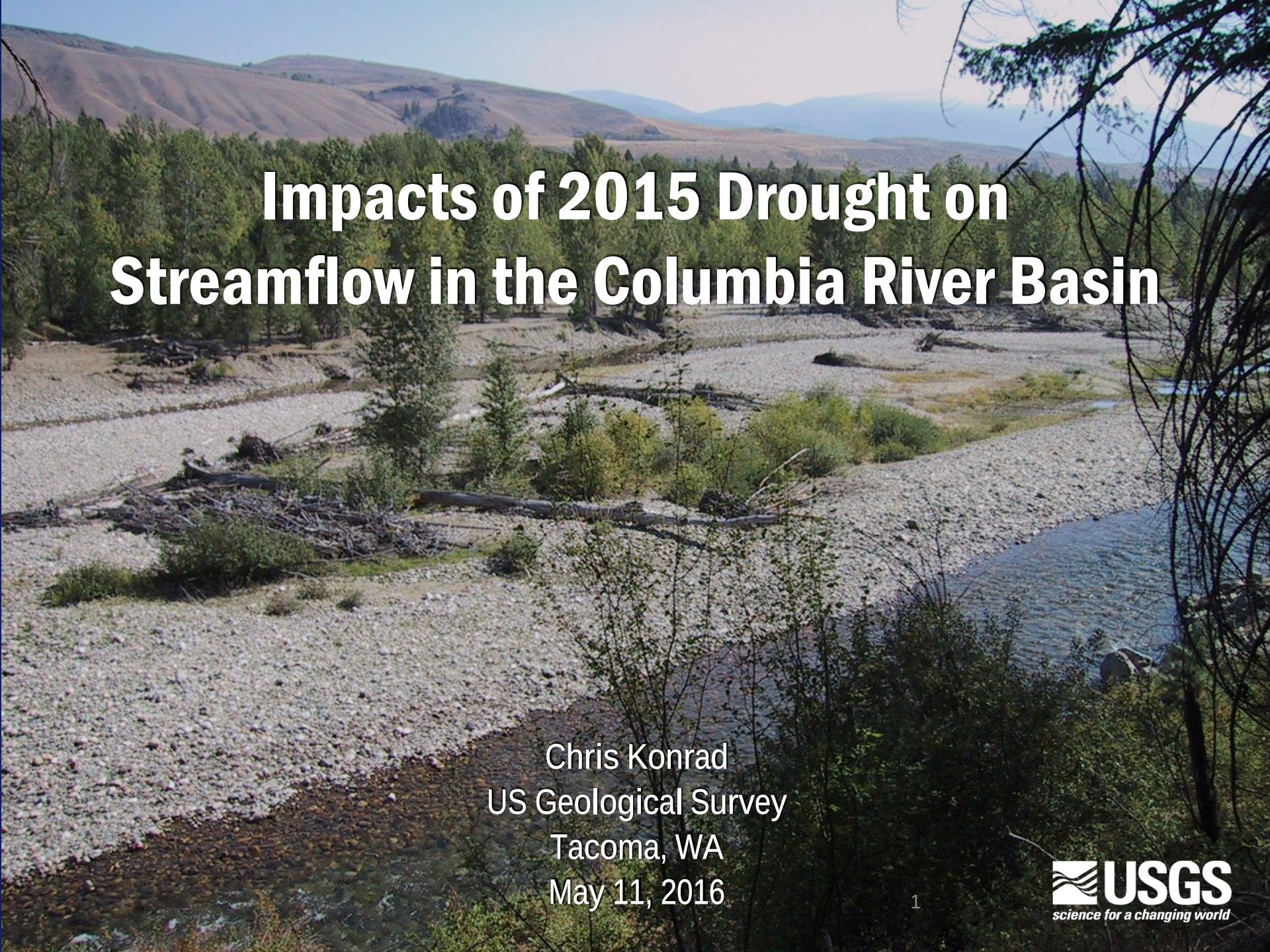

Impacts of 2015 Drought on Streamflow in the Columbia River Basin

Chris Konrad
US Geological Survey
Tacoma, WA
May 11, 2016

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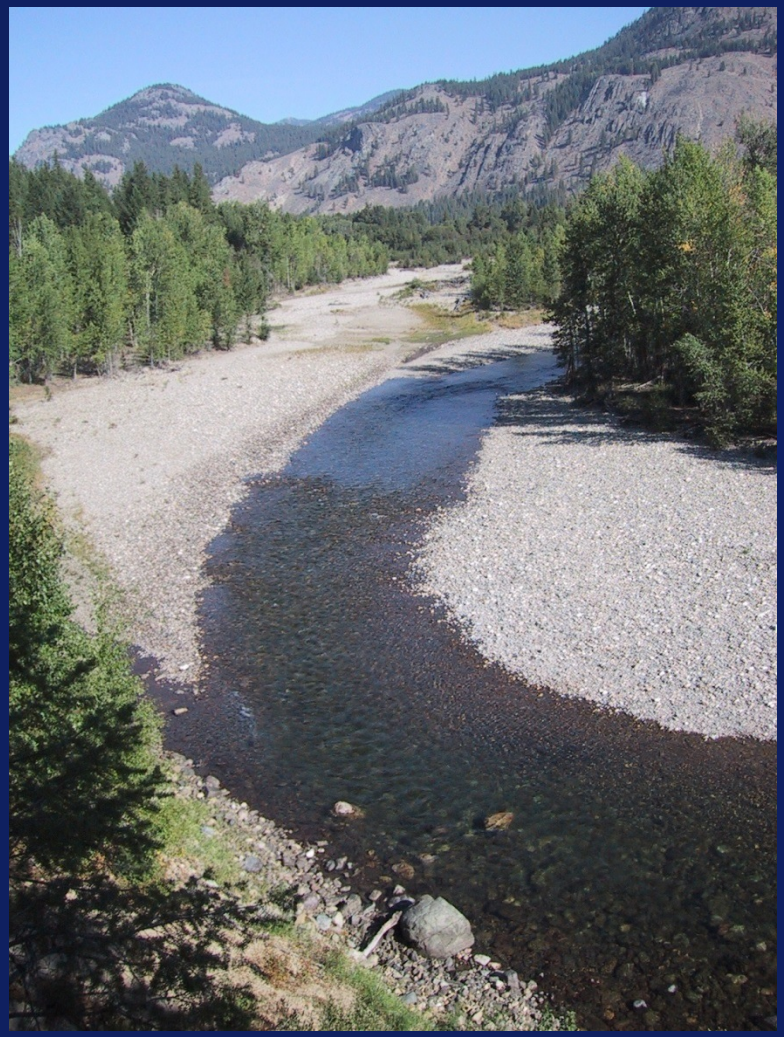
Overview of USGS Investigation



Western US had low snowpack, warm temperatures, and an extended summer dry period in 2015

USGS is investigating streamflow response in six western states

<u>Objectives</u>

- Document extent and severity of 2015 drought
- Assess differences in sensitivity across systems in 2015
- Identify factors influencing vulnerability of particular systems to future droughts

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Importance of Low Flow

Streams that resist drought

- high "unit-area" low flow, constant year-to-year
- provide cold-water refugia for fish
- priorities for habitat protection and connection.

Streams that are vulnerable to drought

- low unit-area low flow, variable year-to-year
- priorities for water transactions
- could be affected by groundwater withdrawals

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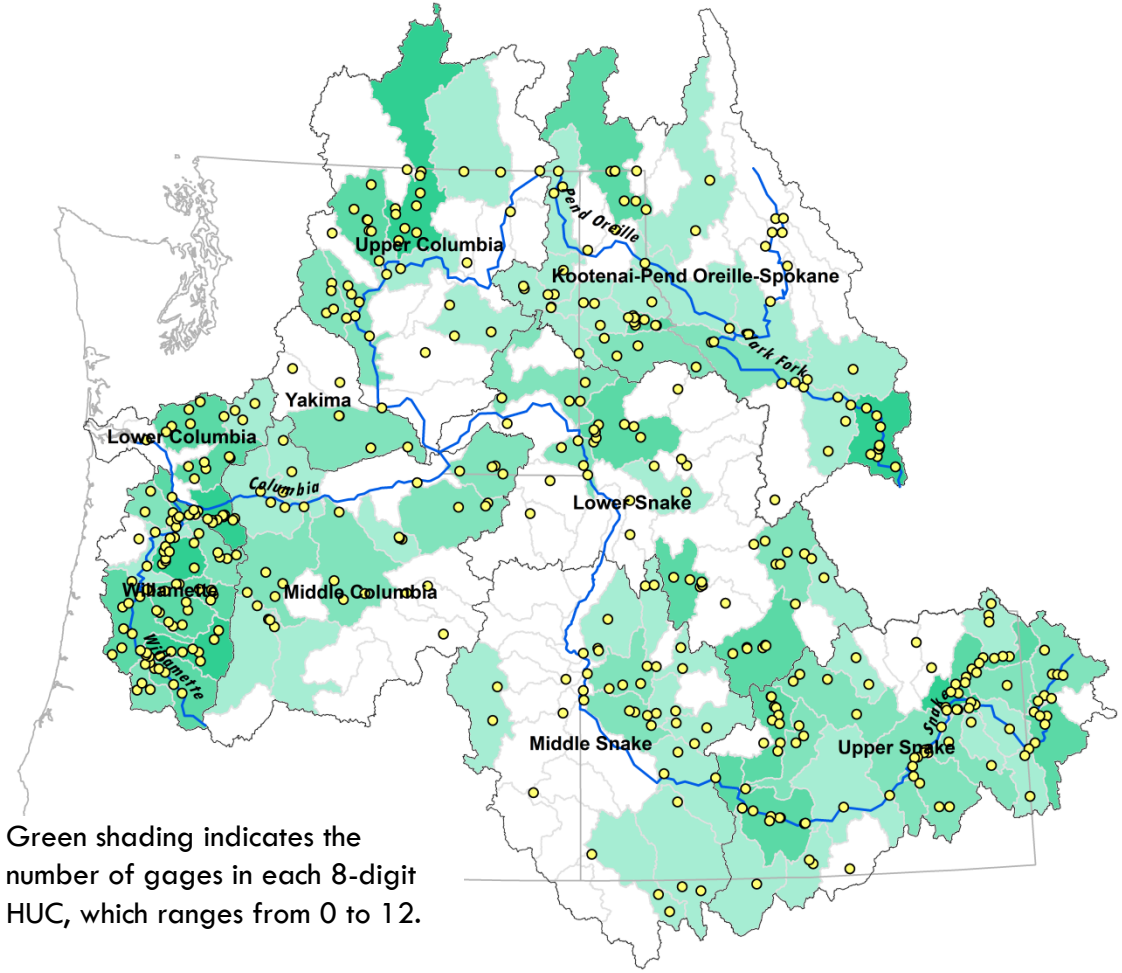
Analysis of Factors Affecting Low Flows

Stream vulnerability to drought depends on precipitation, snow and ice melt, and groundwater. Ice melt and groundwater reduce vulnerability of streams to single-year drought.

Primary question: what was the comparative influence of these factors on 2015 low flows at gaged sites?

If the vulnerability of streams can be linked to specific factors, water managers will be able to forecast where water availability is likely to be an issue in a particular year.

Columbia River Basin Sites



Green shading indicates the number of gages in each 8-digit HUC, which ranges from 0 to 12.

434 USGS gages located in all of the major sub-basins and many watersheds

Gaps in about half of the watersheds (0 or 1 gages for the watersheds in white)

Low flow measurements during the summer of 2015 at 340 ungaged sites

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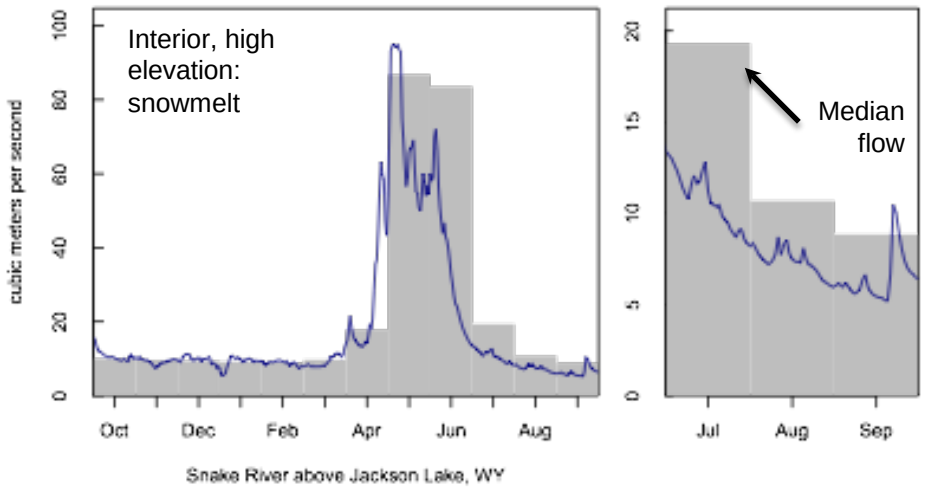
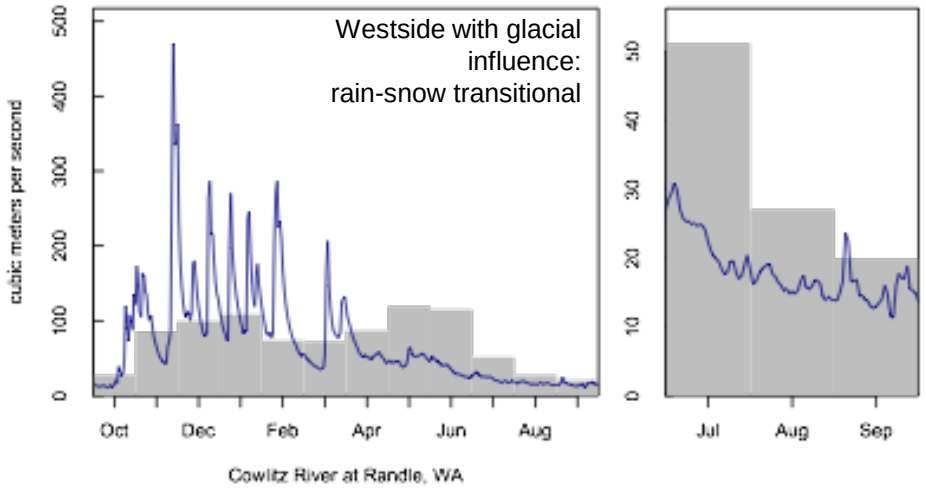
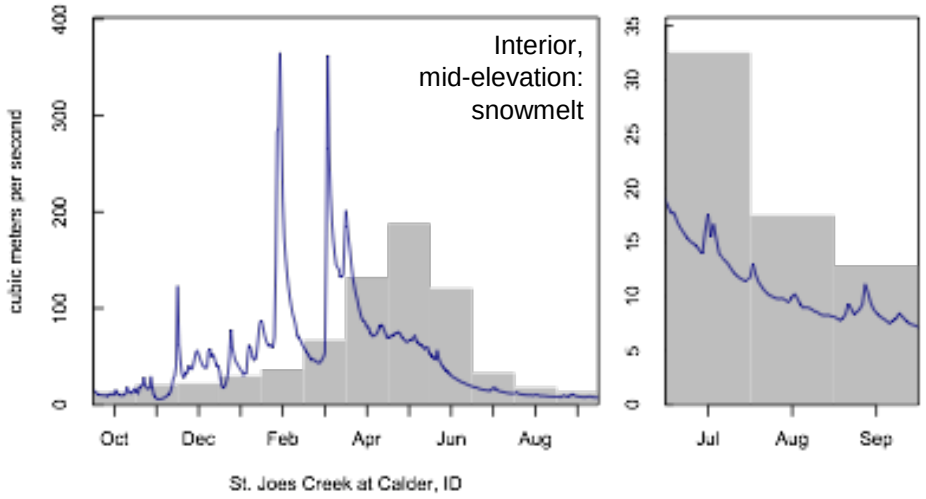
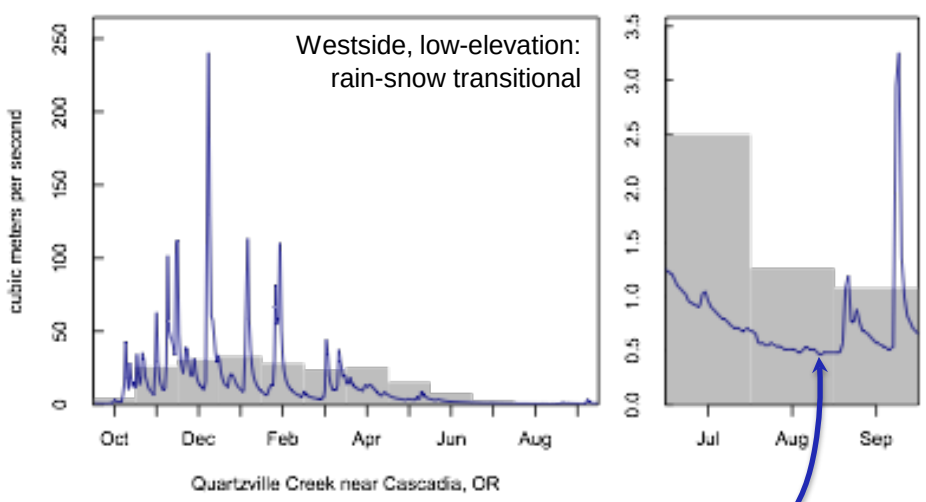
Streamflow in 2015 was below normal









Westside, lower elevation rivers and streams generally had the most extreme low flows in 2015.

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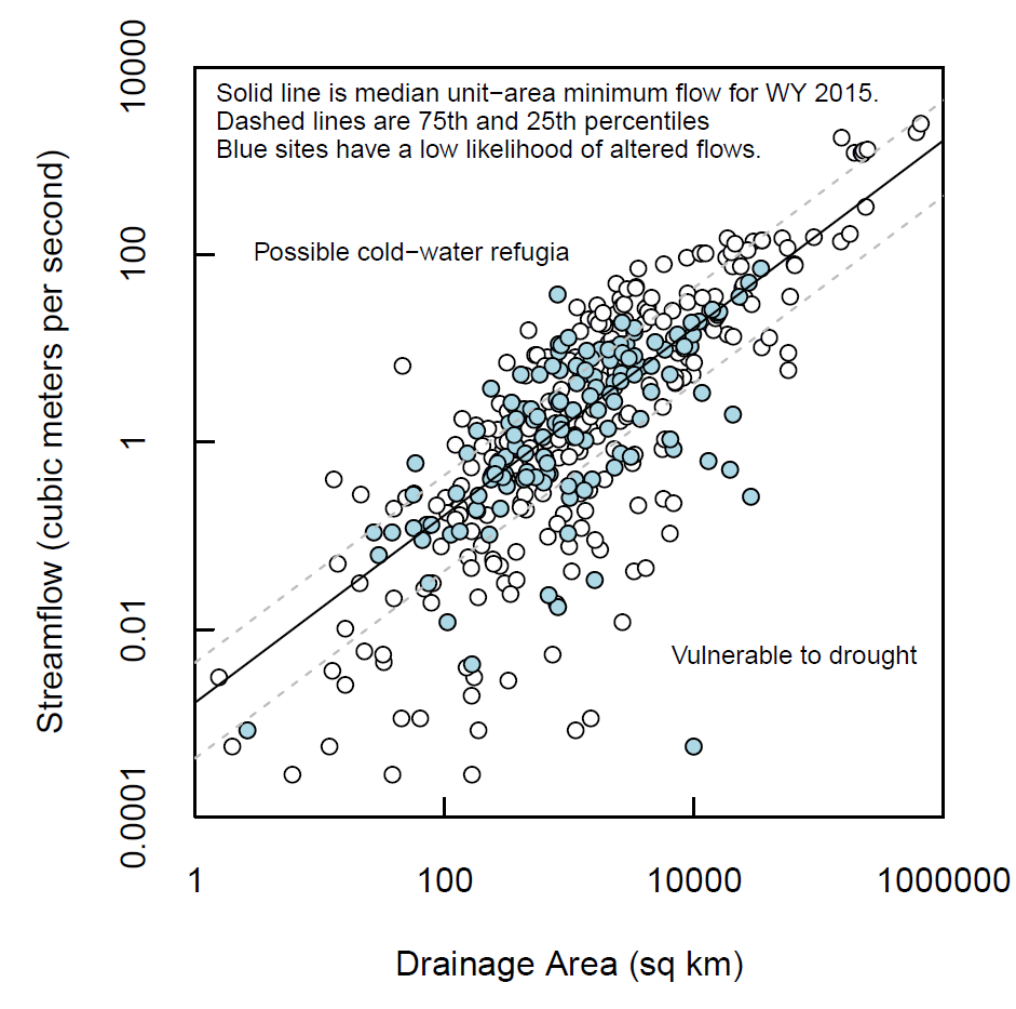
2015 Low Flows at USGS Gages in Columbia River Basin

Median unit-area low flow ~0.15 cfs per sq mile (diagonal line)

Only 4% higher for 184 "natural-flow" sites (blue shading)

Variability in unit-area streamflow due to differences in precipitation and groundwater



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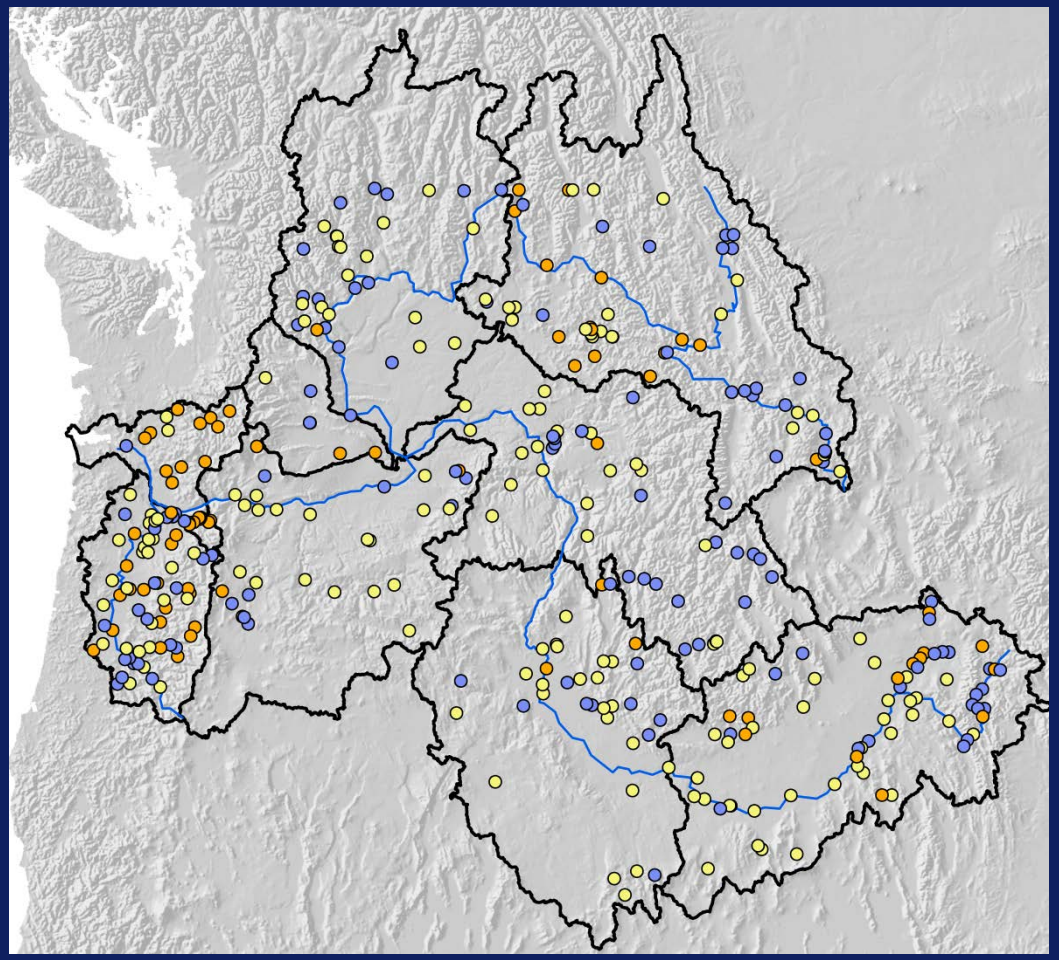
Were Low Flows Extreme in 2015?

Difference between extreme and normal low flow is small: 10th percentile is typically 60% of the median ("2-year") annual low flow or about 0.05 cfs/ sq mile.

Low flows in 2015 were lower than normal in especially in Willamette, Lower Columbia, Spokane, and Upper Snake.



Blue –above normal low flow
Yellow –below normal low flow
Orange – >0.05 cfs/sq mile below normal

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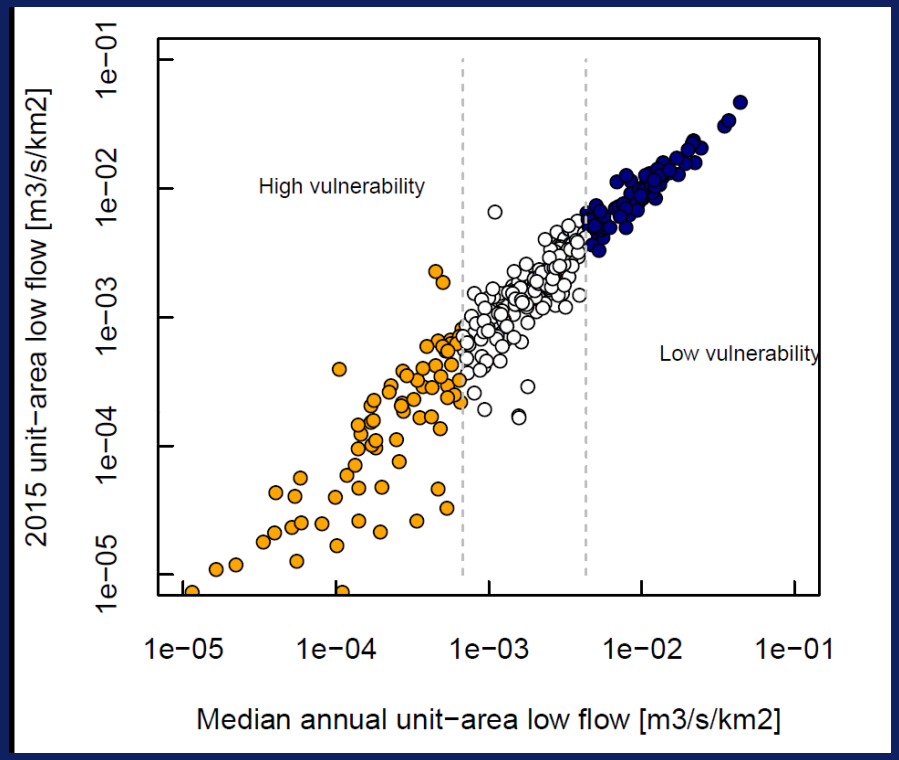
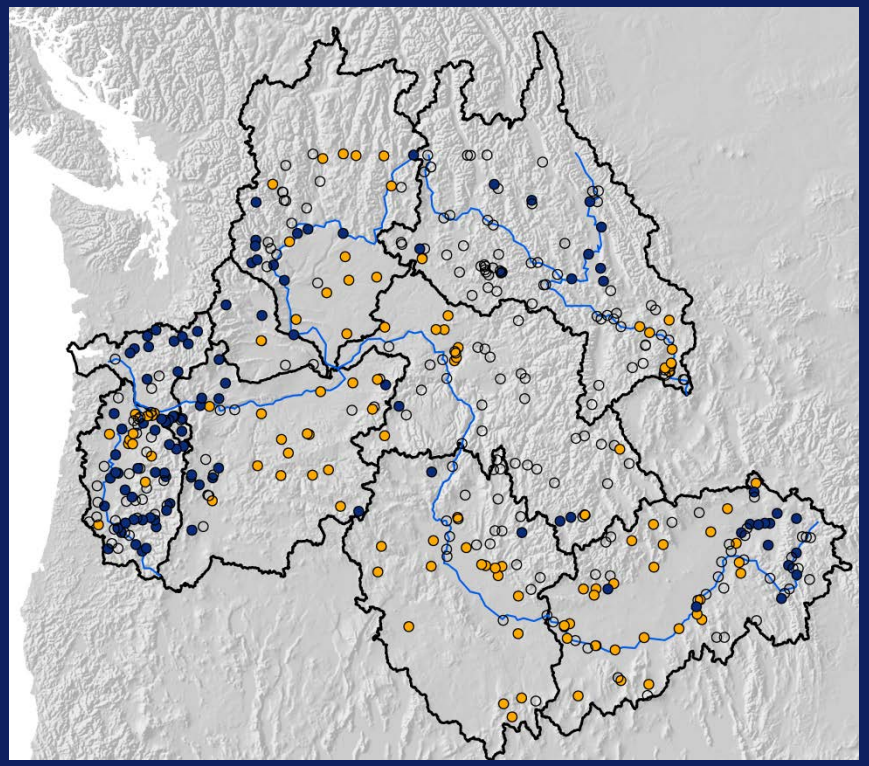
Assessing Stream Vulnerability to Drought





Median annual low flow provides a simple index of vulnerability.

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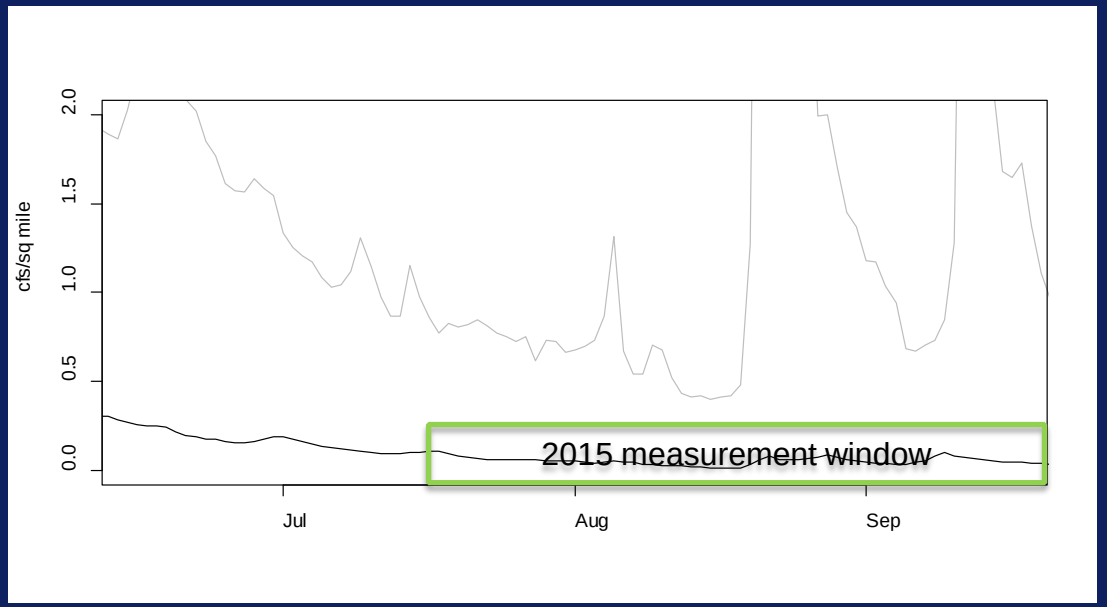
Assessing Stream Vulnerability to Drought

Median annual low flow provides a simple measure of stream vulnerability to drought.

Measurements made from July through September were likely to be within 0.2 cfs/sq mile of 2015 low flow.

Difference between daily and minimum streamflow for 95th and 50th percentiles of gages.



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Next Steps

Products from initial analysis (2016)

Assessment of stream-specific vulnerability to drought

Method for estimating low flows from single measurements

Possible tasks for the future

1. Expand the assessment of stream vulnerability to ungaged sites;
2. Basin-wide mapping of stream vulnerability
3. Assess groundwater recharge from snowmelt in rivers and its significance for base flow and water supply during droughts r
4. Incorporate stream-specific vulnerability into drought forecasting

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Summary

Streamflow was below in normal in the Columbia River Basin during the summer of 2015 particularly because of the lack of snowmelt.

Low flows were exceptionally low in some streams (westside, low elevation) but were close to normal in many streams.

Past response of streams is a good indicator of their vulnerability to drought. There is value to having even one low flow measurement.