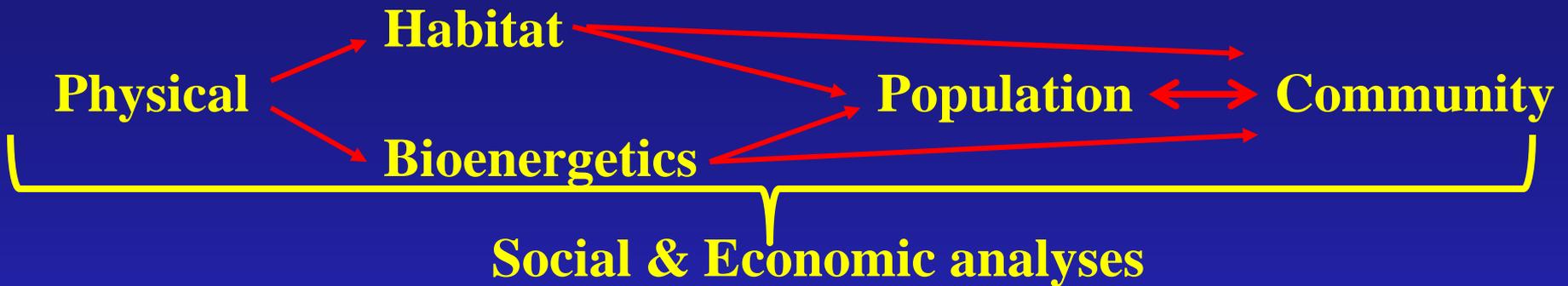


Climate change, ecosystem services & socio-economic considerations in the Columbia River Basin.

**Alec G. Maule, Supervisory Research Physiologist
Leader, Ecology & Environmental Physiology Section
USGS, WFRC, Columbia River Research Laboratory
Cook, Washington**

Linking models to predict CC effects



Alec Maule – Project Manager

DeWayne Cecil – Chief Science Applications, Climate Change

Mark Mastin & Frank Voss (WaWSC) - Physical models

Jim Hatten & Tom Batt – Habitat criteria, GIS, DSS

Matt Mesa & Jill Hardiman – Bioenergetics

Pat Connolly & Russ Perry – Fish pop analyses, Cohort survival

Jessica Montag (Ft Collins, CO) — Sociologist

Lynne Koontz (Ft Collins, CO) – Economist

Chris Lynch, (BOR-Yakima) - Water management (RiverWare)

David Graves — Tributary Water Temps

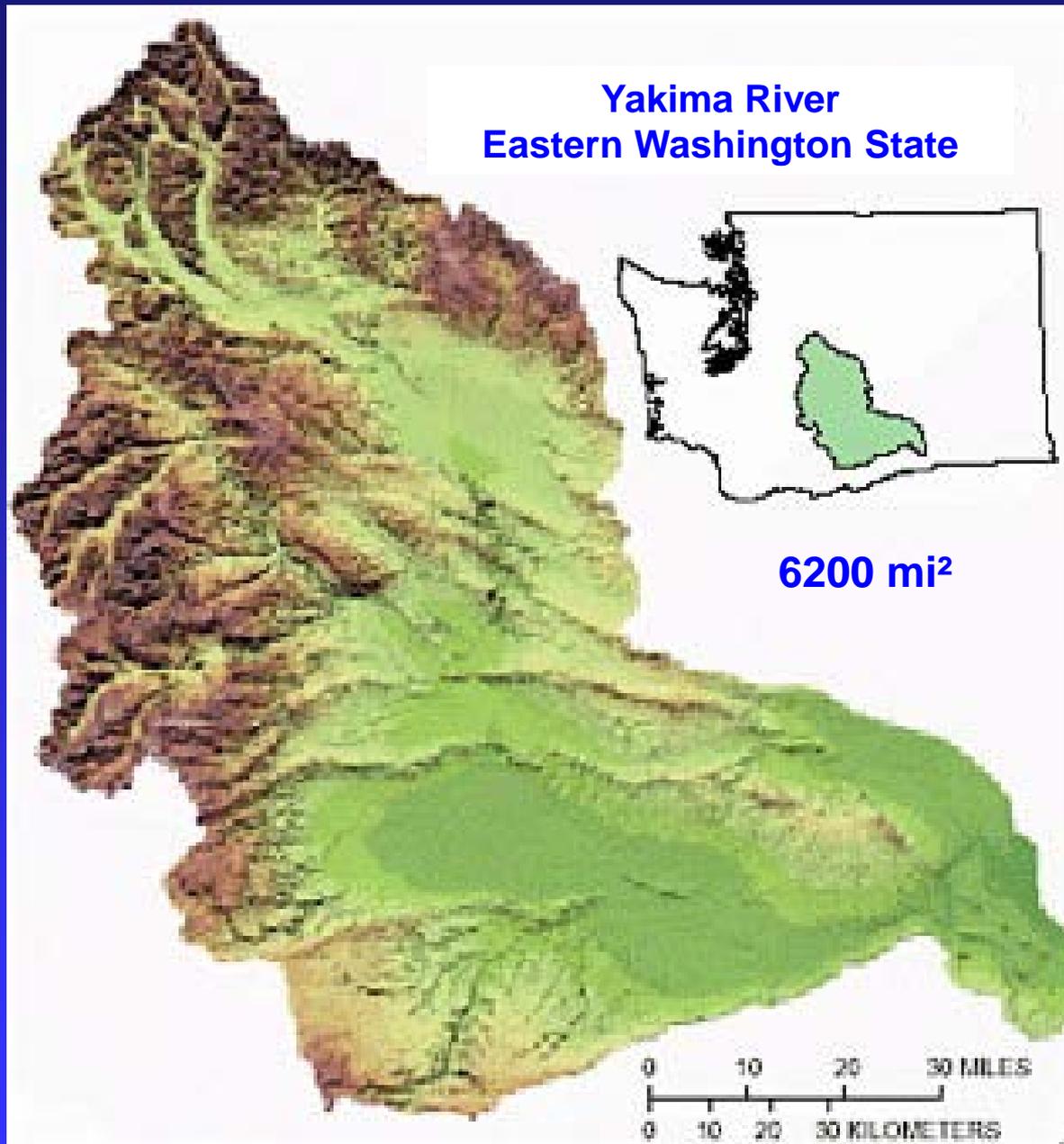
Columbia River Inter-Tribal Fish Commission

100 in / yr

Yakima River Eastern Washington State

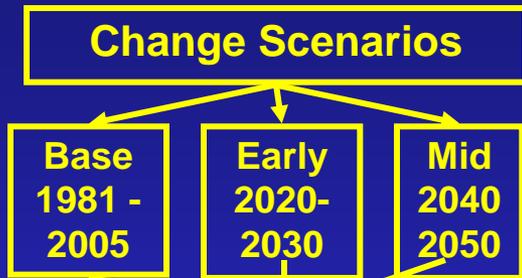


6200 mi²

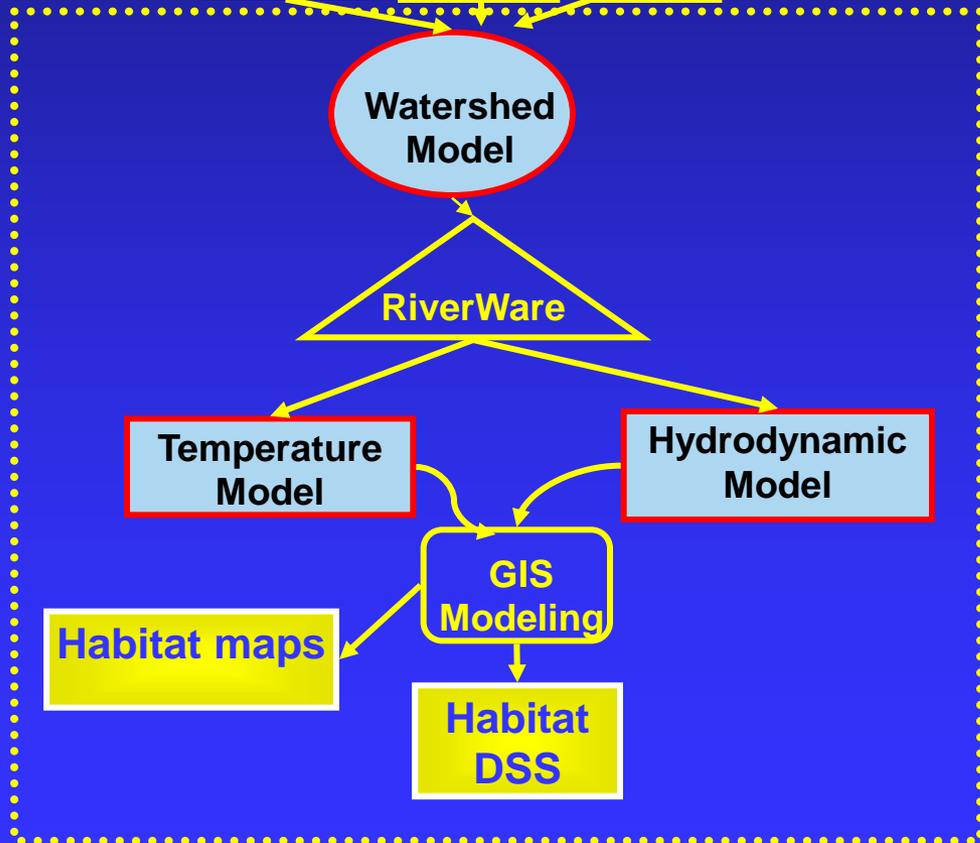


6 in / yr

Climate Change in the Yakima



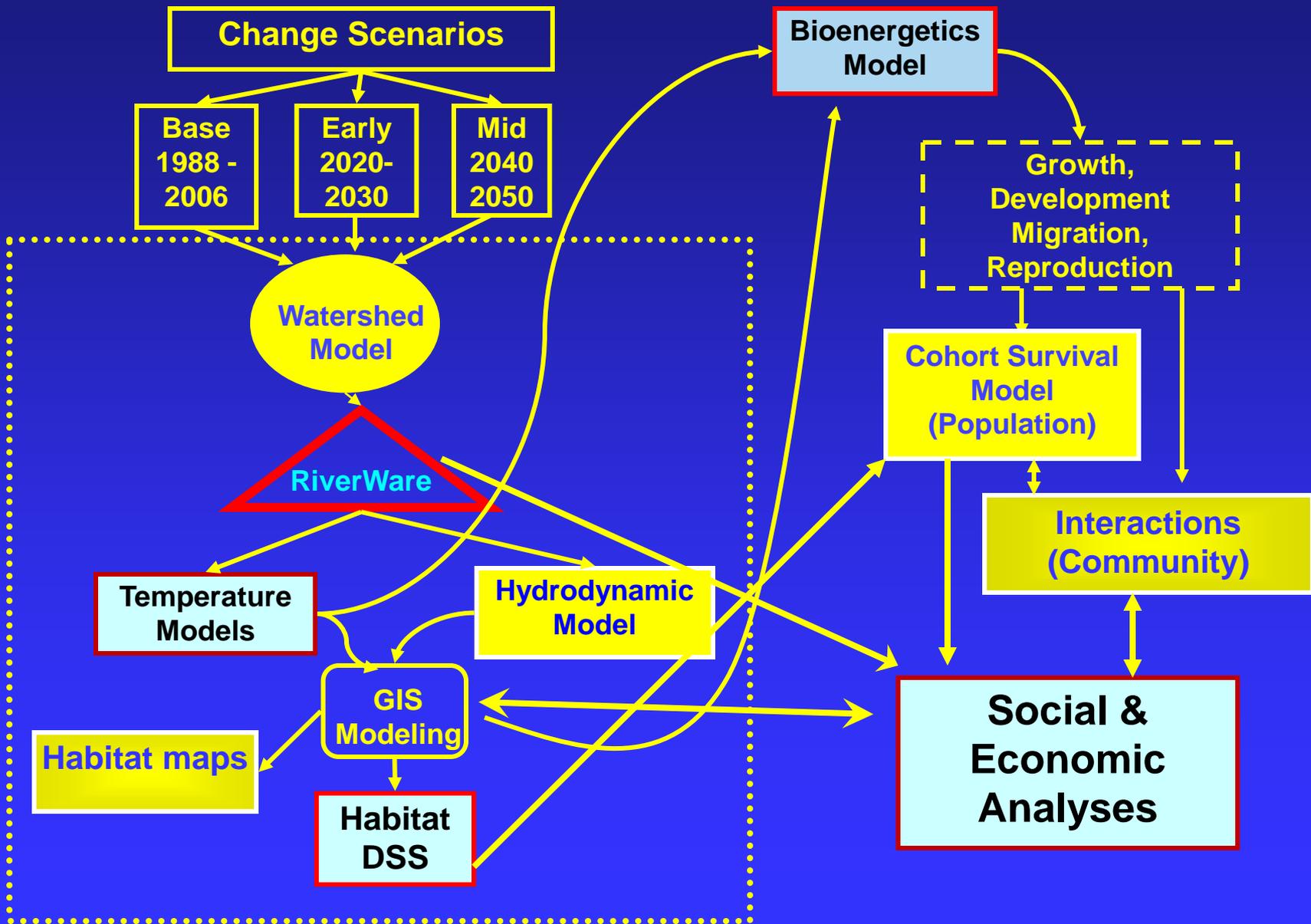
Mastin 2008



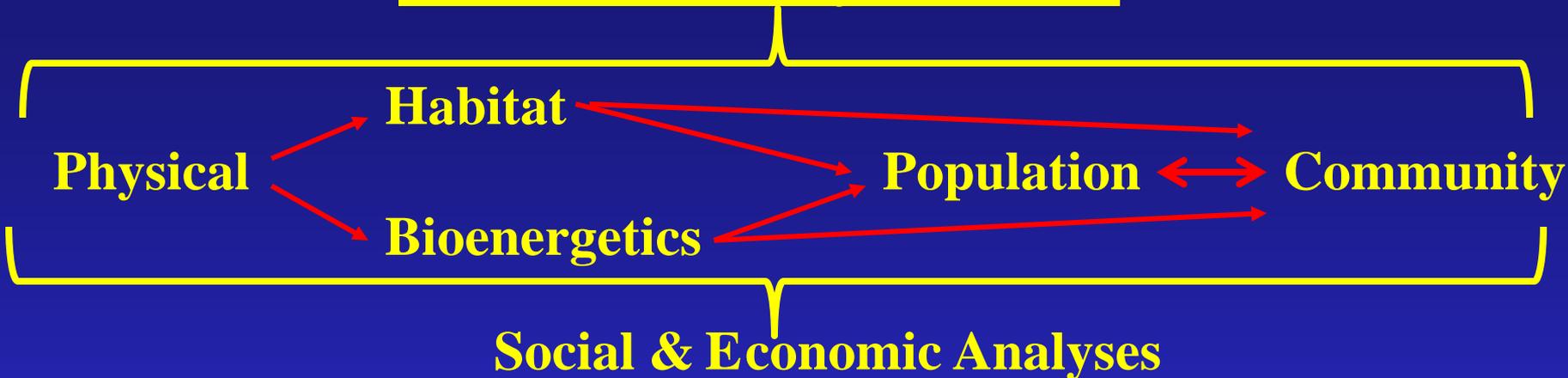
Bureau of Reclamation

Bovee et al. 2008

Global Climate Change Decision Support System



Decision Analysis (DA)



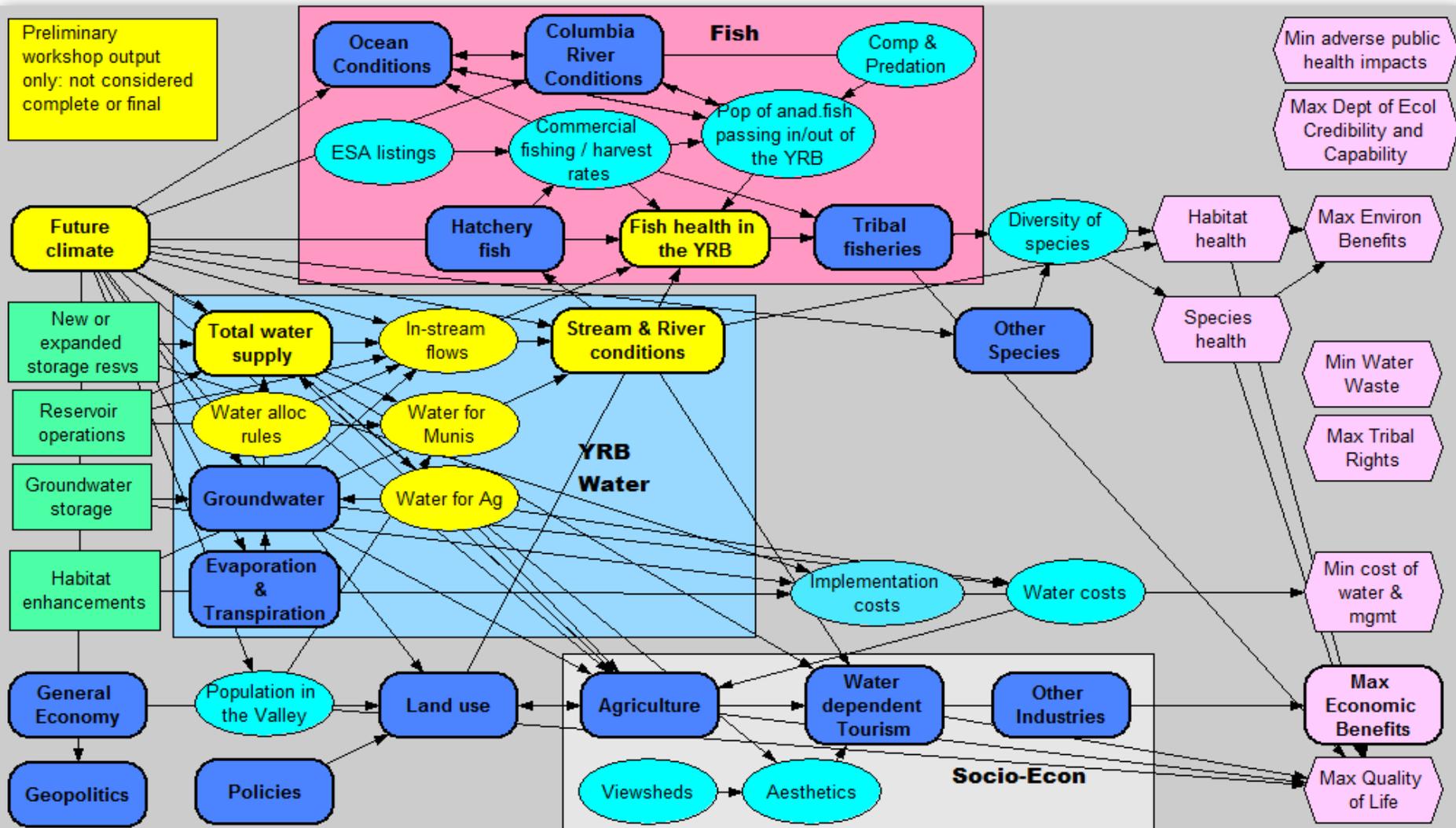
DA Stakeholders Workshop – July 2009; 20+ attendees

Karen Jenni & Tim Nieman, DA Consultants

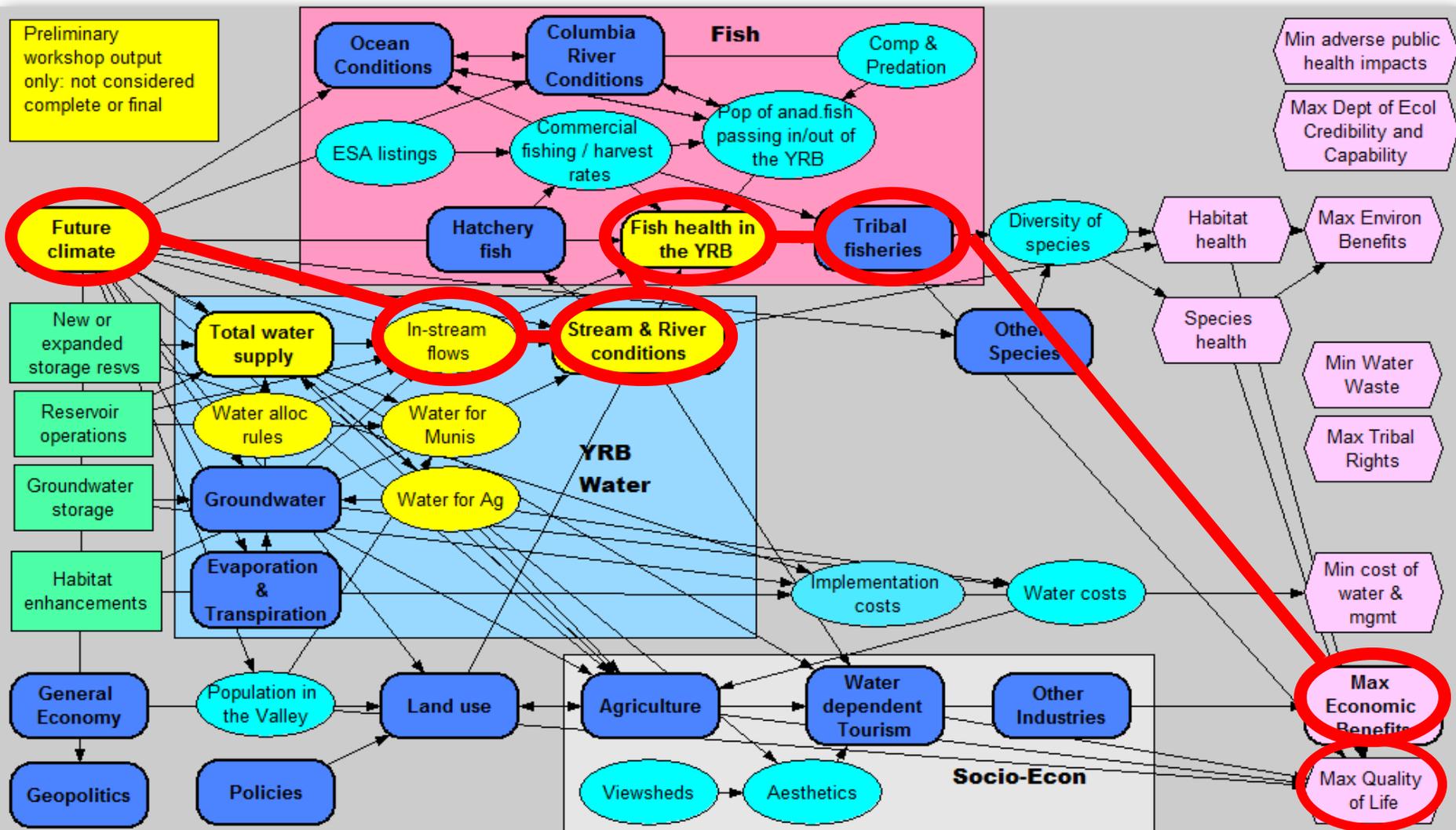
Results:

- Shifted species investigation Districts steelhead
- Added temporary elected officials & lower river
- Columbia River Inter-Tribal Fish Commission
- Developed State Water Managers Yakima Basin

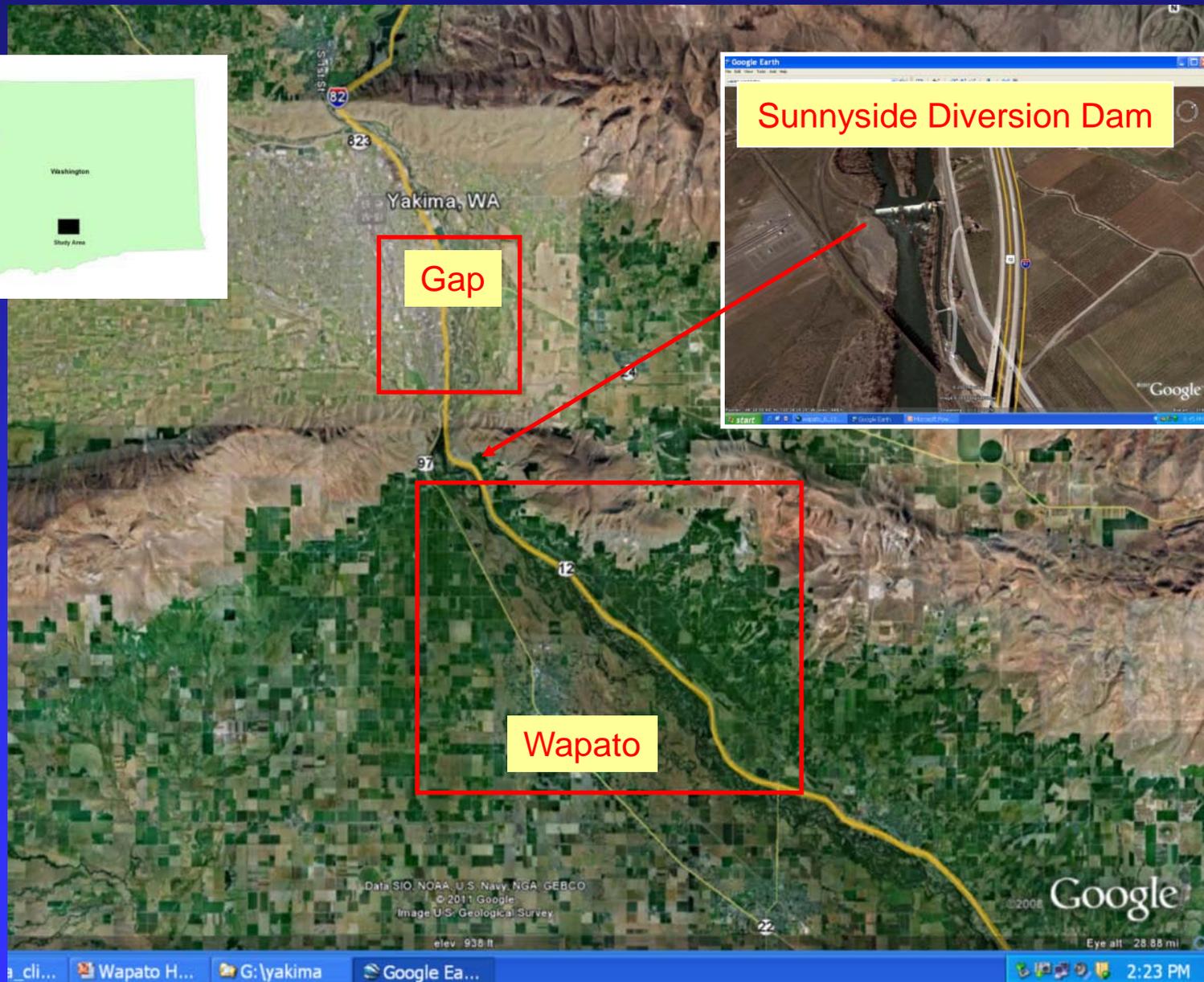
Stakeholders' Workshop Conceptual Model



Modeling CC in the Yakima River Basin

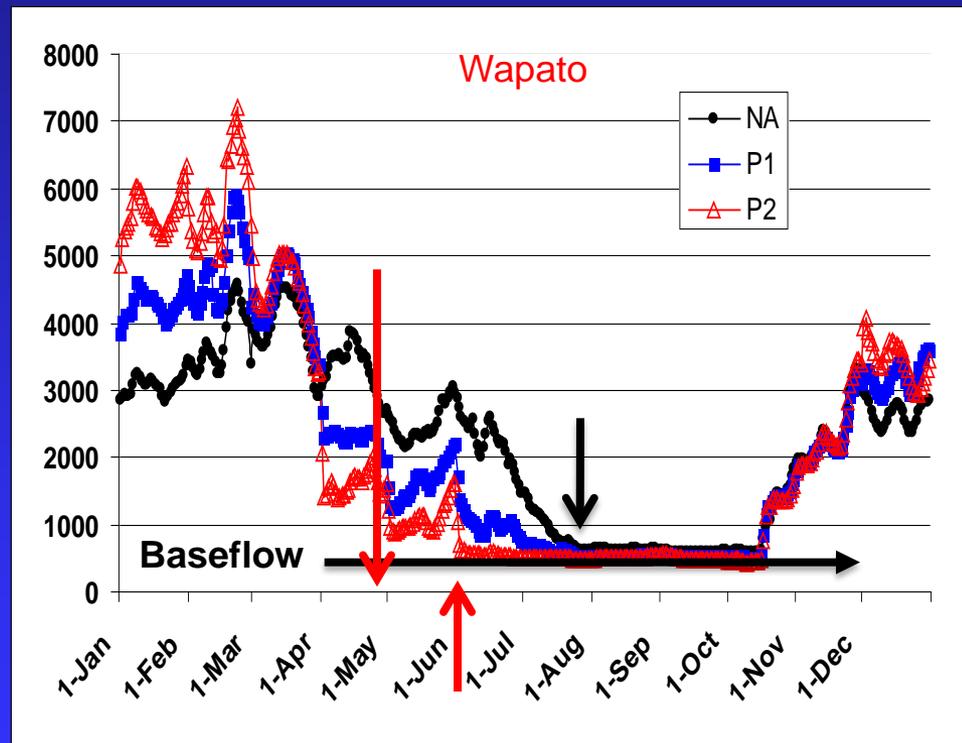
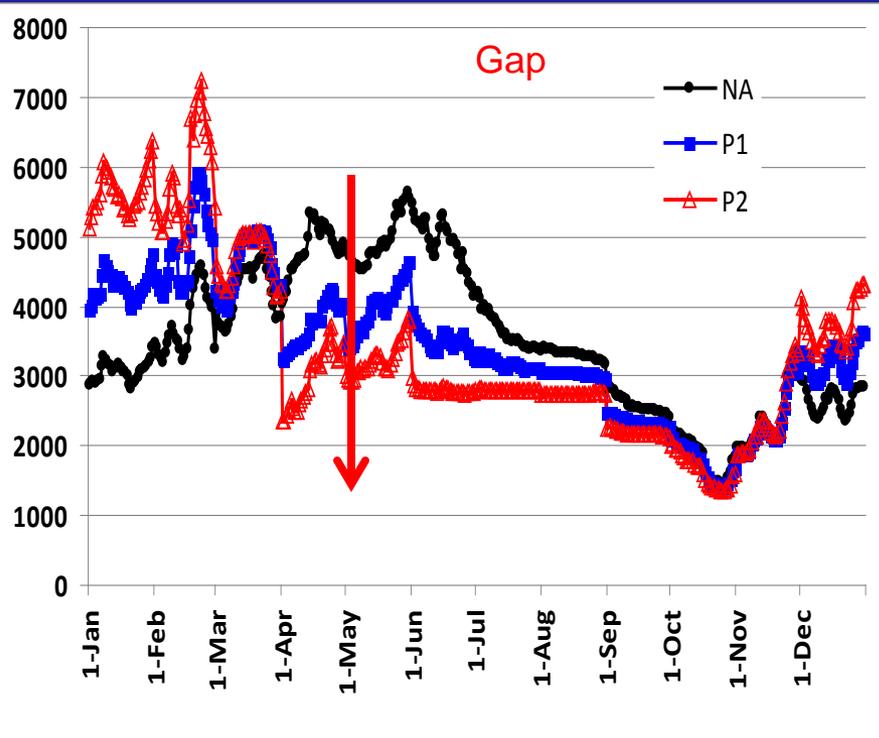


Changes in Habitat Area by Reach



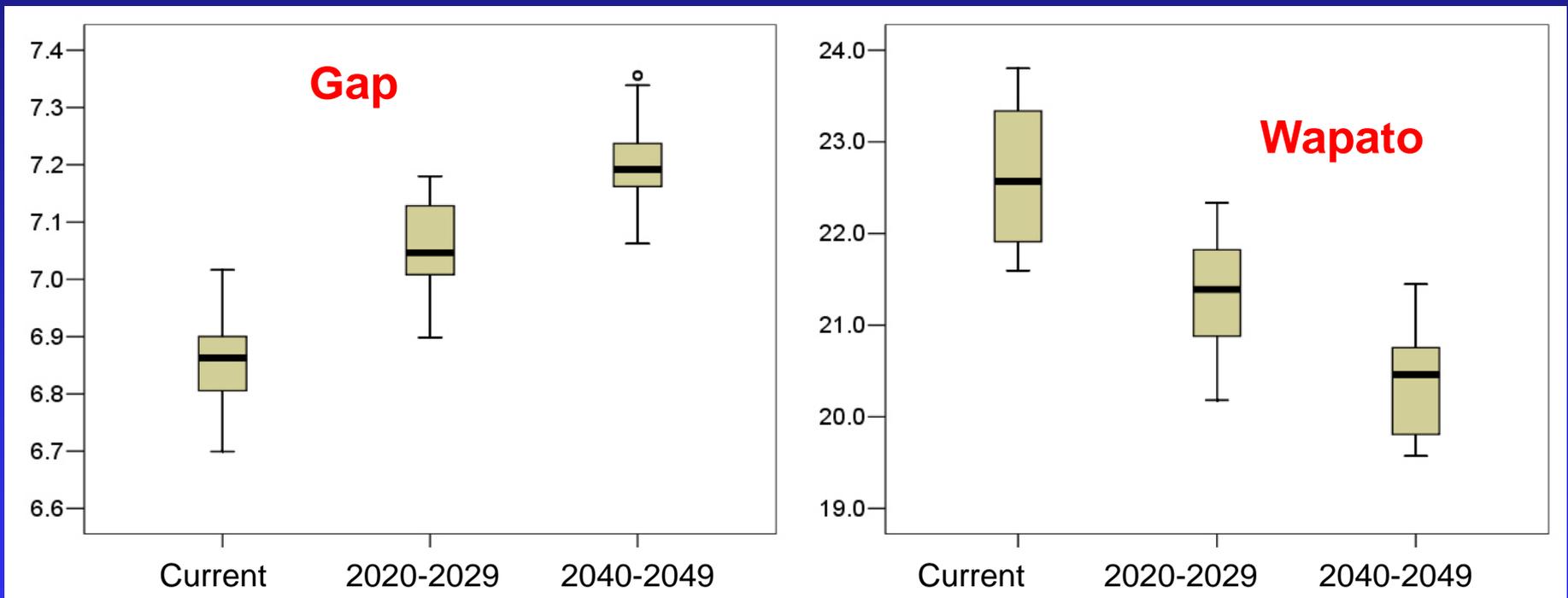
Baseline & Future Hydrographs

Coho salmon fry rearing



Baseline vs. Future Habitat Estimates

Coho Fry Habitat (hectares)

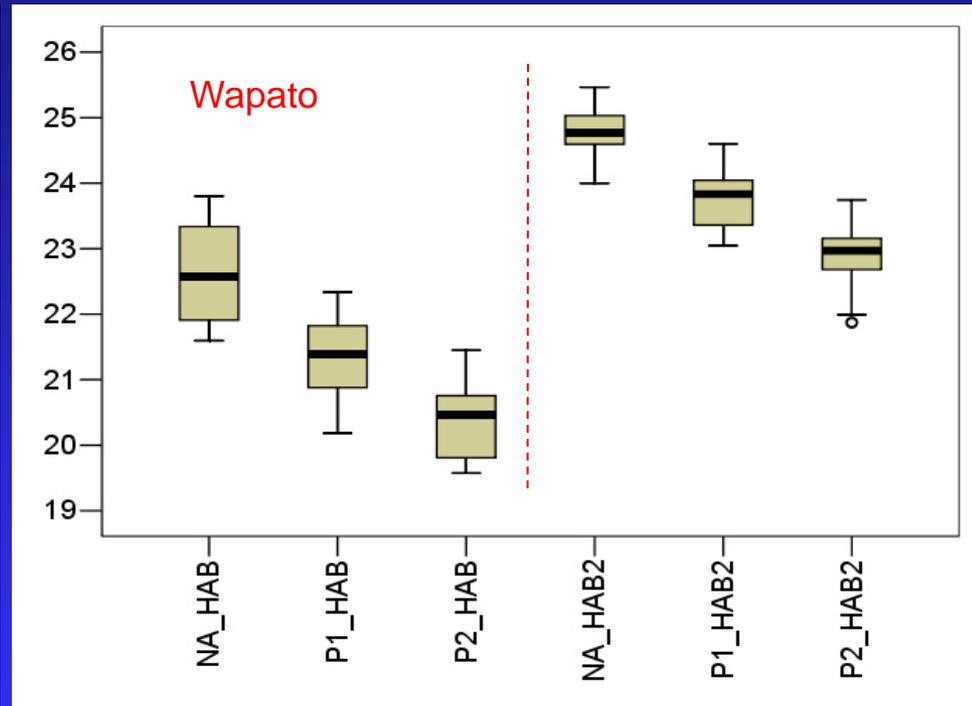
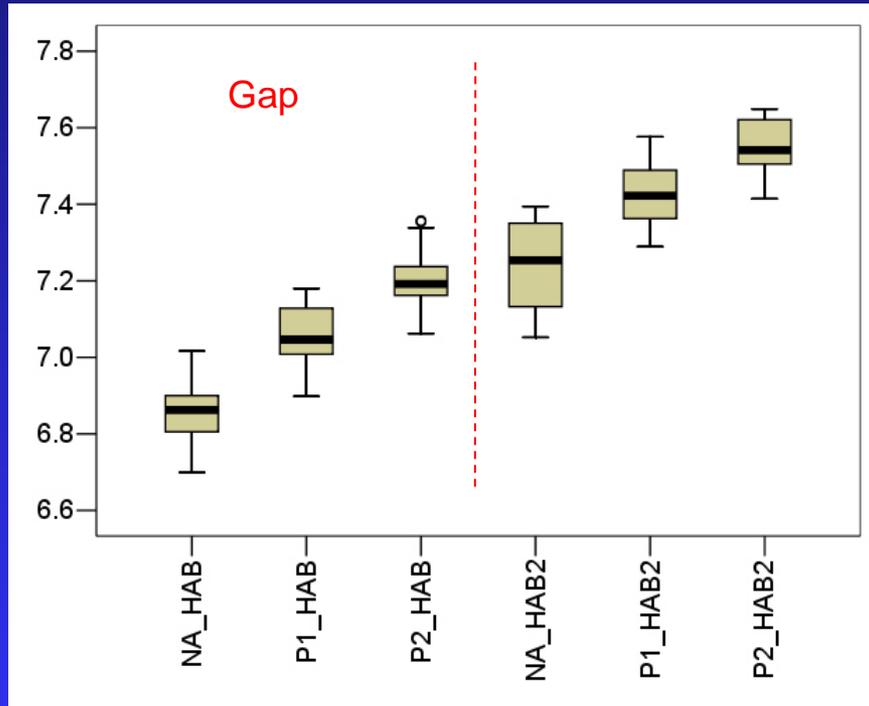


**Flows – decreasing; Lower in Wapato,
Higher in Gap**

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

Sensitivity Analysis

Decrease in flows; flow lower in Gap,
higher in Wapato



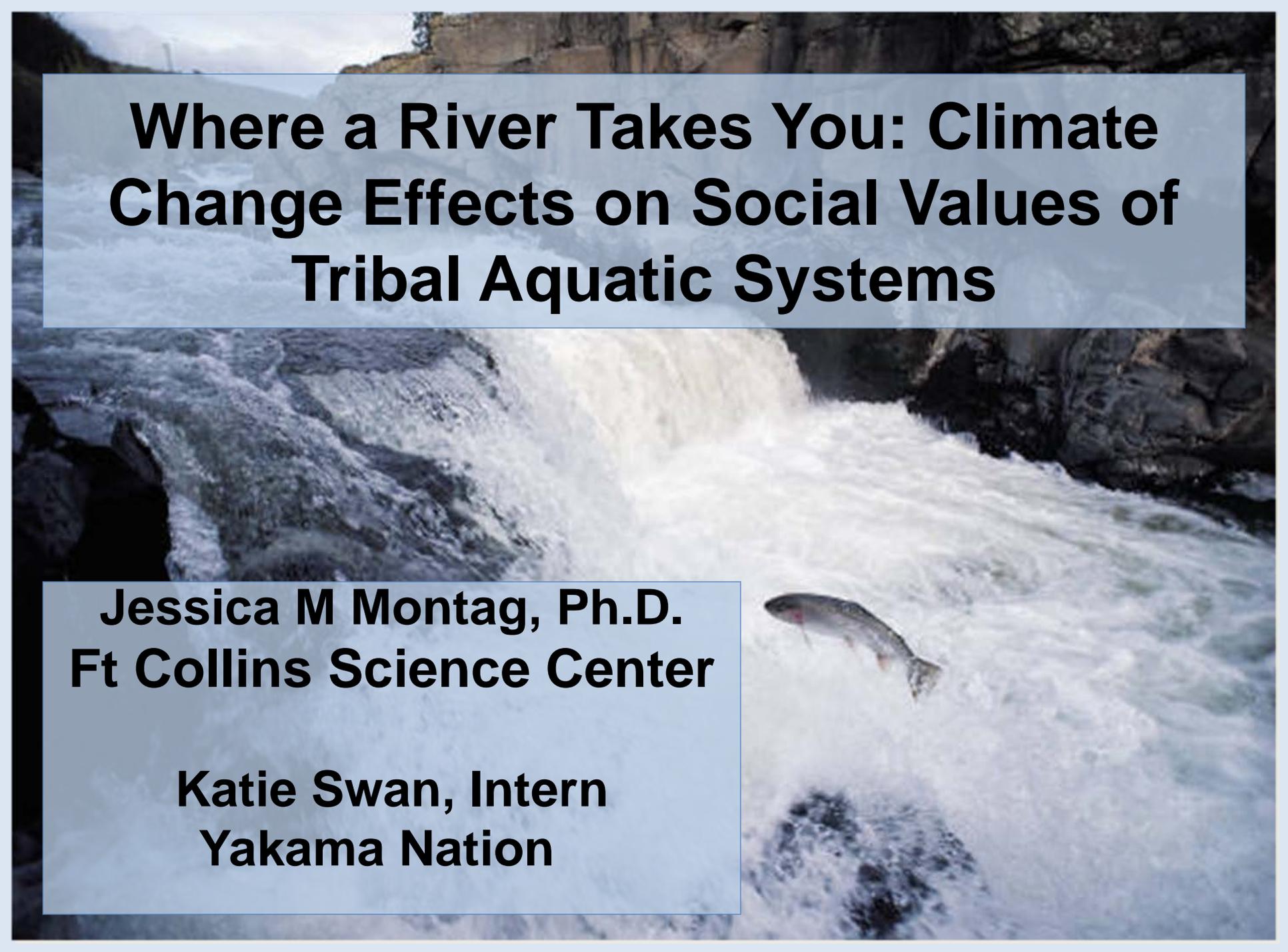
Current
Regulation

“Flip-Flop”
Water Flows

Current
Regulation

“Flip-Flop”
Water Flows

Different Geomorphology

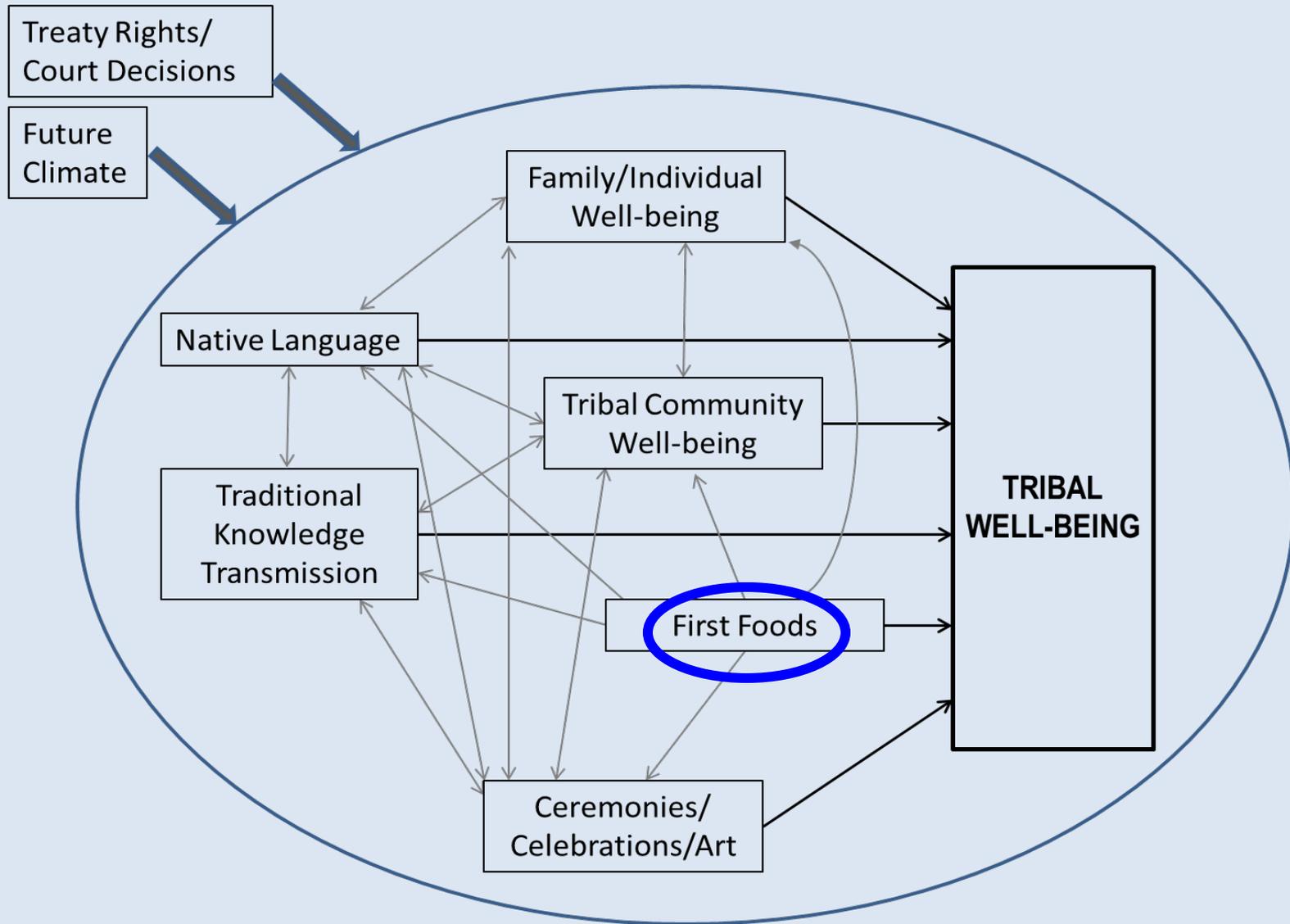
A photograph of a river with a waterfall. The water is white and turbulent as it falls over dark rocks. In the foreground, a fish is captured mid-jump, leaping out of the water. The background shows more of the river and some distant hills under a cloudy sky.

Where a River Takes You: Climate Change Effects on Social Values of Tribal Aquatic Systems

**Jessica M Montag, Ph.D.
Ft Collins Science Center**

**Katie Swan, Intern
Yakama Nation**

Tribal Well-Being





Future
Climate

Treaty Rights/
Court Decisions

Family/Individual Well-being

Tribal Community Well-being

Berries

Roots

Wildlife

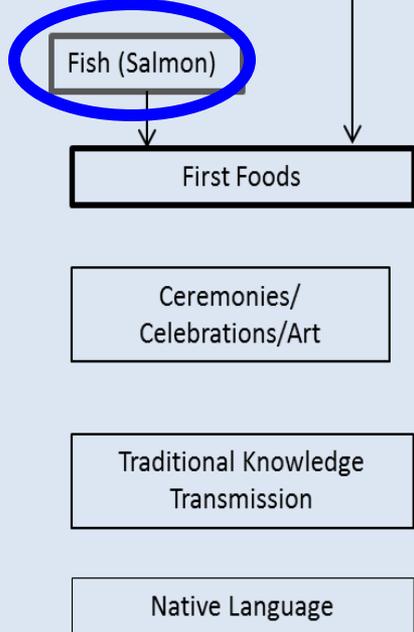
Fish (Salmon)

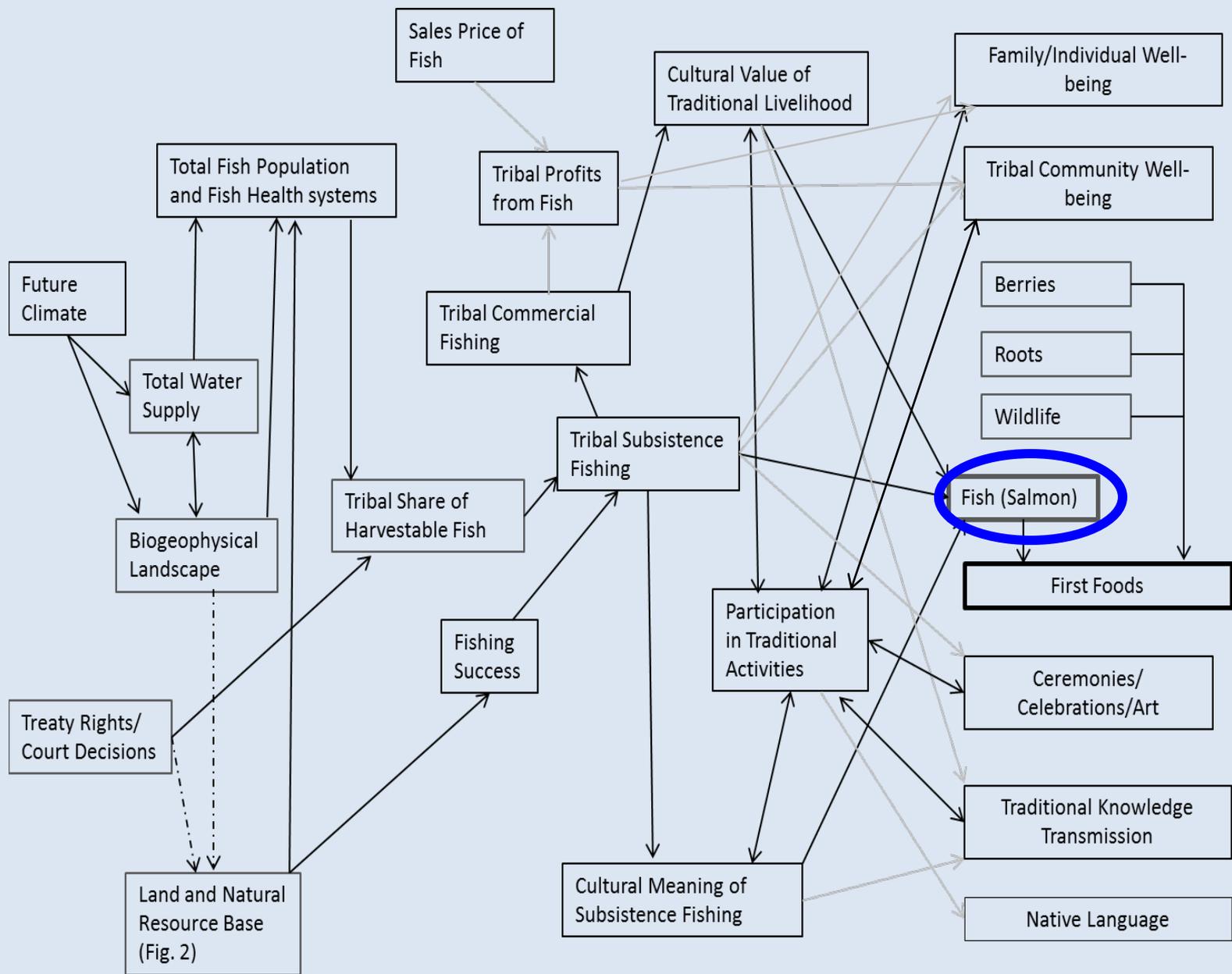
First Foods

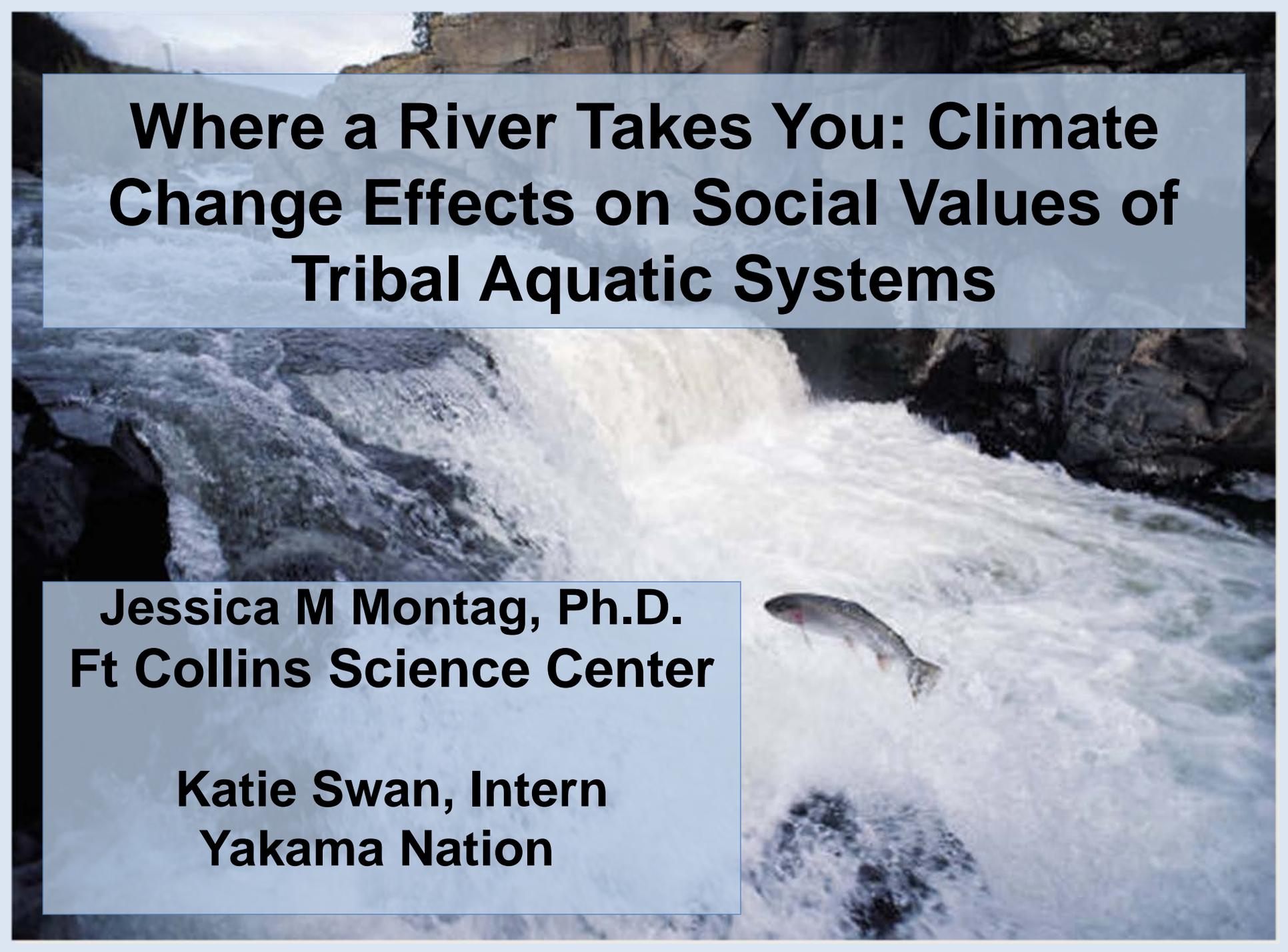
Ceremonies/
Celebrations/Art

Traditional Knowledge
Transmission

Native Language





A photograph of a river with a waterfall. The water is white and turbulent as it falls over dark rocks. In the foreground, a fish is captured mid-jump, leaping out of the water. The background shows more of the river and some distant hills under a cloudy sky.

Where a River Takes You: Climate Change Effects on Social Values of Tribal Aquatic Systems

**Jessica M Montag, Ph.D.
Ft Collins Science Center**

**Katie Swan, Intern
Yakama Nation**

Yakima Basin Chapters (1st Author)

- 1. Stakeholders' workshp & conceptual model (Jenni, Consult.)**
- 2. Mainstem temperature modeling (Voss, WaWSC)**
- 3. Tributary temperature modeling (Graves, CRITFC)**
- 4. Temperature and bioenergetics of juvenile steelhead and Chinook salmon (Hardiman & Mesa, WFRC)**
- 5. Hydrograph and available species- & life-stage-specific habitat (Hatten, WFRC)**
- 6. Estimating the effects of CC on the social & economic life of the Yakama Tribe (Montag, FORT)**

Columbia Basin CC Trans-boundary Workgroup

[Research-to-Operations (R2O); 20+ Fed (US & Canada), State, Tribal & NGOs]

Pilot project: Methow River Basin

- **Oct. 2009 First R2O meeting**
- **Jan. 2010 Methow CC Team ~20 researchers/managers**
- **March 2010 - DA Stakeholders Workshop**
- **Feb. 9 – 10, 2011 – check in with R2O**
- **March 1, 2011- check in w/ Methow Community**
- **FY2011-2012**

Columbia Basin CC Trans-boundary Workgroup

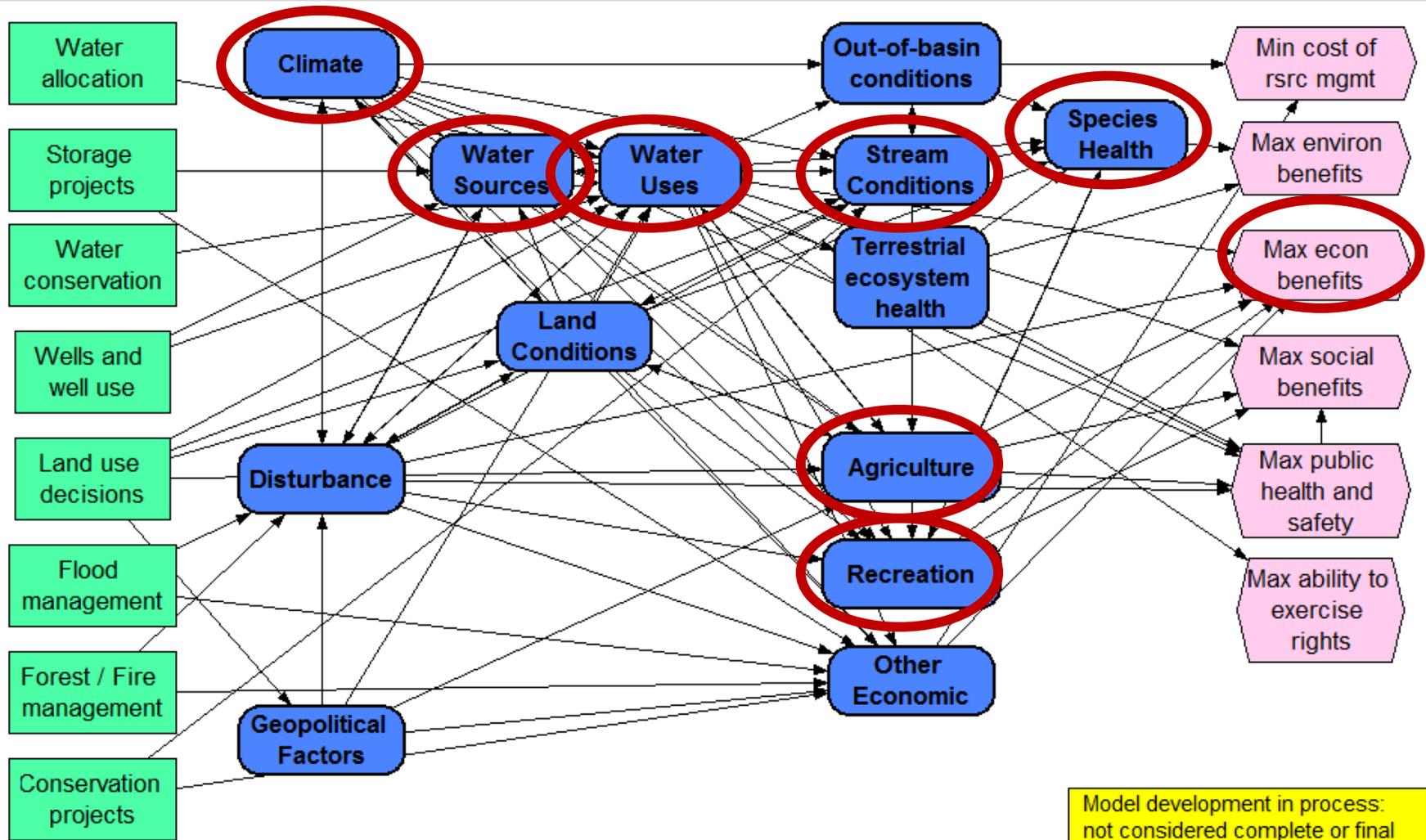
[Research-to-Operations (R2O); 20+ Fed (US & Canada), State, Tribal & NGOs]

Pilot project: Methow River Basin

Partnerships & Leveraging

- BOR (PDX) - Fish Abundance & Distribution.
- USGS Global Change - Stakeholders' Workshop
- USGS NWA - Watershed runoff model 3 CC scenarios.
- BOR (Denver) - CC & 2-D hydro model.
- GNLCC & NW CSC - CC & Habitat connectivity.
- USGS-USFS - CC & steelhead life history strategies.
- BOR (PDX) - Fisheries Modeling Center @ CRRL.
- WA DOE - funds to Methow Watershed Council

Methow River Basin Conceptual Model



2011-2012: Complete additional modeling & provide decision support tool w/ user's guide

Methow River Basin Decision Support Tool

Methow Basin Climate Impacts Model

Preliminary demonstration model only

DECISIONS

Storage Projects

Storage projects **No projects** ▼

Storage Inputs

Conservation

Water conservation **0** ▼

SCENARIOS

Climate

Climate model **Model 3** ▼ (?)

Emissions scenario **High GHG emi** ▼ (?)

Future time **All** ▼ (?)

Climate Charts

Population

M&I population gro... (per yr) **0.01** ▼

Exempt population g... (per yr) **0.02** ▼

Habitat

Fish Species **All** ▼

Life Stage WUA **List**

Recreation

Rec growth scenario **None** ▼

Rec visit growth user defined **Edit Table**

DECISIONS

Agriculture

Irrig acres planted (acres) **Edit Table**

Irrig system choices **Current** ▼

Irrig systems in use **DetermTable**

Adjust Ag Diversions **Yes** ▼

Irrig Efficiency **All ditches** ▼

Lag Scenarios **Base estimat** ▼

KEY OUTPUTS

Years to use for display **All** ▼ (?)

Avg mo streamflow contributions (cfs) **Calc** μ

Baseflow outputs by month **Calc** μ

Agr diversions, AF avg/mo (AF) **Calc** μ

Irrig % used for Crop ET, avg/mo **Calc** mid

Avg annual crop gross rev (\$) **Calc** mid

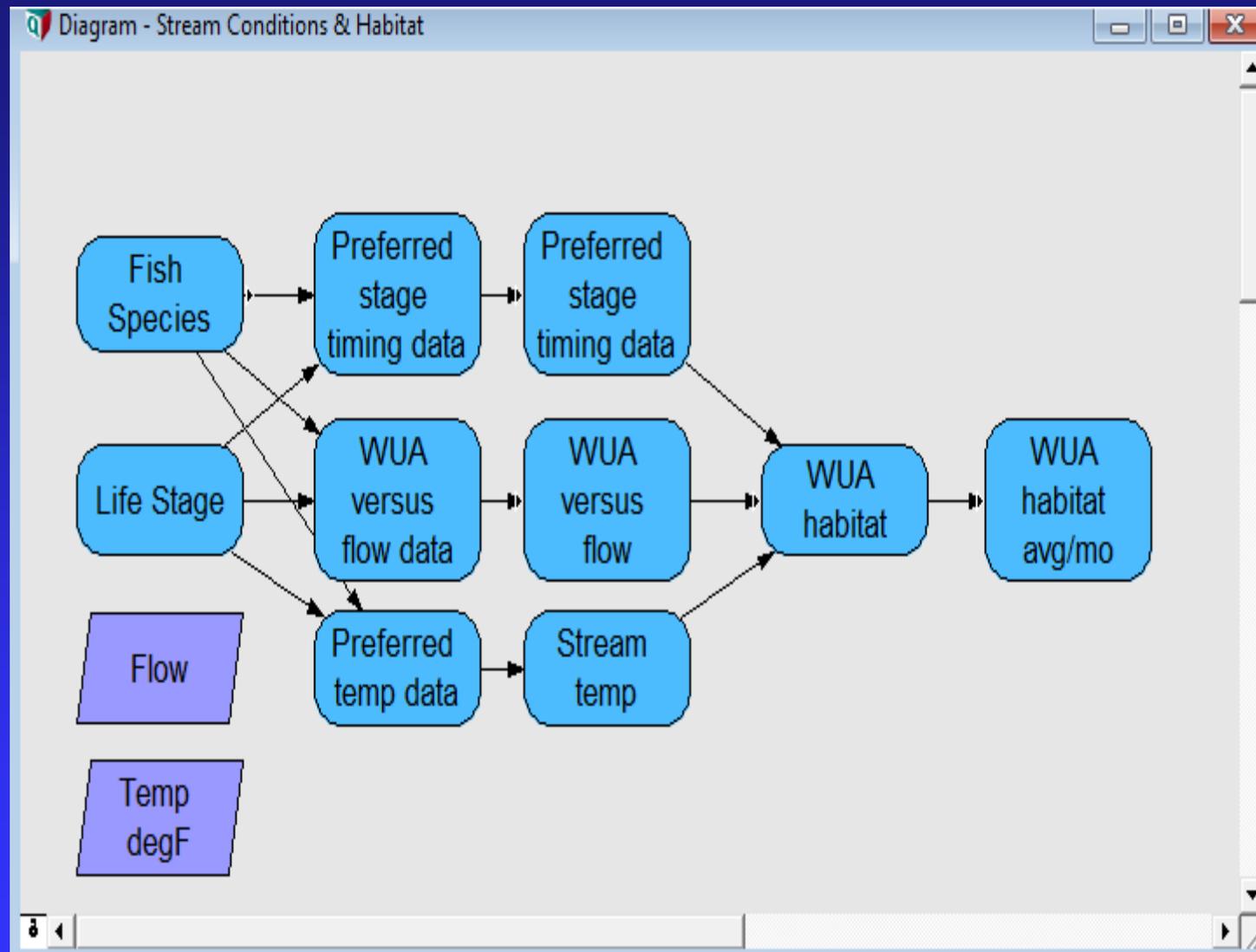
WUA habitat... (sq ft/1000 ft of stream) **Result** mid

Fish by life stage, avg/mo **Calc** mid

Visitor spending, outdoor recreation (\$) **Calc** μ

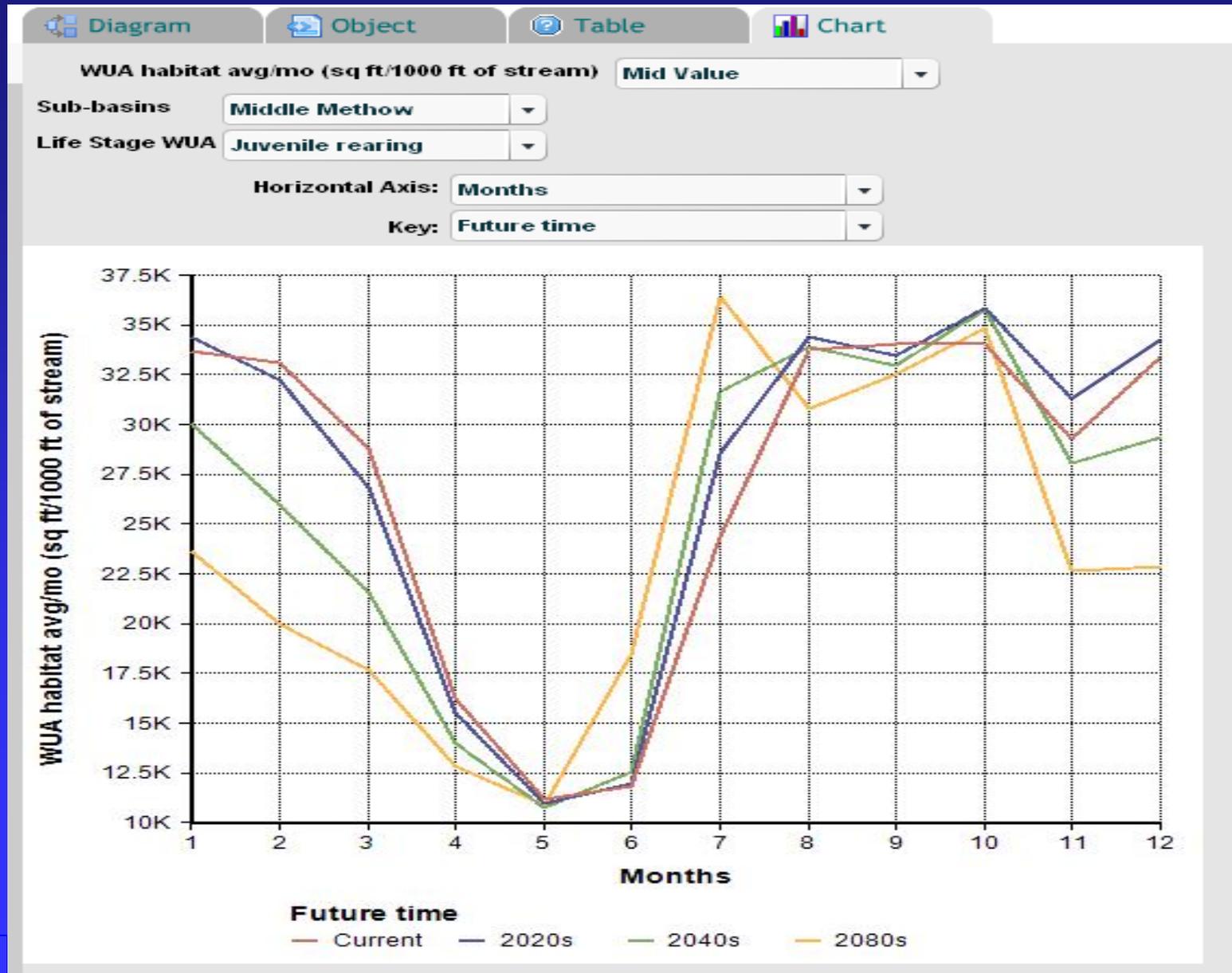
Model Details

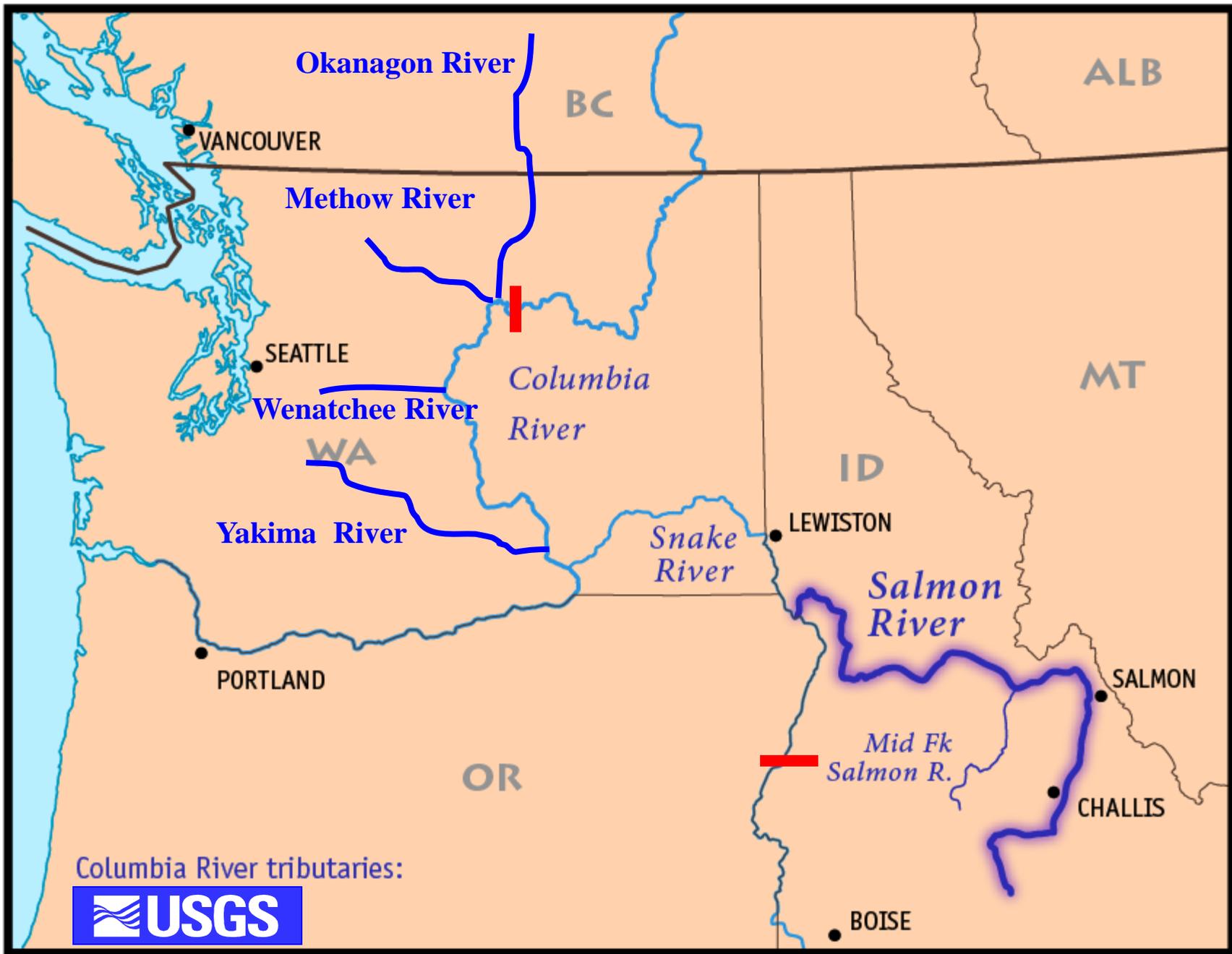
Methow River Basin Decision Support Tool



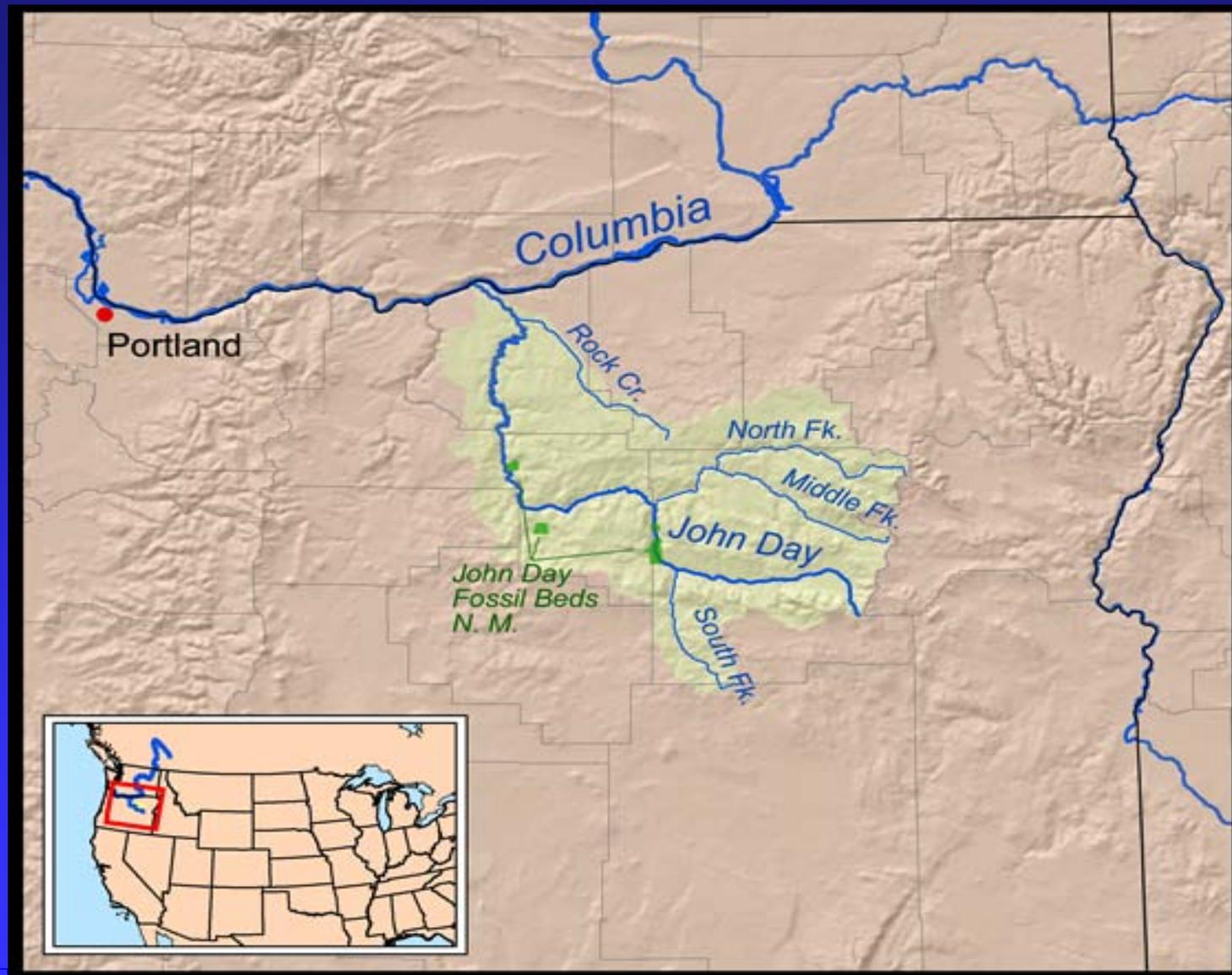
Based on: IFIM, WDOE 1992

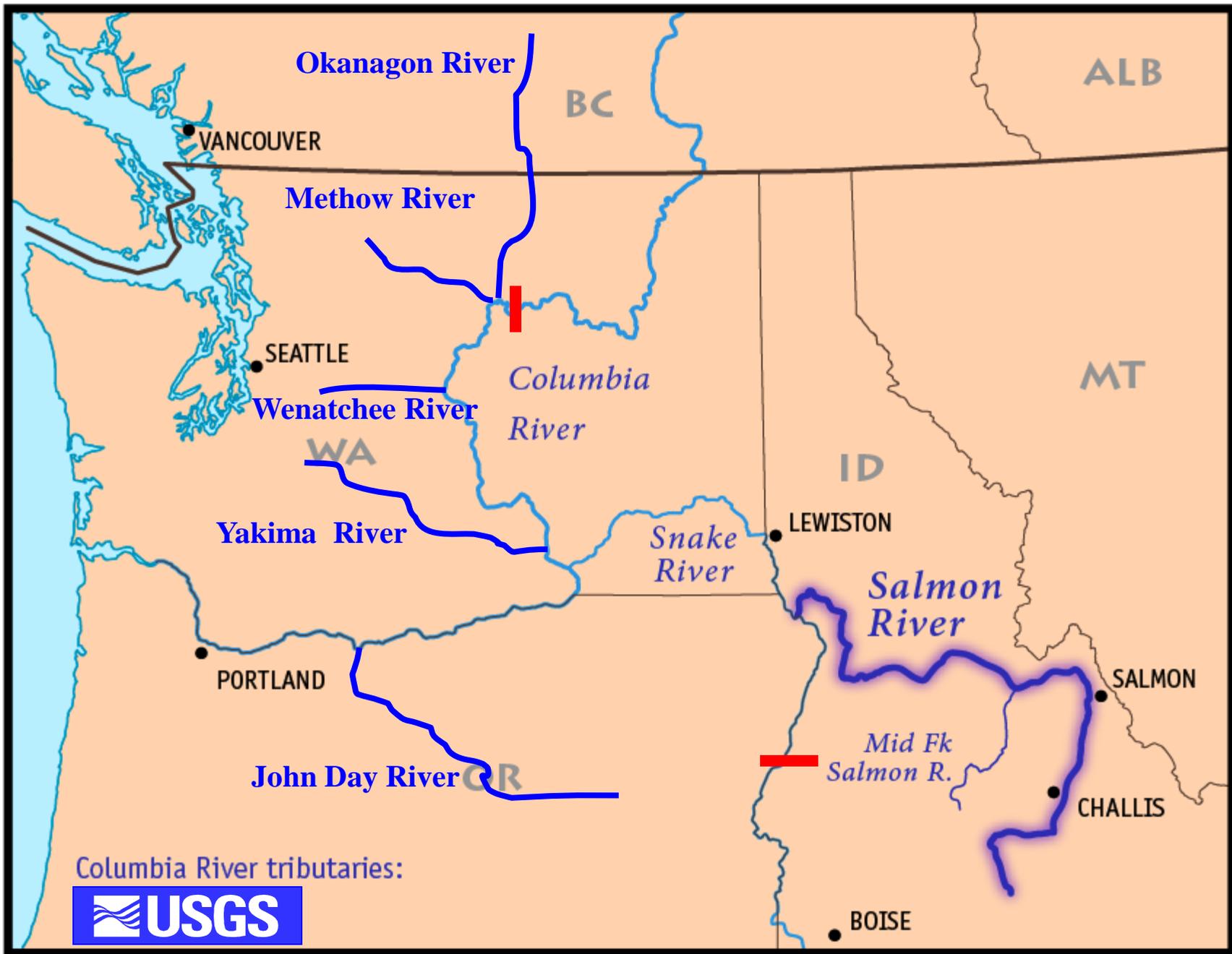
Methow River Basin Decision Support Tool





Tribal Lands & First Foods – John Day River Basin





Questions?

