



When, Where, and How Much Juvenile Salmonid Habitat is There on the Willamette River?

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Many people involved and contributing to study

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Mackenzie Keith, Krista Jones

USACE: Rich Piaskowski, Jacob Macdonald, Greg Taylor, Jeff Balantine, Norman Buccola, Paul Sclafani

Oregon State University: Jessica Pease, Tyrell DeWeber

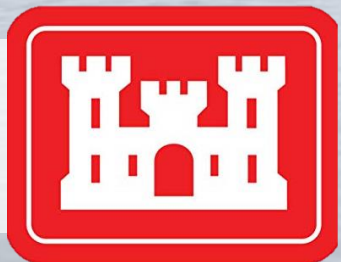
USGS WFRC: Gabriel Hansen, Russ Perry

NOAA Fisheries: Anne Mullan

ODFW: Luke Whitman, Brian Bangs



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Study Goals

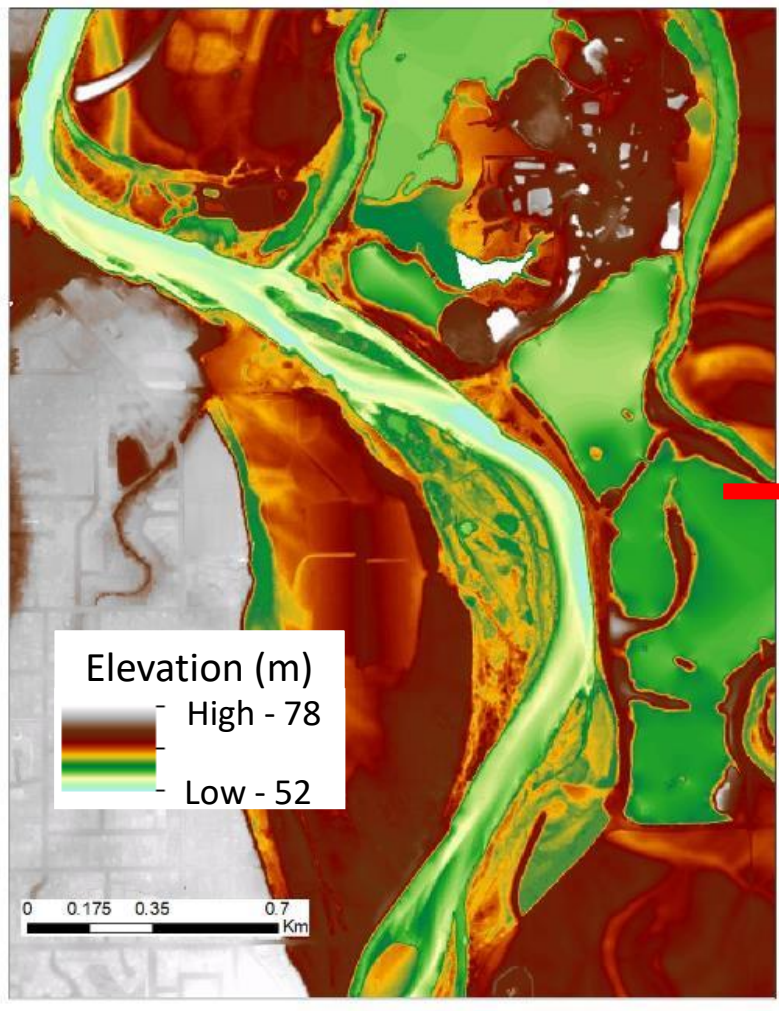
Improve understanding of juvenile Chinook and steelhead habitat dynamics and how it varies with streamflow

- How much habitat is available for these salmonids to use throughout the year?
- How would potential changes of instream flow targets affect habitat availability?

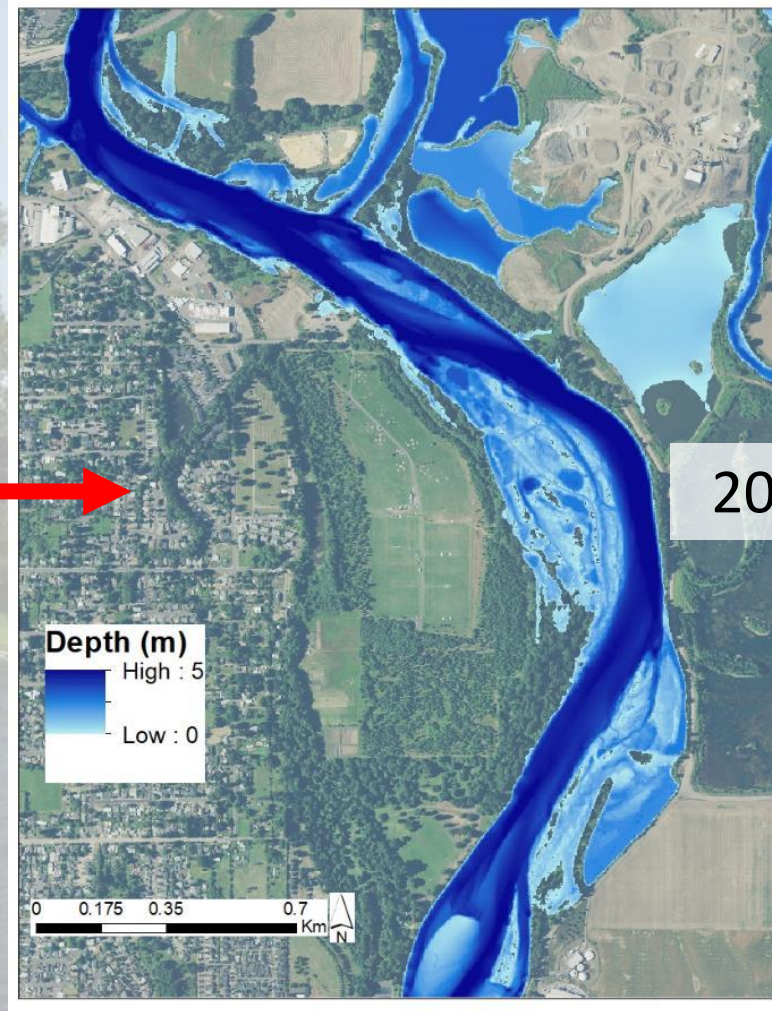
Hydraulic Modeling

Bathymetry

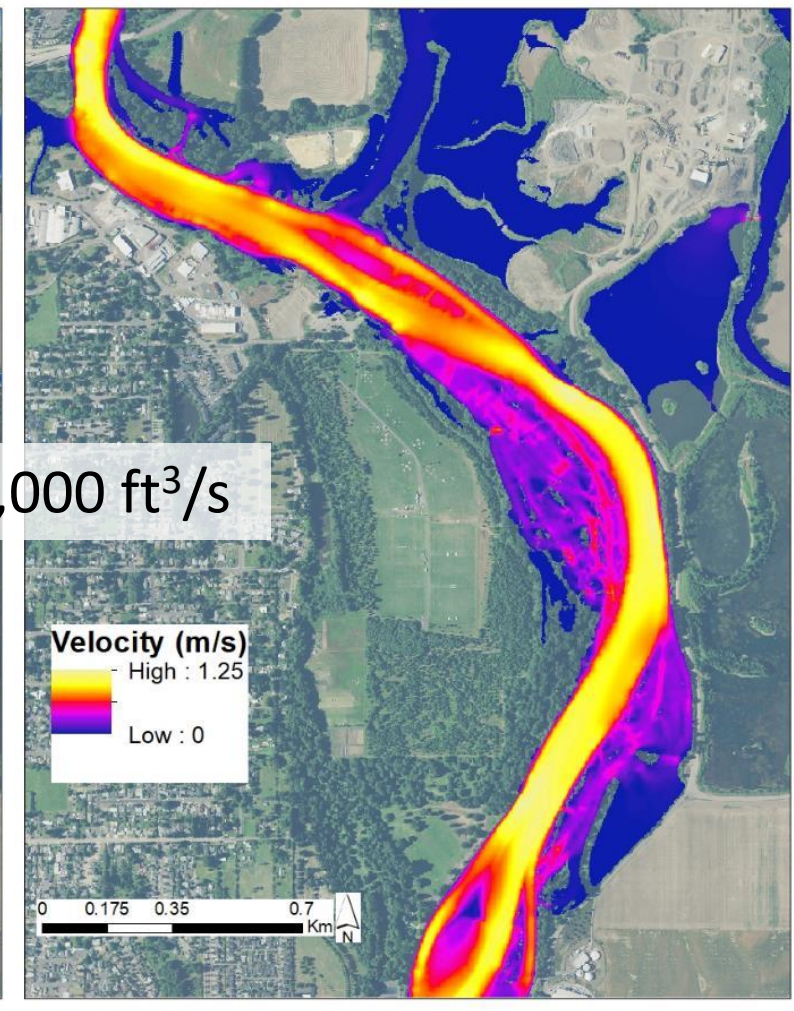
(QSI TB lidar + USGS sonar)



Continuous Depth

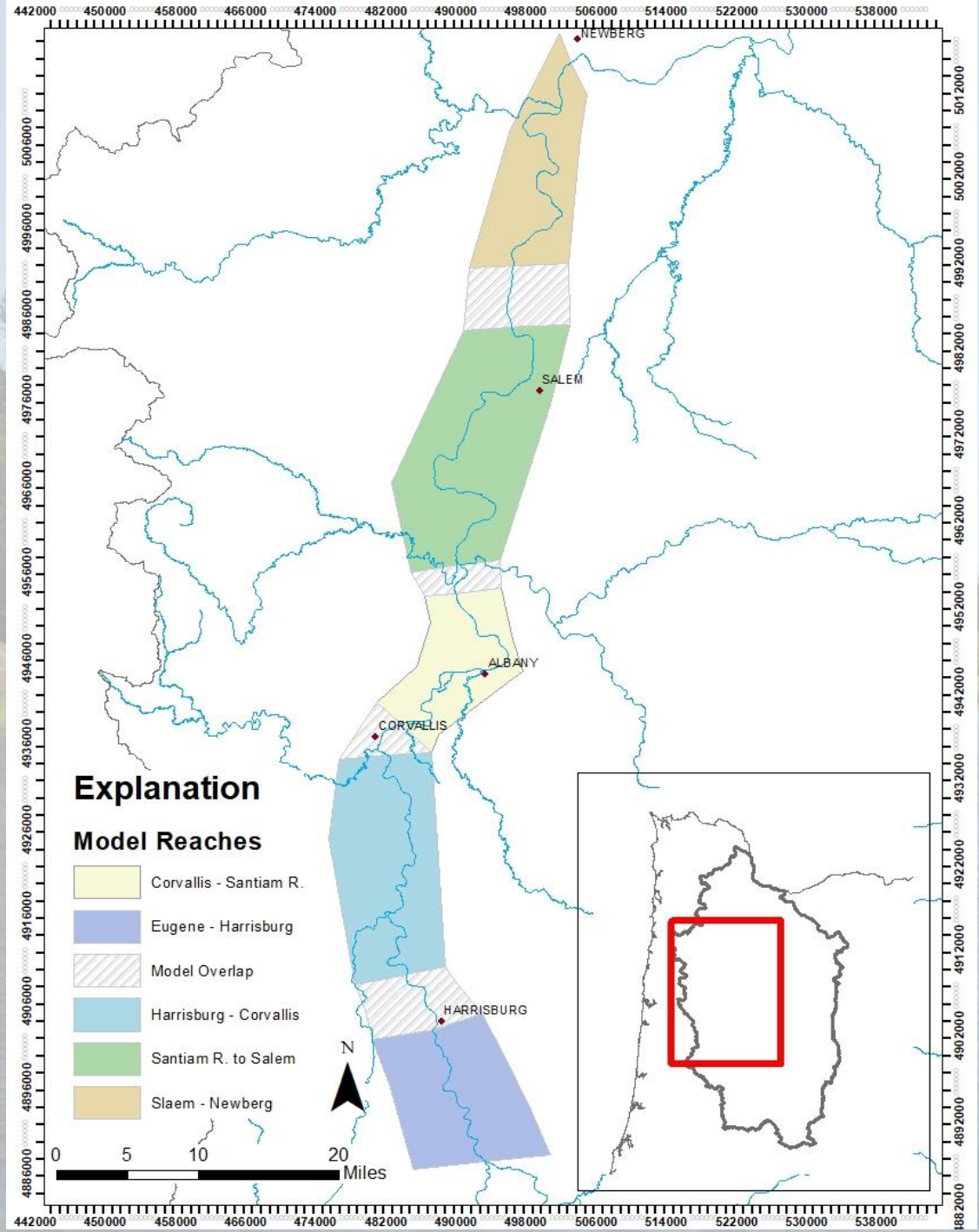


Continuous Velocity



Simulating flows from below current BiOP targets to annual peak flows (80,000 cfs at Salem, for reference)

Two-dimensional hydraulic model reaches
Total covering about 200km of river



Habitat Modeling

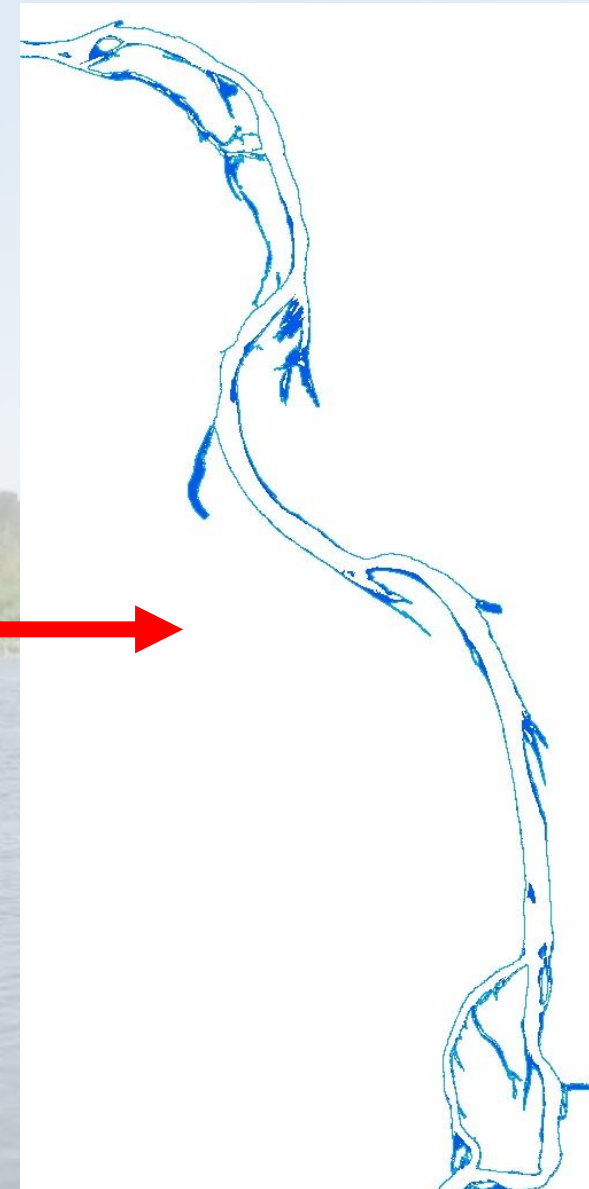
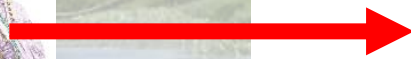
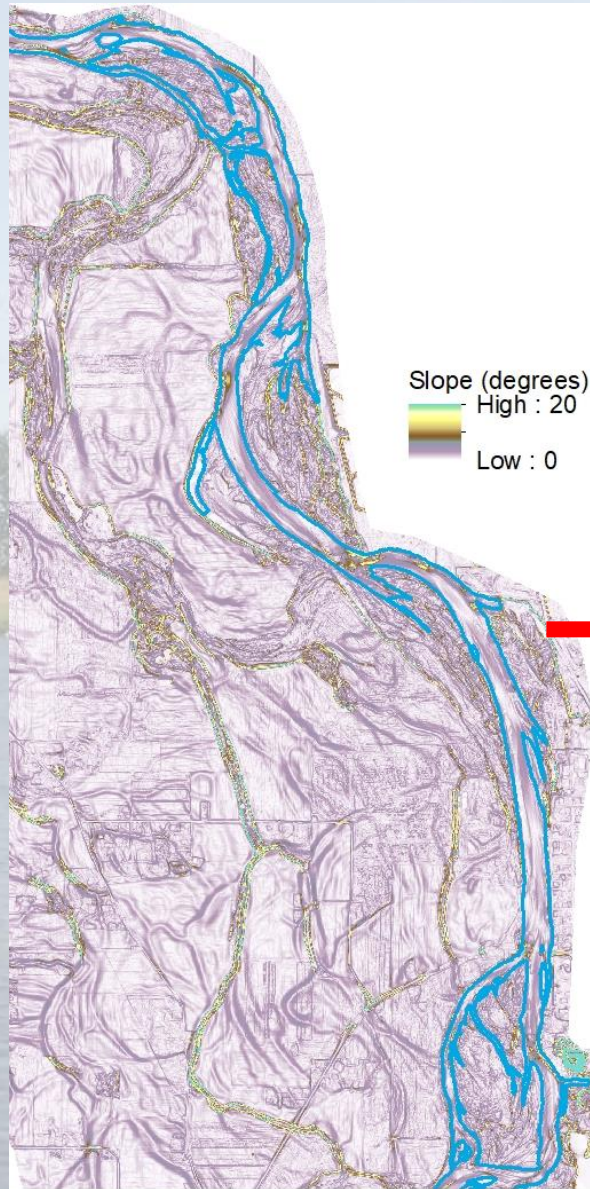
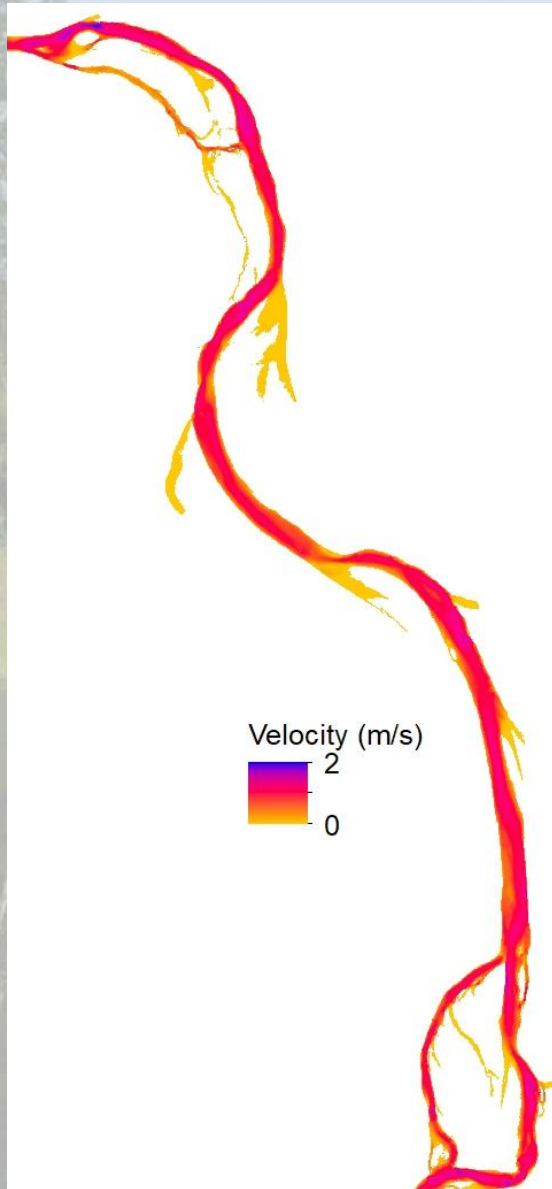
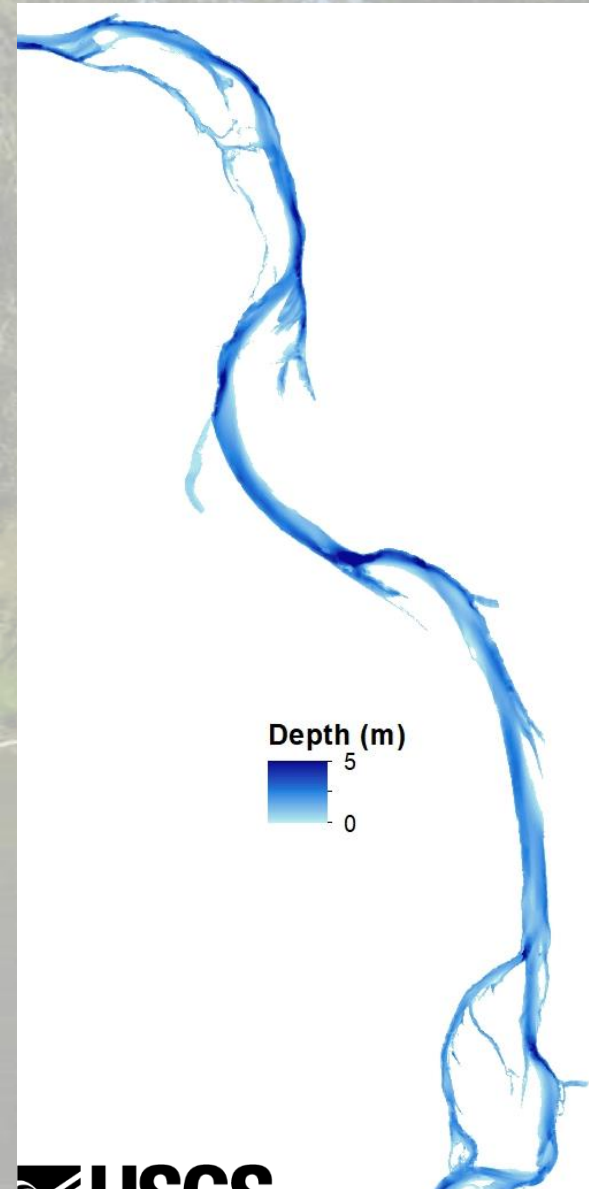
Methods – Habitat Model

Depth

Velocity

Slope

Habitat

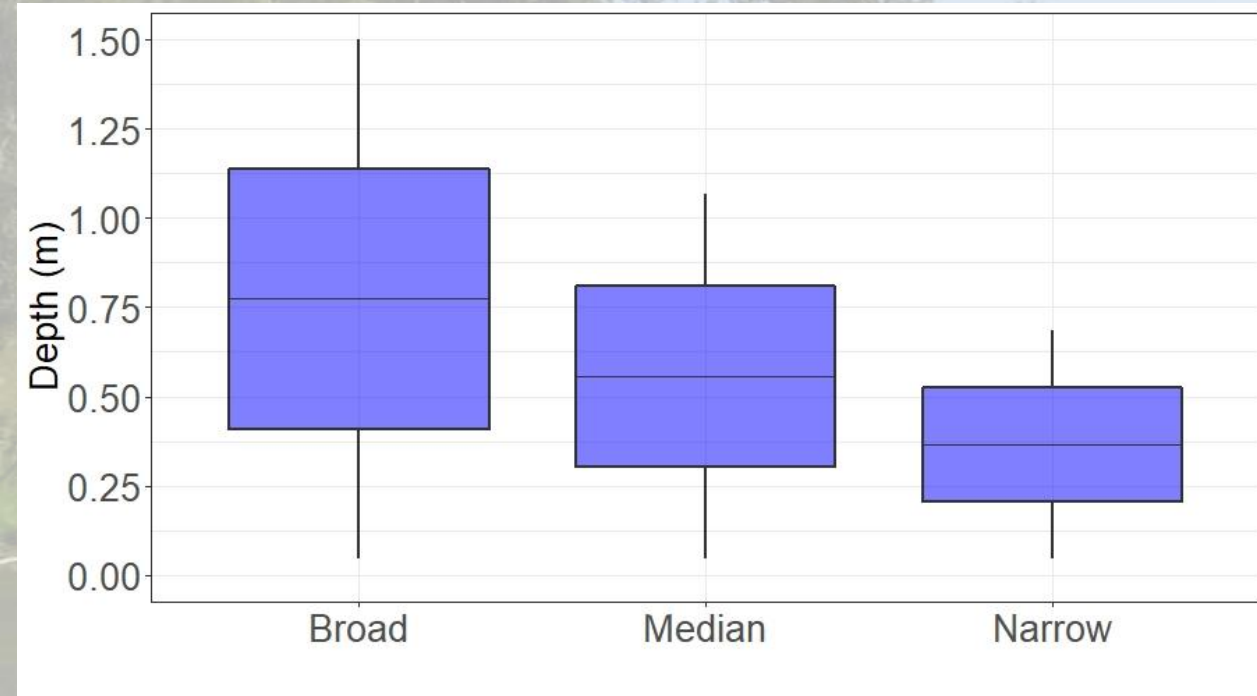


Methods – Habitat Model

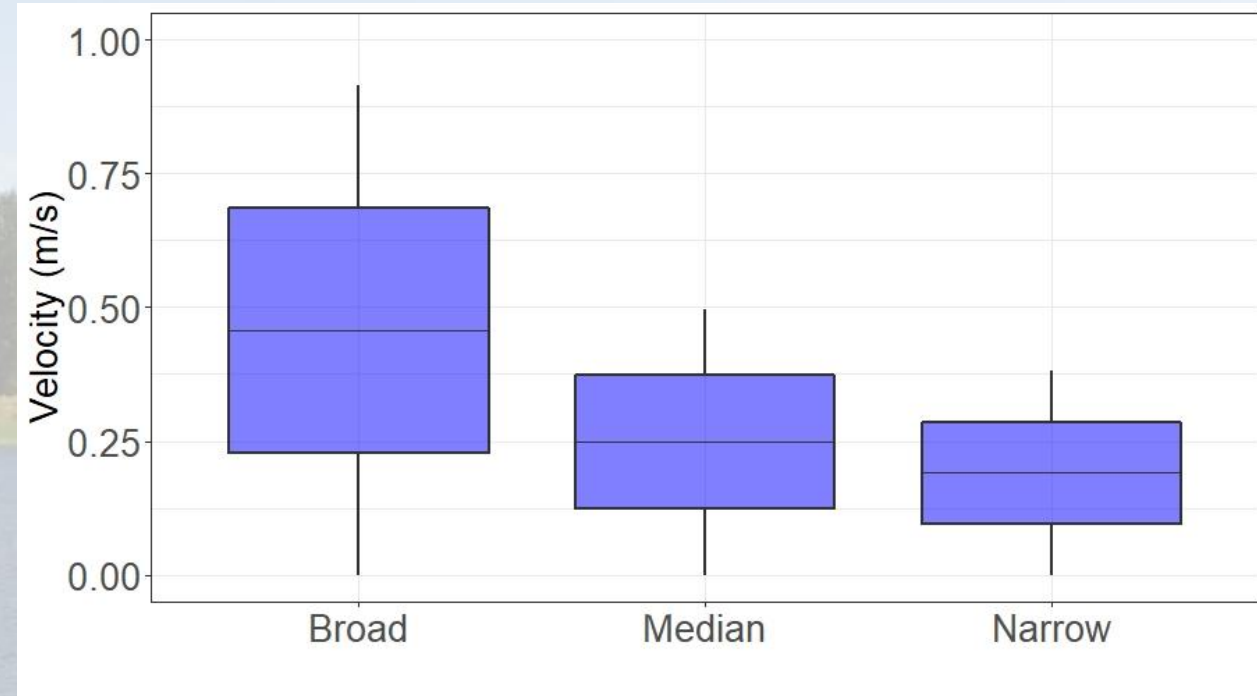
Species	Size Class	Criteria	Narrow	Median	Broad
Chinook salmon	Pre-smolt (>60mm)	Depth (ft)	0.15-2.25	0.15-3.5	0.15-Inf
		Velocity (ft/s)	0-1.25	0-1.63	0-3
		Bed Slope	<0.4	<0.55	Any
Chinook salmon	Fry (<60mm)	Depth (ft)	0.15-2.0	0.15-3.5	0.15-5
		Velocity (ft/s)	0-0.5	0-1.25	0-1.5
		Bed Slope	<0.4	<0.55	Any
Steelhead	Pre-smolt (>60mm)	Depth (ft)	0.15-1	0.15-1	0.15-Inf
		Velocity (ft/s)	0-1.75	0-3.25	0-3.5
		Bed Slope	NA	NA	NA
Steelhead	Fry (<60mm)	Depth (ft)	0.25-1.25	0.25-2	0.25-5
		Velocity (ft/s)	0-0.5	0-1.25	0-2
		Bed Slope	NA	NA	NA

Methods – Habitat Model

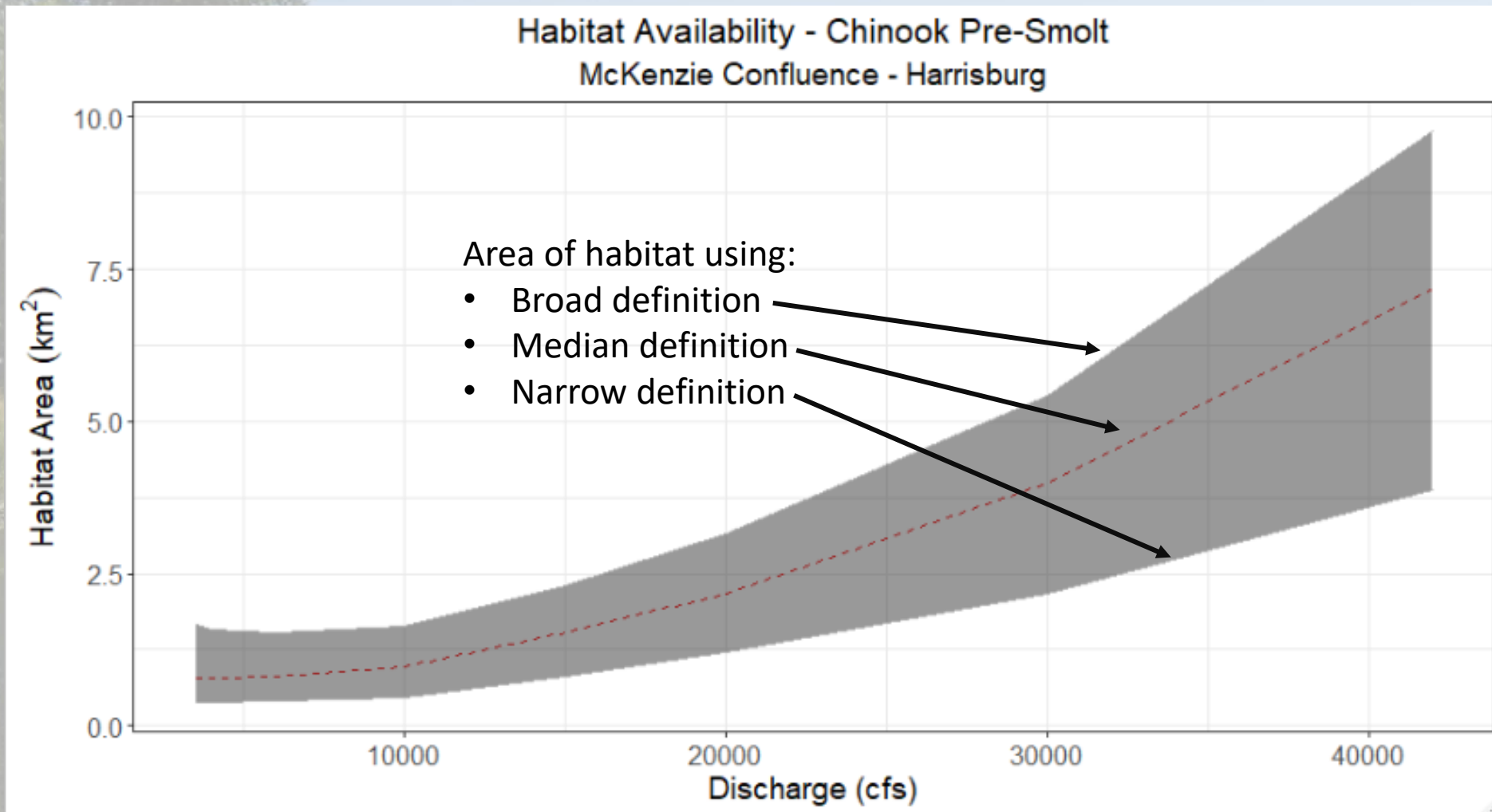
Depth Metrics



Velocity Metrics



Habitat Model Results –Willamette River

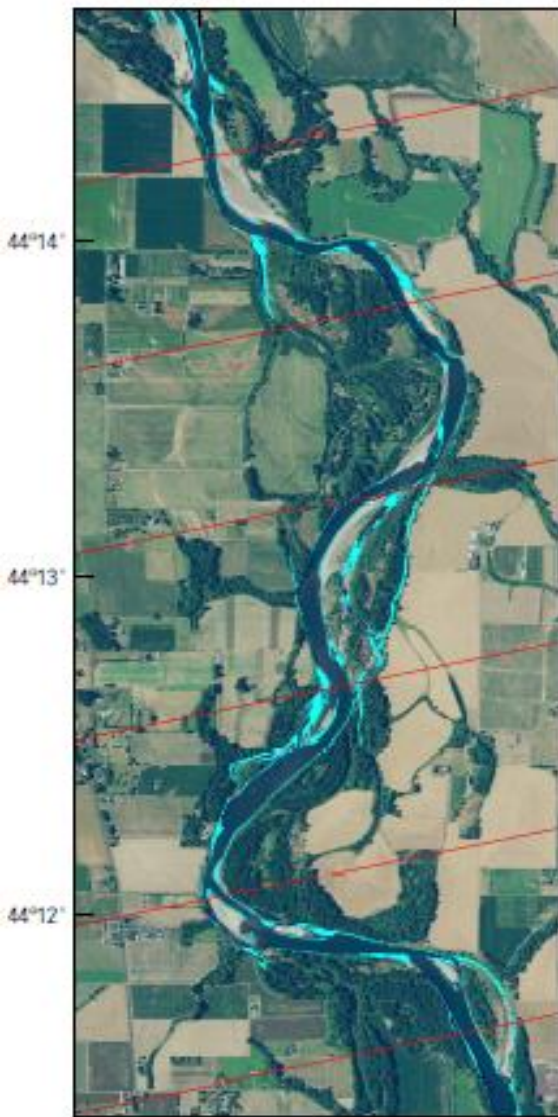


Preliminary Results
Do Not Cite



4,000 cubic feet per second,
4 percentile flow

-123°10' -123°9'



Summer Flow

10,000 cubic feet per second,
65 percentile flow



Winter Flow

42,000 cubic feet per second,
98 percentile flow

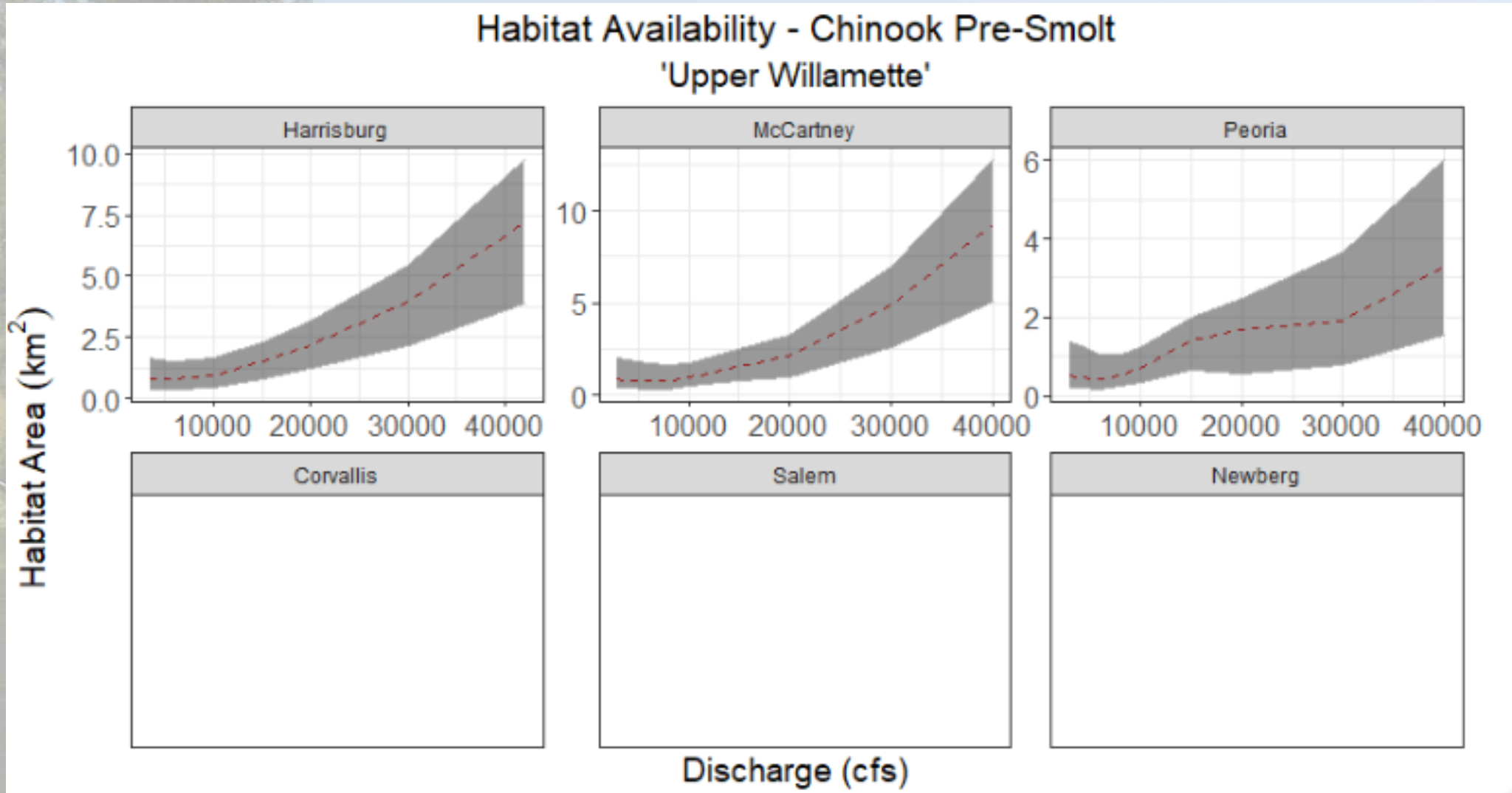


Storm Flow

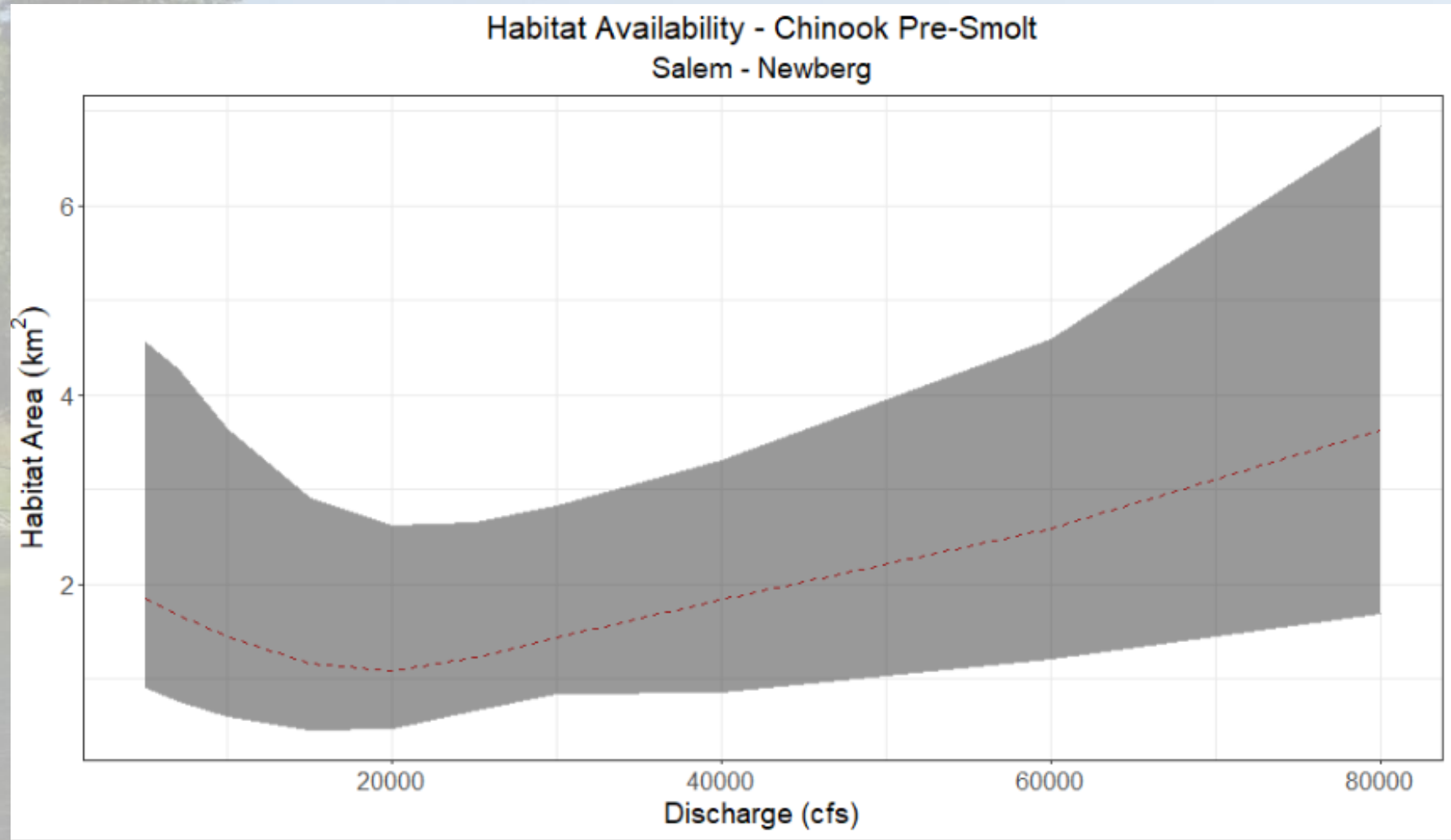


Preliminary Results
Do Not Cite

Habitat Model Results – Willamette River



Habitat Model Results – Willamette River



Preliminary Results
Do Not Cite

6,000 cubic feet per second,
3 percentile flow

18,000 cubic feet per second,
60 percentile flow

80,000 cubic feet per second,
96 percentile flow

-123°4'



Summer Flow

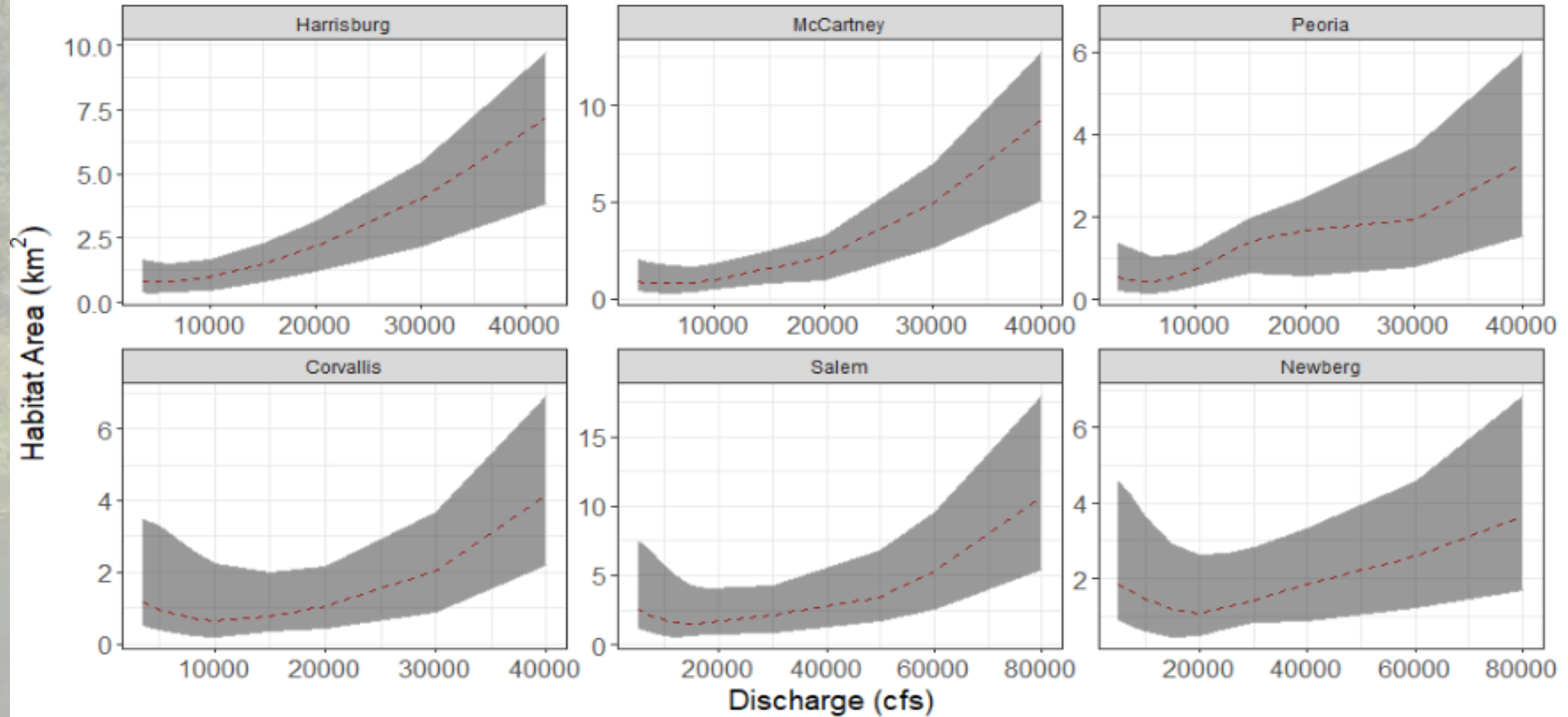
Winter Flow

Storm Flow

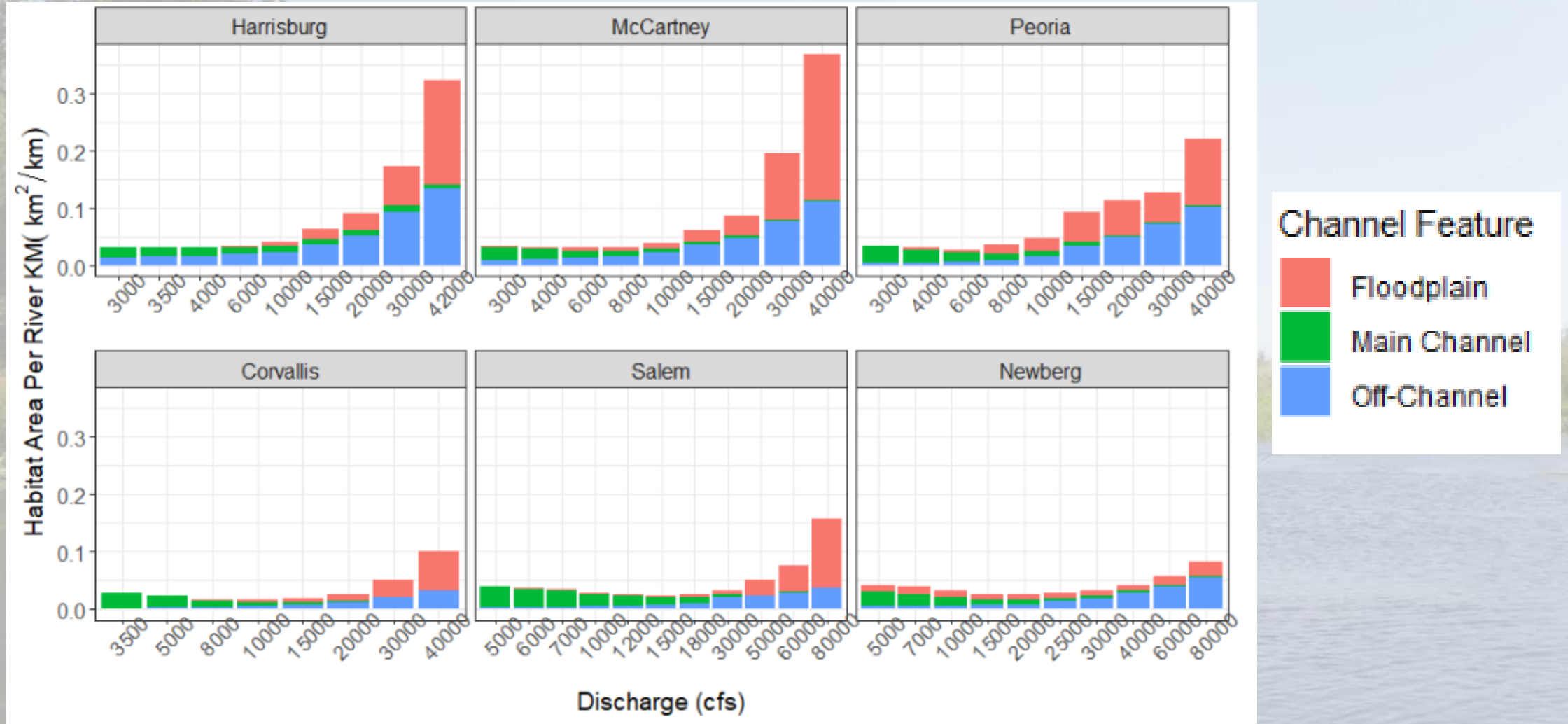
Preliminary Results
Do Not Cite

Habitat Model Results – Willamette River

Habitat Availability - Chinook Pre-Smolt
All Reaches



Habitat Model Results – Willamette River



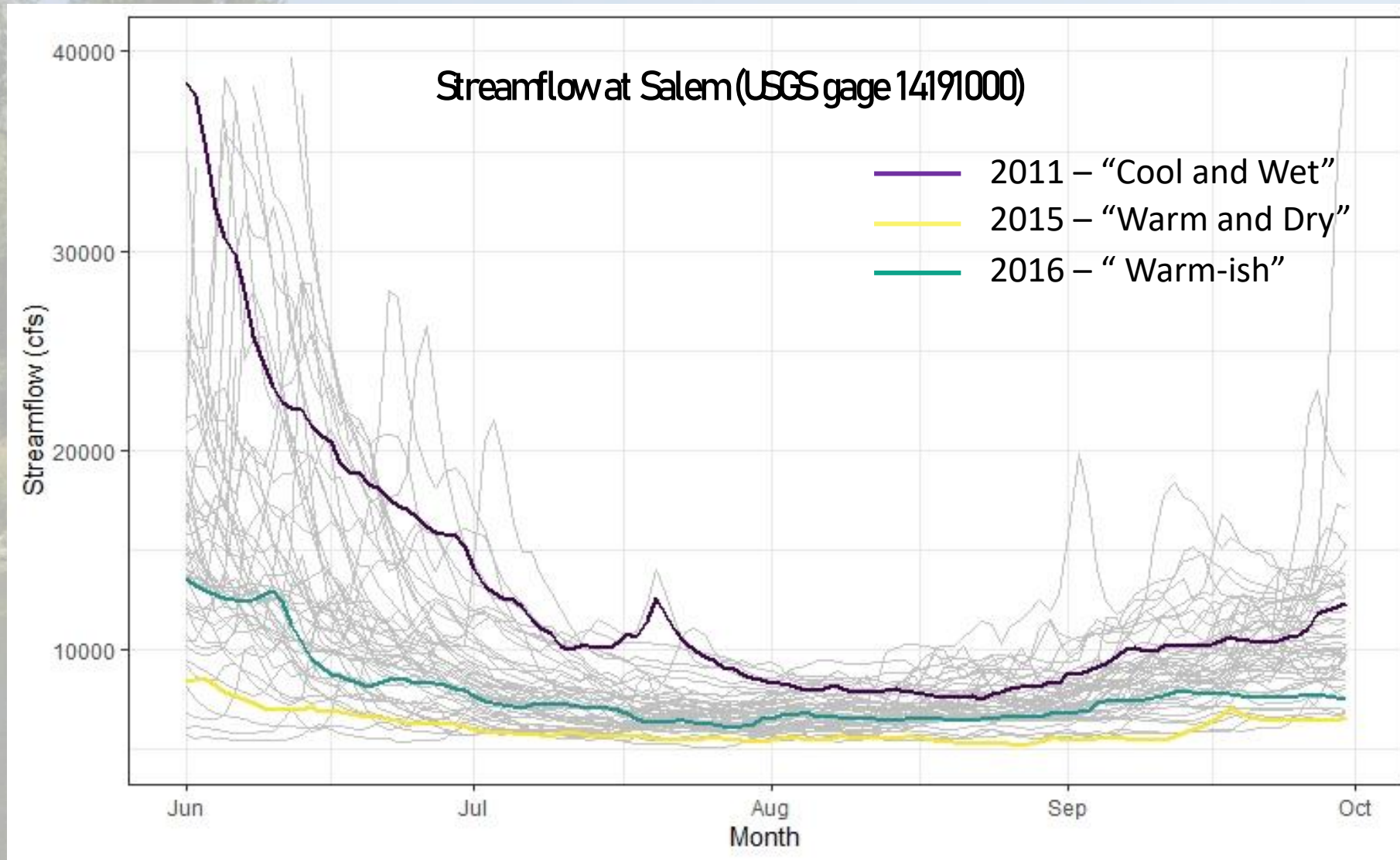
Preliminary Results
Do Not Cite

Integrating Temperature Into Habitat

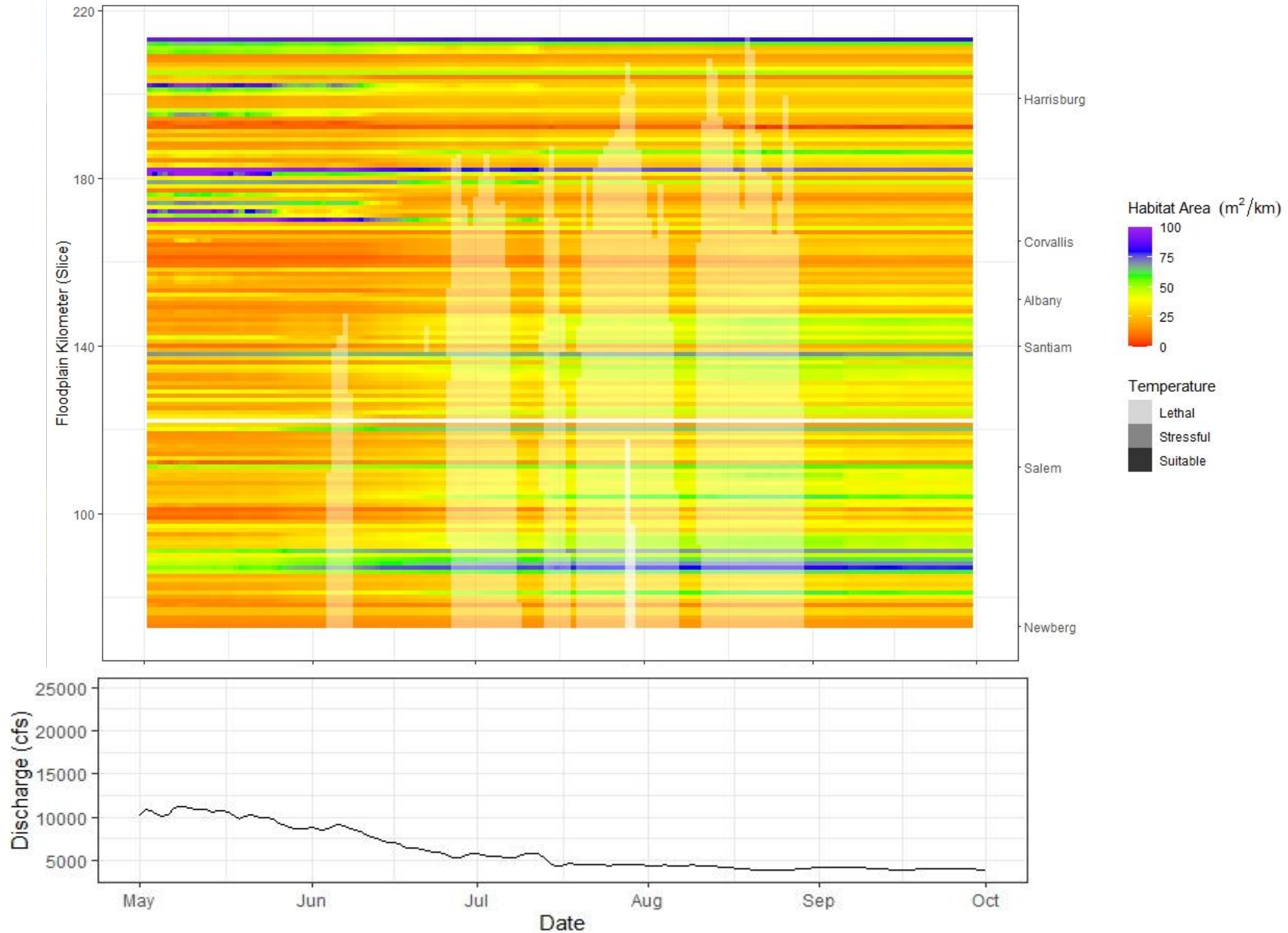
Table 1. Summary of water temperature thresholds for juvenile and adult Chinook salmon for use in habitat assessments in the Willamette River, Oregon.

Juvenile rearing and growth		Adult migration	
Temperature range (°C)	Effects on fish	Temperature range (°C)	Effects on fish
$\geq 24.1^{\circ}\text{C}$	Mortality	$\geq 23.1^{\circ}\text{C}$	Mortality
20.1–24° C	Increased stress, decreased growth, disease	19.1–23° C	Migration impaired
10.1–20 °C	Optimal	12.1–19° C	Optimal
$\leq 10^{\circ}\text{C}$	Safe, but decreased growth	$\leq 12^{\circ}\text{C}$	Safe, preferred for spawning

Habitat Model Results – Willamette River

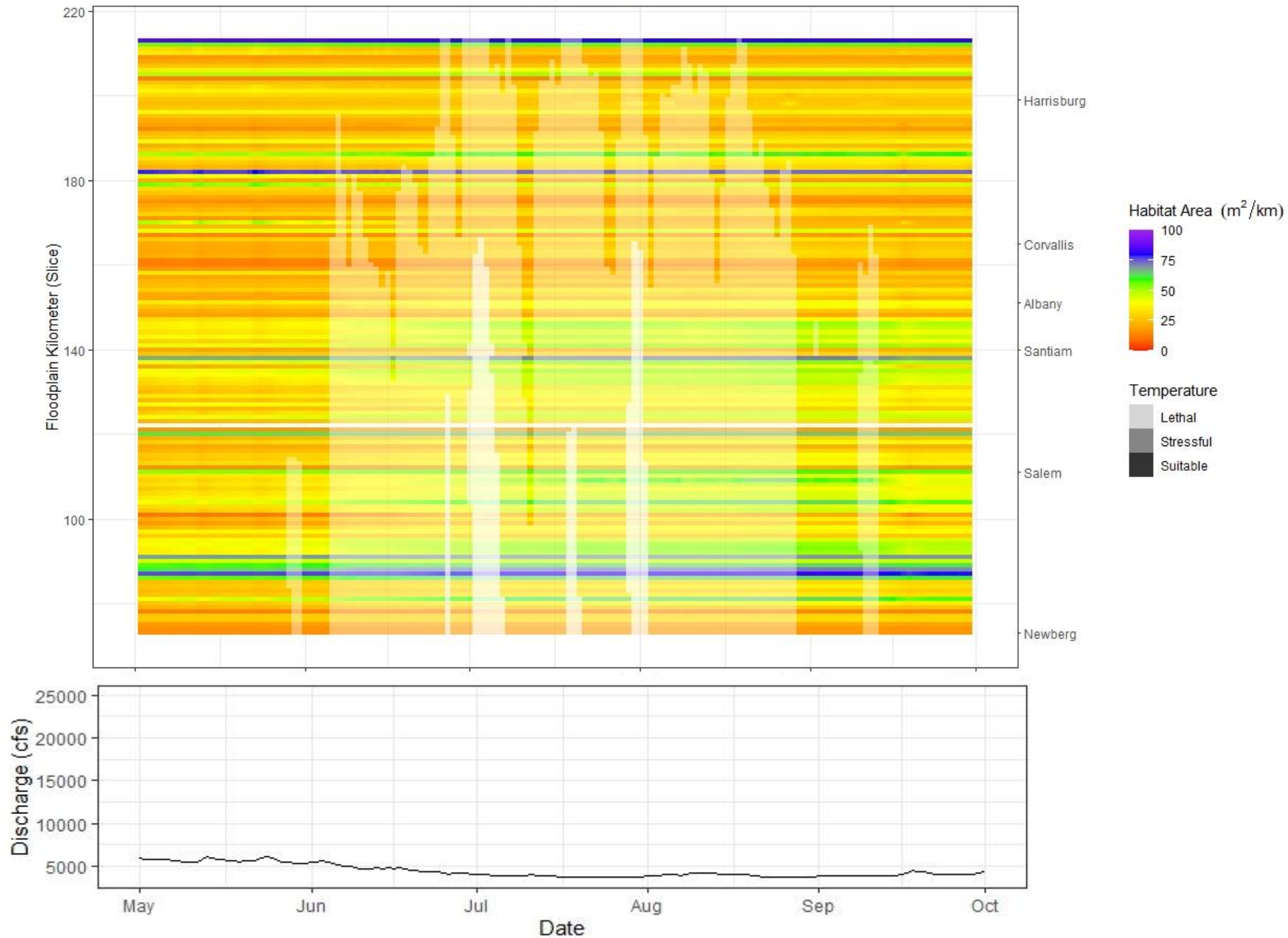


Habitat + Temperature 2016



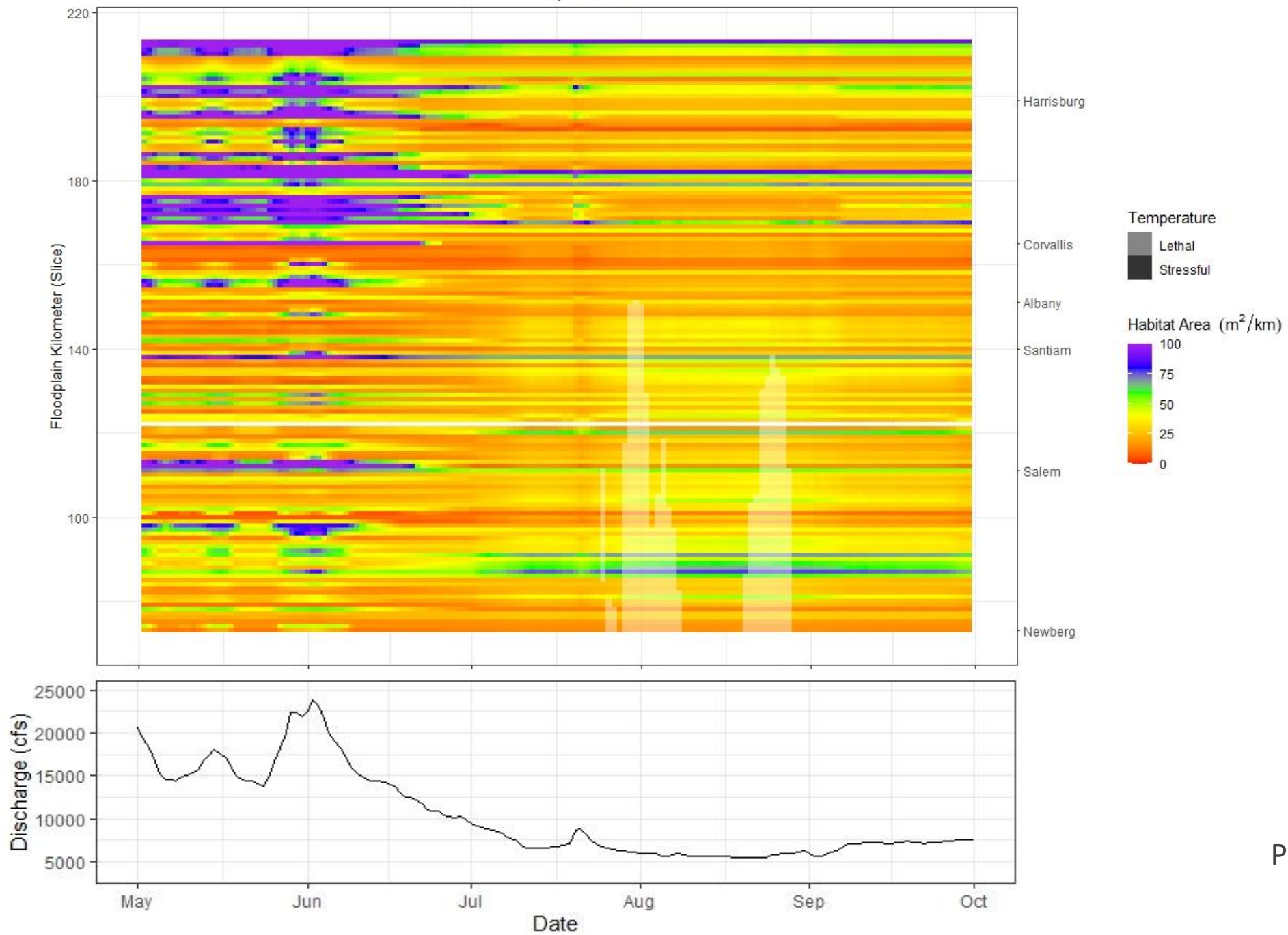
Preliminary Results
Do Not Cite

Habitat + Temperature 2015



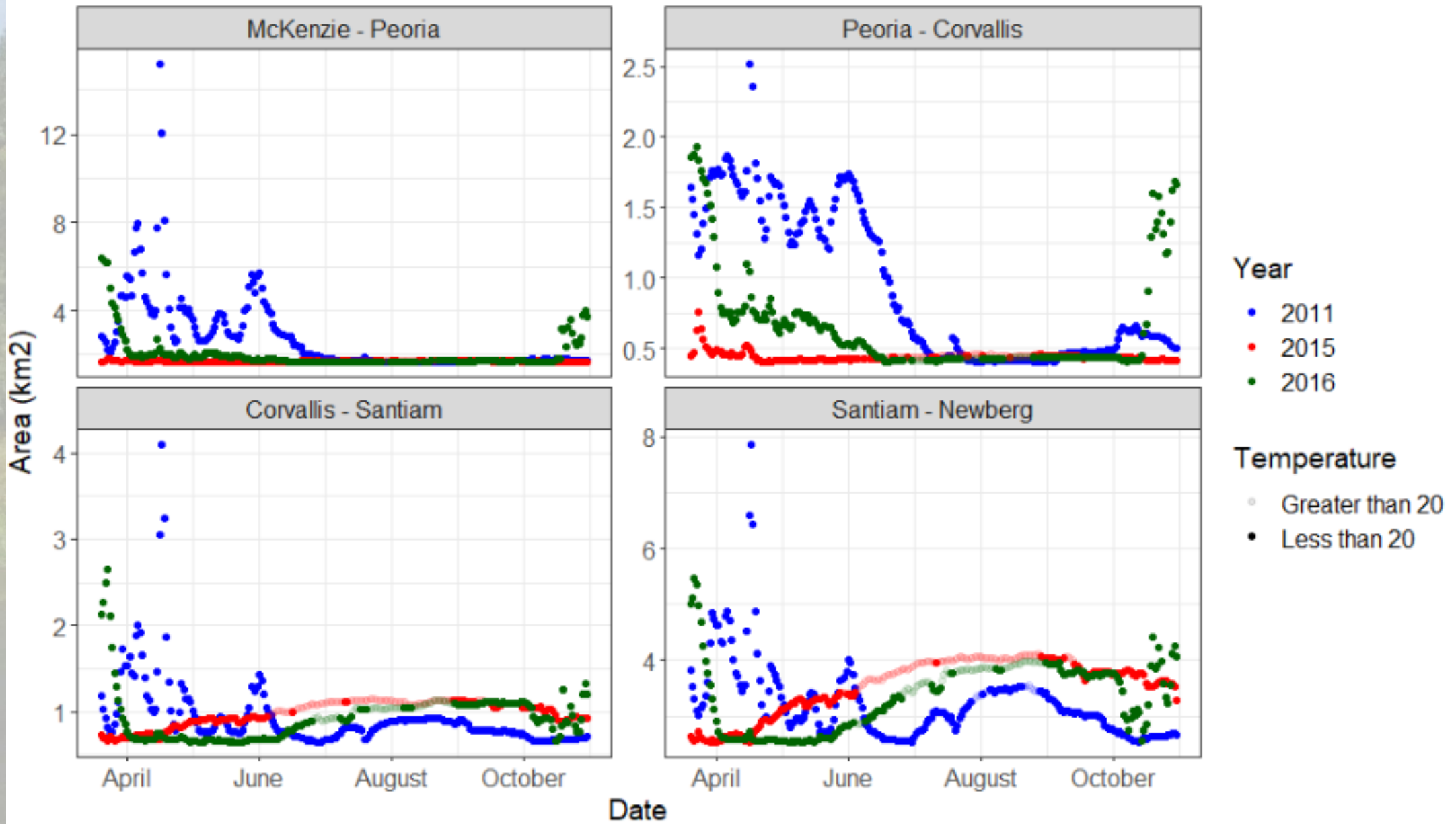
Preliminary Results
Do Not Cite

Habitat + Temperature 2011



Preliminary Results
Do Not Cite





Summary of Habitat Modeling Results

- Habitat response to increasing streamflow varies throughout Willamette
 - Habitat on upstream of Corvallis consistently increase with added streamflow, while reaches downstream decrease from low-moderate flows
 - Primarily driven by local geomorphology → bars, channel complexity, & floodplain accessibility
- Temperature, not hydraulic habitat, is most limiting factor in summer
- Habitat availability is greatest at highest flows. This is most pronounced upstream of Corvallis.
 - Results highlight habitat at low and moderate flows is most limiting

Questions

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