Reservoir provides cool-water refuge for adult Chinook salmon in a trap-and-haul reintroduction program

Reservoir provides cool-water refuge for adult Chinook salmon in a trap-and-haul reintroduction program

Matthew Keefer[1], George Naughton[1], Tami Clabough[1], Matthew Knoff[1], Tim Blubaugh[1], Cameron Sharpe[2], & Christopher Caudill[1],

[1]University of Idaho, [2]Oregon Department of Fish & Wildlife

OREGON Fish & Wildlife

US Army Corps of Engineers®

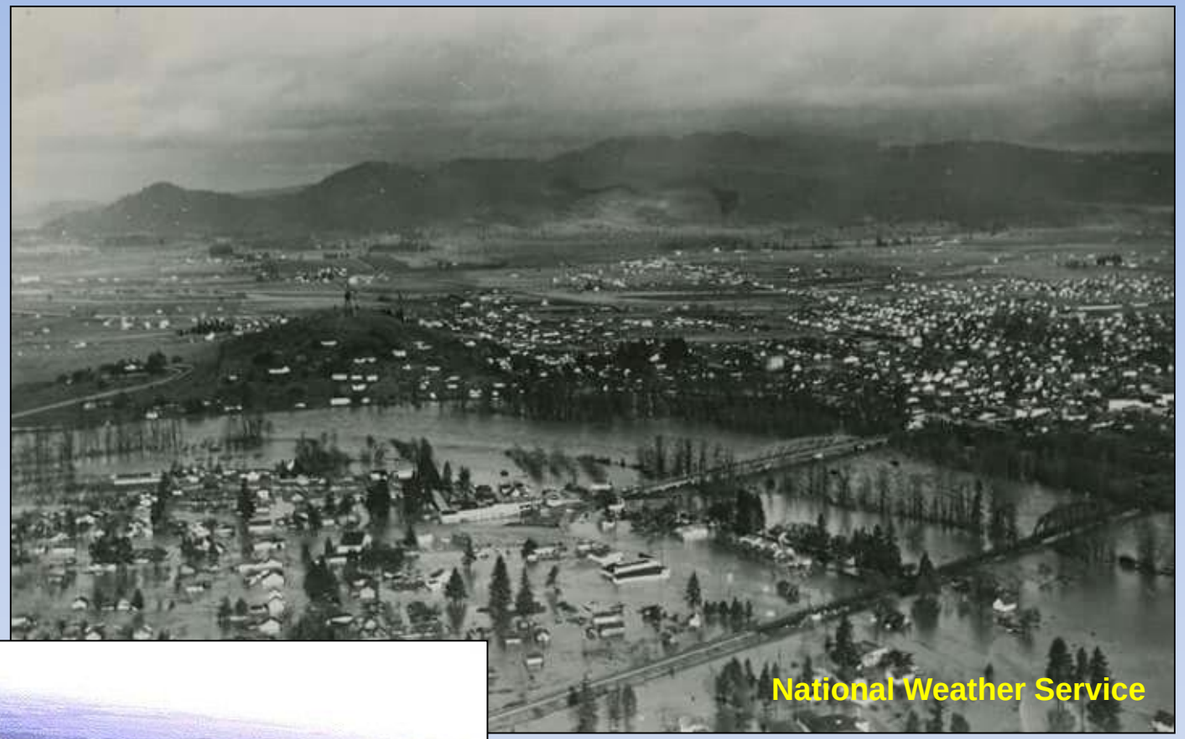
University of Idaho
College of Natural Resources

Willamette River basin, OR (~30,000 km^2)

University of Idaho
College of Natural Resources

Willamette River floods

1948

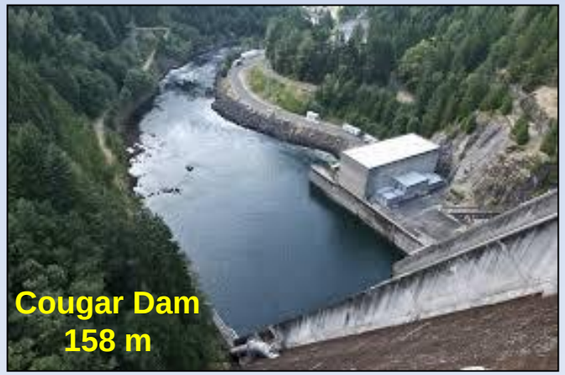


1996

University of Idaho
College of Natural Resources

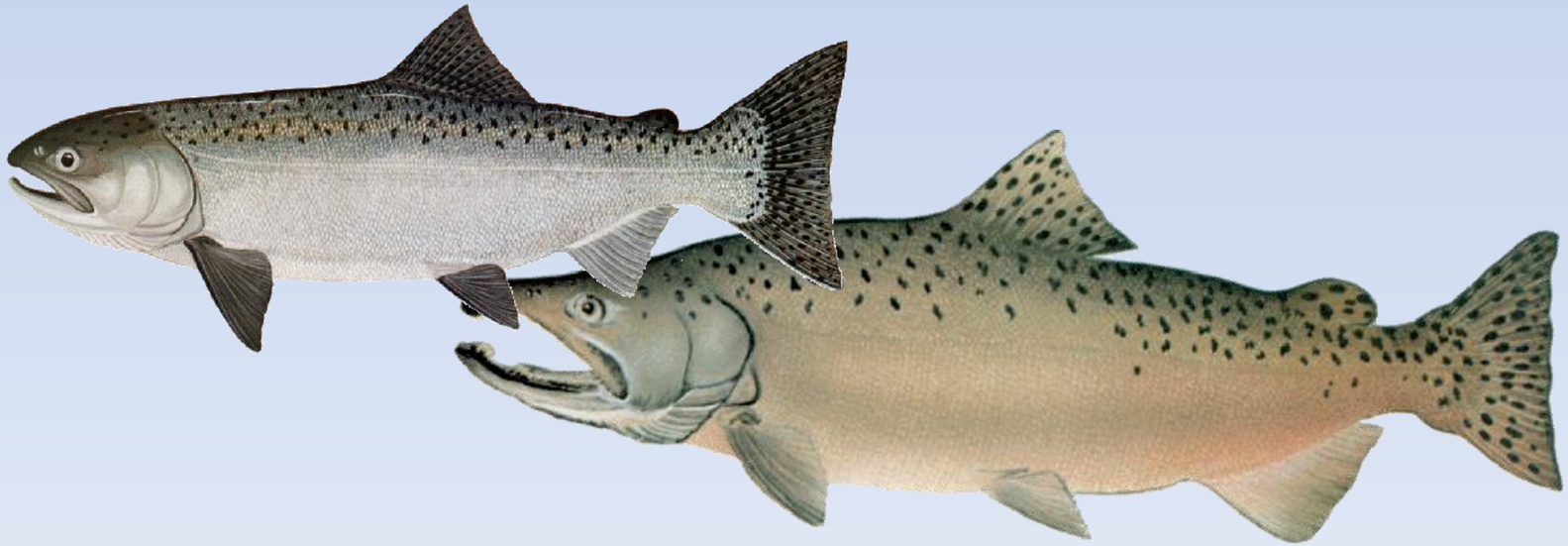
Willamette Valley Project

- 13 multi-purpose dams
  - Flood control
  - Hydropower
  - Irrigation
  - Water supply



Chinook Salmon

- *Oncorhynchus tshawytscha*
- Native, anadromous, cold-water species
- High ecological, economic, and social value



University of Idaho
College of Natural Resources

Chinook salmon

- Spring-run population
- Historically widespread
  - Spawn in tributaries
  - No adult fish passage at dams
- Extirpations / Declines
- ‘Threatened’
  - U.S. Endangered Species Act

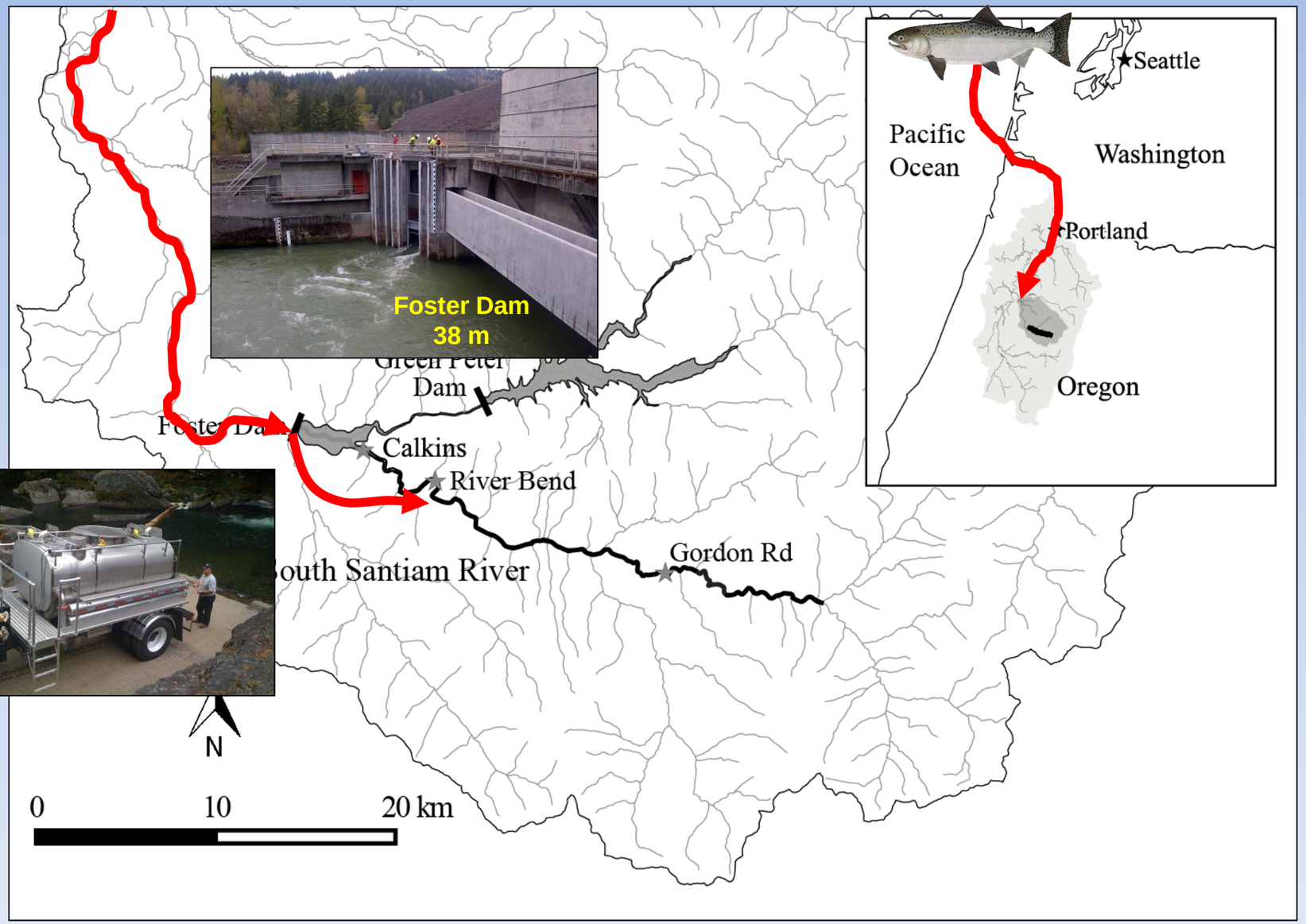
Research context

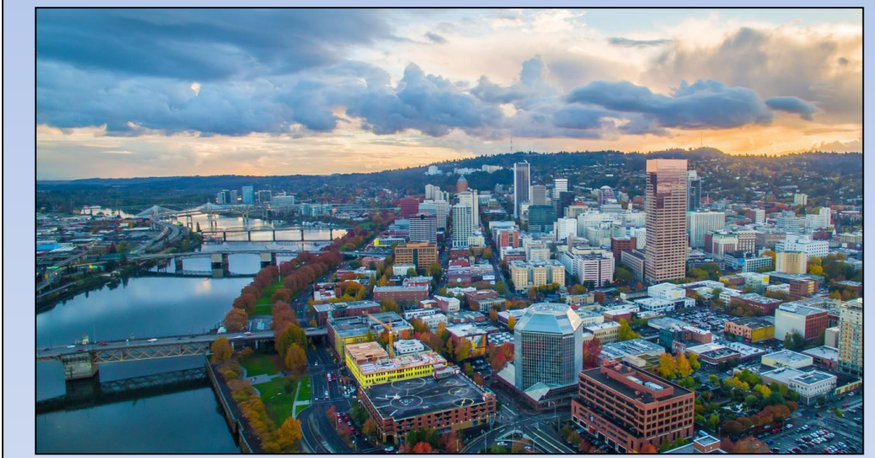
- Large effort to restore Willamette River Chinook
- Historical focus: hatcheries
- Expanded: reintroduction into historic habitats

Historically-used Chinook salmon habitat above dams

University of Idaho
College of Natural Resources

Research context

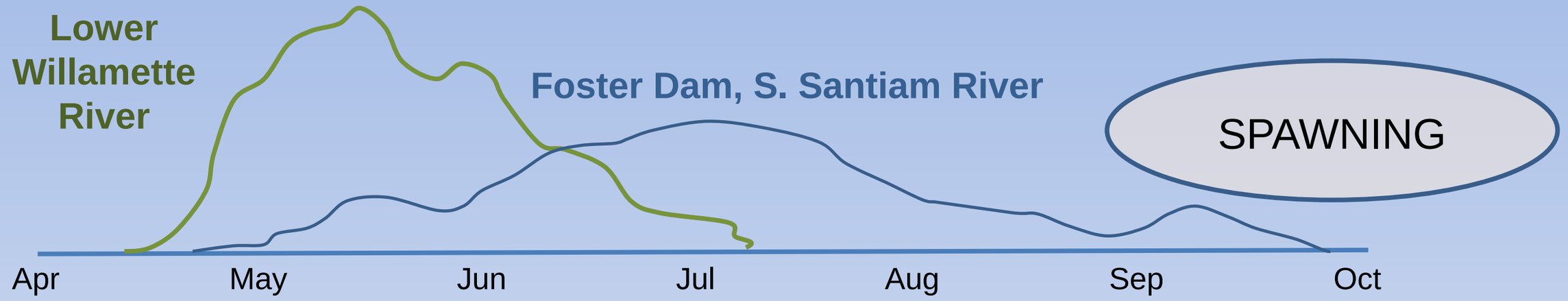


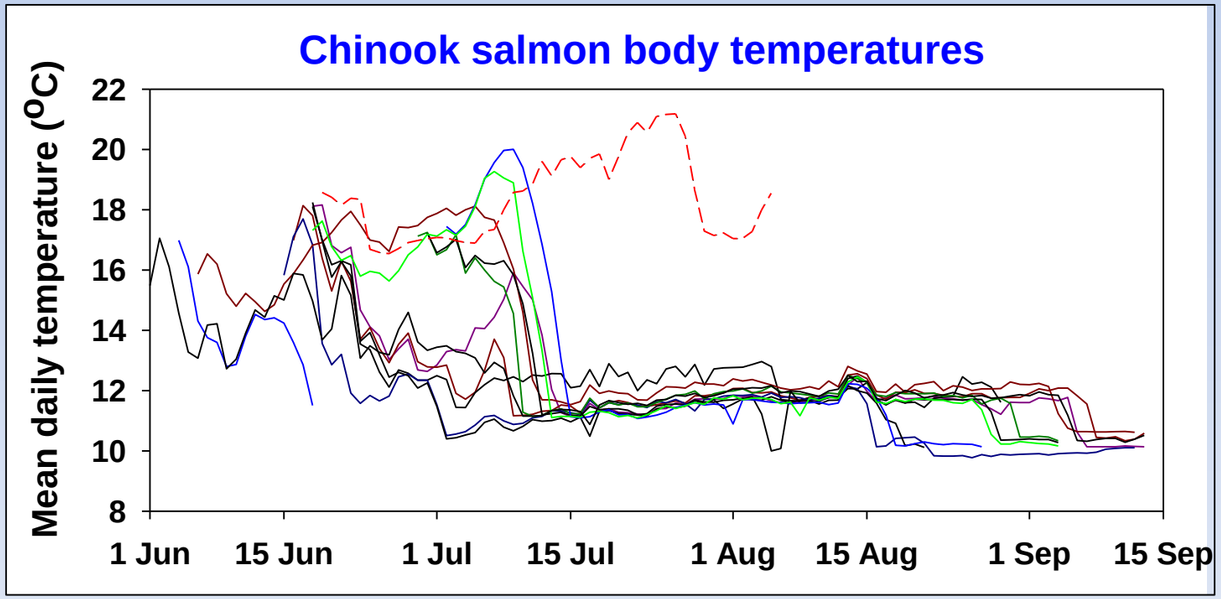


Portland: 84 Craft Beer Breweries

University of Idaho
College of Natural Resources

Research context



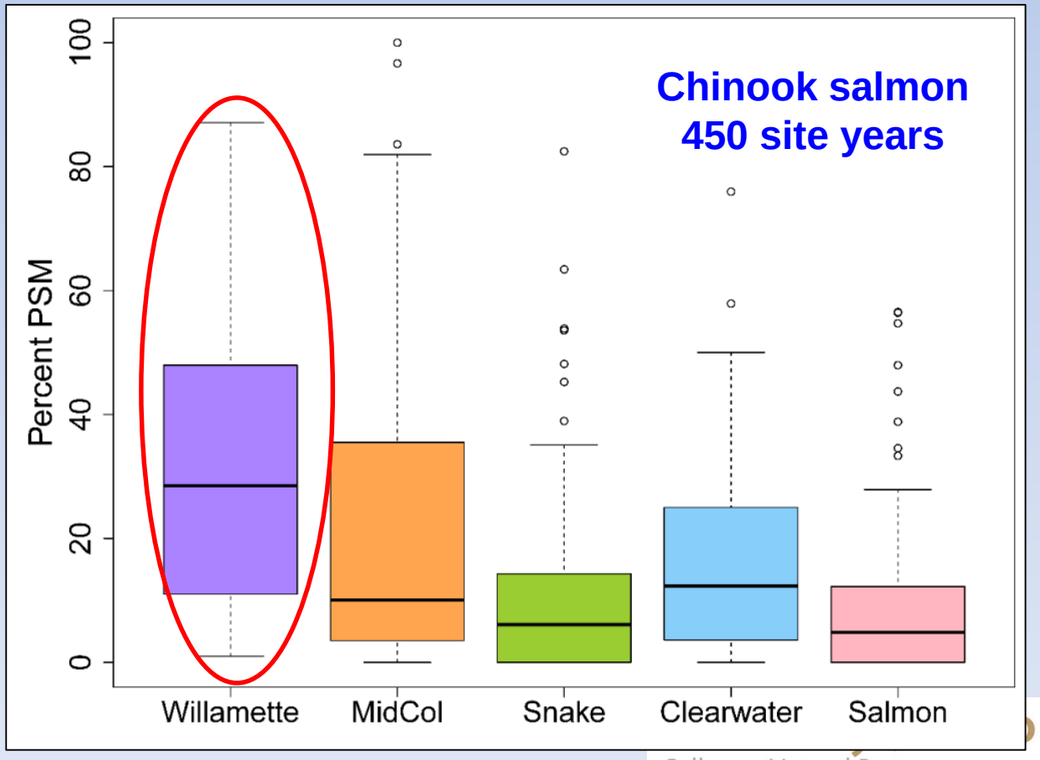


Keefer et al. 2015 (J Therm Biol)

University of Idaho
College of Natural Resources

Research context

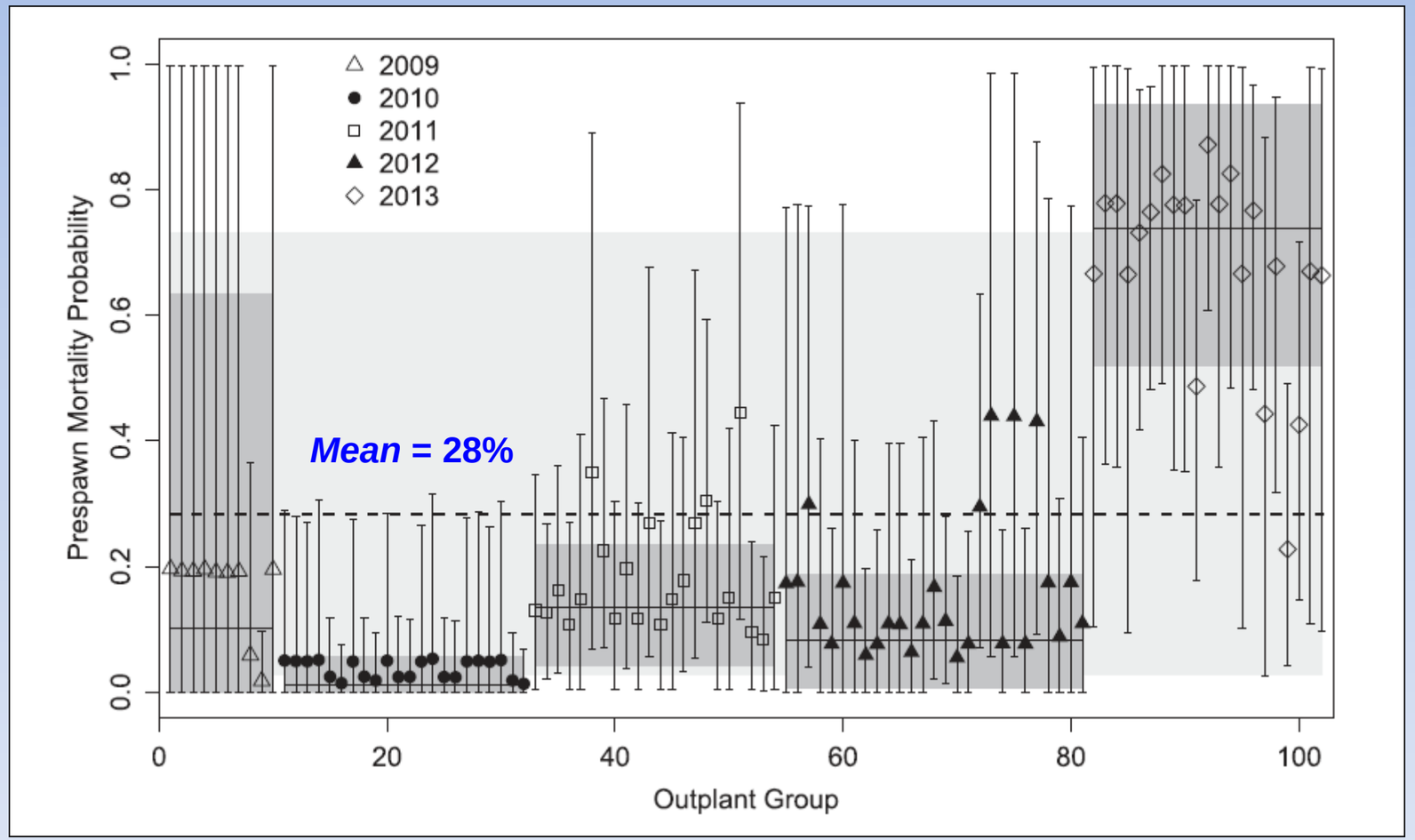
- Long migration (~420 km), long residency time
- Exposure to warm water temperatures. . . .
- Adult prespawn mortality



Bowerman et al. 2016 (Fisheries)

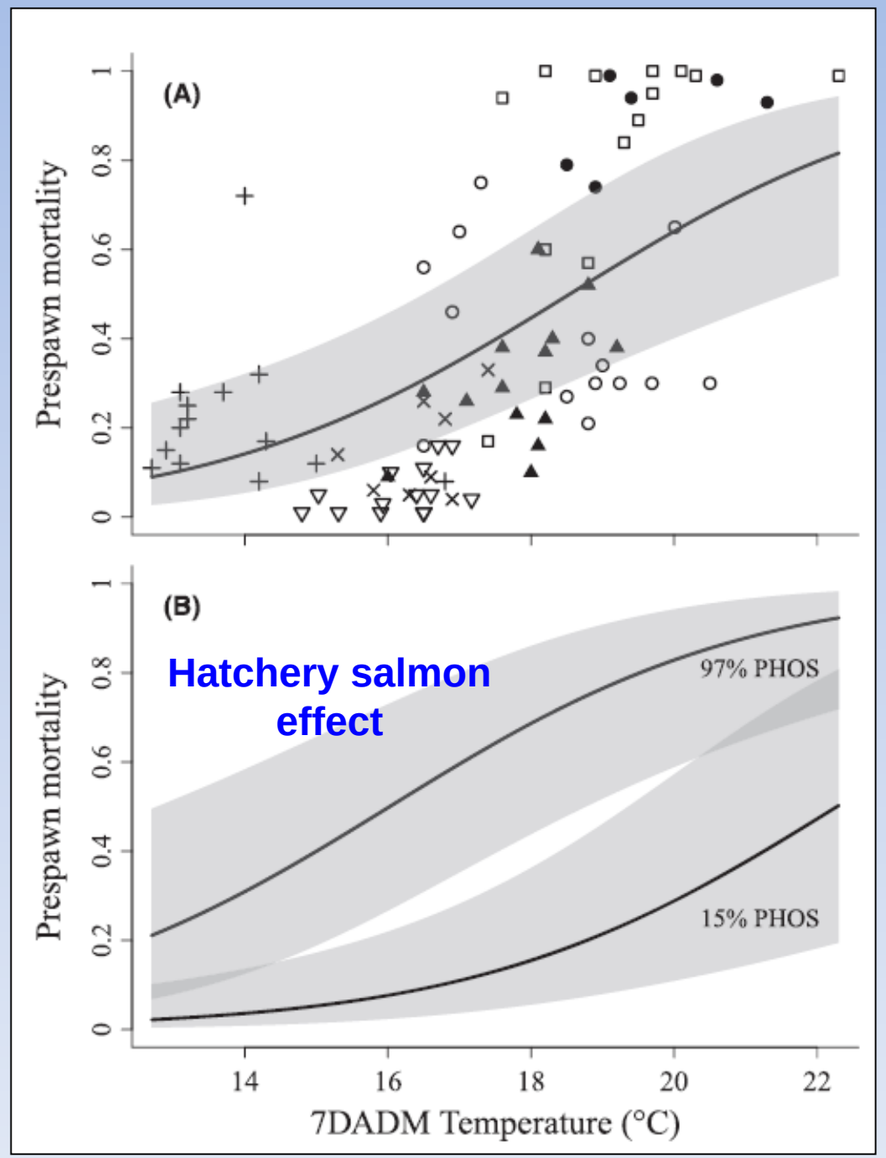
Research context

Prespawn mortality of Chinook salmon above Foster Dam



DeWeber et al. 2017 (N Am J Fish Manage)

Temperature effect on mortality



Bowerman et al. 2018
(Trans Am Fish Soc)

Reservoir release study hypotheses

- Releasing adult Chinook salmon into the reservoir will reduce thermal exposure
  - Prespawn holding in cold, hypolimnetic water
- Lower exposure will reduce prespawn mortality

Methods

- Collection and tagging
- Transport (2-3 h, in total)

'Wild' Chinook salmon collected and radio-tagged

Year	River release	Reservoir release
2012	41	33
2013	25	50
2014	8	44
2015	23	14
2017	5	19
Total	**102**	**160**

Lotek Wireless transmitters:

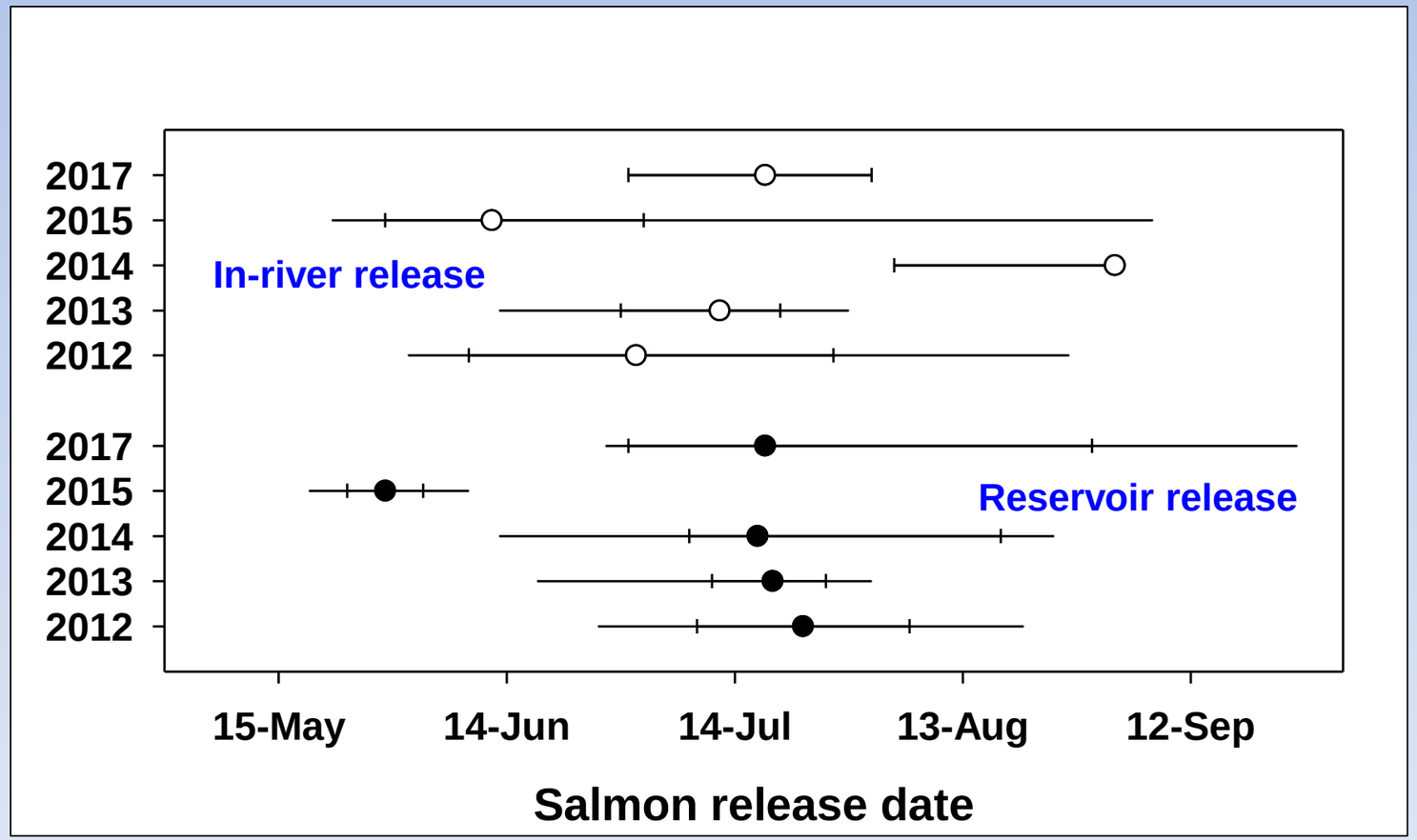
46 × 16 mm, 16 g

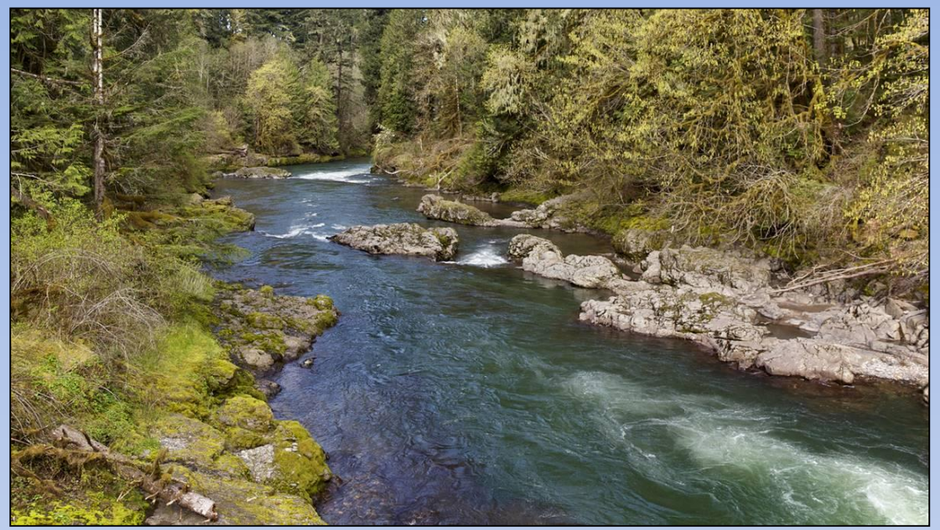
61 × 16 mm, 23g

iButton loggers

Methods

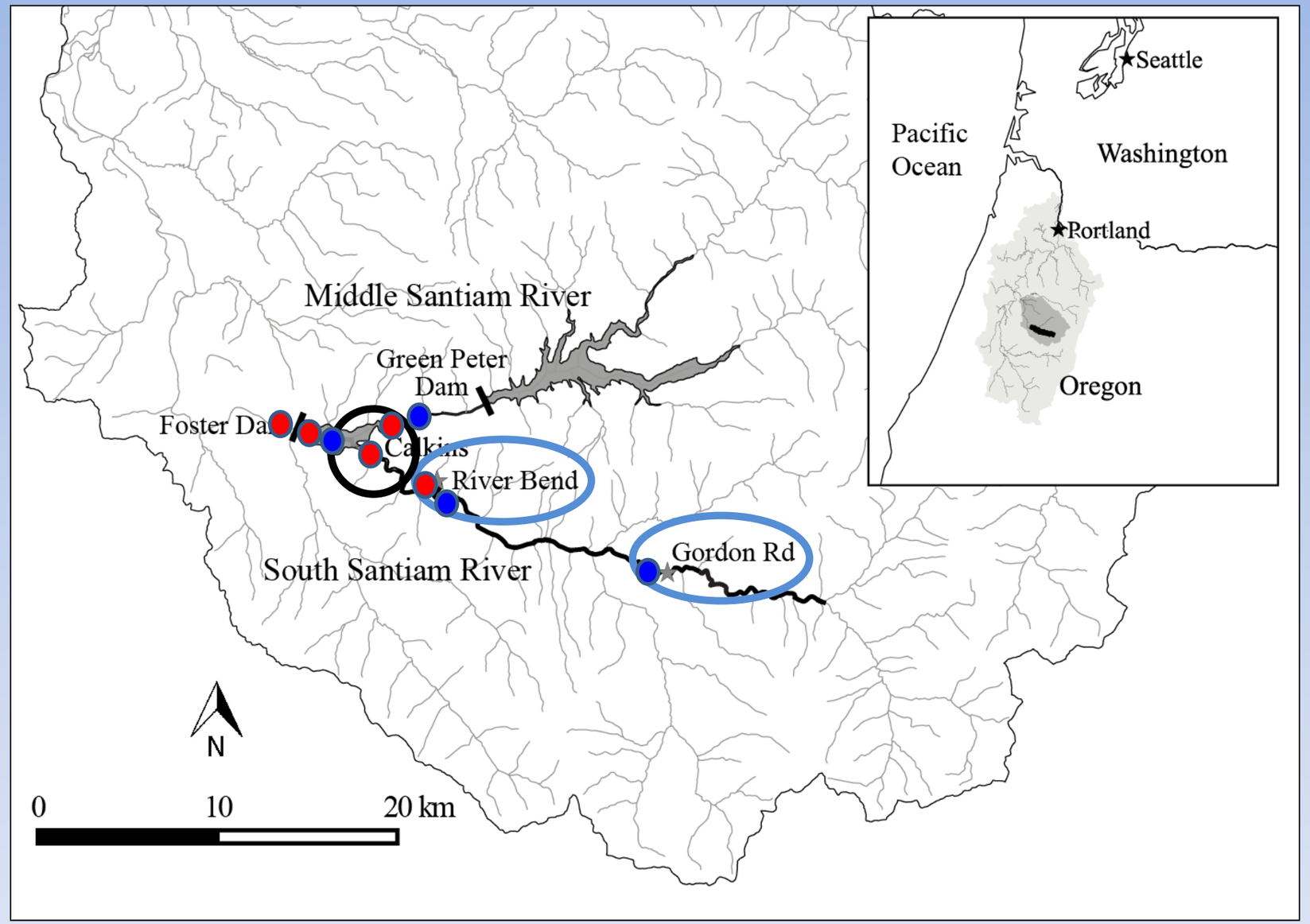
- Release timing





Methods

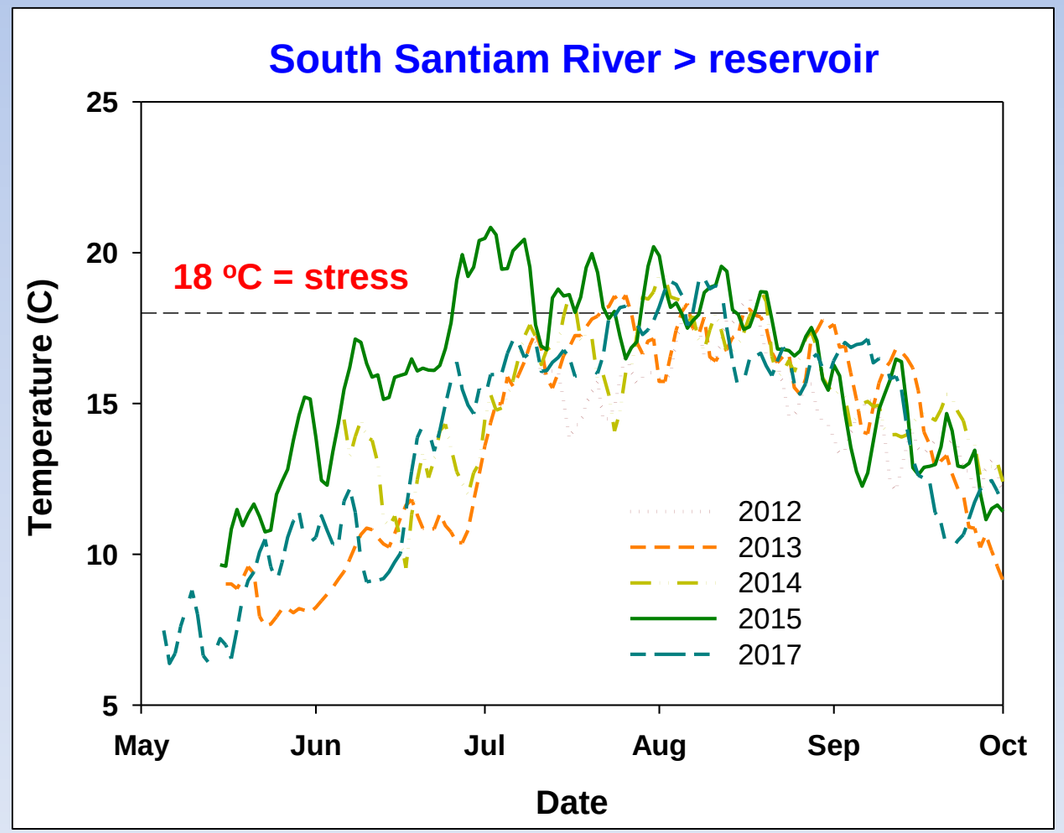
- Adult salmon release sites
- Temperature monitoring
- Radiotelemetry antennas

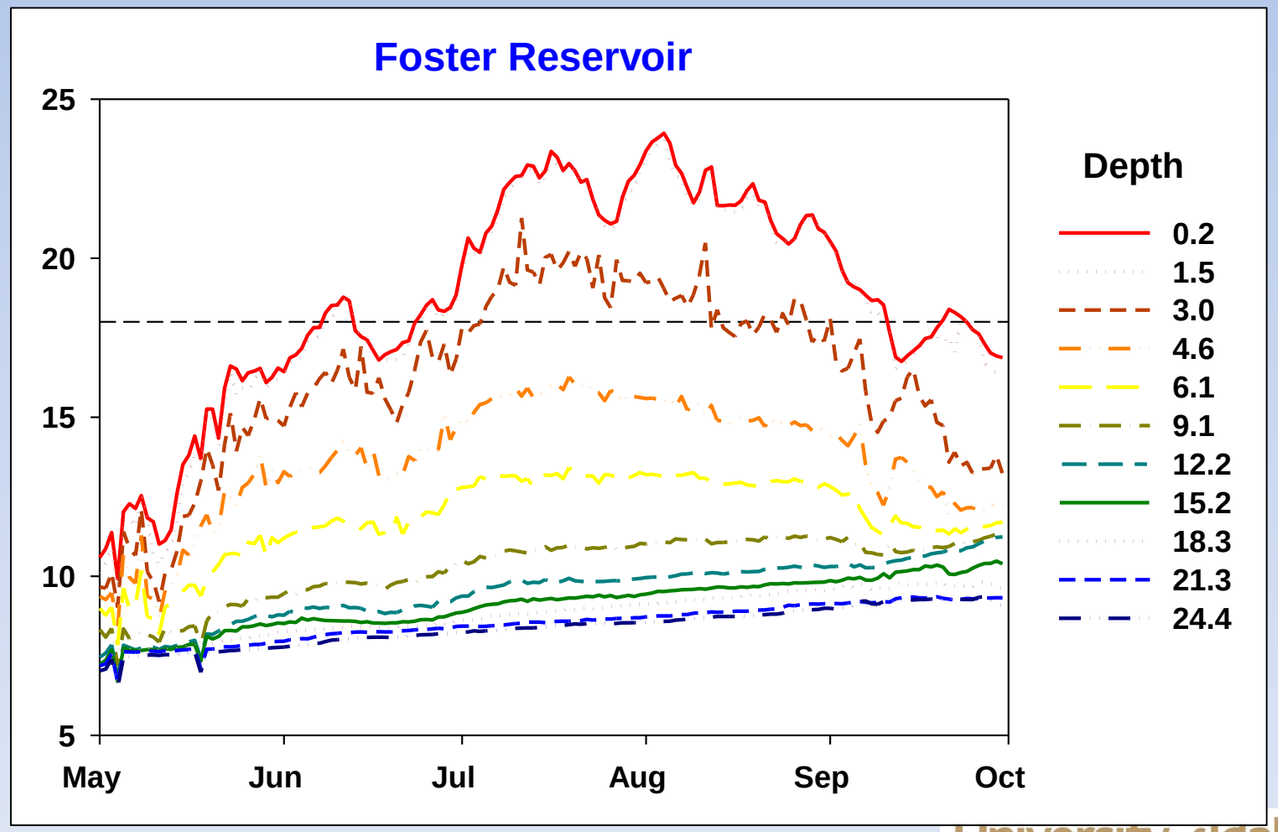


University of Idaho
College of Natural Resources

Results

- Water temperatures

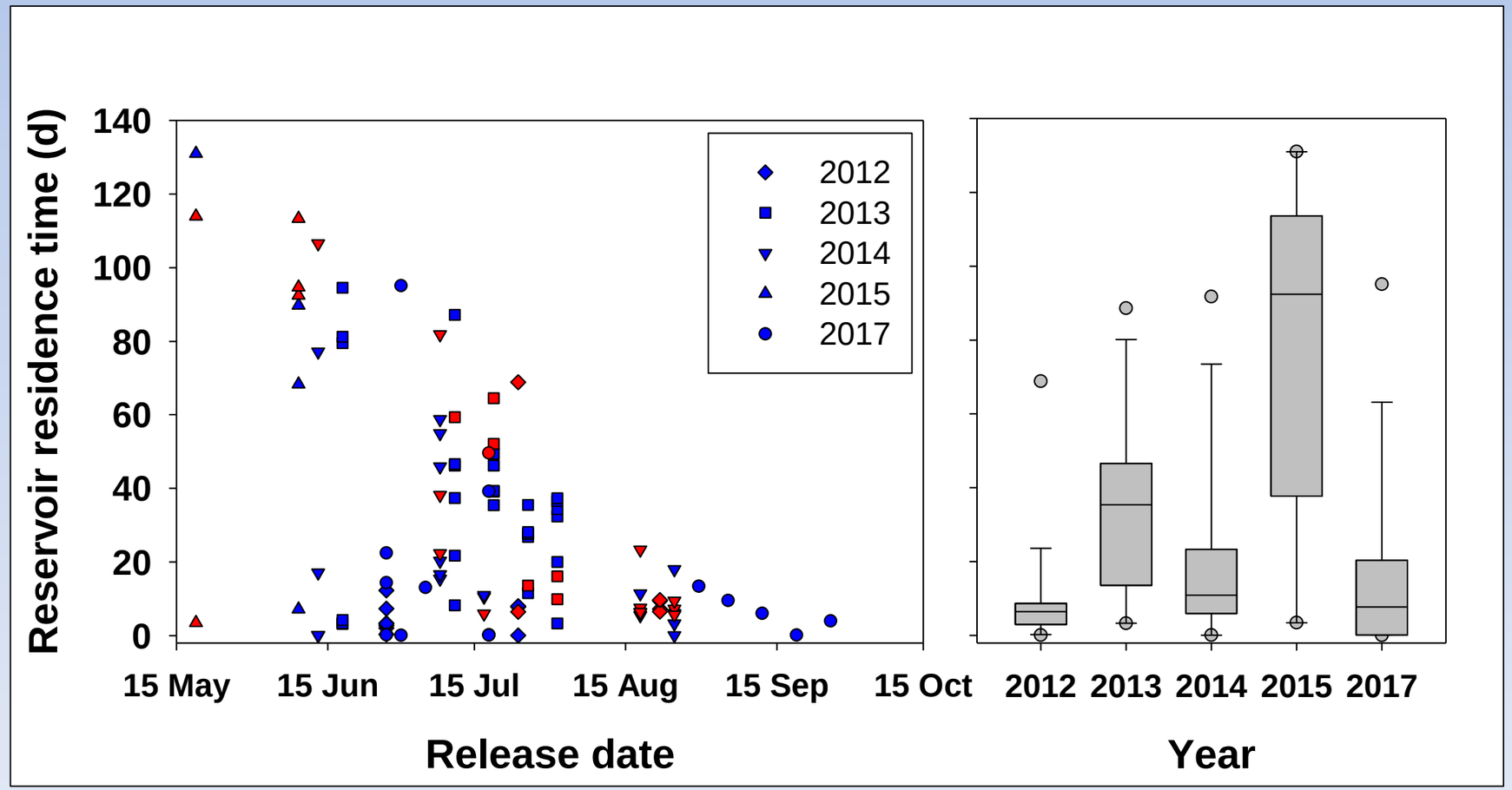




University of Idaho
College of Natural Resources

Results

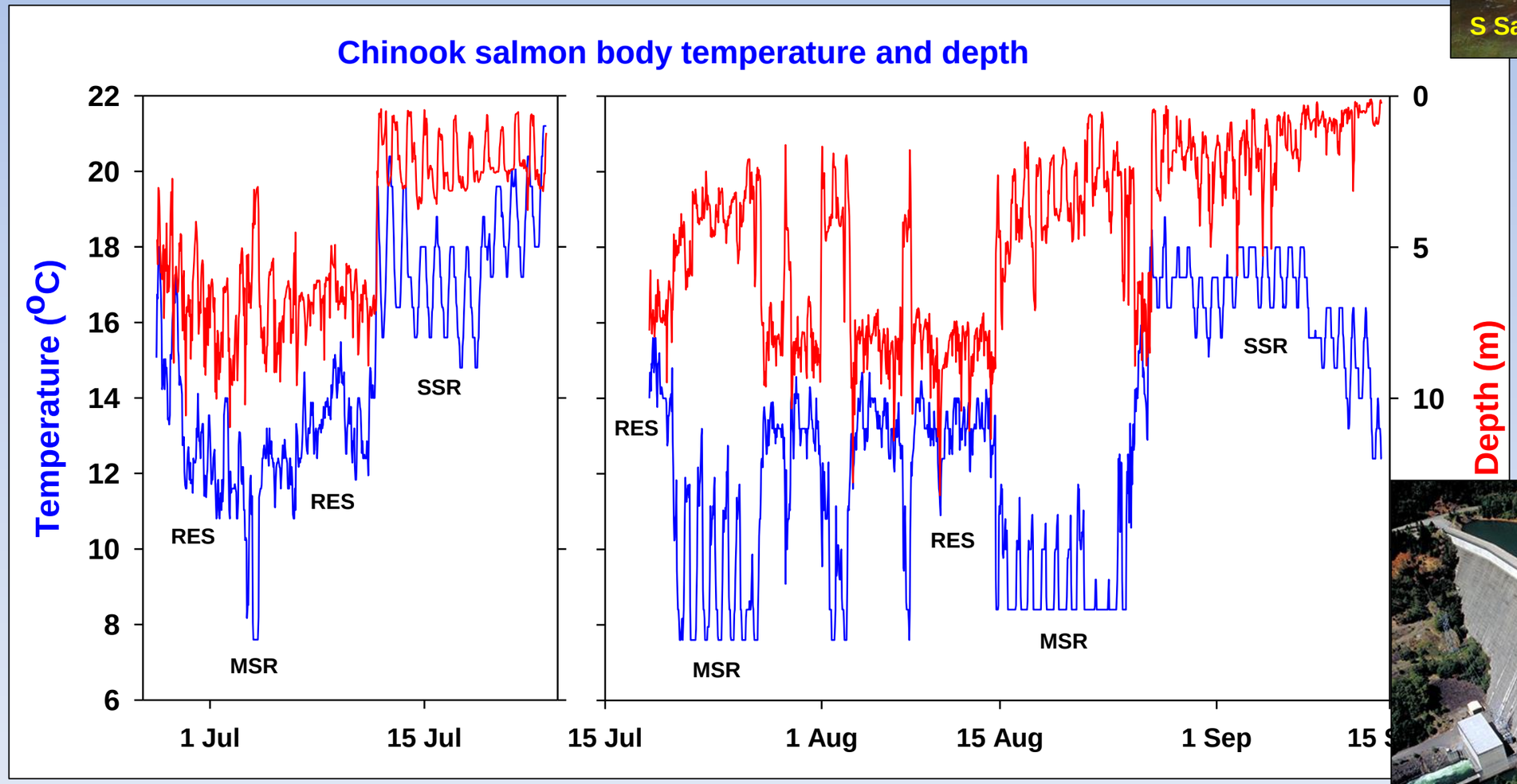
- Salmon residency times in reservoir
  - Annual medians ~ 7, 35, 11, 93, 8 days



University of Idaho
College of Natural Resources

Results

- Salmon thermal histories



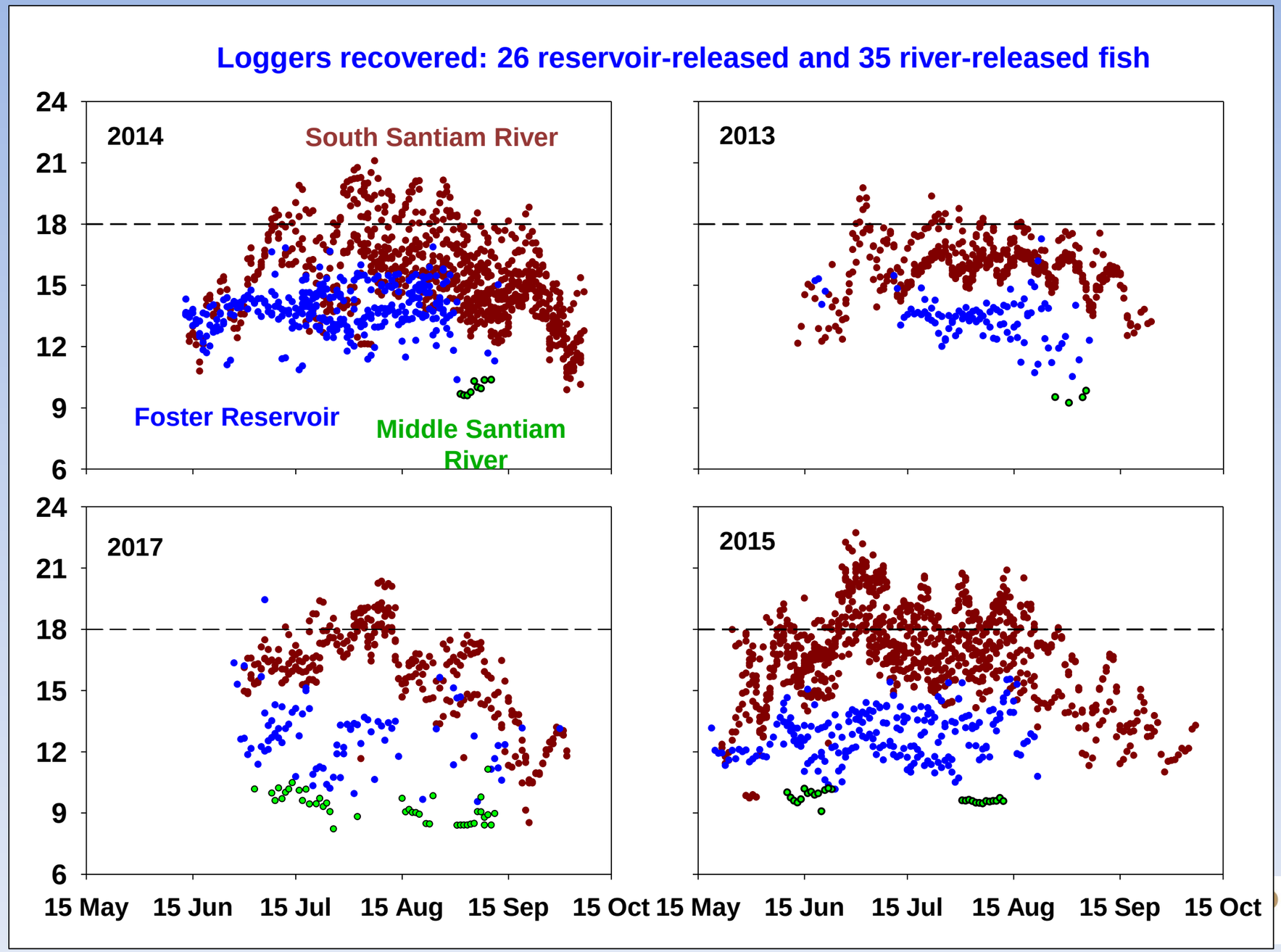
Green Peter Dam: 100 m

Results

- Thermal benefits

- 73% of reservoir-released had an estimated thermal benefit
- Mean benefit ~107 degree days per fish

Mean daily Chinook salmon body temperature



Results

- Final distribution

Salmon released in river

Salmon released in reservoir

University of Idaho
College of Natural Resources

Conclusions: the good

- Salmon released in the reservoir entered tributaries
  - At least 70% were last detected in upstream rivers

University of Idaho
College of Natural Resources

Conclusions: the good

- Salmon used cool water refuge in reservoir
  - Extended thermoregulatory behavior
  - Presumed selection for preferred temperature range
  - Reduced cumulative and acute thermal exposure

University of Idaho
College of Natural Resources

Conclusions: the inconclusive

- Some salmon (~19%) entered the Middle Santiam
  - Historic spawning site, but current spawning unknown
- Some salmon (~14%) fell back past Foster Dam
  - Direct mortality and injury risk
  - Homing behaviors? Natal sites downstream?

University of Idaho
College of Natural Resources

Conclusions: the inconclusive

- Effect of release in reservoir on spawning success
- Much larger samples required to estimate prespawn mortality

??

Some take-homes

- Fish trap-and-haul may be a useful recovery strategy for migratory populations
- Reservoirs may provide thermal refuge for temperature-sensitive species
- Novel strategies + adaptive management experiments are critically needed for progress


Kevin Belcher


Willamette Falls

University of Idaho
College of Natural Resources

Bibliography

Bowerman et al. (2016). Pacific salmon prespawn mortality: patterns, methods, and study designconsiderations. Fisheries 41:738-749.

Bowerman et al. (2018). Prespawn mortality of female Chinook salmon increases with water temperature and percent hatchery origin. Trans. Am. Fish. Soc. 147:31-42.

DeWeber et al. (2017). A hidden-process model for estimating prespawn mortality using carcass survey data. Trans. Am. Fish. Soc. 37:162-175.

Keefer et al. (2015). Thermal exposure of adult Chinook salmon in the Willamette River basin. J. Thermal Biol. 48:11-20.

Naughton et al. (2018). Reservoir provides cool-water refuge for adult Chinook salmon in a trap-and-haul reintroduction program. Mar. Freshw. Res. 69:1995-2007. (*Special Issue for Fish Passage*)

https://www.uidaho.edu/cnr/fish-ecology-research-lab

University of Idaho
College of Natural Resources