Previous Fish-Climate Studies Are Coarse...

- Meisner 1988, 1990
- Eaton & Schaller 1996
- Keleher & Rahel 1996
- Rahel et al. 1996
- Mohseni et al. 2003
- Flebbe et al. 2006
- Rieman et al. 2007
- Kennedy et al. 2008
- Williams et al. 2009
- Wenger et al. 2011
- Almodovar et al. 2011
- Etc.
Air Temp ≠ Stream Temp

$r^2 = 0.26$

PRISM Air Temperature (°C)

Stream Temperature (°C)

Complex topography

Glaciation

Groundwater buffering

Riparian differences
Better Stream Climate Information = Better Decision Making?

Climate-Aquatics Workshop in Boise

Understanding and Adapting To Climate Change in Aquatic Ecosystems at Landscape and River Basin Scales: A decision support workshop for integrating research and management

Objectives: 1) climate-aquatics short-course, 2) use accurate stream climate scenarios in “real-world” prioritization exercise, 3) receive manager feedback

Attendees: In-house 60 attendees from 16 different state, federal, tribal, private resource organizations; Online > 400 webinar short-course participants
A Real World Example Using Accurate Spatial Data for Fish & Climate

Spatial data layers
1. Boise Basin Topography
2. Land ownership
3. Roads
4. Fish barriers from road culverts
5. Recent wildfire perimeters
6. Crown fire potential
7. Stream gradient
8. Unconfined valley bottoms
9. Extant bull trout populations
10. Brook trout occurrence
11. Historic & future summer temperatures
12. Historic & future summer stream flow
13. Historic & future winter flood frequency

Existing Bull Trout Populations

Interagency, Interdisciplinary Groups
Bull Trout Climate Decision Support Tool

Tool integrates stream climate & habitat quality parameters

Downscaled Stream Scenarios

VIC Hydrology

NorWeST temp

How Did It Work?

Stream Climate Scenarios

Priorities

VIC Hydrology

NorWeST temp

Decision Support Tool

Spatial Data Layers
Subsequent Focus on Developing High-Resolution Stream Climate Scenarios

GCM → Regional Climate → Stream reach

River network
VIC Streamflow Scenarios

Ecological Flow Metrics

Website: http://www.fs.fed.us/rm/boise/AWAE/projects/modeled_stream_flow_metrics.shtml

A1B IPCC Scenarios for the western U.S.

NHD+ stream segment resolution

Google “Stream flow Metrics”

Wenger et al. 2010. Water Resources Research 46, W09513
NorWeST Stream Temp Scenarios

>60 agency contributors

Isaak et al. 2010. Ecol. Apps. 20:1350-1371
Historic Scenario for SpoKoot Unit
1993-2011 mean August stream temperatures

1 kilometer resolution
55,000 stream kilometers
NorWeST Website Distributes Stream Temperature Data & Scenarios

1) GIS shapefiles of stream temperature scenarios

2) GIS shapefiles of stream temperature model prediction precision

3) Temperature data summaries

Google “NorWeST” or go here...

http://www.fs.fed.us/rm/boise/AWAE/projects/NorWeST.shtml
Climate-Smart Strategic Prioritization of Stream Restoration

- Maintaining/restoring flow...
- Maintaining/restoring riparian...
- Restoring channel form/function...
- Prescribed burns limit wildfire risks...
- Non-native species control...
- Improve/impede fish passage...

High Priority

Low Priority
NorWeST is “Crowd-Sourced” and Developed from Everyone’s Data.

Data Collected by Local Bios & Hydros

Coordinated, Interagency Responses?

Management Actions
Can We Bring it All Together & Make Difficult, Proactive Choices?
Better Information Should Enable Better Decisions, but...

Invest Here

...future uncertainties are large
...no guarantees
humans are rational creatures

Sorry Charlie

Not here?
Start Thinking about Fish Reserves
Where can we maintain native fishes?

**Feature:**
FISHERIES MANAGEMENT

Native Fish Conservation Areas: A Vision for Large-Scale Conservation of Native Fish Communities

Jack E. Williams, Richard N. Williams, Russell F. Thurow, Leah Elwell, David P. Philipp, Fred A. Harris, Jeffrey L. Kershner, Patrick J. Martinez, Dirk Miller, Gordon H. Reeves, Christopher A. Frissell, and James R. Sedell

The Past as Prelude to the Future for Understanding 21st-Century Climate Effects on Rocky Mountain Trout

The End
How Fast Are Fish Distributions Shifting?

Distribution shift rates for terrestrial species:
6.1 km/decade poleward
OR
6.1 m/decade higher


March of the fishes...
Significant Unknowns:
How Much Habitat is Needed to Persist?

Westslope cutthroat trout

<table>
<thead>
<tr>
<th>Occurrence</th>
<th>Stream length (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$p &gt; 0.5$</td>
<td>$\sim 2$</td>
</tr>
<tr>
<td>$p &gt; 0.9$</td>
<td>$\sim 10$</td>
</tr>
</tbody>
</table>
NorWeST Related Projects...

- Regional bull trout climate vulnerability assessment (J. Dunham)
- Cutthroat & bull trout climate decision support tools (Peterson et al., 2013)
- Landscape-scale bull trout monitoring protocol (Isaak et al. 2009)
- Consistent thermal niche definitions & more accurate bioclimatic models for trout & nongame fishes (S. Wenger, In Prep.)
- Efficient stream temperature monitoring designs

“Apps” Run on a Consistent Data Network