Potential for Stream Restoration to Mitigate Climate Change Impacts to Salmon Populations: A Case Study in the Grande Ronde River

Catherine Creek, Southern Cross Reach

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Organization:
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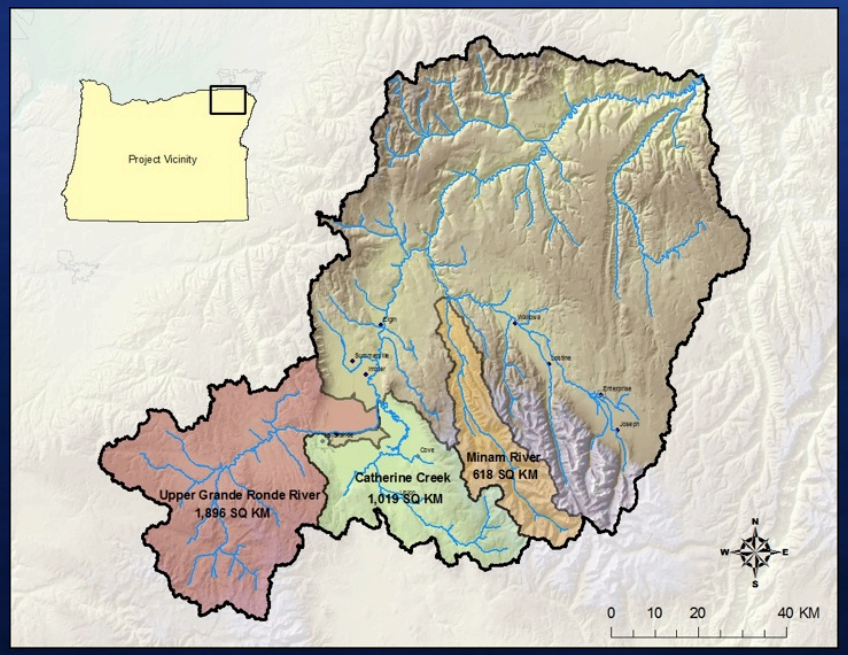
Funded By:

Bonneville Power Administration

Columbia Basin Fish Accords 2008-2018

Current Habitat Conditions



• Fish habitat in the upper Grande Ronde basin has been heavily degraded by land use including timber harvest, agriculture, mining, grazing, and beaver trapping.

• Spring Chinook Salmon and steelhead populations were listed as “Threatened” under the Endangered Species Act in 1992 and 1997, respectively. Other important species such as Pacific Lamprey and freshwater mussels have also been severely impacted by land use.

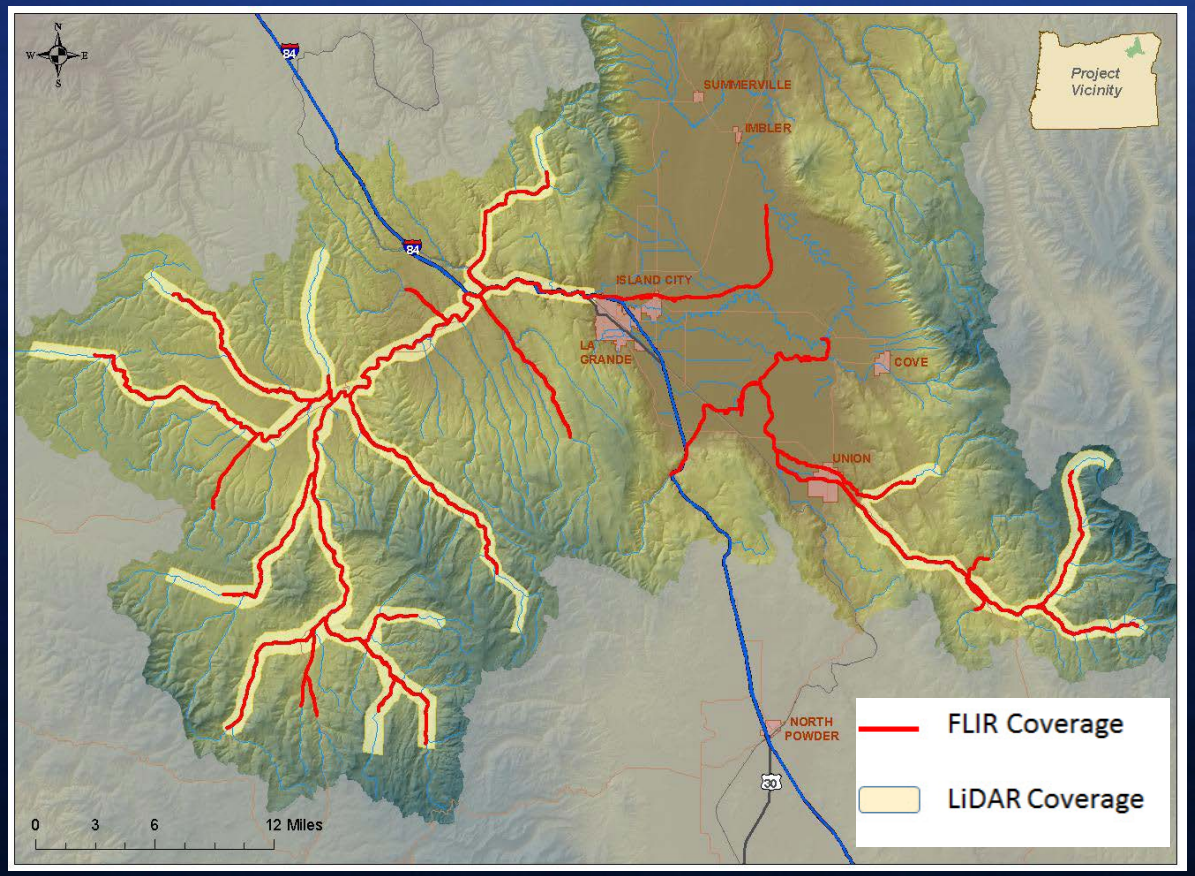
• Habitat limiting factors for salmon recovery include:

1) **Elevated summer water temperature,**
2) Diminished summer streamflow,
3) Reduced channel complexity and structure,
4) Reduced floodplain connectivity,
5) Degraded riparian conditions, and
6) Excess fine sediment.

Catherine Creek,
Grande Ronde Valley

Upper Grande Ronde River,
Vey Meadows

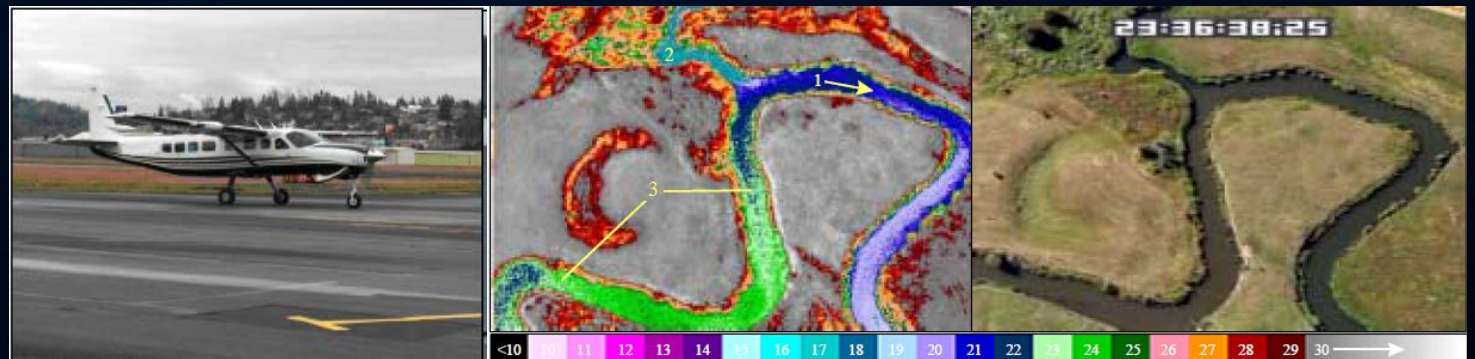
Heat Source Water Temperature Model



LiDAR Data

- LiDAR data for 500-m stream buffer in 2009.
- FLIR data for 364 river km in 2010.

FLIR Data



Heat Source Model

Calibrated for July 10 – September 20, 2010

- Channel Geometry (LiDAR)
- Riparian Vegetation (LiDAR)
- Stream Temperature (FLIR and loggers)
- Discharge
- Climate

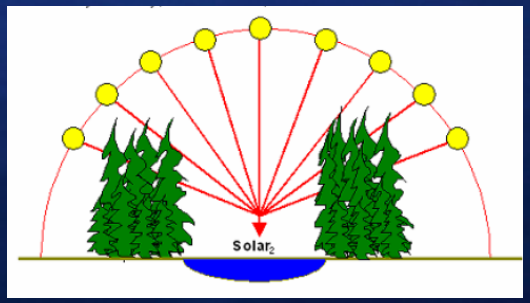
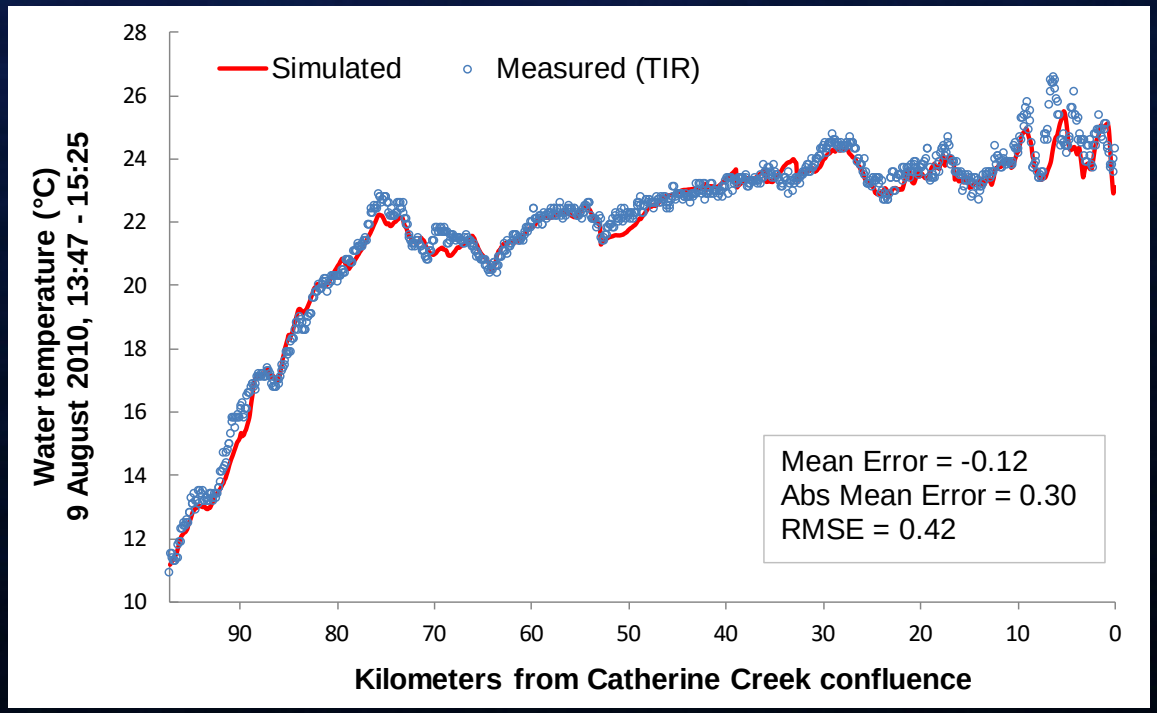
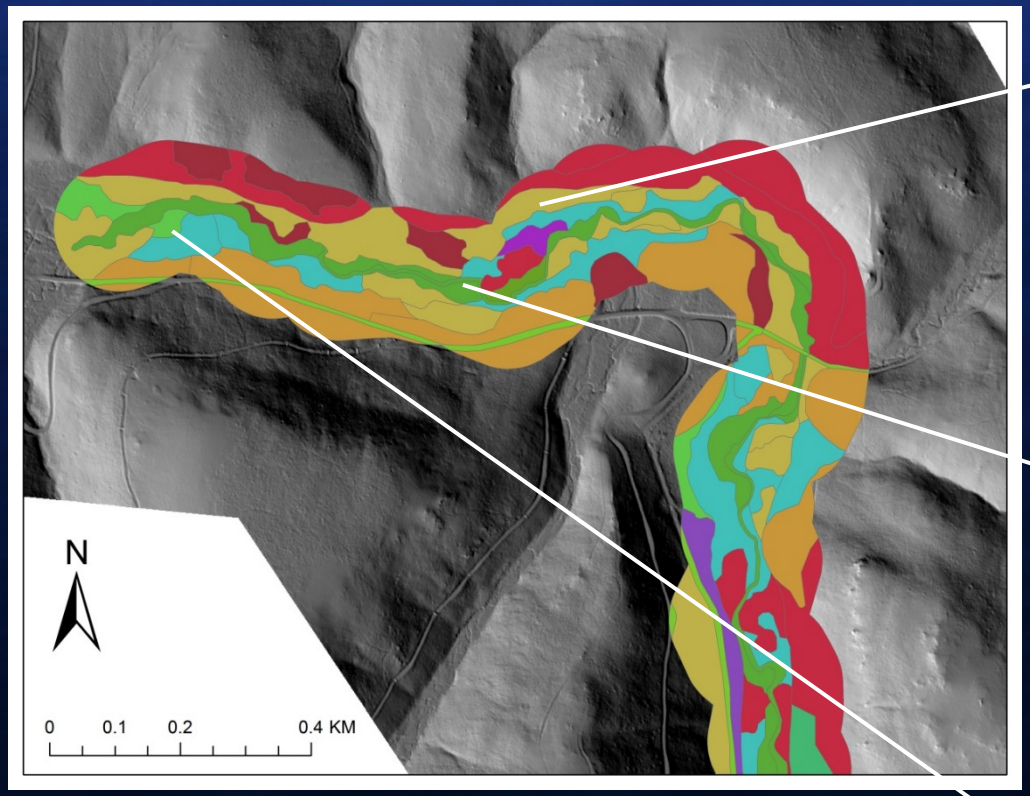


Image from Boyd and Kasper (2003)



Riparian Mapping

Plant Association Groups (PAGs)
Meadow Creek



Open Lodgepole Pine Forest

Open Tall Willow

Forb Meadow

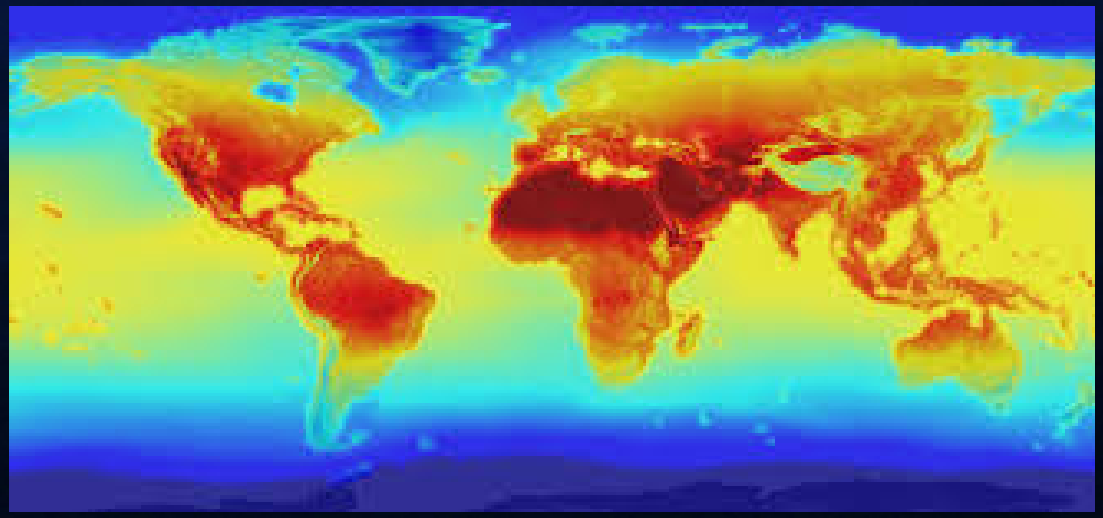
Riparian classification based on:

1) Physiography (lowland, upland, riverine),
2) Geomorphology (bedrock, alluvial fan, terrace, etc.)
3) Soils,
4) Vegetation, and
5) Disturbance

Wells et al. (2015)

Climate Change Scenarios

- Climate change projections from University of Washington's Climate Impacts Group for 2040s (2030-2059) and 2080s (2070-2099).
- Summer air temperature increase (2080s): + 4.7 °C
- Summer streamflow decrease (2080s): - 20 %

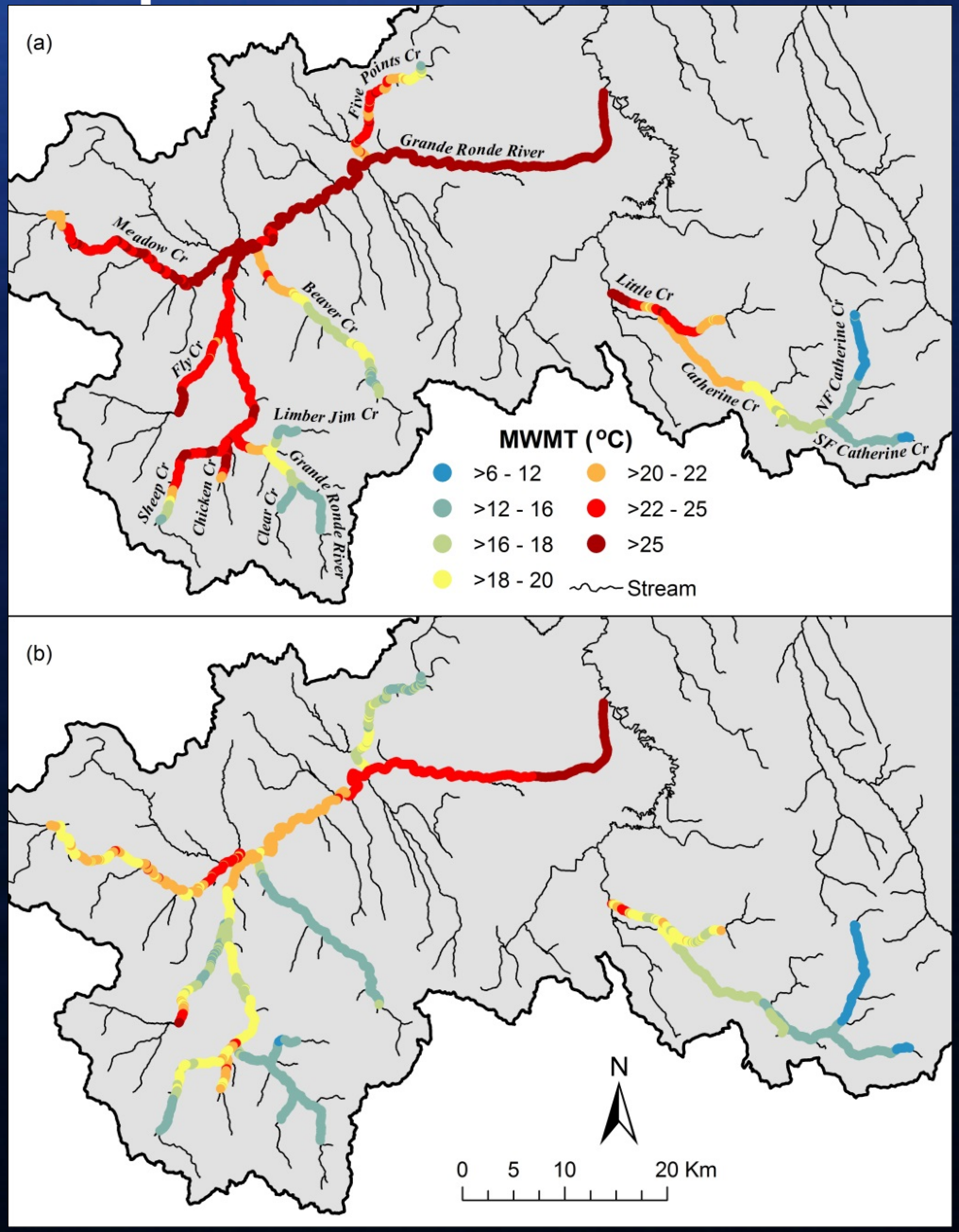


Results: Water Temperature Predictions

Current Conditions (2010)

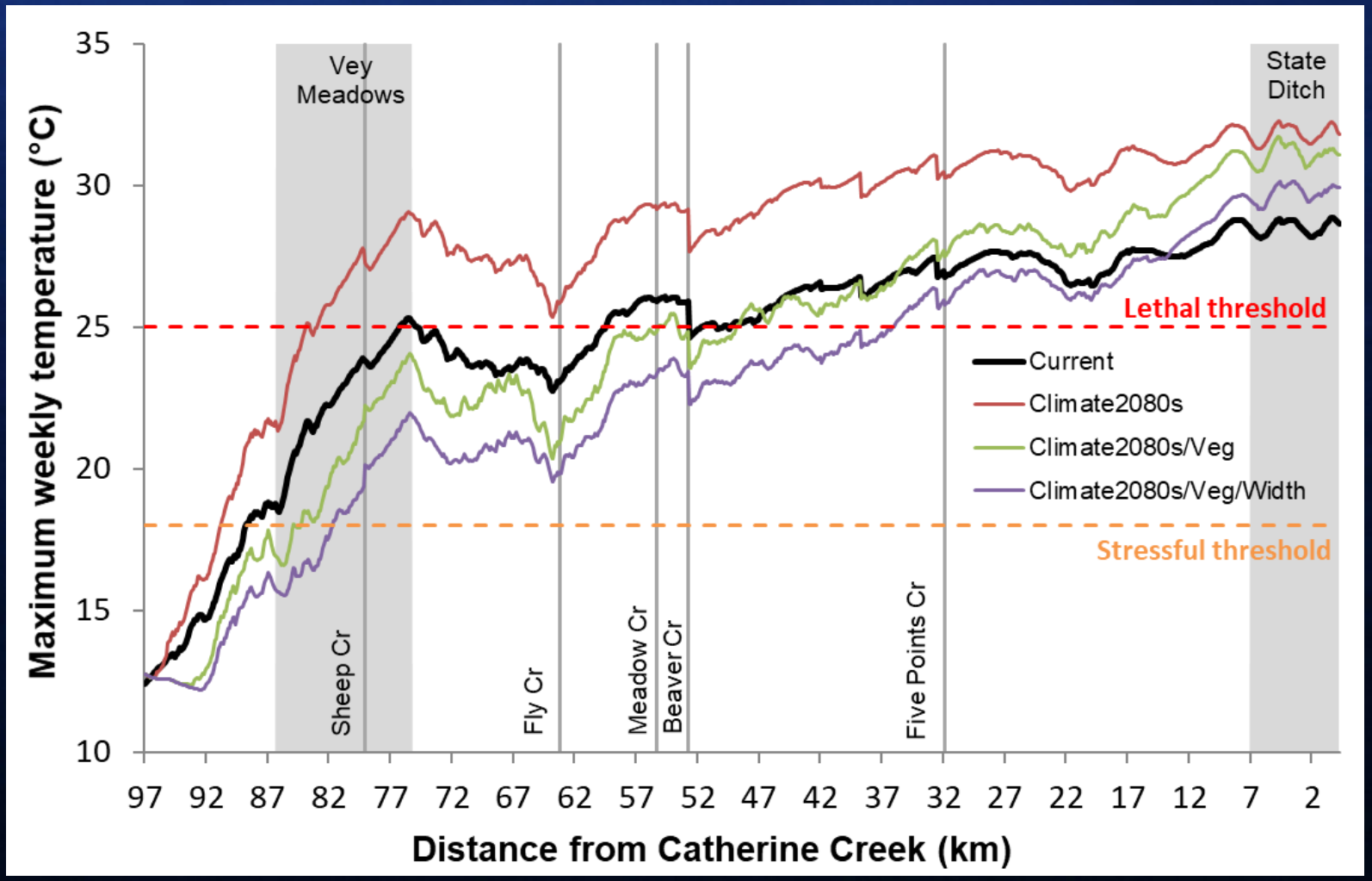
Restored Vegetation (PNV)

Median Temperature Reduction:
Upper Grande Ronde: -5.5 °C
Catherine Creek: -2.4 °C



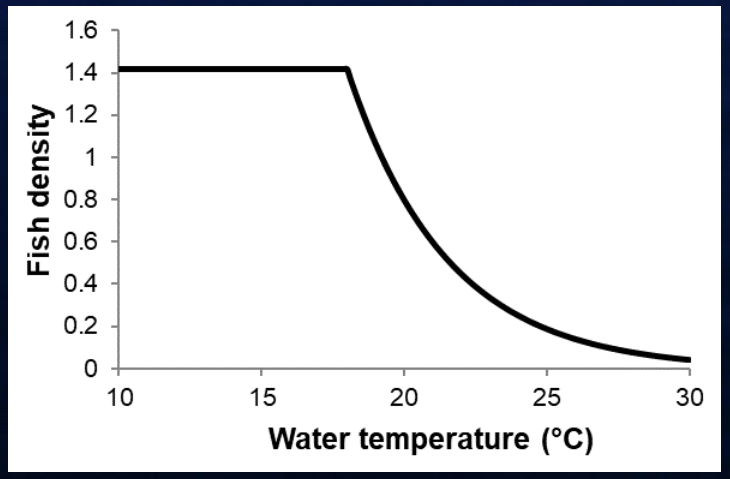
From *Justice et al. (2017) Journal of Environmental Management*

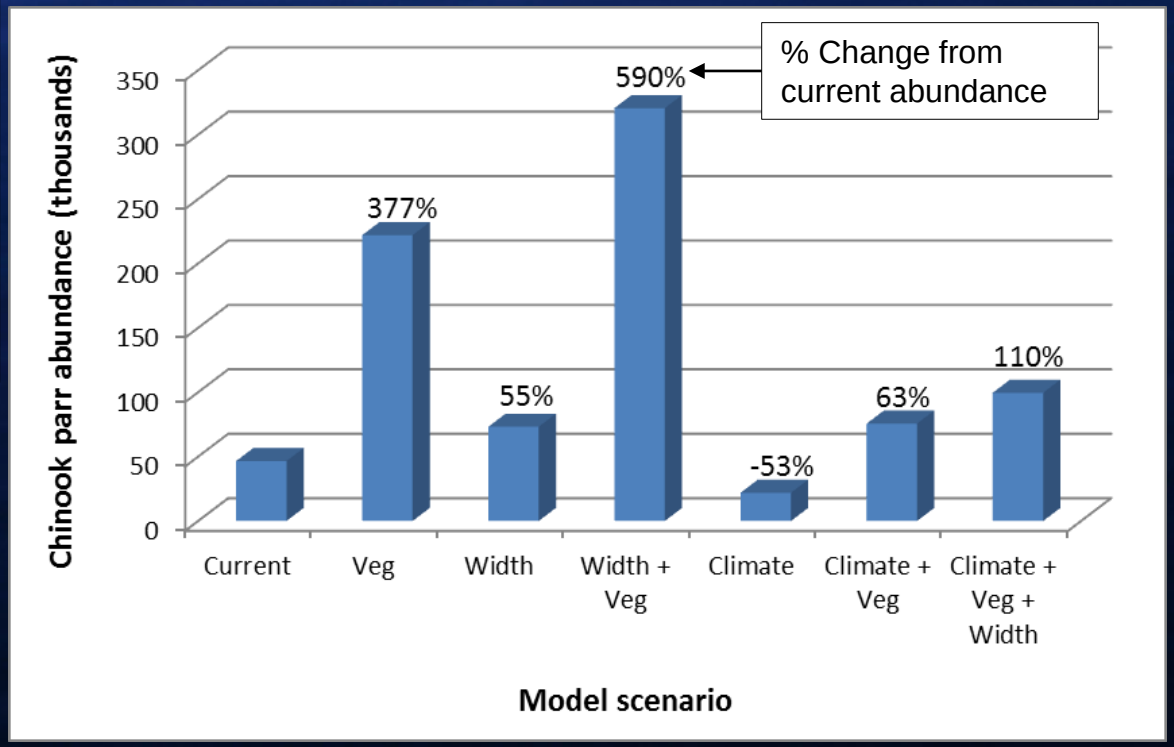
Water Temperature Predictions
Climate Change



Median temperature change:
(Climate + Veg + Width) = -2 °C

Fish Abundance





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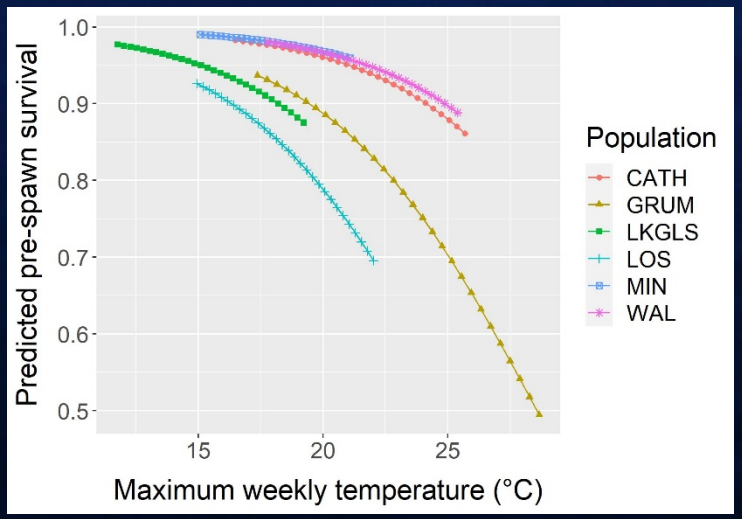
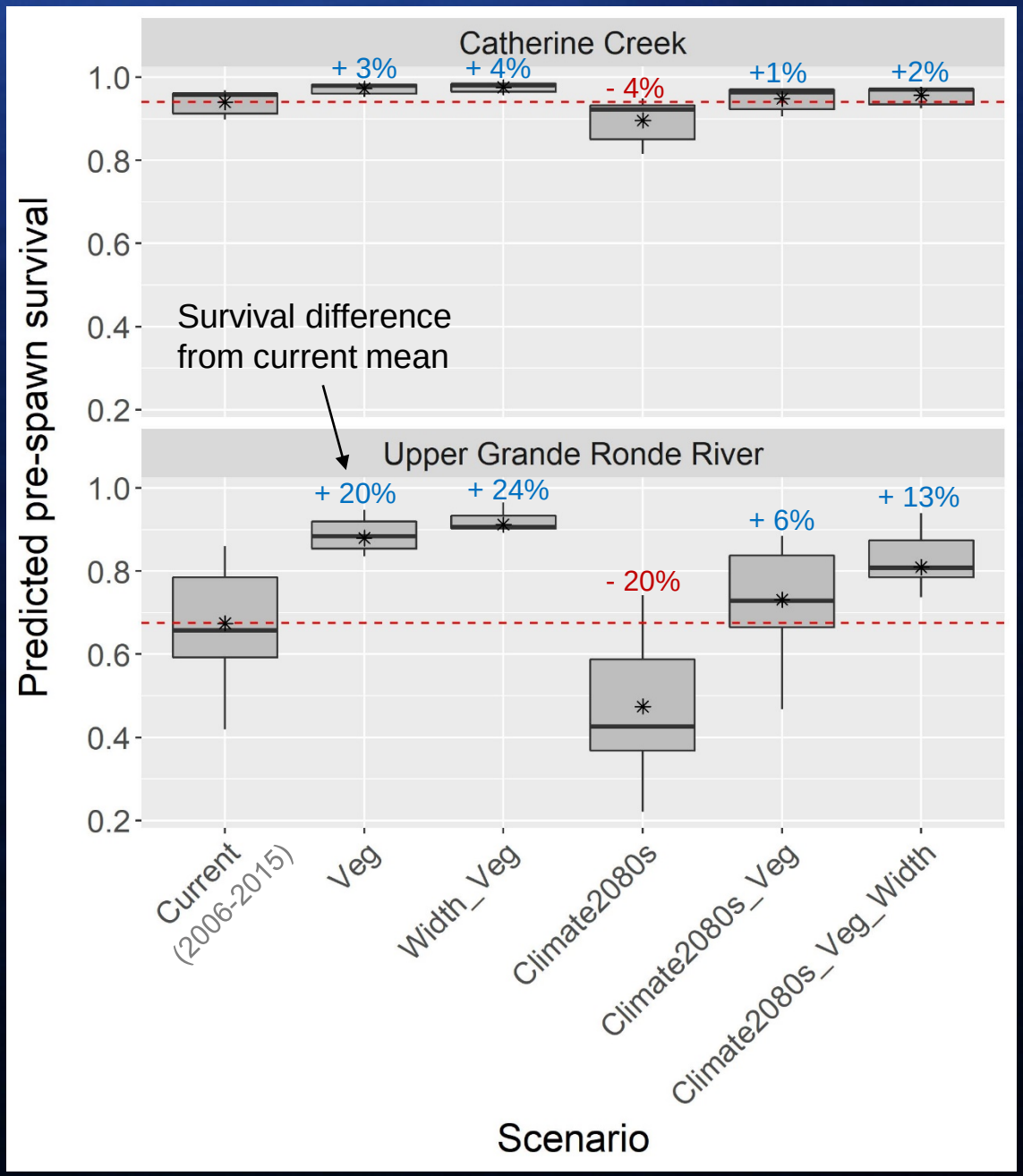
Pre-spawn Survival



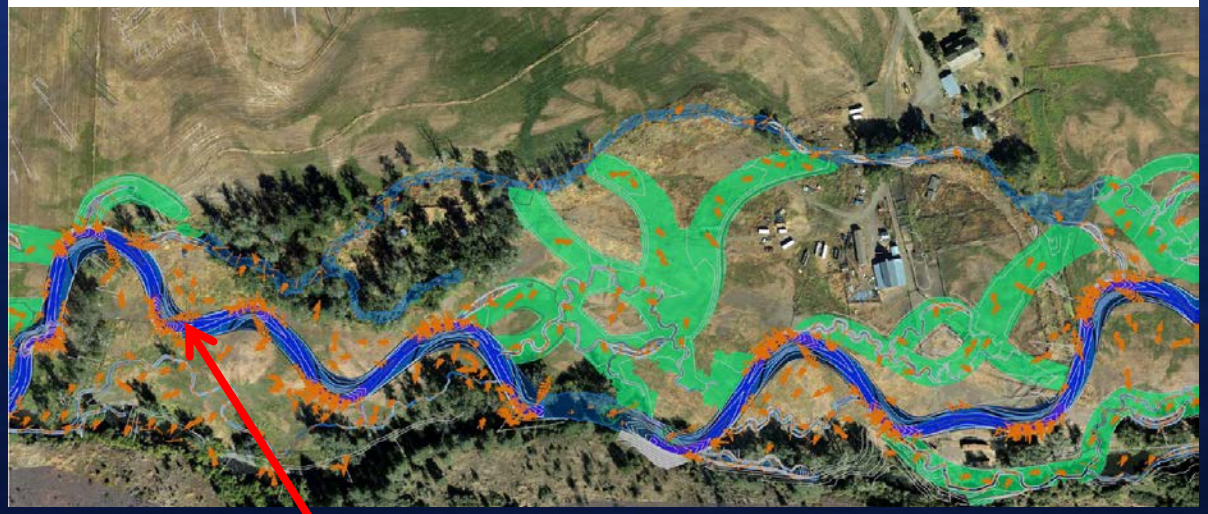
Model covariates:

- Water temperature
- Origin (hatchery or wild)
- Streamflow
- Spawner density
- Pool frequency



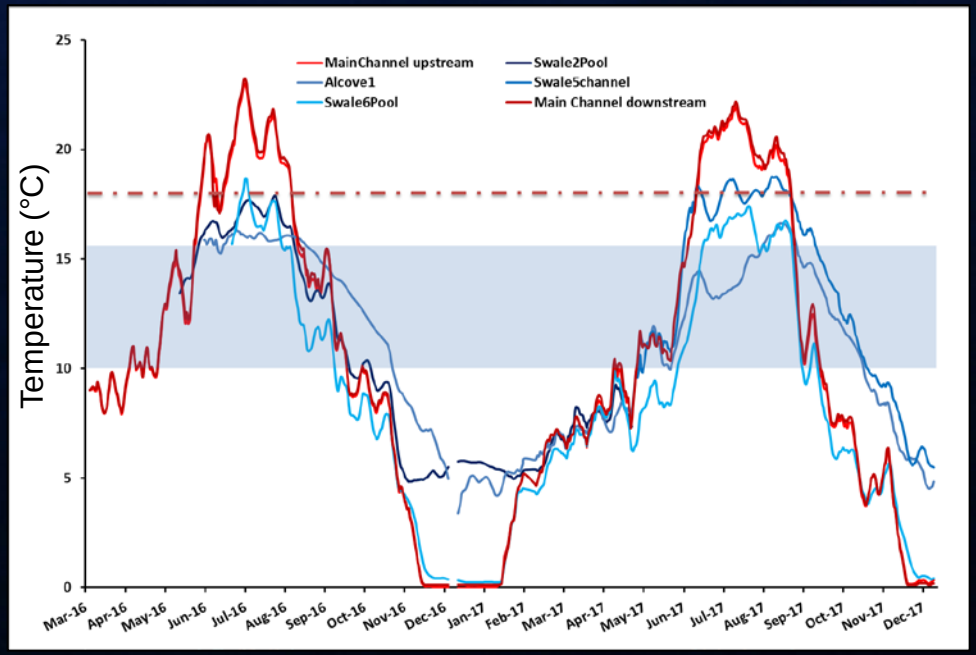
Southern Cross ‘Saaxsaaxinma’ Floodplain Restoration Project, Catherine Creek

Final Design, Completed 2016



Restoration Metrics

- Increased floodplain connectivity (64 acres)
- 21% increase in main channel length
- 18 main channel large pools
- 142 main channel large wood/habitat structures
- 374 floodplain and side channel roughness/habitat structures
- 22,000 trees and shrubs planted



Confederated Tribes of the Umatilla Indian Reservation

Conclusions

- Basin-wide restoration actions targeting both riparian vegetation and channel morphology could significantly increase juvenile salmon abundance and adult pre-spawn survival above current baseline levels in the Upper Grande Ronde and to a lesser extent, in Catherine Creek, even in the face of climate change.

- Additional thermal benefits could likely be achieved by restoring floodplain connectivity and improving hyporheic exchange, which are primary targets for current restoration actions.

- However, a holistic approach which addresses survival impairments at all stages of the salmon life cycle will likely be required to achieve recovery goals.