods, but results vary depending on source of dam releases and other factors[1].

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[1] Stratton Garvin, 2022, Preliminary data, do not cite

Questions?

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White, J.S., Peterson, J.T., Stratton Garvin, L.E., Kock, T.J., and Wallick, J.R., 2022, Assessment of habitat availability for juvenile Chinook salmon (Oncorhynchus tshawytscha) and steelhead (O. mykiss) in the Willamette River, Oregon: U.S. Geological Survey Scientific Investigations Report 2022–5034, 44 p., https://doi.org/10.3133/sir20225034.

White, J.S., and Wallick, J.R., 2022, Development of continuous bathymetry and two-dimensional hydraulic models for the Willamette River, Oregon: U.S. Geological Survey Scientific Investigations Report 2022–5025, 65 p., https://doi.org/10.3133/sir20225025.

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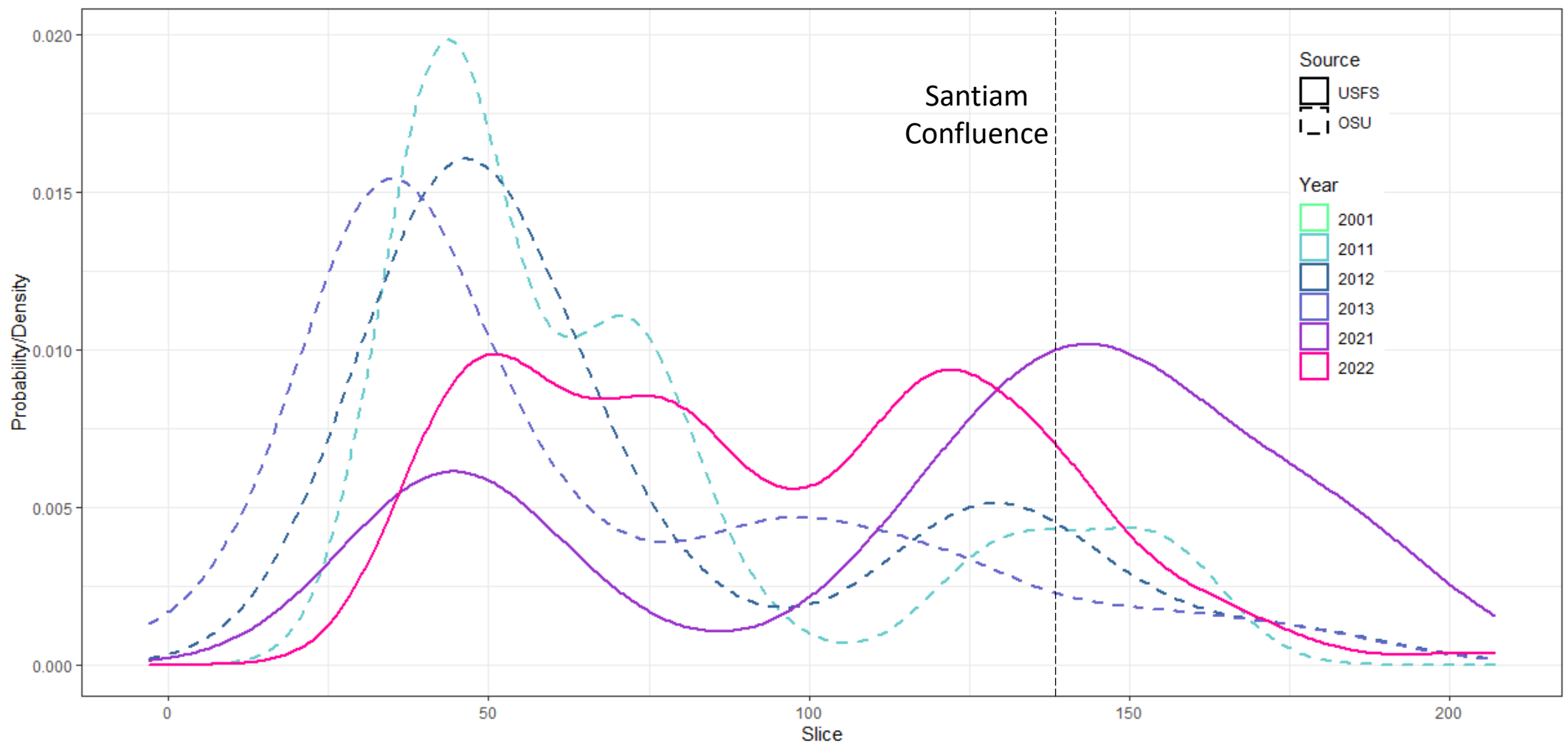
Relative distribution of Smallmouth Bass observations each sampling year



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