

Assessing Climate Change Risks to Cultural and Natural Resources in the Yakima River Basin

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Project Overview

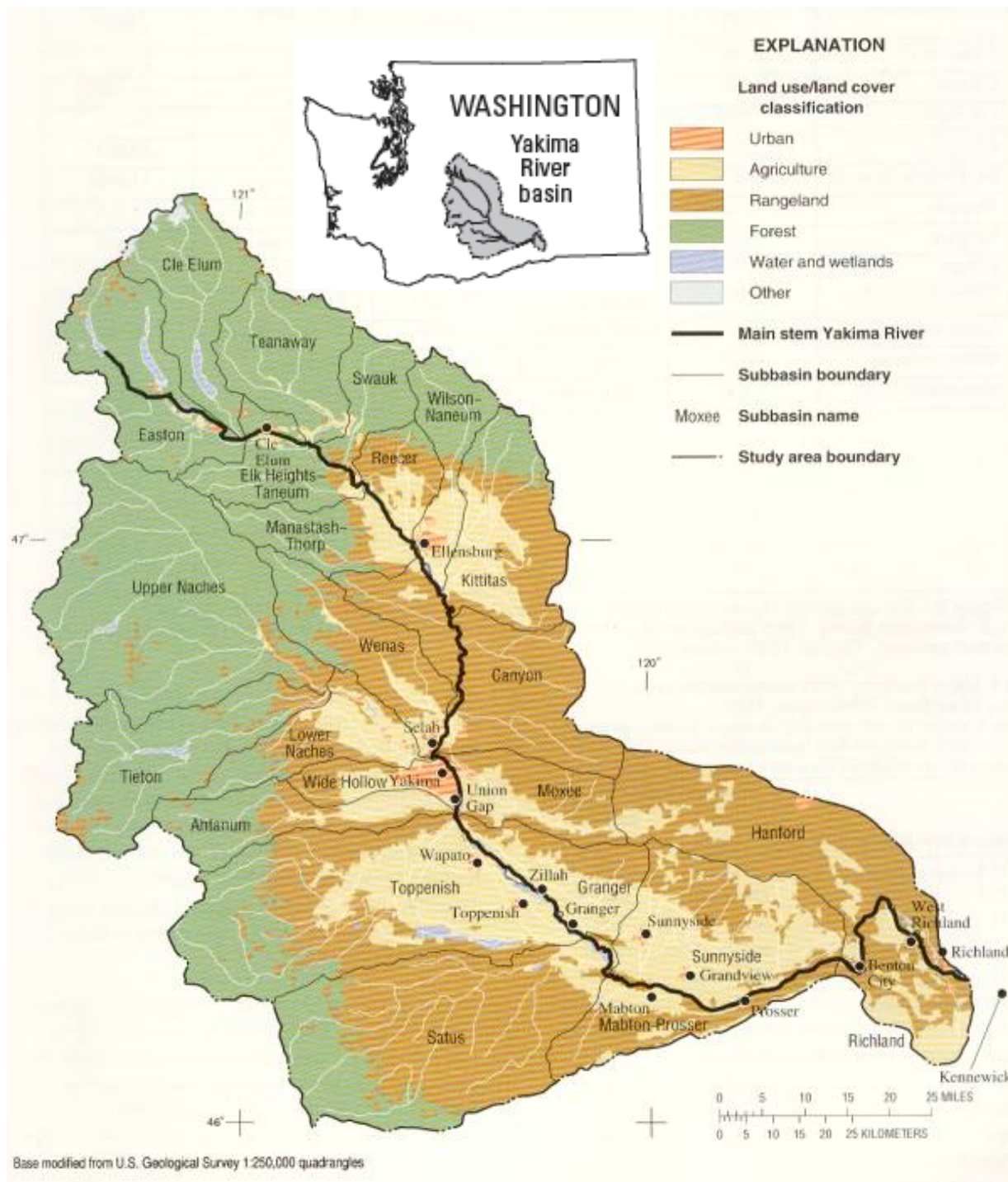
- Multi-disciplinary and multi-agency
- Climatic Change Special Issue – May 2014, 6 articles
 - Stakeholder engagement
 - Conceptual model development
 - Stream temperature modeling
 - Steelhead growth modeling
 - Salmonid habitat modeling
 - Tribal well being



Background

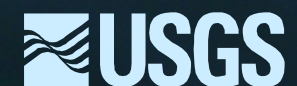
➤ Why the Yakima River Basin?

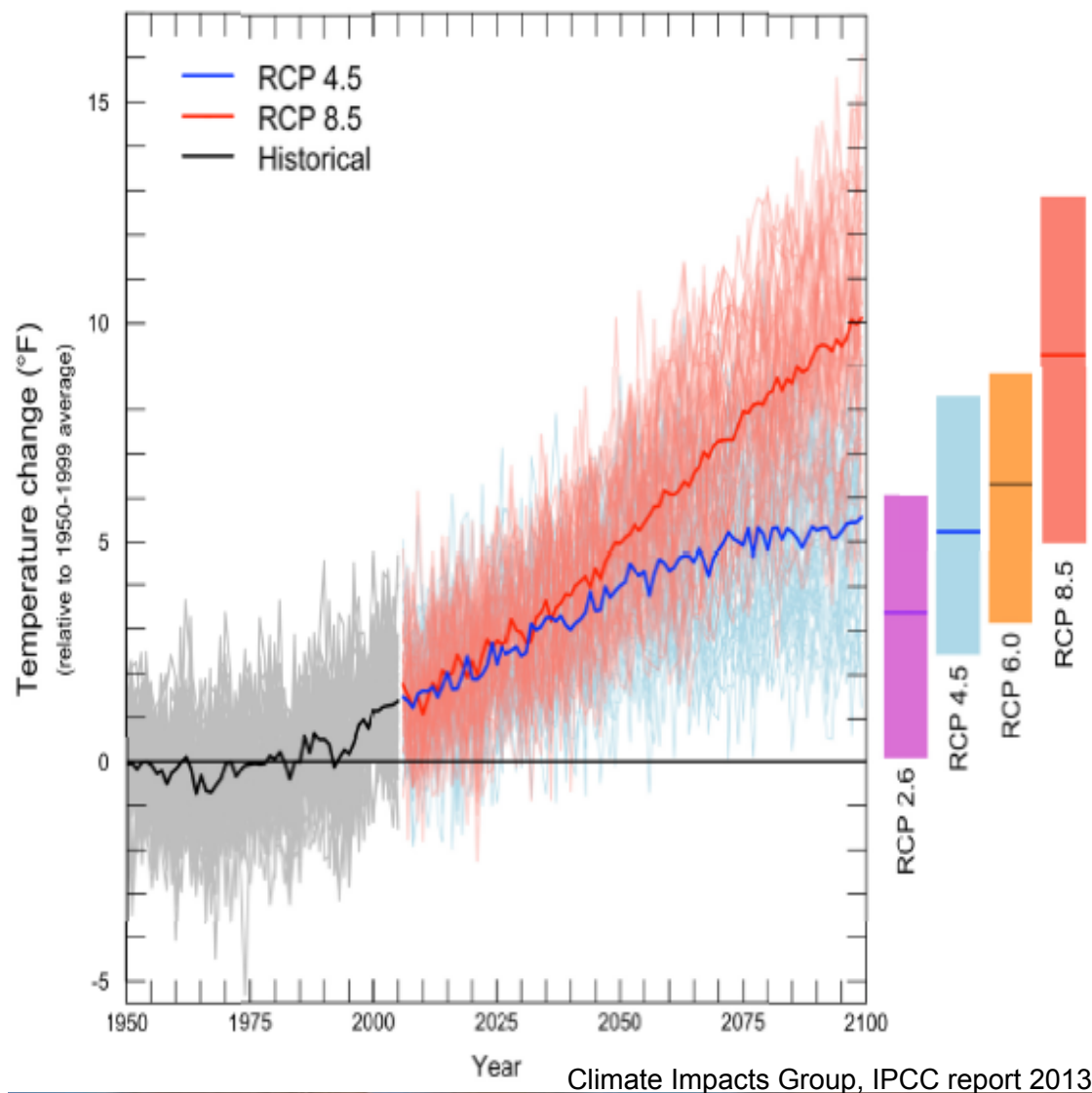
- Varied user groups with disparate goals
 - Tribal interests to maintain culturally significant fisheries
 - Large agricultural interests that rely heavily on irrigation as a water source
 - Recreational and natural resources
- Common interests in assessing the effects of climate change impacts on water delivery and natural resources



Yakima River Basin

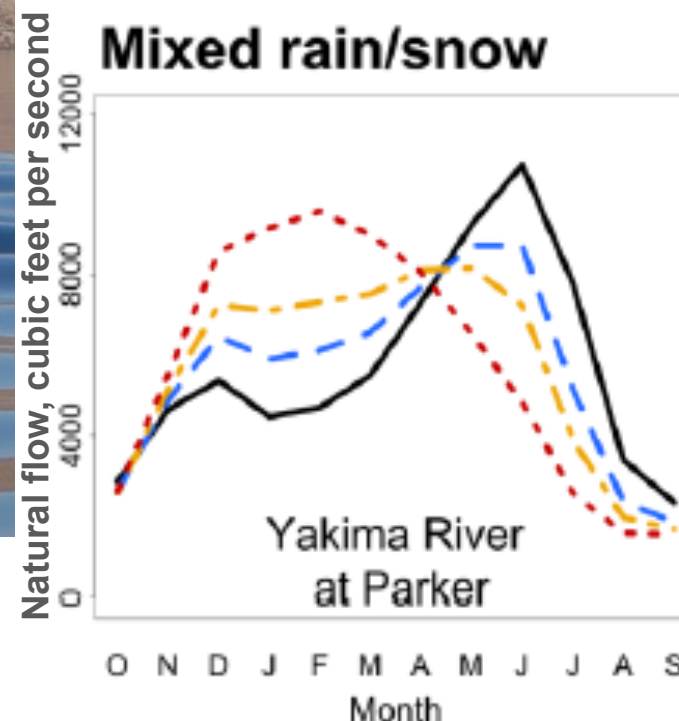
- 100" rain/yr headwaters to 6"/yr at mouth
- Snow accumulation late Oct early Nov
 - Snowmelt is critical to fill reservoirs and meet irrigation
- Mean annual surface-water demand ~2.5 million acre-ft
- Demand partially met by five Bureau of Reclamation reservoirs





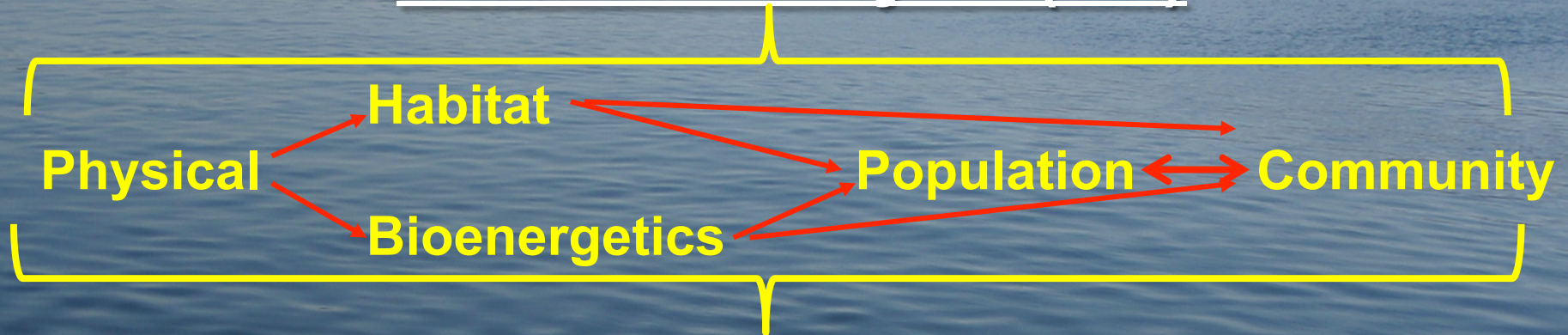
Climate change impacts

- Increased stream temps and changes in hydrologic regimes
 - Water availability
 - Thermal stress for salmonids
 - Altered growth
 - Survival/population impacts
 - Invasive species



Elsner et al. 2010

Decision Analysis (DA)



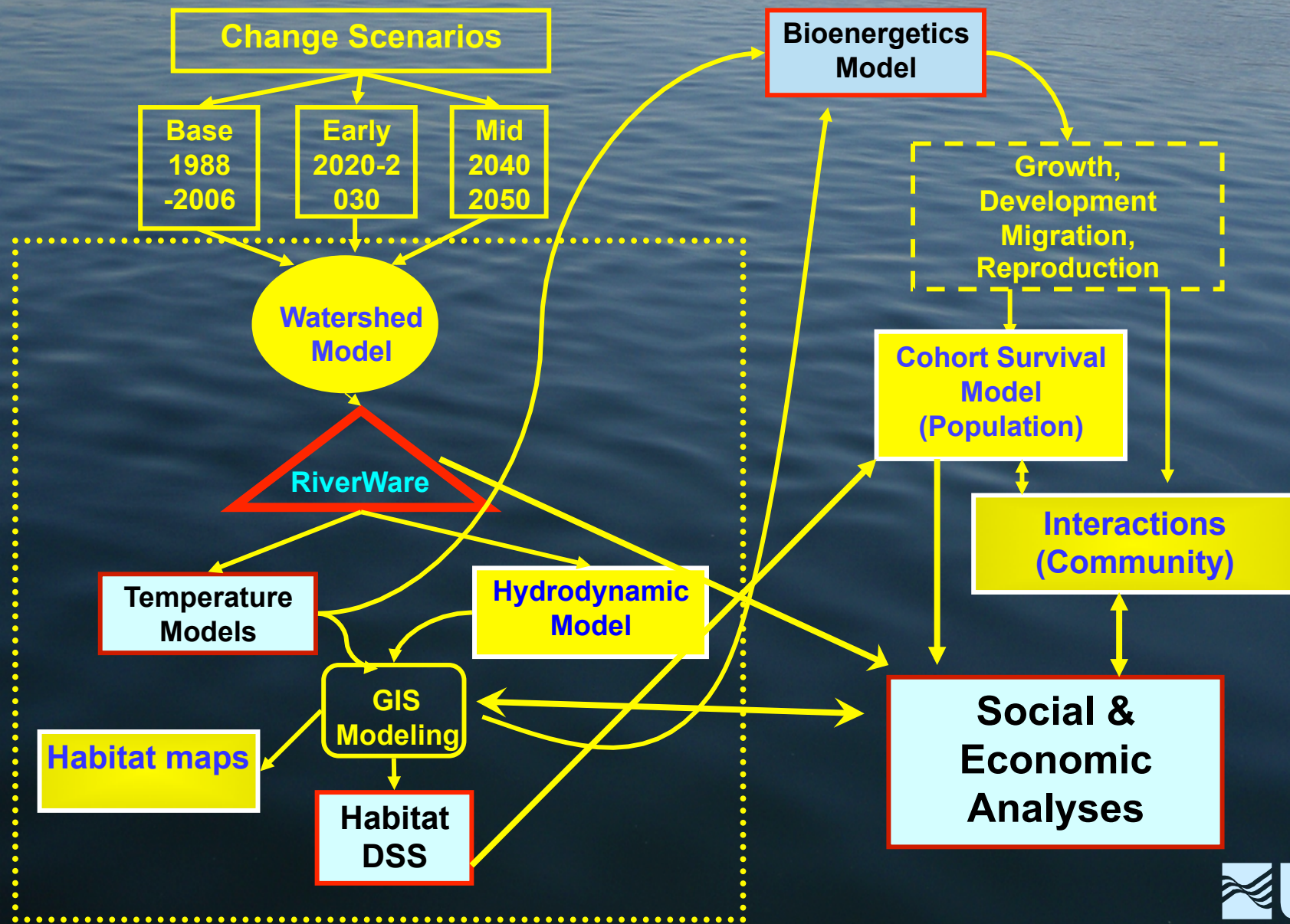
Social & Economic Analyses

DA Stakeholders Workshop – 20+ attendees representing:
Irrigation districts, local elected officials, federal, state,
and tribal fish and wildlife managers, and federal and
state water managers

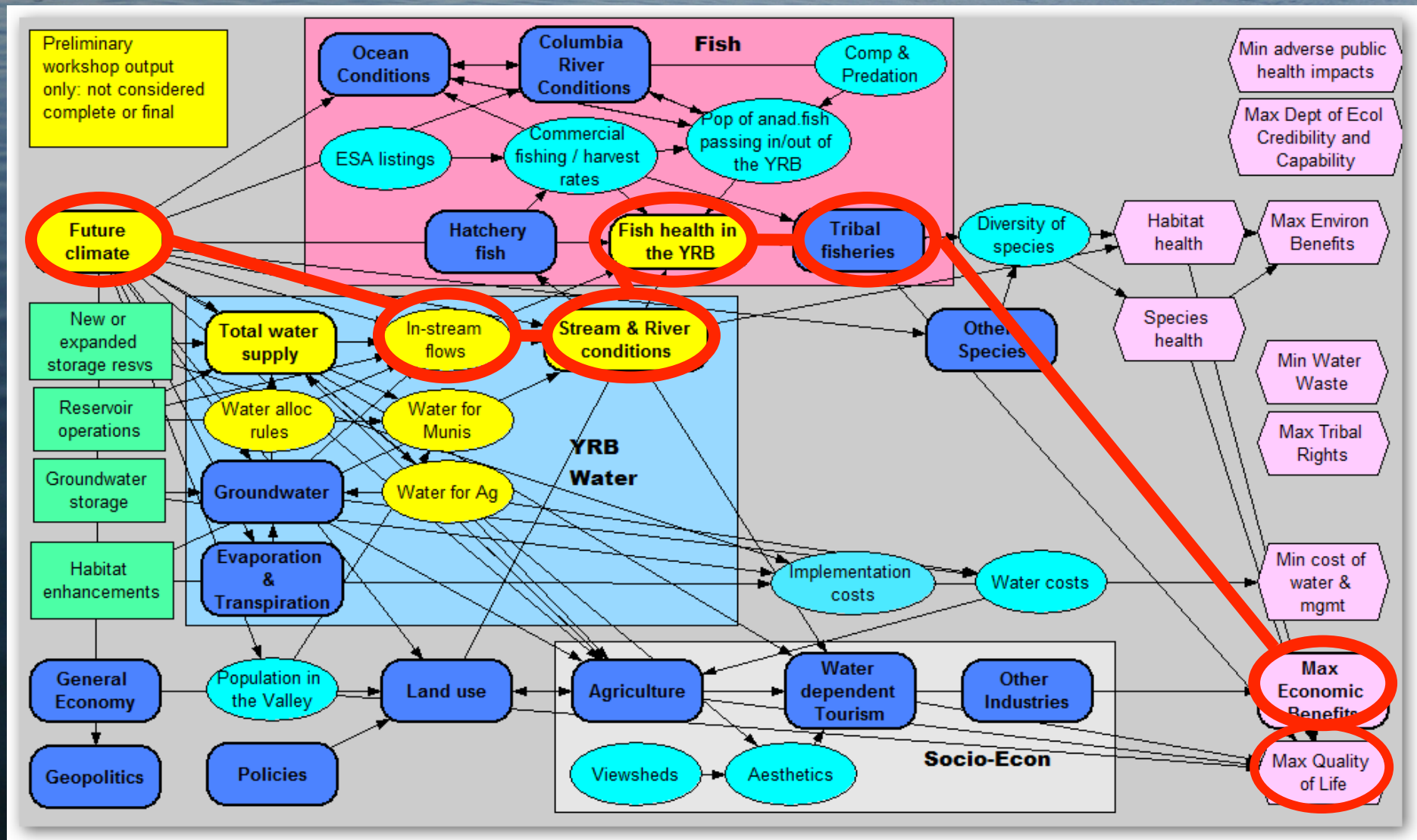
Results:

- Shifted species of concern -- steelhead
- Added temp modeling tributaries & lower river by Columbia River Inter-Tribal Fish Commission
- Developed a conceptual model of Yakima Basin

Global Climate Change Decision Support System

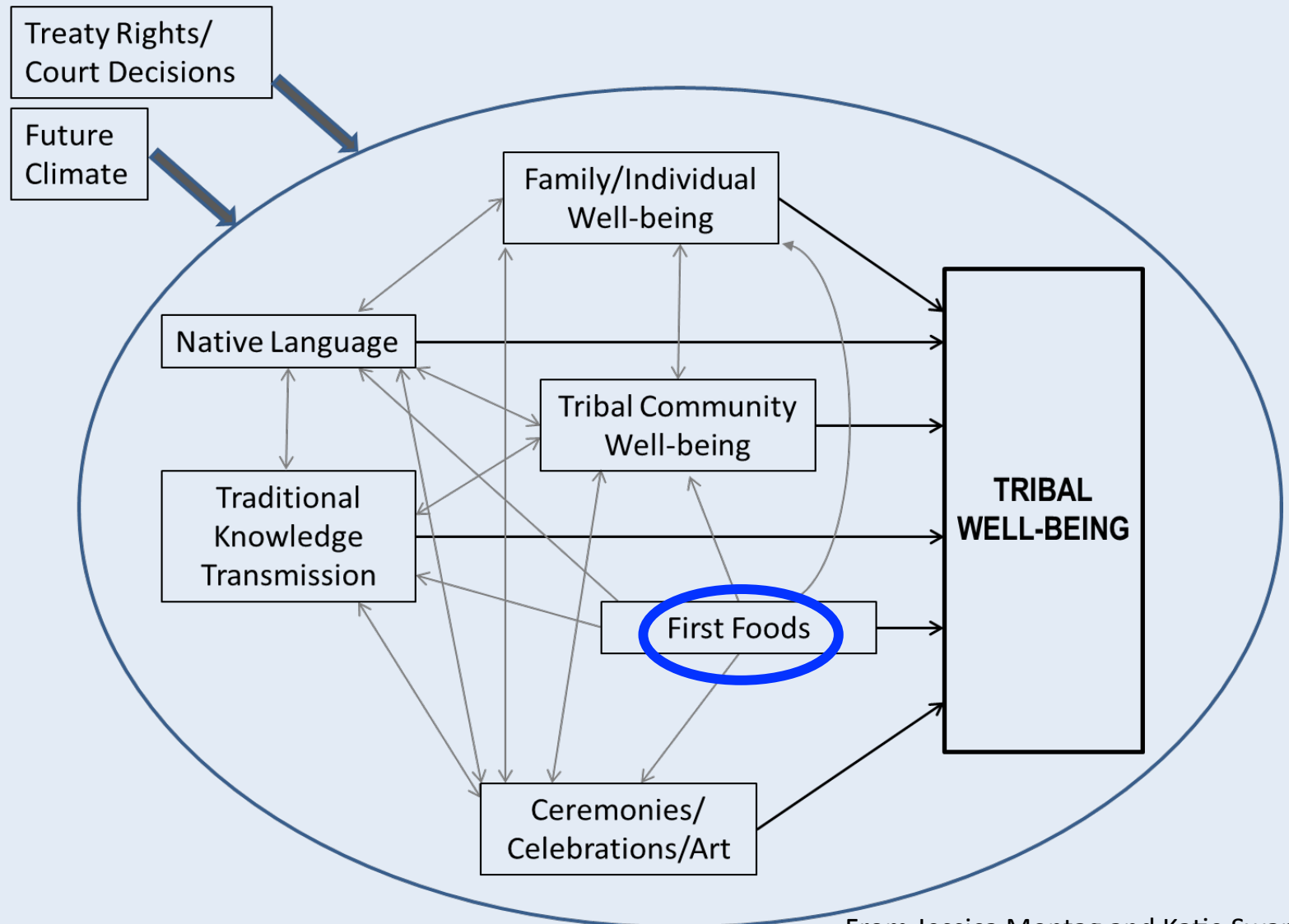


Modeling CC in the Yakima River Basin

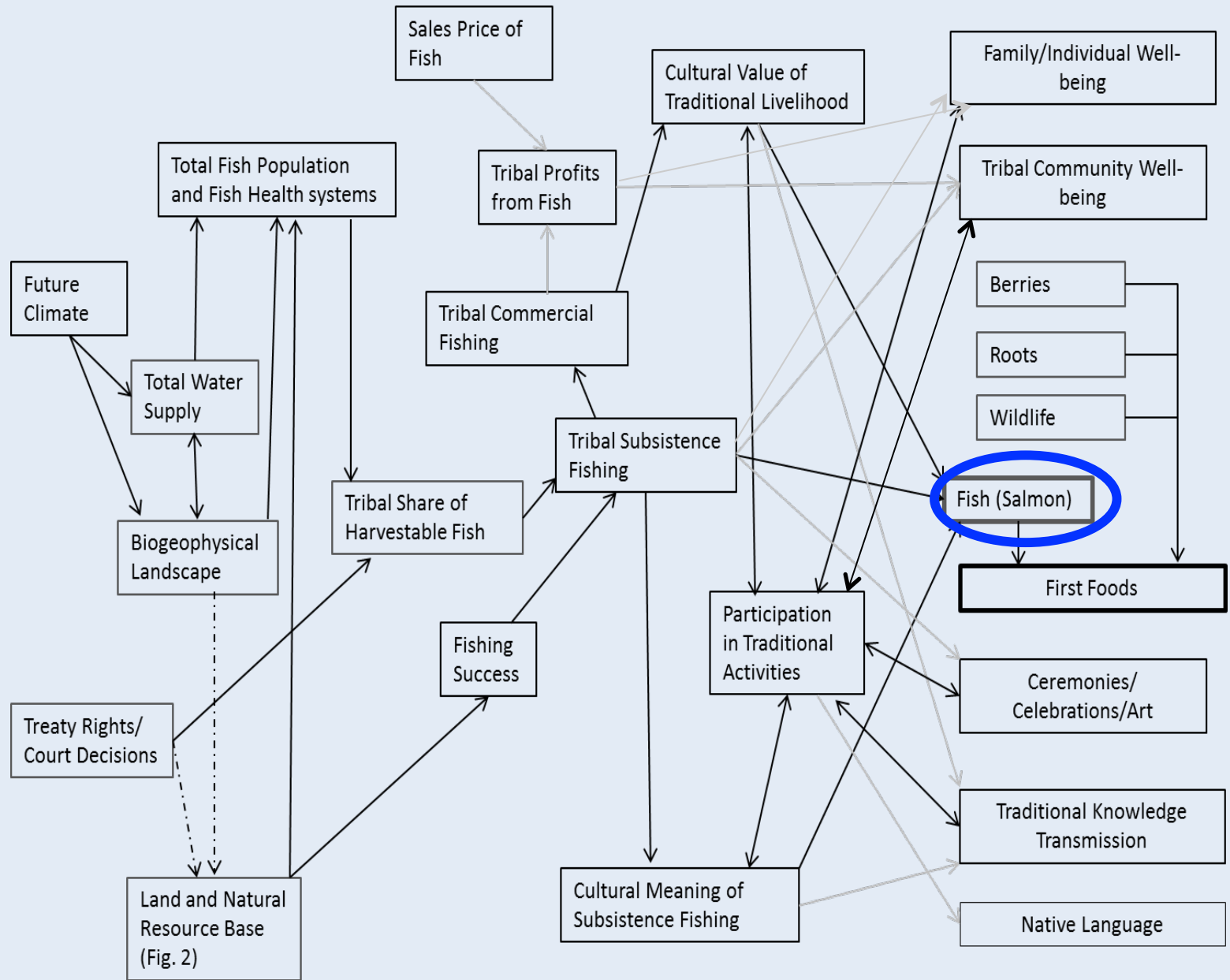




Tribal Well-Being

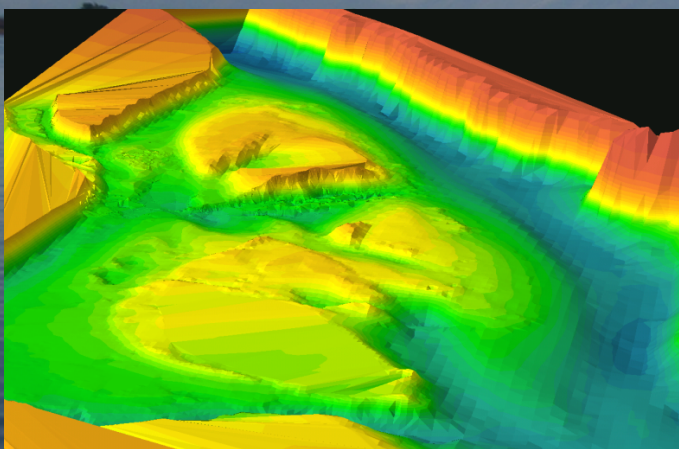


From Jessica Montag and Katie Swan

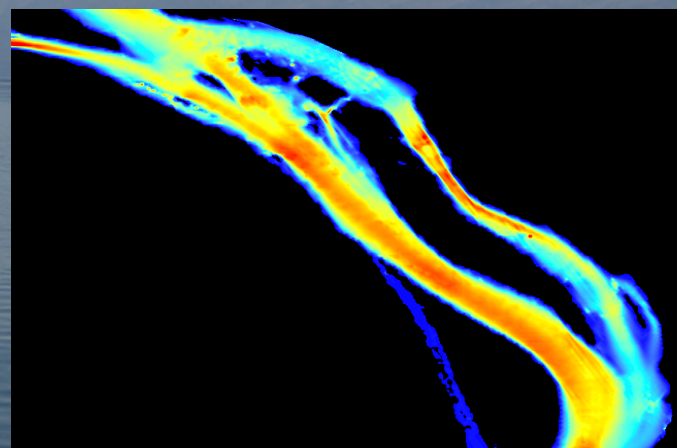


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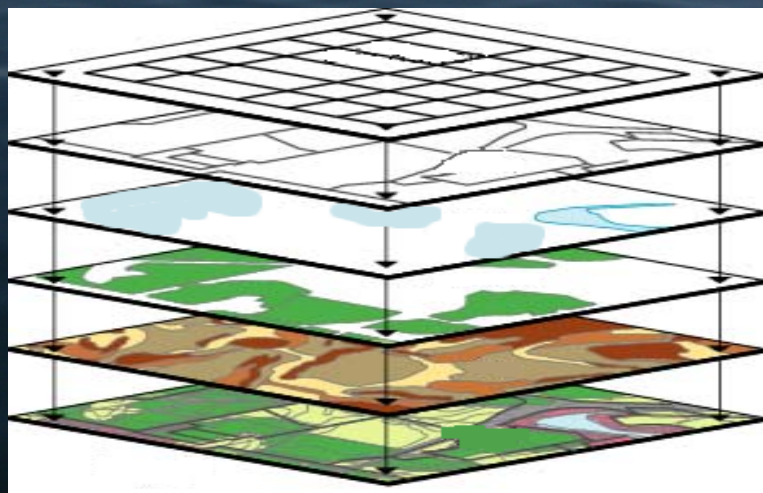
Developing Spatially Explicit Habitat Models by Integrating River Hydraulics and Fish Habitat Criteria



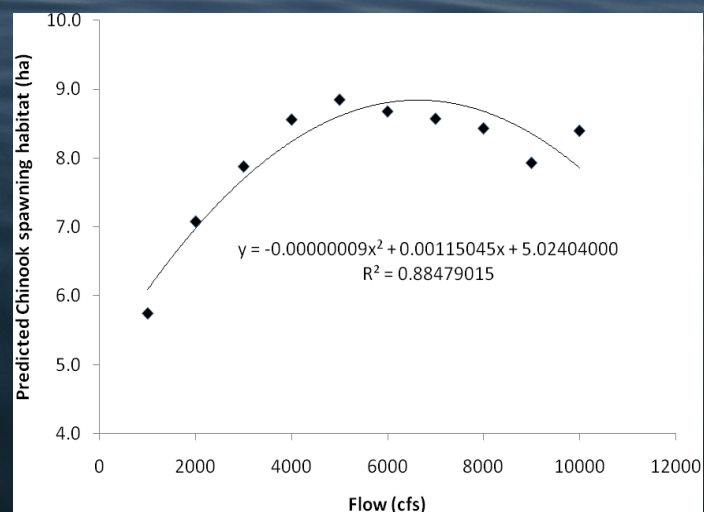
Bathymetry



Hydraulic Model Output



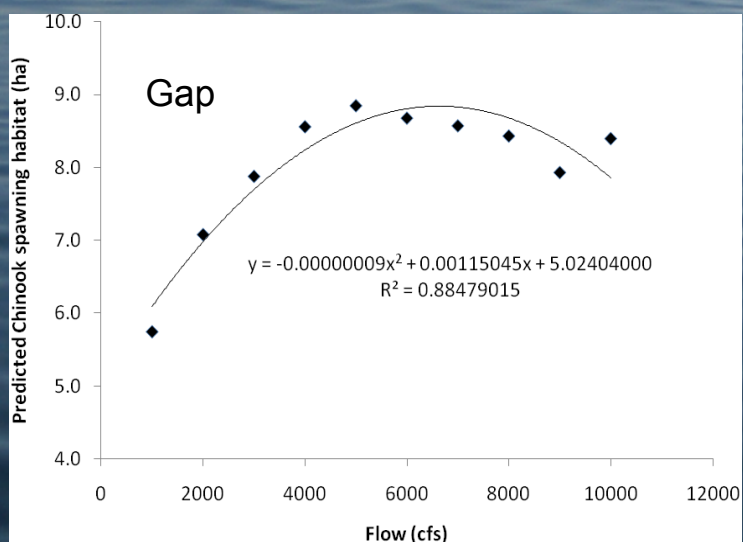
GIS: cell-based modeling



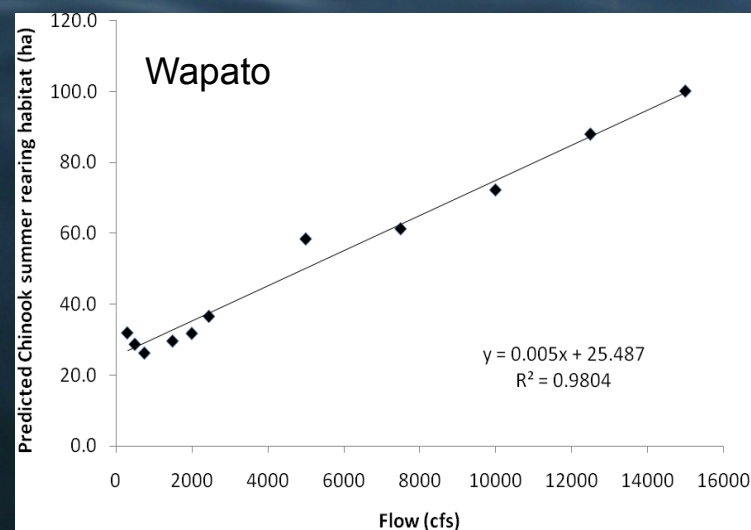
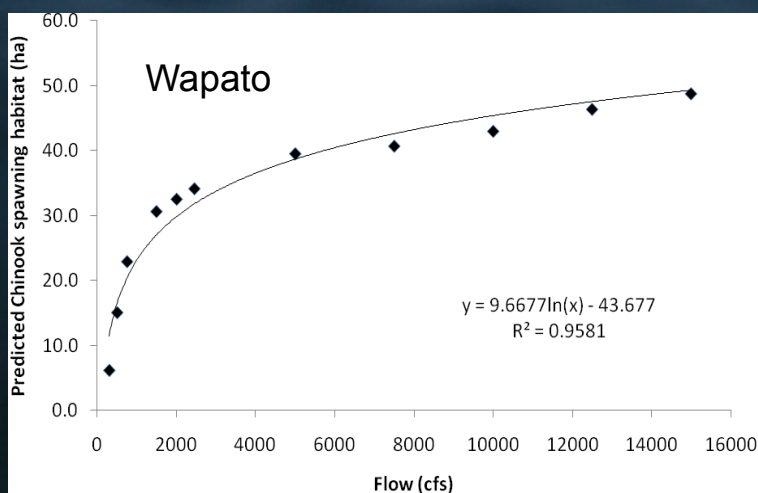
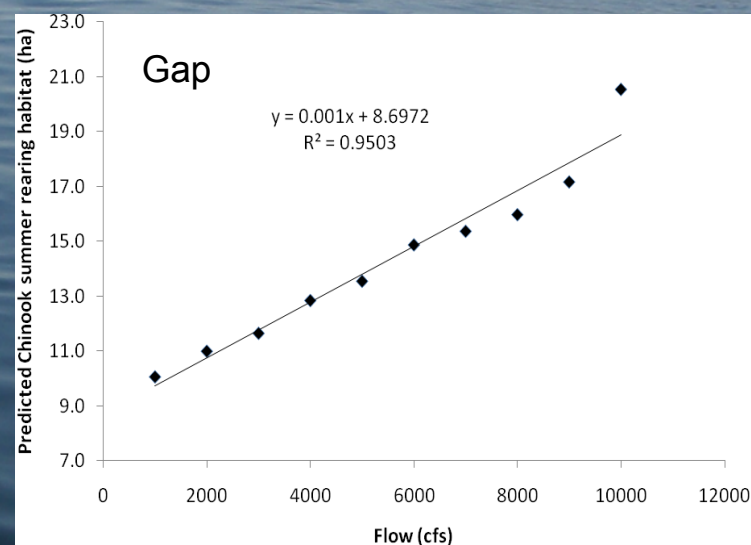
Habitat-Discharge Curves

Habitat-discharge Response Curves

Fall Chinook salmon spawning habitat

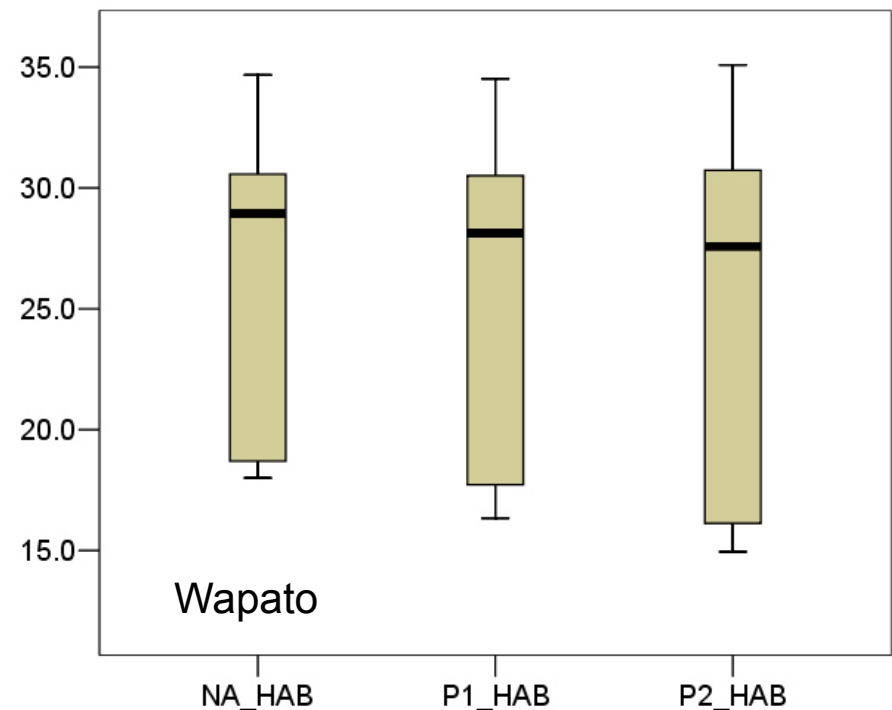
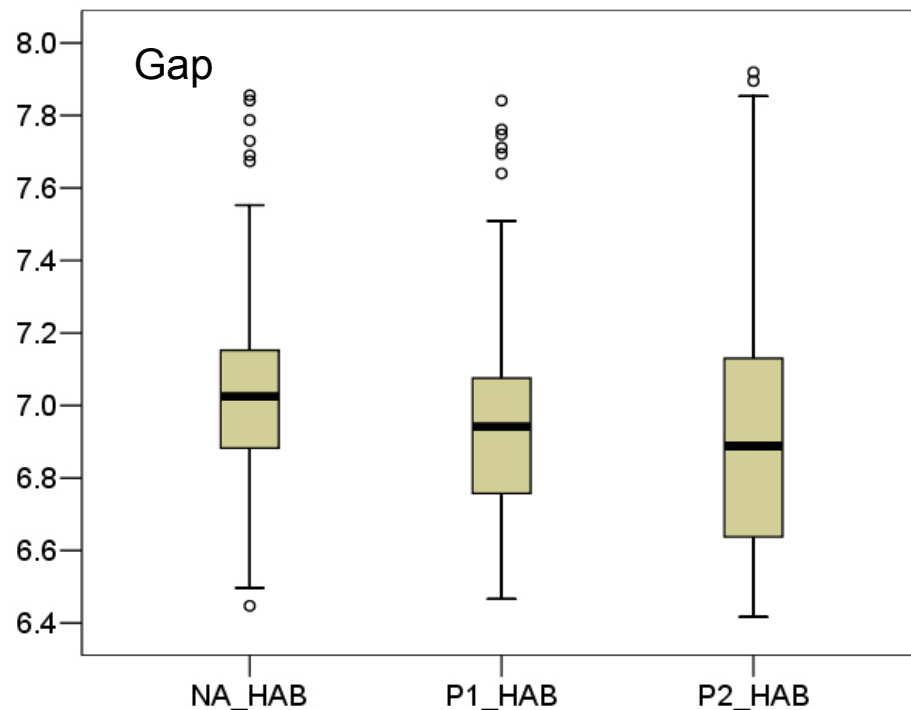


Fall Chinook spring rearing habitat



Baseline vs. Future Habitat Estimates

Fall Chinook Spawning Habitat

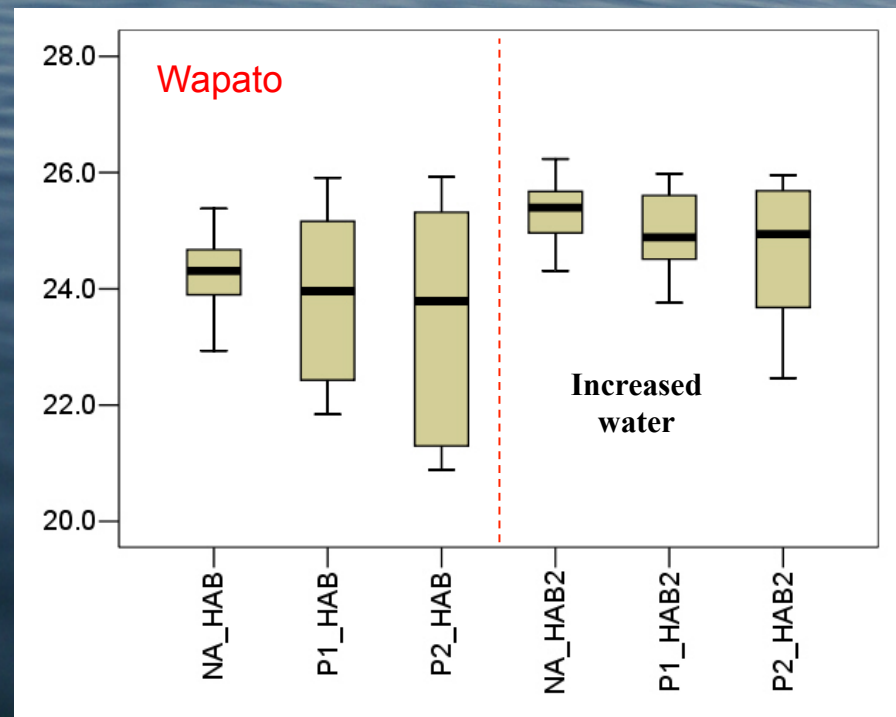
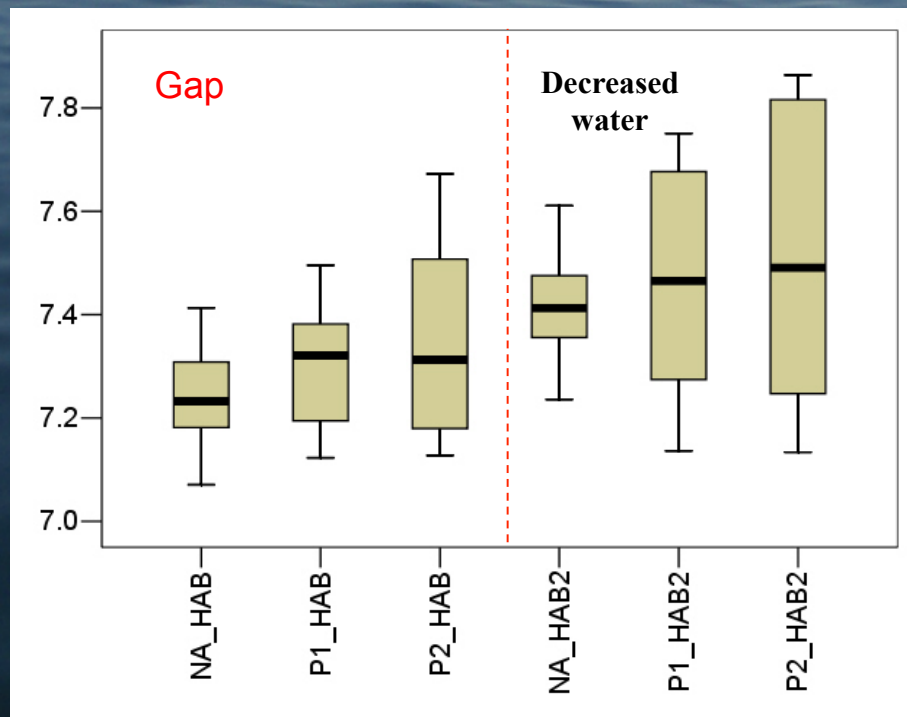


Habitat based on water velocity and depth per Bovee et al. (2008)

Sensitivity Analysis

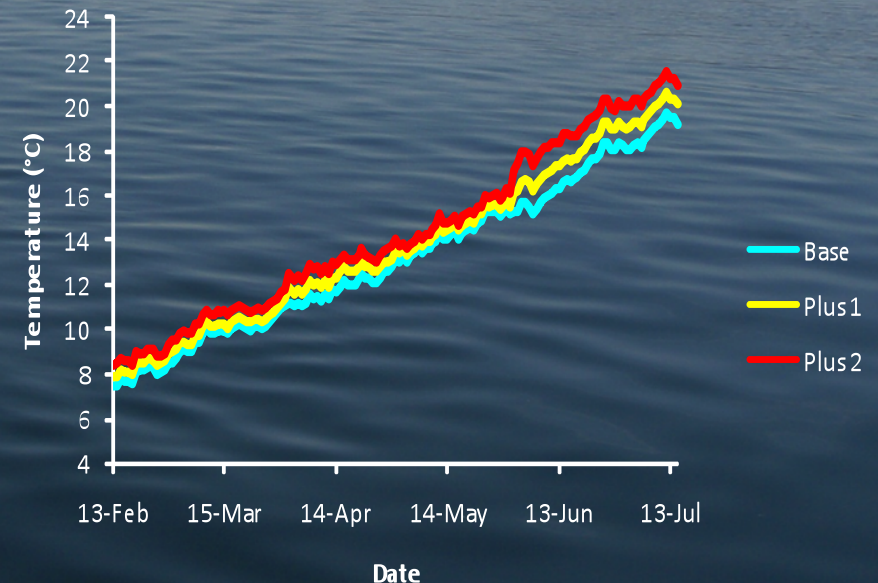
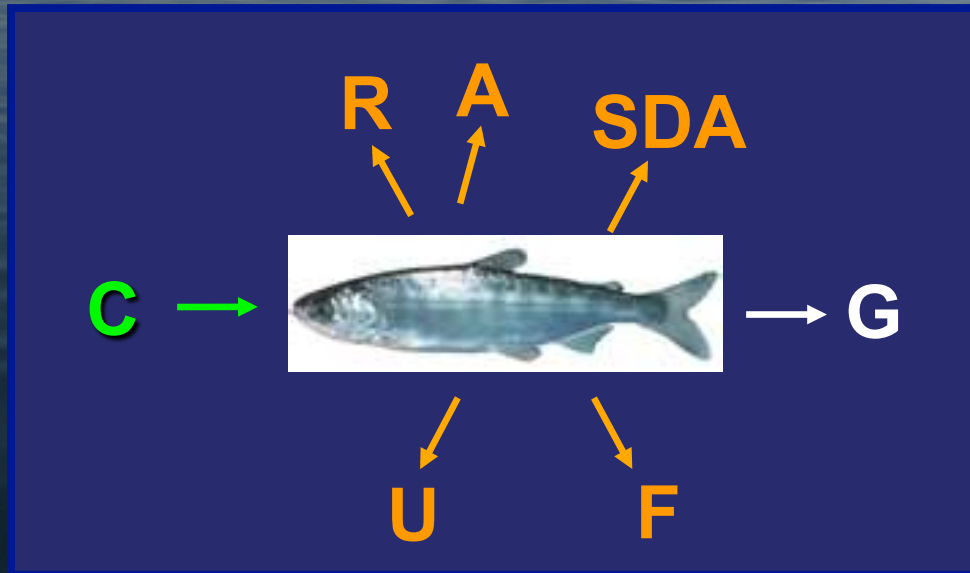
Alternate management scenarios

Chinook Fry Habitat



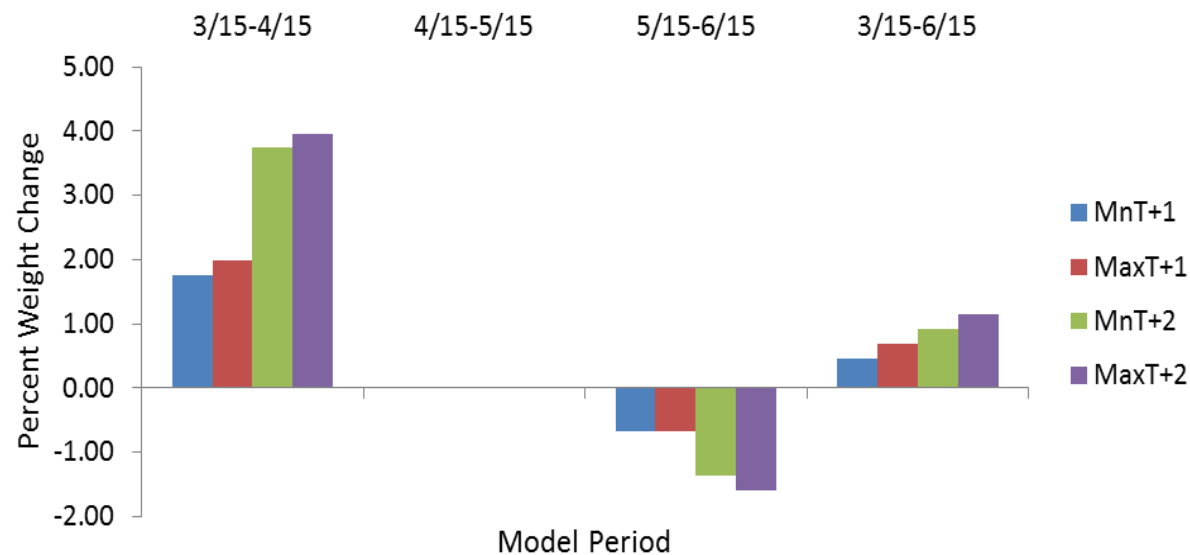
Bioenergetics Modeling

Mass-balance model of fish energy budget as a function of body size and temperature



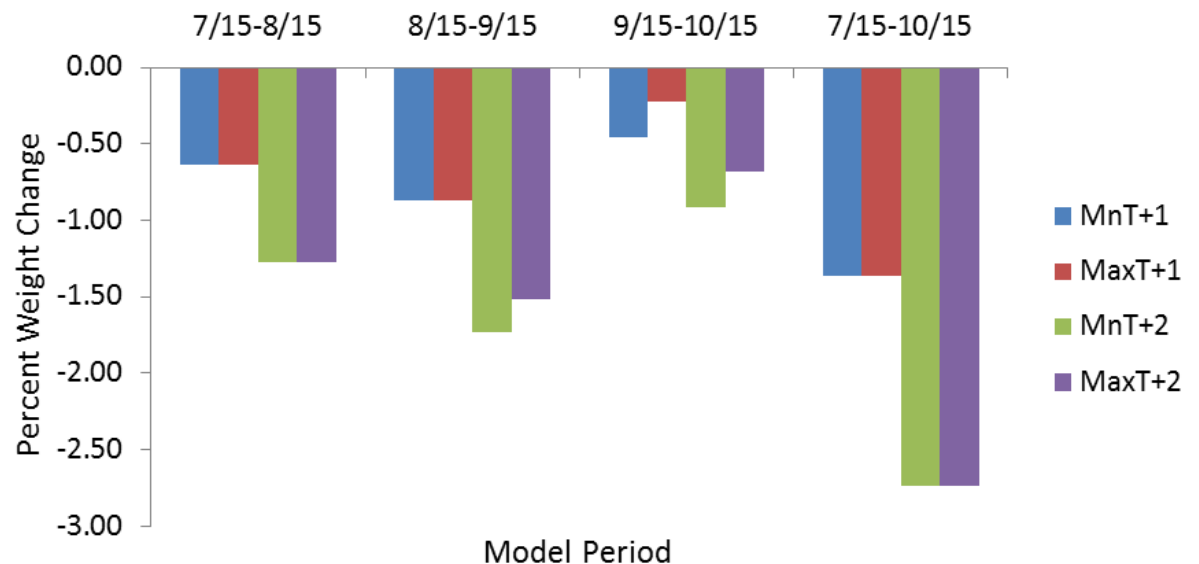
Growth = Consumption – Respiration – Wastes

Changes in Fish Growth



- Model inputs: modeled stream temperatures from climate scenarios and fish size and diet data from YRB
- 1 mo and 3 mo model runs, spring and summer

- Early season growth increase, in March
- June-July fish lose weight compared to baseline scenarios



Conclusions

- Effects of CC on salmonid habitats dependent on species and life history stages
- Overall downward trend in habitat abundance and decrease in persistence with CC scenarios
- Summer bottleneck period for salmonids
 - Low flows, higher temps, decreased habitat
 - Altered growth, population persistence
- Management implications/strategies
 - Keep streams cool, riparian corridors
 - Manage flows for fish
 - Stream restoration projects, maintain function – food sources

Accomplishments

- Multiple agencies and disciplines working collaboratively
- Conceptual model developed with stakeholder interests
- Decision analysis and support tools help managers understand tradeoffs under climate scenarios and potential critical time periods

Questions?

Contribution authors and agencies

- Tom Batt, USGS, Western Fisheries Research Center
- Pat Connolly, USGS, Western Fisheries Research Center
- David Graves, Columbia River Inter-Tribal Fish Commission
- Karen Jenni, Insight Decisions LLC
- Mark Mastin, USGS, Washington Water Science Center
- Matt Mesa, USGS, Western Fisheries Research Center
- Jessica Montag, USGS, Fort Collins Science Center
- Tim Nieman, Decision Applications Inc
- Karen Swan, USGS, Fort Collins Science Center
- Frank Voss, USGS, Washington Water Science Center
- Washington Department of Fish and Wildlife
- Yakama Nation Fisheries



Columbia River
Inter-Tribal
Fish Commission

