Developing a Common Understanding for the State-of Knowledge and Assumptions for Managing and Restoring the Willamette River Basin

J. Rose Wallick[1], Rachel Laird[2], Richard Piaskowski[2], Tobias Kock[3]

[1]U.S. Geological Survey Oregon Water Science Center

[2]U.S. Army Corps of Engineers, Portland District

[3]U.S. Geological Survey, Western Fisheries Research Center

USGS science for a changing world

Cottage Grove Dam and Reservoir

Outline

- Intro and background
- Common assumptions
- New data available
- Symposium plans
- Examples of science synthesis for symposium

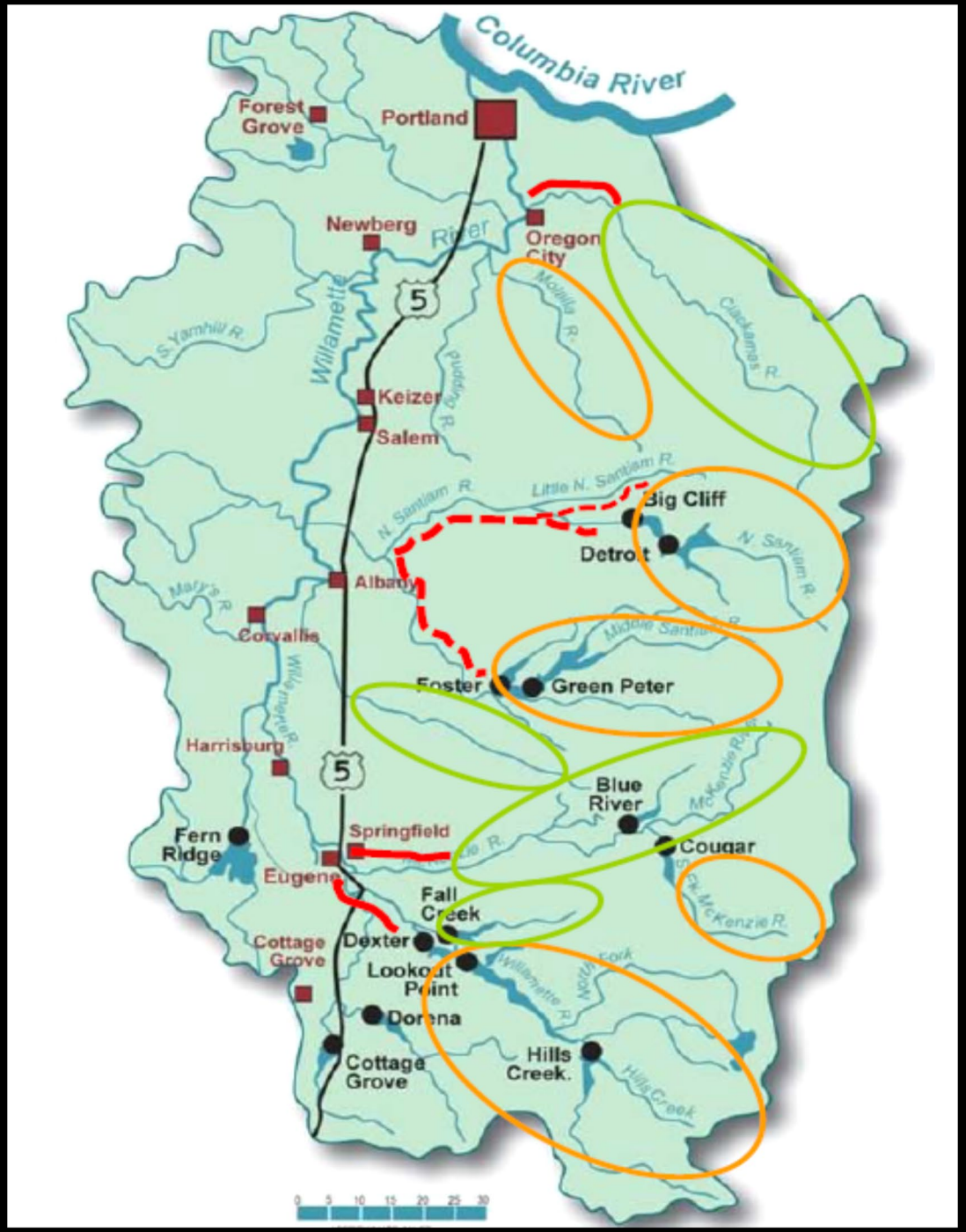
Overarching Approach

“Split-Basin” strategy

- Wild fish above dams, mix of hatchery & wild fish below

Highest priority

- Fish passage
- Pre-spawning mortality
- Downstream habitat attributes



Opportunities, uncertainties and adaptive management

Considering present-day river conditions,

- What are realistic expectations for restoration?
- Where is uncertainty/risk greatest?
- What opportunities are there for adaptive management?

What have we learned since 2008 to help answer these questions?

What assumptions are commonly made regarding:

- Floodplain inundation
- Channel complexity
- Off-channel habitat
- Non-native fish
- Optimizing river flows
- Salmon and steelhead productivity
- Contribution of life history pathways to adult recruitment
- Density dependent mortality in salmon and steelhead

We now have building blocks to revisit assumptions and address recurring questions

Examples of research 2008-2021

Fisheries:

- *Salmon and steelhead research (many topics evaluated by UI, PNNL, USGS, and many others)*
- *Native fish communities (OSU, ODFW)*
- *Habitat capacity (NOAA, USGS)*
- *Genetics (OSU, ODFW)*
- *Science framework for ecological flows (SWIFT framework; USGS)*

Stream Temperature and Coldwater Refuges:

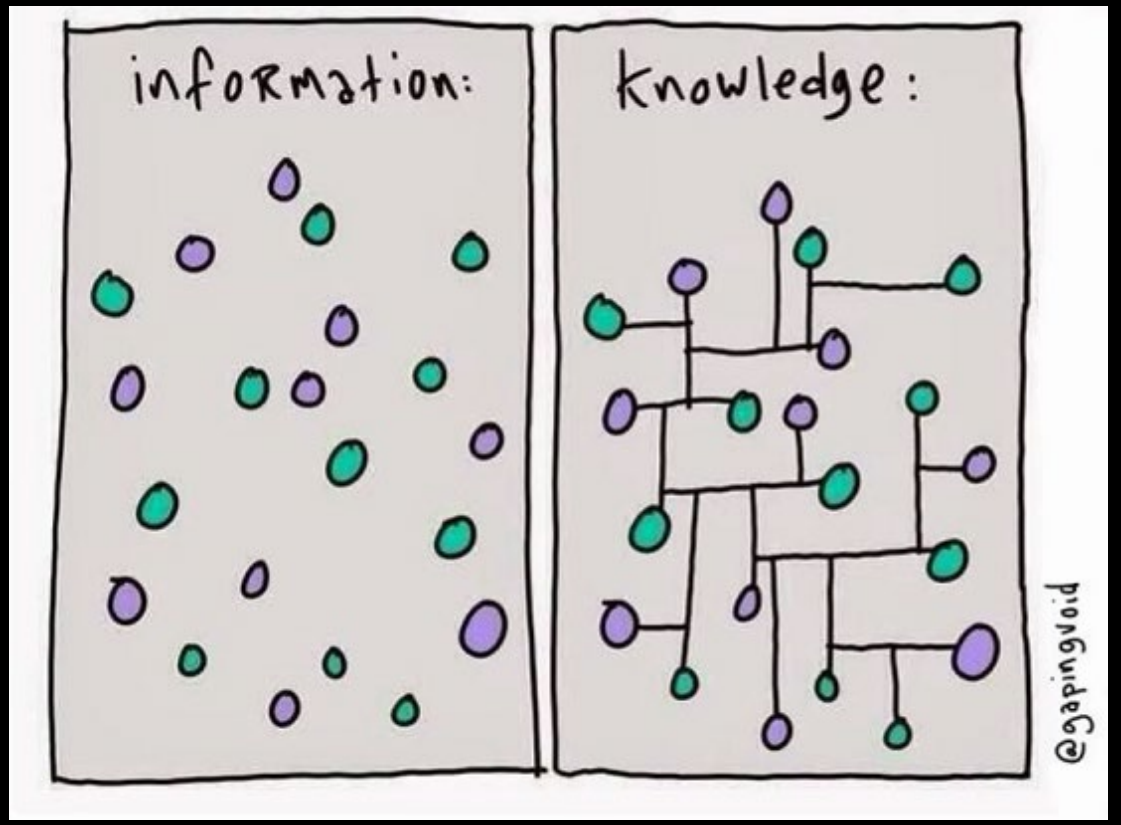
- *Thermal conditions in reservoirs and below dams (USGS, USACE)*
- *Off-channel water quality (USGS, OSU...)*
- *Coldwater refuges (USGS, OSU…)*

Spawning and Rearing Habitat Availability

- *PHAB-Sim studies in tributaries (R2, RDG)*
- *2D hydraulic and habitat modeling (USGS)*

Geomorphology and Restoration Monitoring

- *Floodplain geomorphology, floodplain forests (OSU, UO, USGS)*
- *Restoration effectiveness Monitoring (USGS, PSU, BSWCD, USFS)*



Assembling our knowledge foundation: Willamette River Science Symposium

Killdeer nest, Upper Willamette River

Confluence of Willamette and McKenzie Rivers

Willamette River Science Symposium

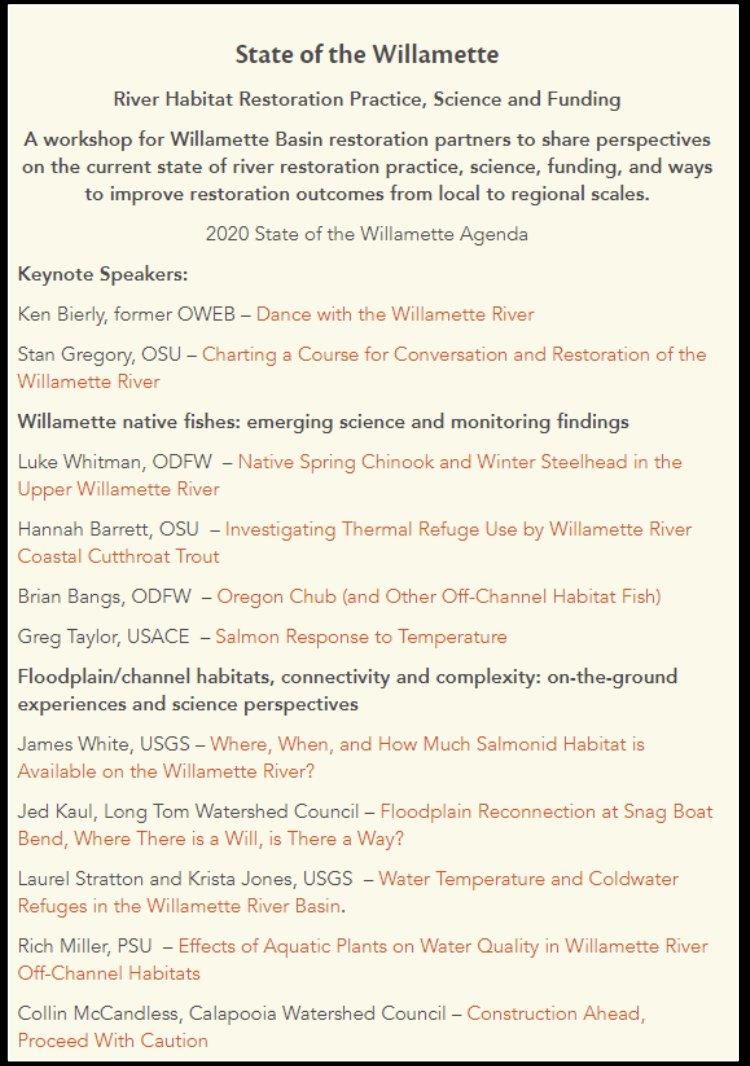
Science Symposium planned for 2022 will:

- Review management assumptions
- Synthesize existing studies and 'on the ground' knowledge
- Identify risks and uncertainties surrounding different assumptions
- Identify new hypotheses
- Identify key questions that warrant further examination

Broader interests/goals:

- Create 'community of practice' among groups, conducting and utilizing river science
- Summarize information in one place
- Establish an adaptive management framework for annual application

Symposium part of a multi-pronged strategy to create a 'common knowledge foundation' to inform the management of Willamette River fisheries and floodplains



State of the Willamette

River Habitat Restoration Practice, Science and Funding

A workshop for Willamette Basin restoration partners to share perspectives on the current state of river restoration practice, science, funding, and ways to improve restoration outcomes from local to regional scales.

2020 State of the Willamette Agenda

Keynote Speakers:

Ken Bierly, former OWEB – Dance with the Willamette River

Stan Gregory, OSU – Charting a Course for Conversation and Restoration of the Willamette River

Willamette native fishes: emerging science and monitoring findings

Luke Whitman, ODFW – Native Spring Chinook and Winter Steelhead in the Upper Willamette River

Hannah Barrett, OSU – Investigating Thermal Refuge Use by Willamette River Coastal Cutthroat Trout

Brian Bangs, ODFW – Oregon Chub (and Other Off-Channel Habitat Fish)

Greg Taylor, USACE – Salmon Response to Temperature

Floodplain/channel habitats, connectivity and complexity: on-the-ground experiences and science perspectives

James White, USGS – Where, When, and How Much Salmonid Habitat is Available on the Willamette River?

Jed Kaul, Long Tom Watershed Council – Floodplain Reconnection at Snag Boat Bend, Where There is a Will, is There a Way?

Laurel Stratton and Krista Jones, USGS – Water Temperature and Coldwater Refuges in the Willamette River Basin.

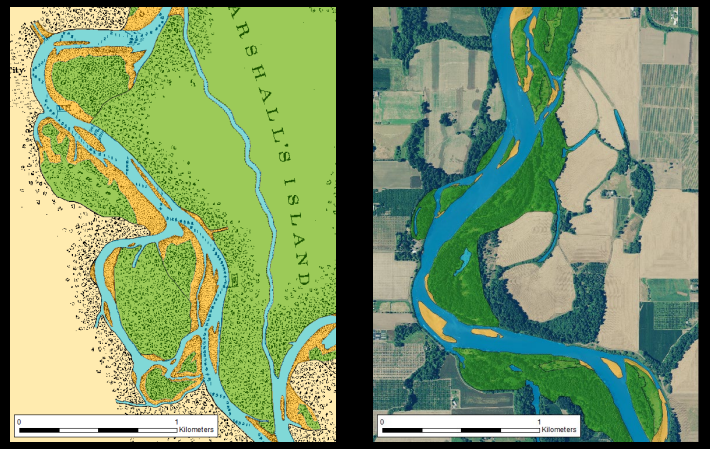
Rich Miller, PSU – Effects of Aquatic Plants on Water Quality in Willamette River Off-Channel Habitats

Collin McCandless, Calapooia Watershed Council – Construction Ahead, Proceed With Caution

2020 State of the Willamette presentations: https://bentonswcd.org/state_of_the_willamette/

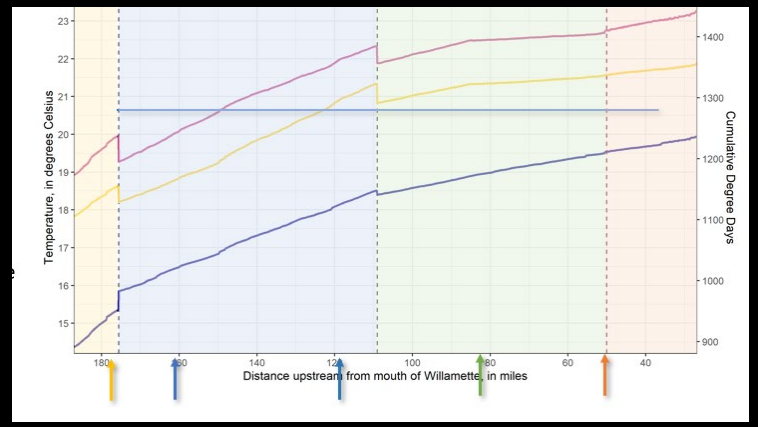
Examples of research to synthesize at symposium

River channel and streamflow



Gordon and others, 1895 and 2016 mapping, in progress.

Thermal conditions



Stratton and Rounds, Thermal Landscape; in press

Habitat conditions

White and others, Rearing habitat modeling, in progress

Movement, survival, life histories

Image courtesy Freshwaters Illustrated

Effects of dam operations

USACE image

Adaptive management

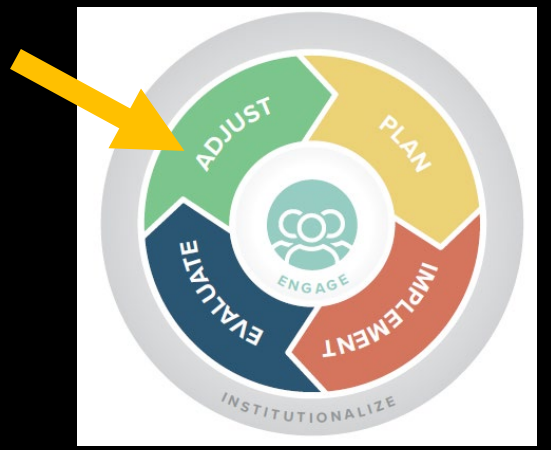
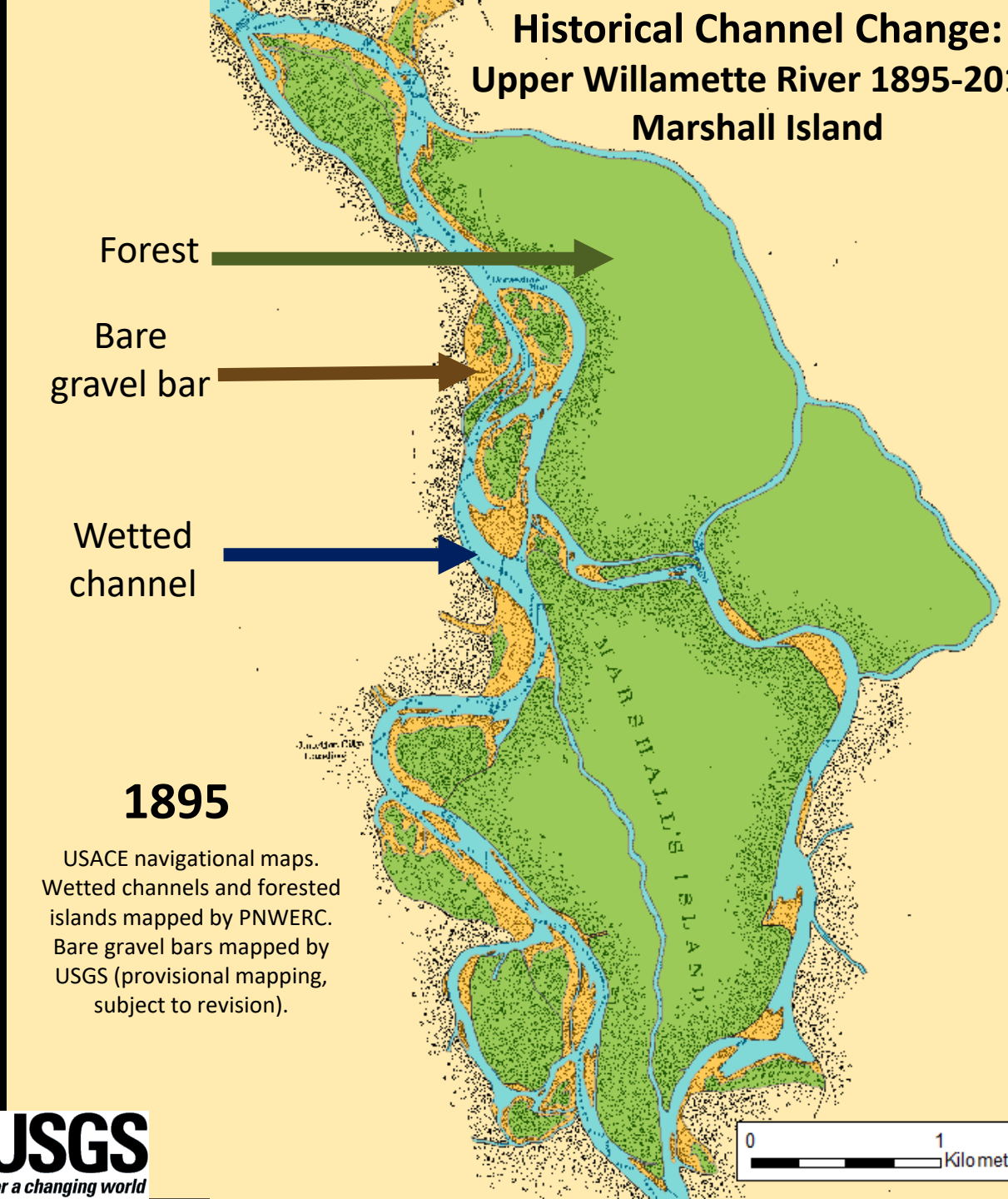


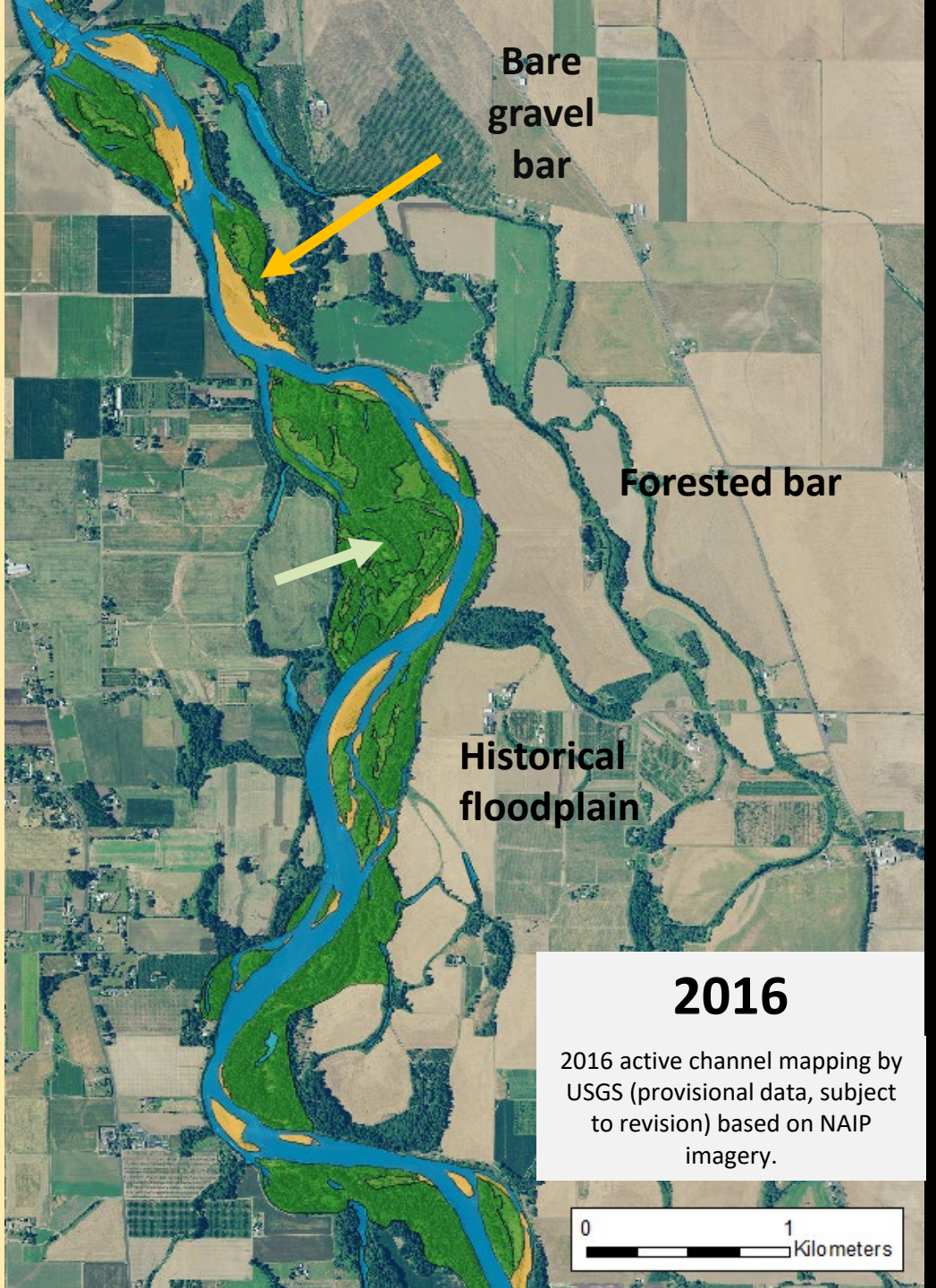
Figure from Warren and others, 2019

Historical Channel Change:
Upper Willamette River 1895-2016
Marshall Island



1895

USACE navigational maps. Wetted channels and forested islands mapped by PNWERC. Bare gravel bars mapped by USGS (provisional mapping, subject to revision).



2016

2016 active channel mapping by USGS (provisional data, subject to revision) based on NAIP imagery.

USGS
science for a changing world

Historical Channel Change:
Middle Willamette River 1895-2016
Windsor Island, near Salem

Forest

Bare gravel bar

Wetted channel

1895

USACE navigational maps. Wetted channels and forested islands mapped by PNWERC. Bare gravel bars mapped by USGS (provisional mapping, subject to revision)

2016

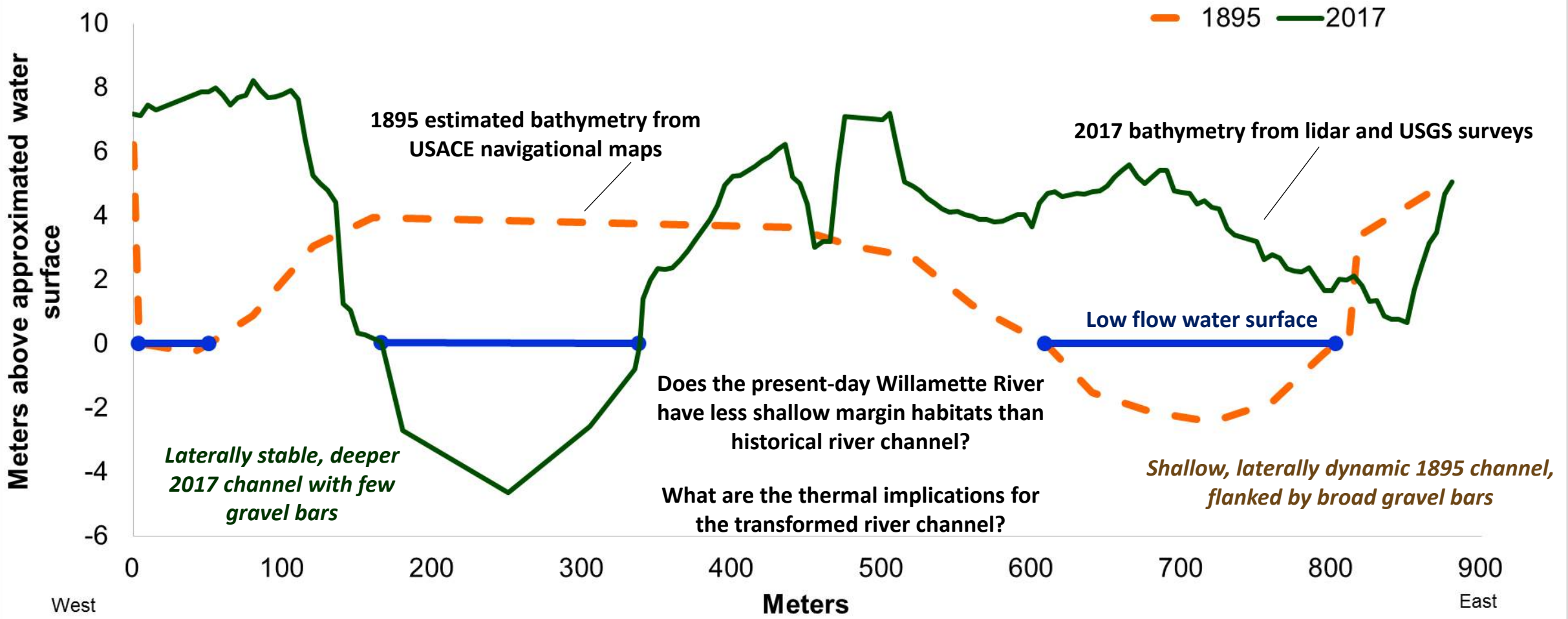
2016 active channel mapping by USGS (provisional data, subject to revision) based on NAIP imagery.

What are the implications for rearing habitat?

USGS
science for a changing world

Generalized changes in Willamette River Cross-Section 1895-2017

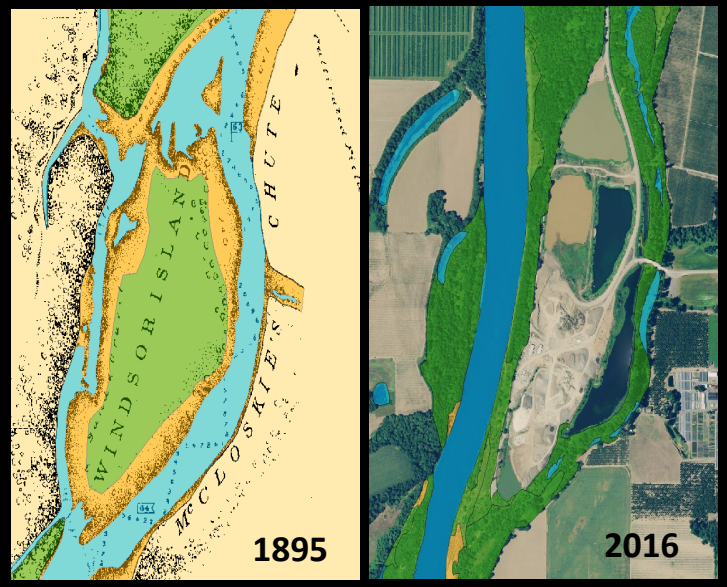
Windsor Island, Willamette River downstream of Salem near Willamette Mission State Park

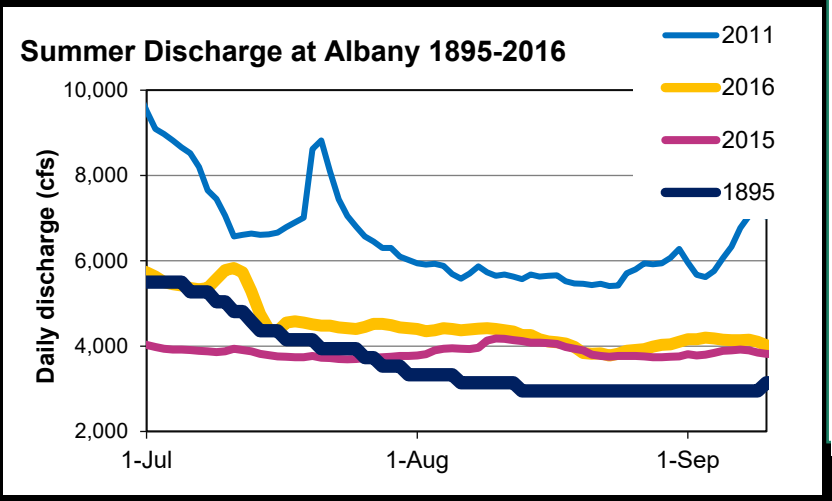


2017 topography from topographic-bathymetric lidar by Quantum Spatial Inc., and USGS boat-based surveys (White and others, 2018). Bathymetry from 1895 approximated from USACE navigational charts. Provisional data and analyses, subject to revision. Prepared by Gabe Gordon, USGS.

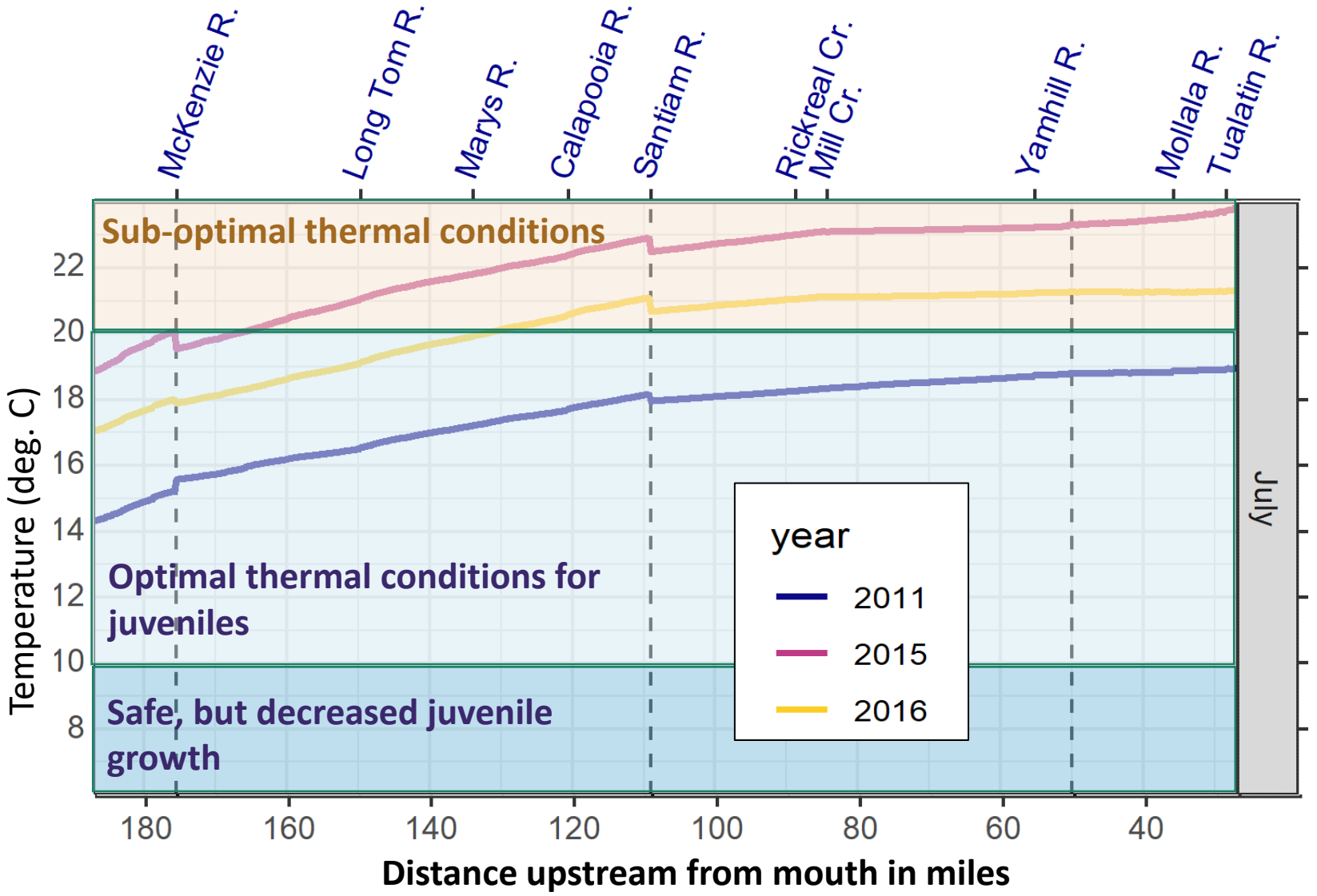
USGS
science for a changing world

Temperature studies provide a foundation for assessing present-day conditions and addressing assumptions



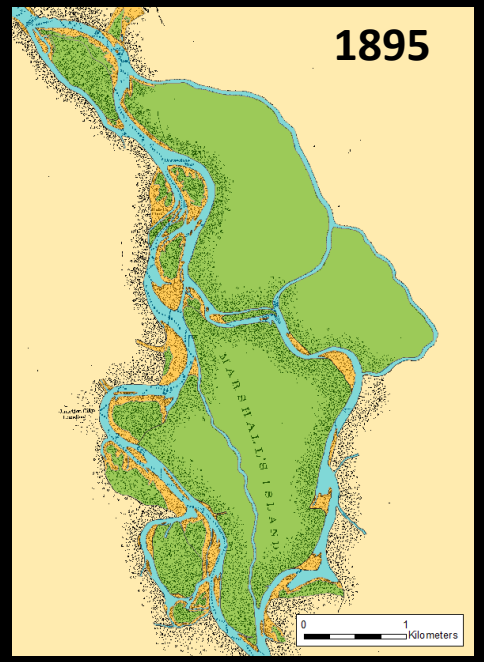


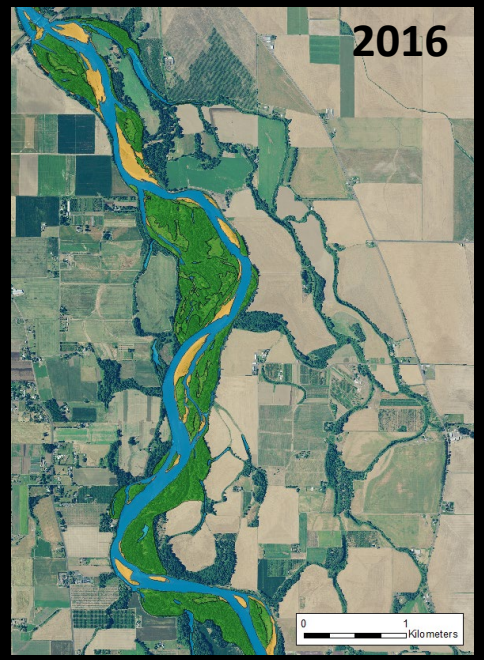
Thermal profile of the Willamette River: monthly temperatures for July, in 2011, 2015, 2016



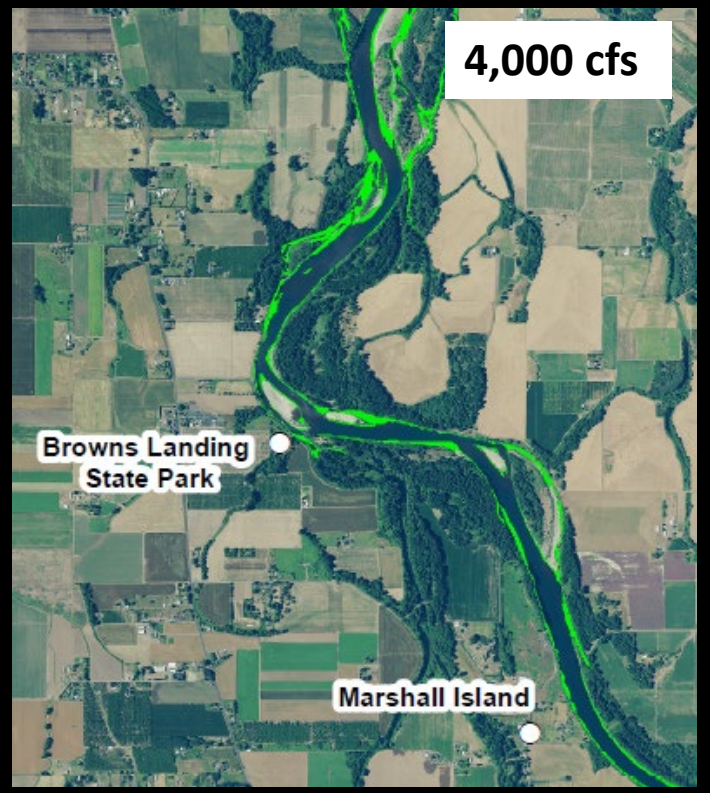
Provisional temperature modeling by Stratton Garvin and Rounds, subject to revision.

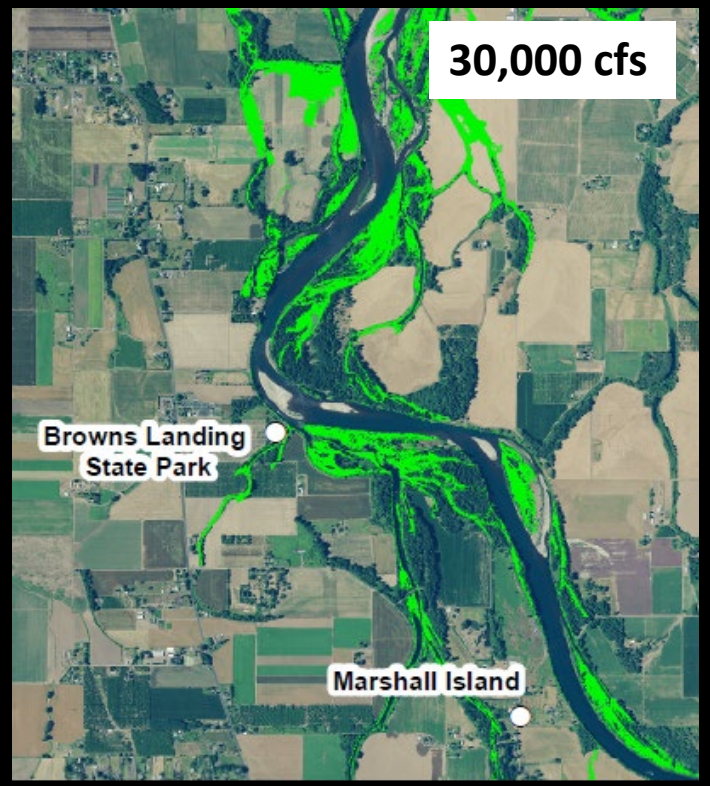
Example: Habitat availability studies can be integrated with historical channel change to address assumptions and establish management priorities





Pre-smolt rearing habitat for juvenile spring Chinook salmon, Upper Willamette River near Harrisburg





Provisional habitat modeling by White and others, subject to revision.

Summary

- Adaptive management requires research and information synthesis
- New science 2008-2021 provides a basis to revisit assumptions and inform adaptive management
- Symposium in 2022 will:
  - Synthesize existing information to evaluate and refine assumptions about the river system
  - Develop common knowledge foundation and shared vision to inform adaptive management

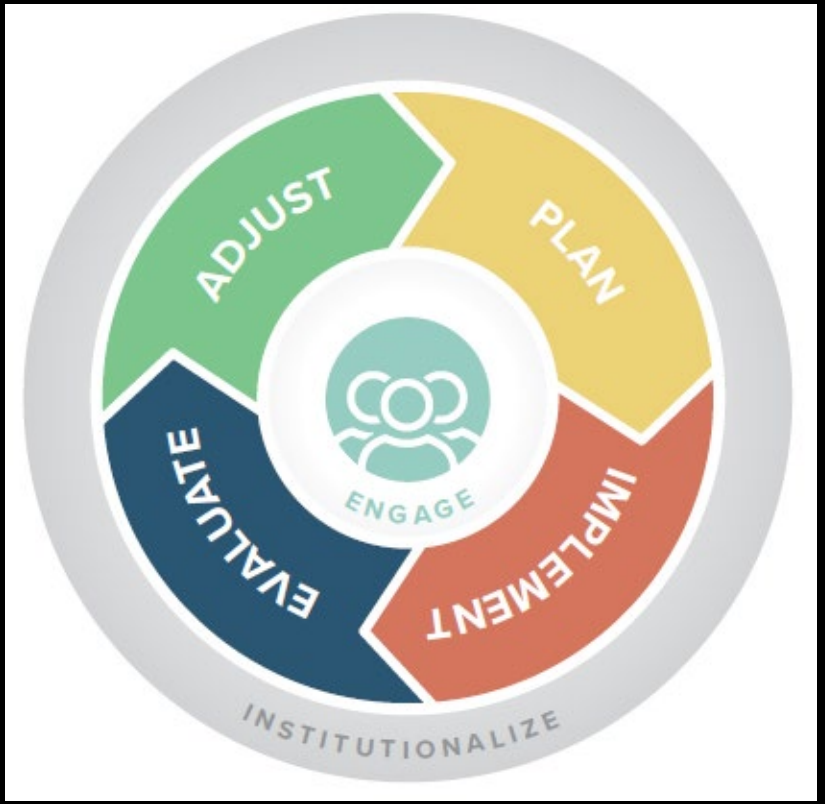


Figure from Warren and others, 2019

USGS science for a changing world

Questions or Symposium Suggestions?

Rose Wallick - rosewall@usgs.gov

Rachel Laird - rachel.d.laird@usace.army.mil

Rich Piaskowski - richard.m.piaskowski@usace.army.mil

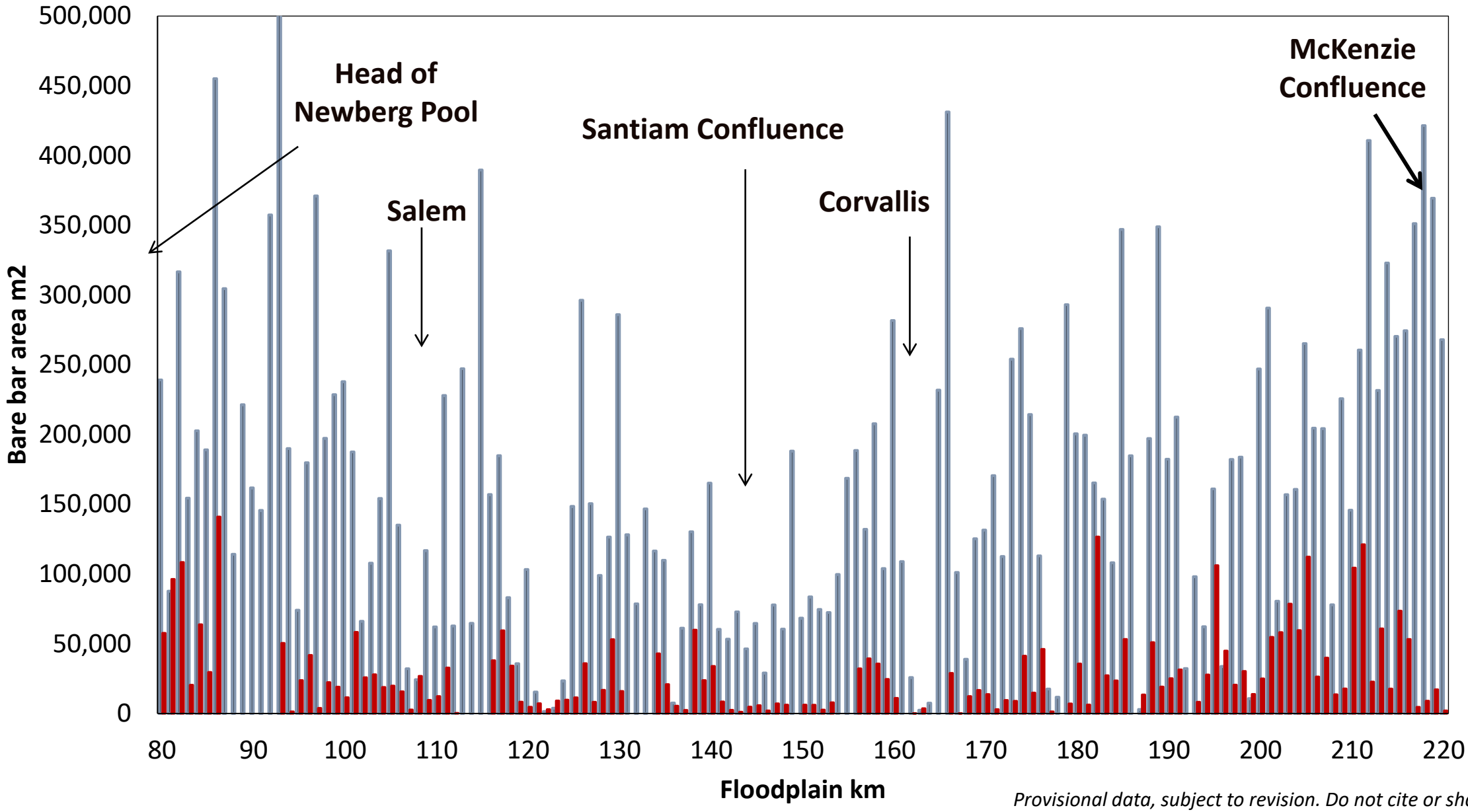
Toby Kock - tkock@usgs.gov

We appreciate all the individuals and organizations contributing in different ways to the Willamette River knowledge foundation. Co-creating a shared knowledge foundation requires contributions from all perspectives, especially folks with deep 'on the ground' insights gained over decades spent working on Willamette River issues.

USGS science for a changing world

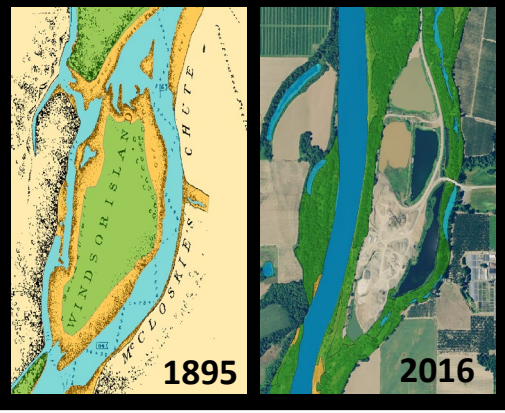
Extra Slides

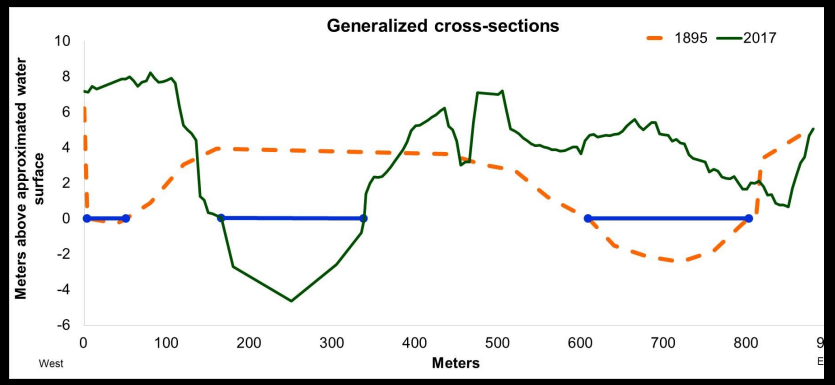
Willamette River gravel bars: 1895-2008

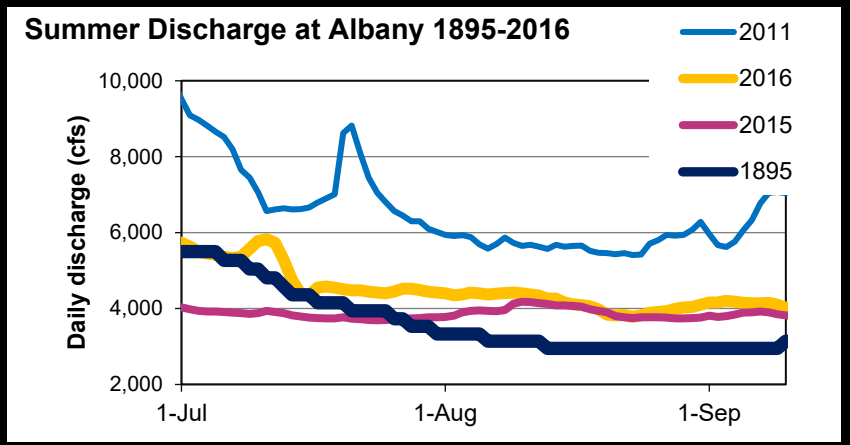


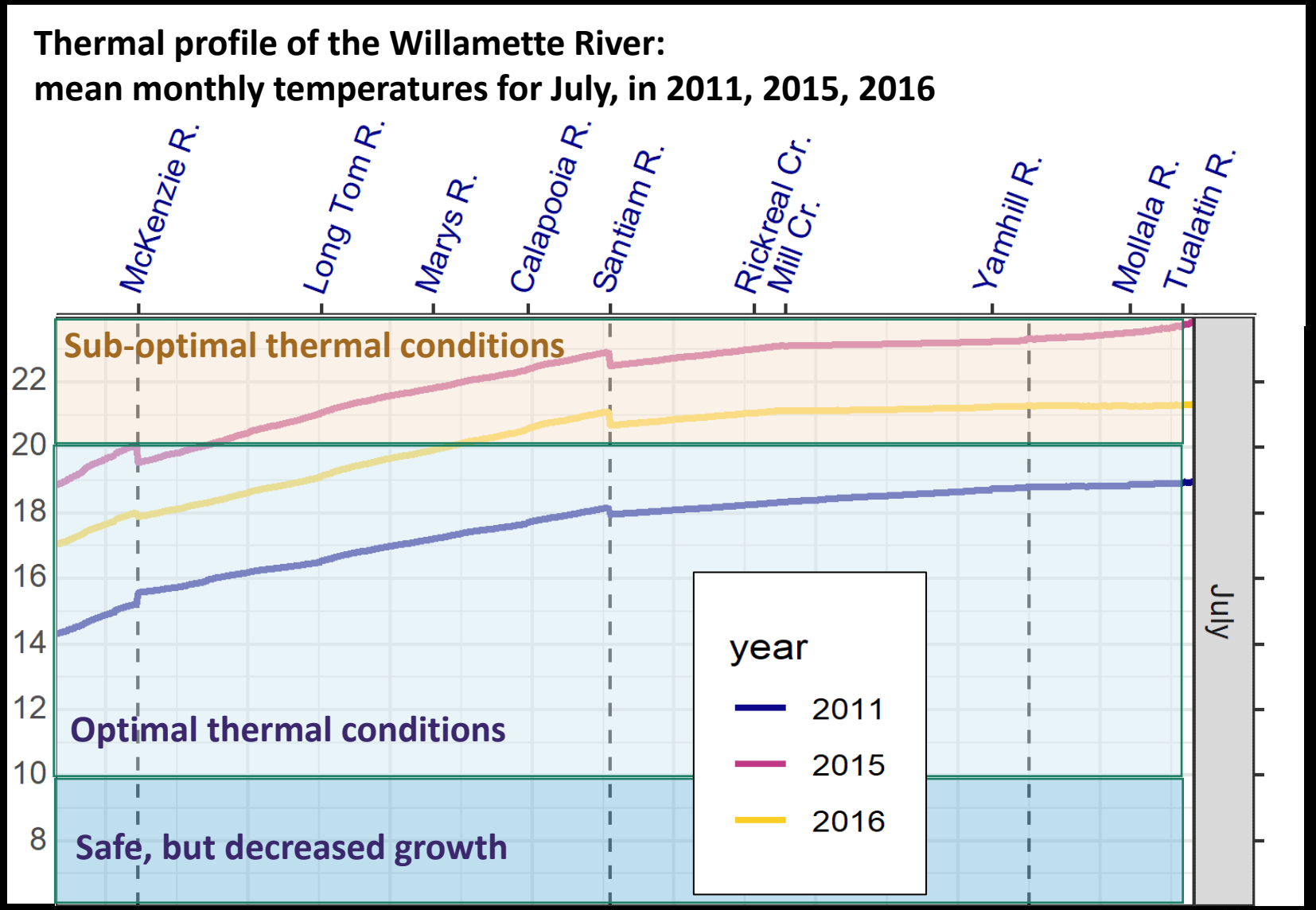
Provisional data, subject to revision. Do not cite or share.

Example: Temperature studies can be integrated with historical channel change to address assumptions and establish realistic expectations





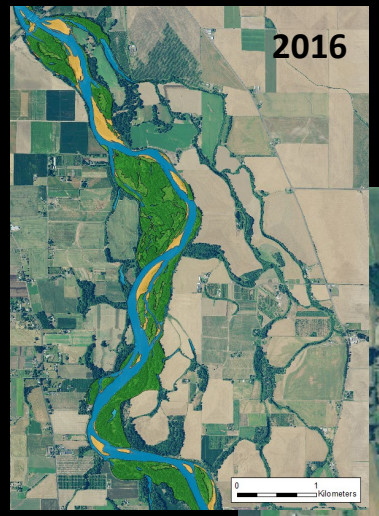




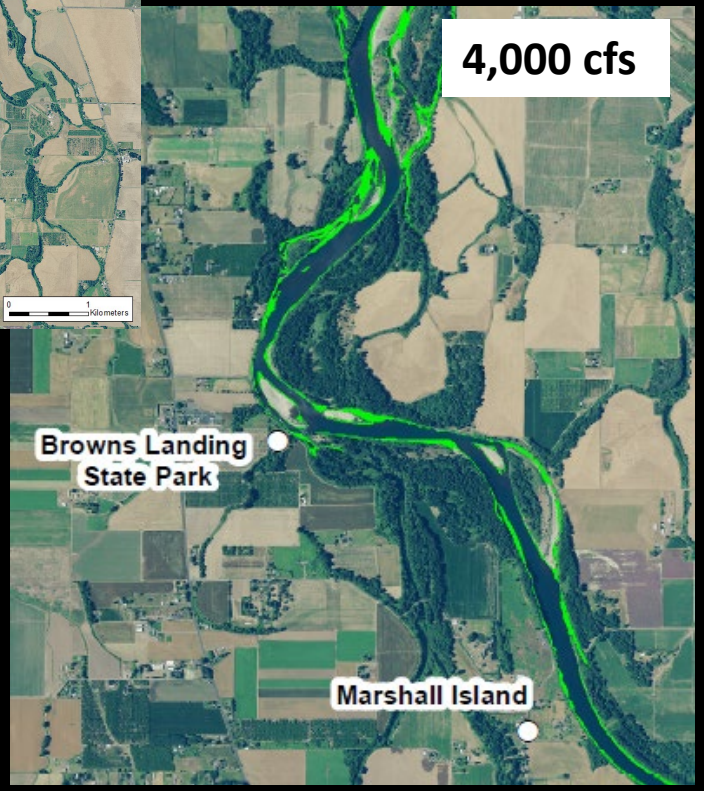
Provisional temperature modeling by Stratton Garvin and Rounds, subject to revision.

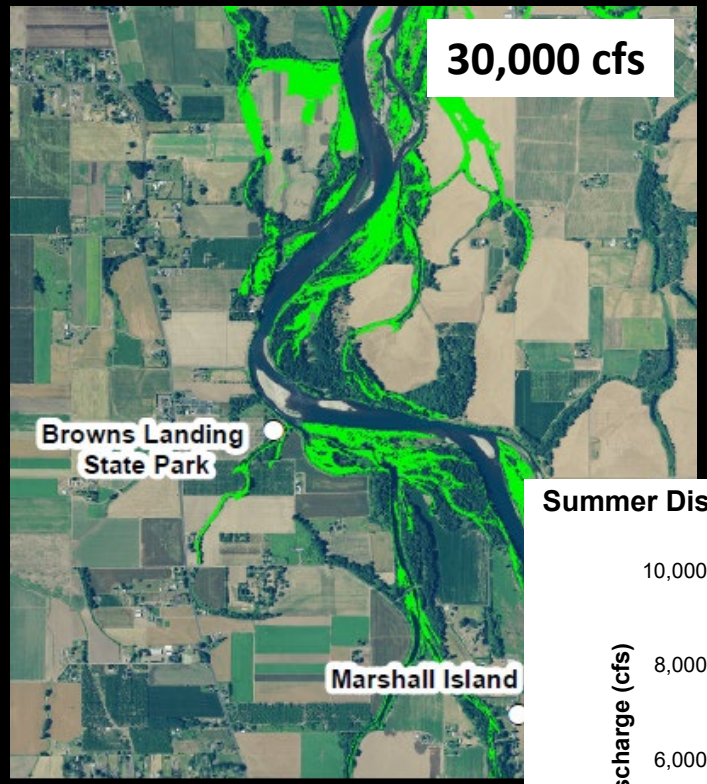
Factors can now be integrated to better inform assumptions and management priorities

Channel conditions



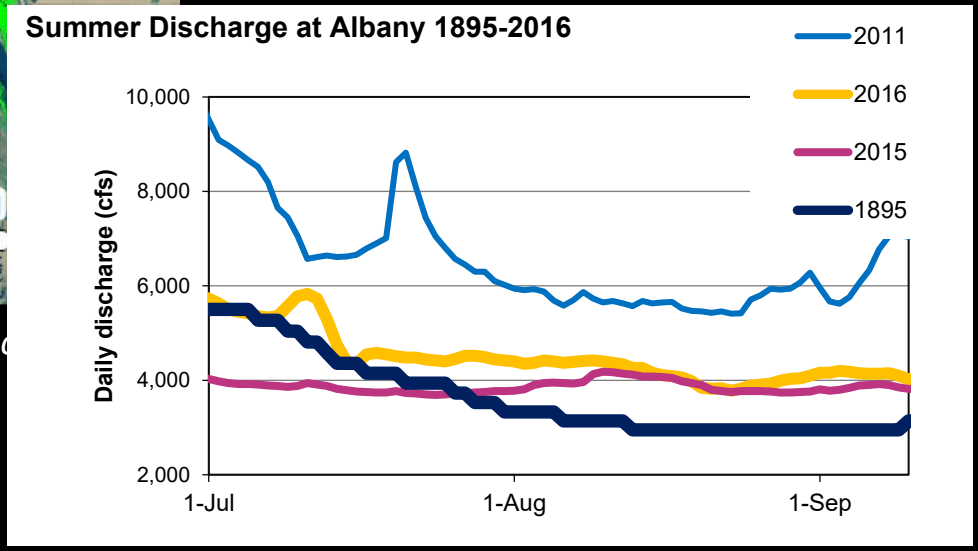
Habitat

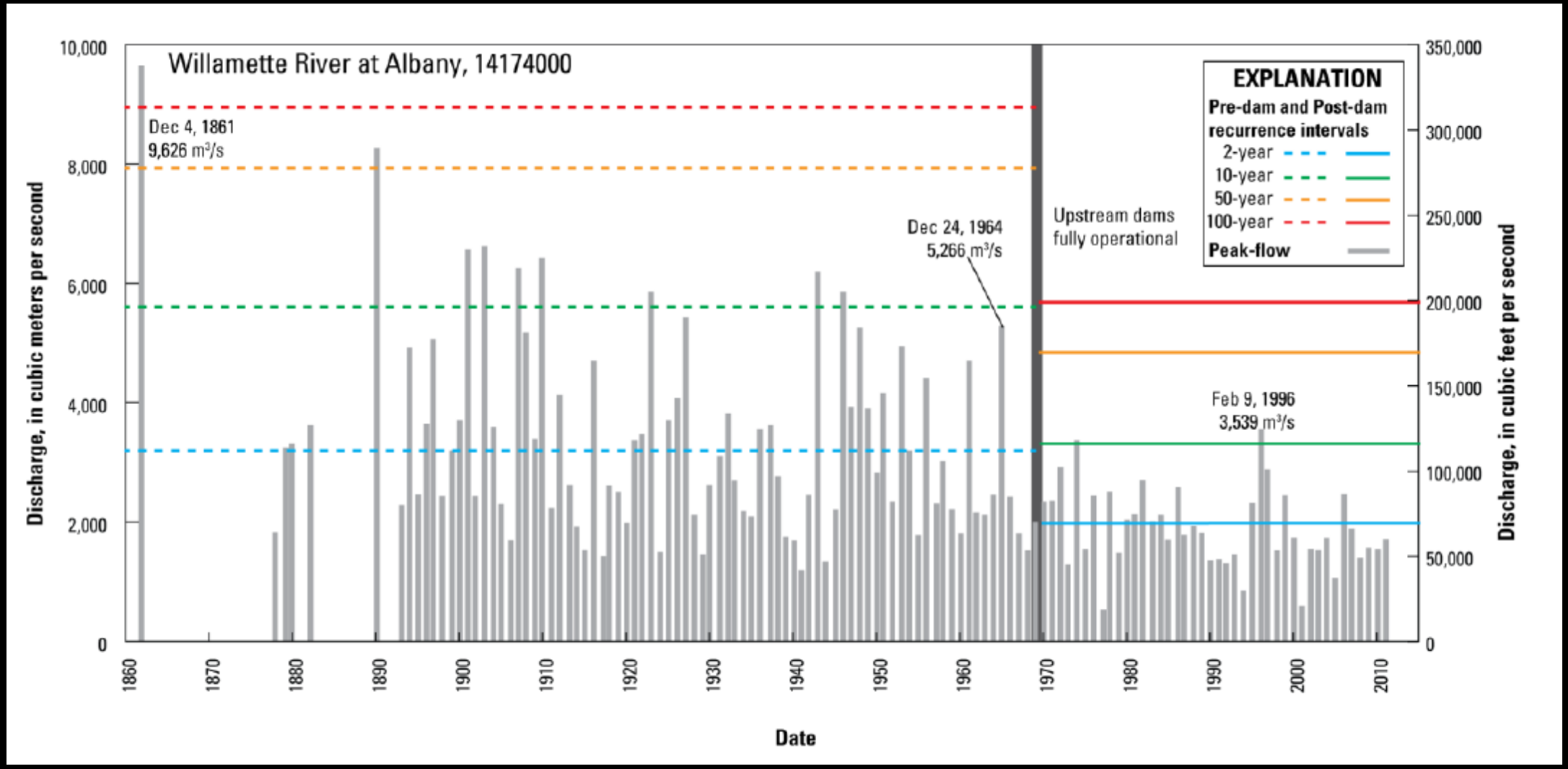




Provisional habitat modeling by White and others, subje

Temperature





Wallick and others, 2013

Summary of flood peaks for April 2019 high flow events and comparison with historical events for select Willamette Basin gages below USACE dams

Flood frequency analyses by Adam Stonewall, USGS, stonewal@usgs.gov; summary by Rose Wallick, USGS, rosewall@usgs.gov;

This table was updated June 26, 2019 and superceds previous version shared in April 2019.

USGS Streamflow Gages			Peak April 2019		Approximate recurrence interval (RI) of April 2019 events, based on AEP for post-dam era	Peak flow of floods of Feb 1996 and Dec 1996 (WY96-97)	Historical peak flow for gage (based on available gage data)		
River	USGS streamflow gaging station name	USGS gaging station number	Discharge (cfs)	date		Peak flow (cfs)	Discharge (cfs)	date	Notes about USGS gaging record
Willamette	WILLAMETTE RIVER AT HARRISBURG, OR	14166000	78,500	4/9/19 9:15	10-25 year RI	83,800	210,000	12/29/1945	Systematic peak flow records start 1945
Willamette	WILLAMETTE RIVER AT CORVALLIS, OR	14171600	99,000	4/10/19 9:30	na	na	77,100	12/20/2015	USGS gage record starts 2010
Willamette	WILLAMETTE RIVER AT ALBANY, OR	14174000	99,200	4/10/19 22:30	10-25 year RI	125,000	340,000	12/4/1861	Systematic peak flow record starts 1893; estimated peak flows from earlier events
Willamette	WILLAMETTE RIVER AT SALEM, OR	14191000	147,000	4/12/2019 12:00	5-10 year RI	244,000	500,000	12/4/1861	Systematic peak flow records start 1910; estimated peak flows from earlier events
Coast Fork	COAST FORK WILLAMETTE RIVER NEAR GOSHEN, OR	14157500	25,000	4/8/19 22:00	10-25 year RI	33,400	58,500	11/22/1909	Systematic peak flow records start 1906
Fall Creek	FALL CREEK BLW WINBERRY CREEK, NEAR FALL CREEK, OR	14151000	5,820	4/10/19 23:00	100-500 year RI	4,640	24,700	12/111956	Systematic peak flow records start 1936;
Middle Fork	MIDDLE FORK WILLAMETTE RIVER AT JASPER, OR	14152000	24,400	4/12/19 2:30	100-500 year RI	23,300	94,000	11/23/1909	Systematic peak flow records start 1906
McKenzie	MCKENZIE RIVER NEAR VIDA, OR	14162500	25,600	4/8/19 18:45	10-25 year RI	30,900	64,400	12/28/1945	Systematic peak flow records start 1925
McKenzie	MCKENZIE RIVER NEAR WALTERVILLE, OR	14163900	35,800	4/8/19 20:45	10-25 year RI	56,100	56,100	2/7/1996	Systematic peak flow records start 1990 (limited/no pre-dam data)
Santiam	SANTIAM RIVER AT JEFFERSON, OR	14189000	62,000	4/8/19 23:15	2-5 year RI	168,000	202,000	11/21/1921	Systematic peak flow records start 1908
South Santiam	SOUTH SANTIAM RIVER AT WATERLOO, OR	14187500	25,500	4/12/2019 4:30	50-100 year RI	29,200	95,200	12/22/1964	Systematic peak flow records start 1906
North Santiam	NORTH SANTIAM RIVER AT MEHAMA, OR	14183000	16,800	4/8/19 15:00	< 2 year RI	53,800	76,600	12/28/1945	Systematic peak flow records start 1906