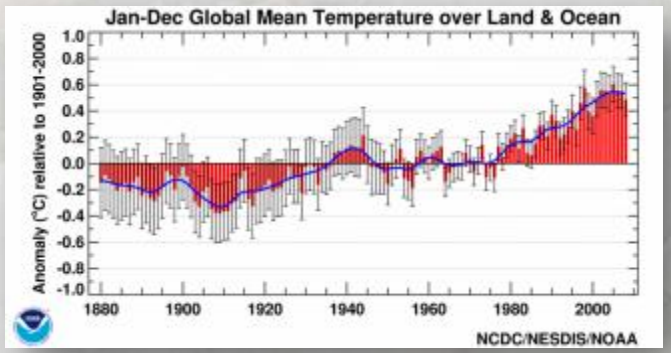
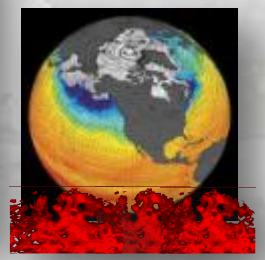
Crowd-Sourcing, Digital Media, & Building Social Networks for Landscape Conservation of Native Trouts in the Climate Change Era

Dan Isaak, US Forest Service

Rocky Mountain Research Station

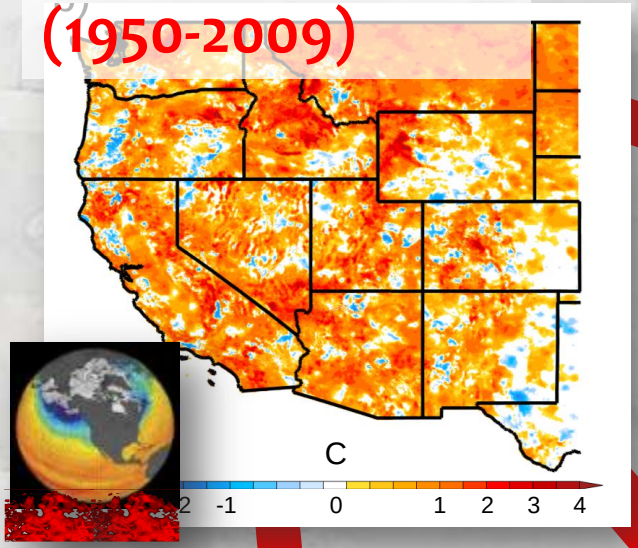
disaak@fs.fed.us; 208-373-4385

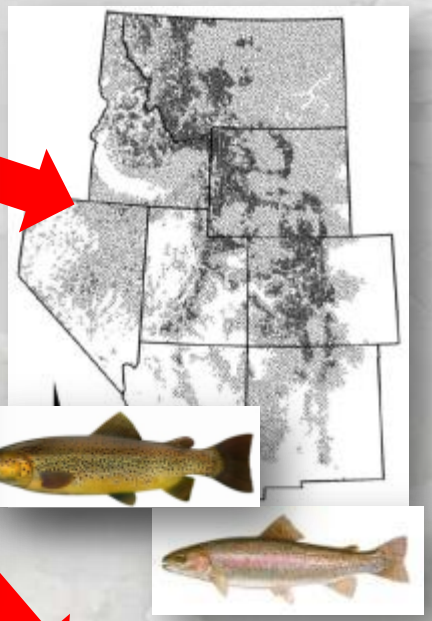


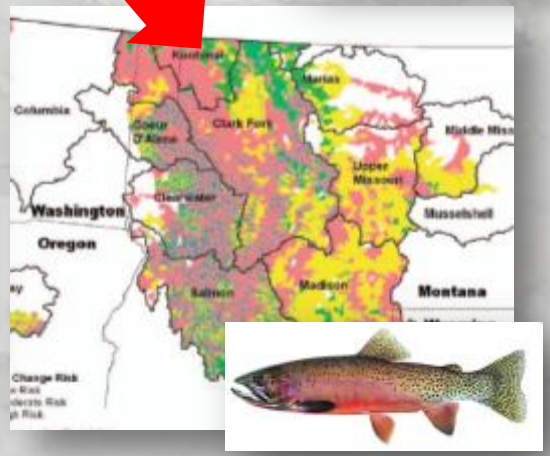


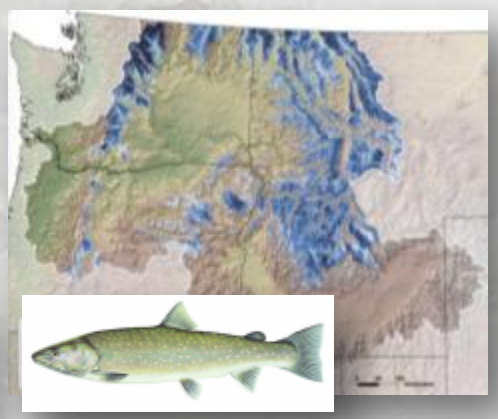
If You're a Coldwater Fish, The Future Ain't so Pretty…

Air Temp trends (1950-2009)







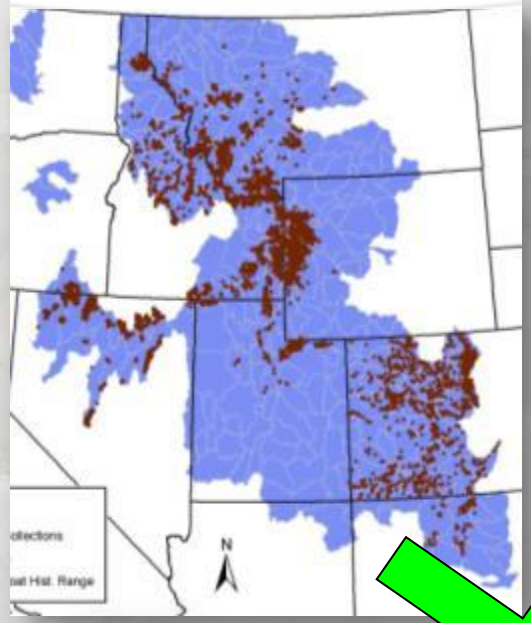


Many Studies…

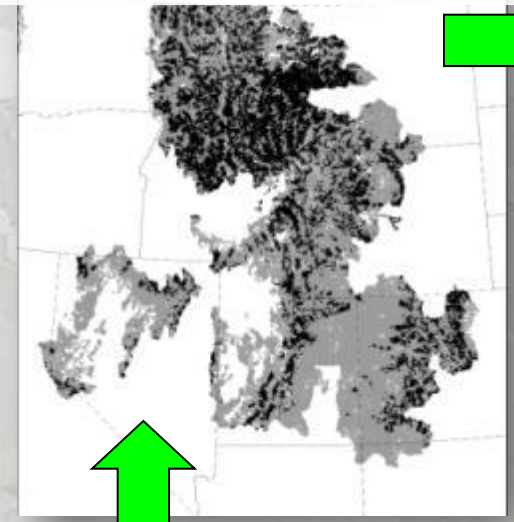
- Meisner 1988, 1990
- Eaton & Schaller 1996
- Keleher & Rahel 1996
- Rahel et al. 1996
- Mohseni et al. 2003
- Flebbe et al. 2006
- Rieman et al. 2007
- Kennedy et al. 2008
- Williams et al. 2009
- Wenger et al. 2011
- Almodovar et al. 2011

Rocky Mountain Trout Climate Assessment

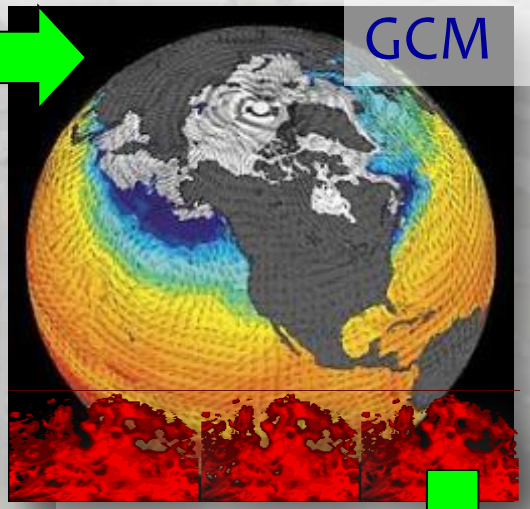
Fish survey database
~10,000 sites



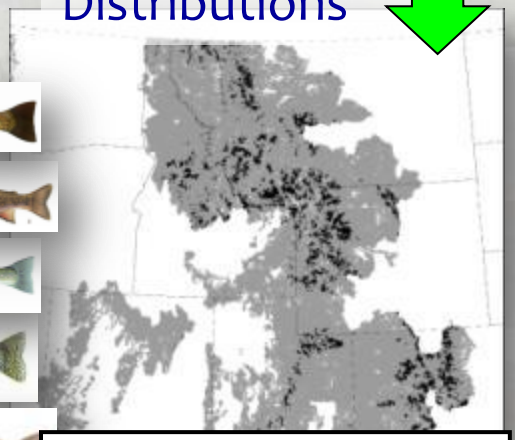
Historic Distributions



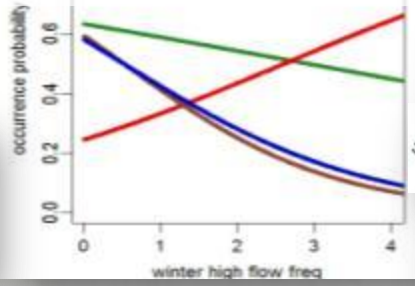
GCM



Future A1B Distributions



Species-Specific Habitat Response Curves

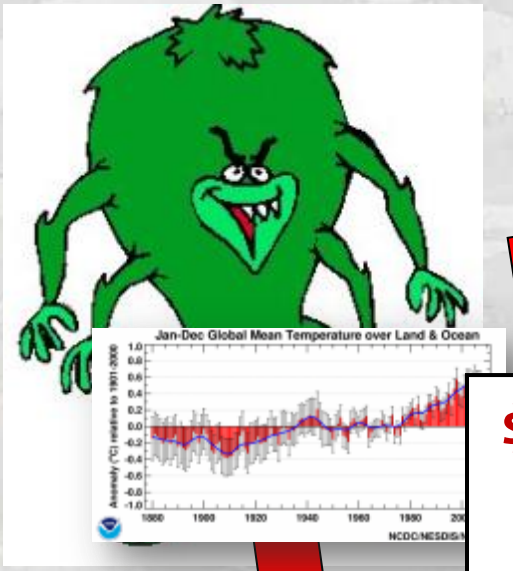


~50% reduction by 2080 under A1B

Wenger et al. 2011. *PNAS* **108**:14175-14180

There's A Lot on the Line…

Climate Boogeyman



Recreational/Commercial Fisheries

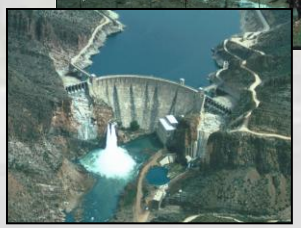
Low Flows Prompt Fishing Closure On Upper Beaverhead River And Reduced Limits On Clark Canyon Reservoir

Wednesday, September 29, 2004
Fishing

High Water Temperature In Grande Ronde Kills 239 Adult Spring Chinook

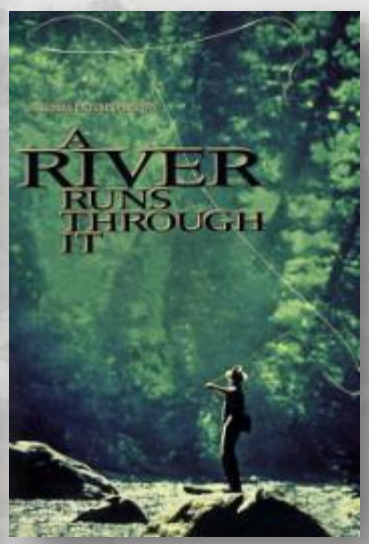
$4 Billion on Fish & Wildlife Recovery Efforts in PNW Since 1980 (ISAB/ISRP 2007)

Land Use & Water Development



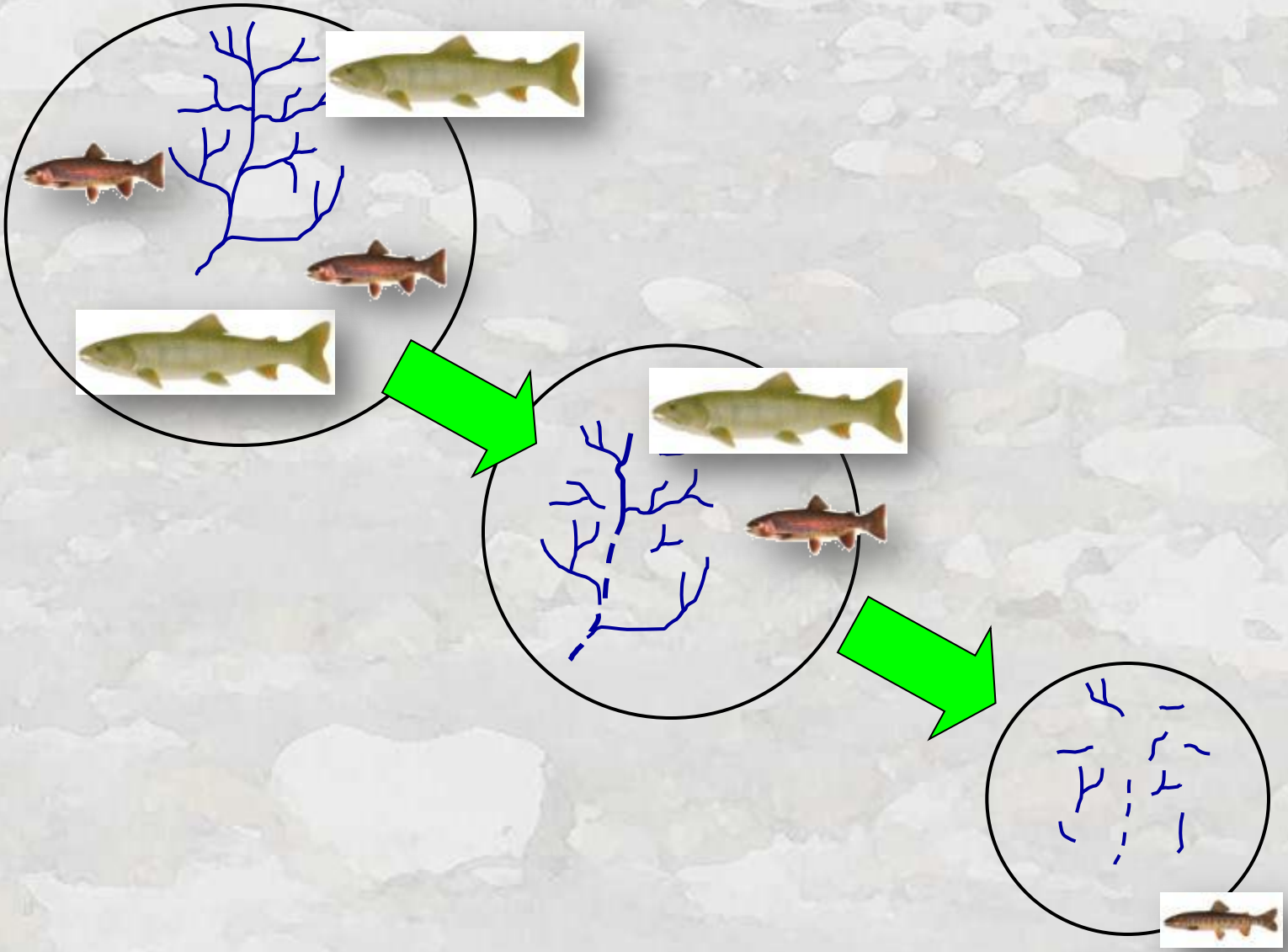
ESA Listed Species

People Love These Fish & Landscapes



We'll Have to Make Difficult Choices

Not all Populations Can be Saved



We'll Have to Make Difficult Choices

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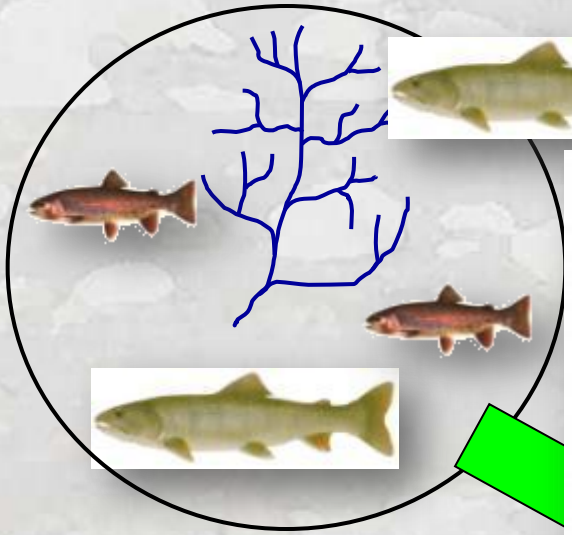
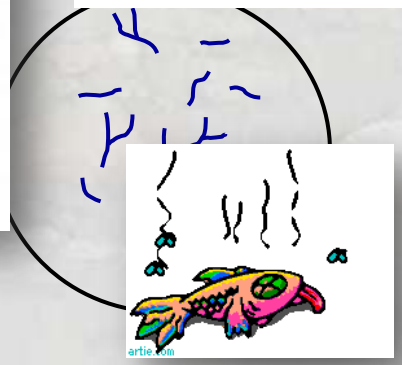


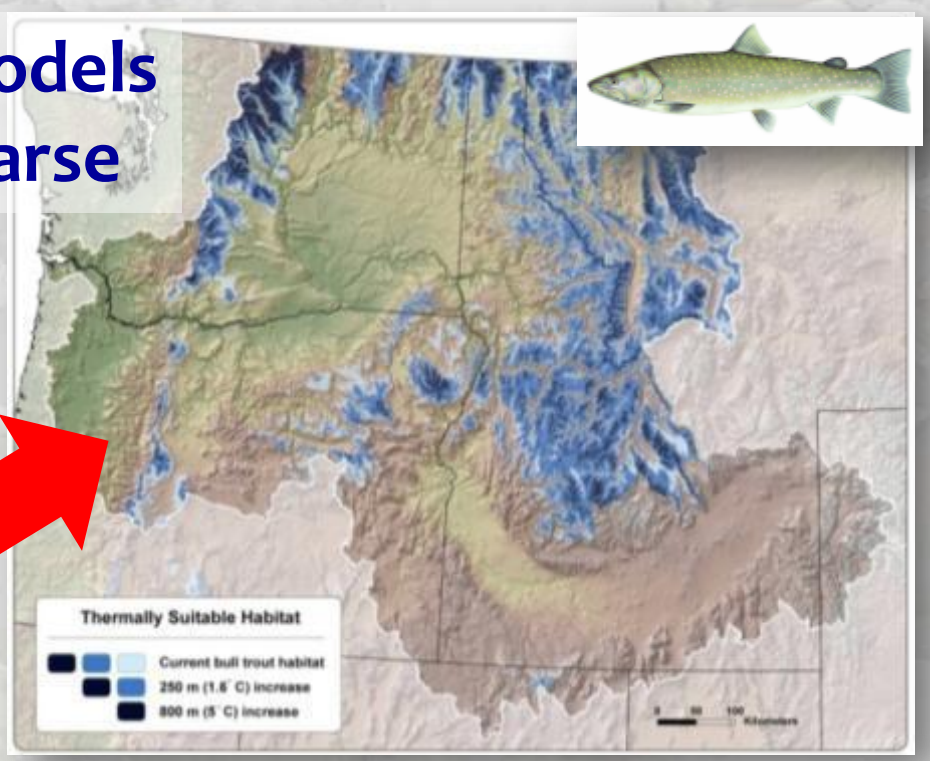
Sorry Charlie



Thresholds Beyond Which Populations Become "Walking Dead"

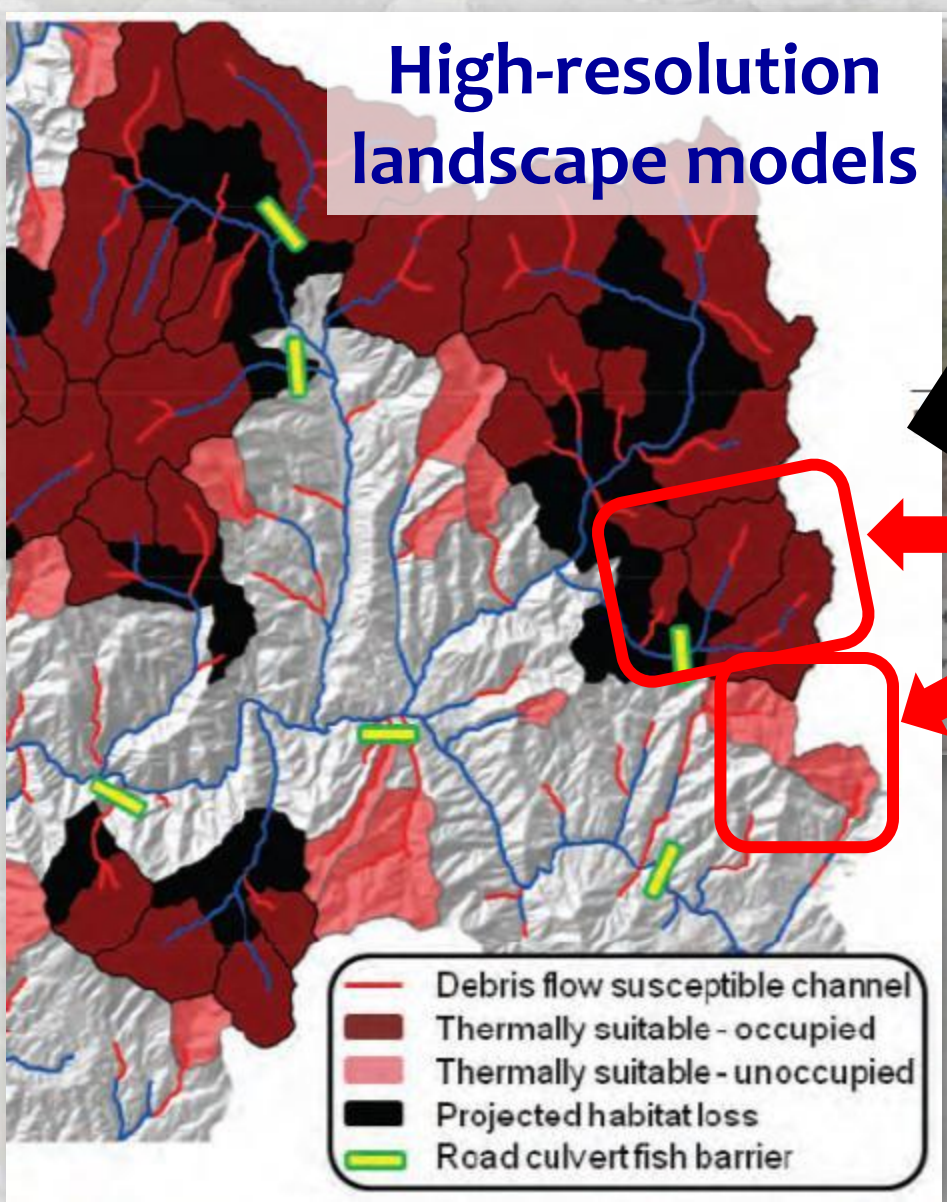
Precise Information Needed to Empower Local Decision Makers

Regional models are too coarse



Not Good Enough for Zombie Detection

Precise Information Needed to Empower Local Decision Makers



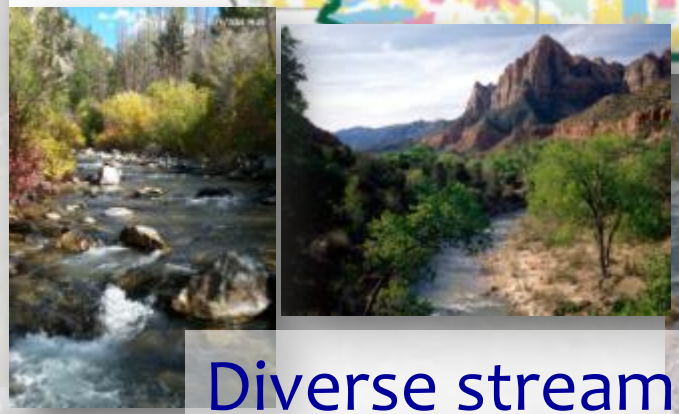
I'm going to invest here...

... instead of here

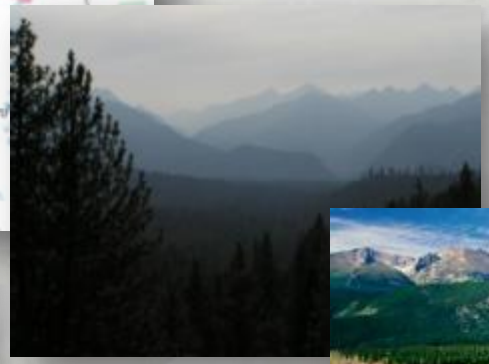
Information Needed Across Broad Areas, Multiple Agencies & Remote Locations

>1,000,000 kilometers of stream

- 193 Million Acres (10% of US)
- 155 National Forests

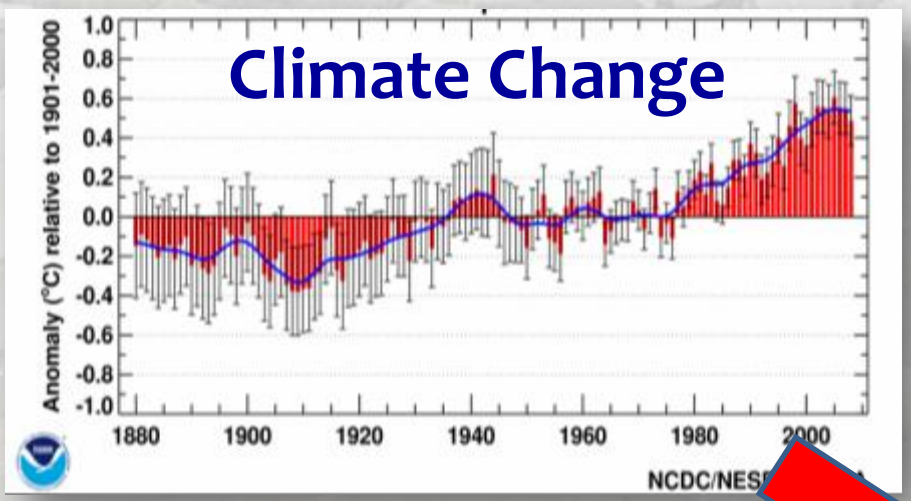


Diverse streams



Remote landscapes

More Pressure, Fewer Resources



Urbanization & Population Growth

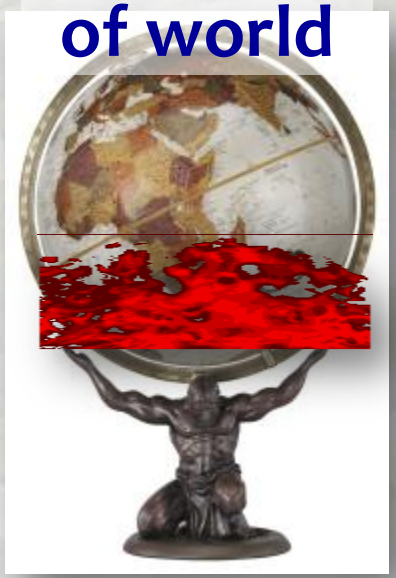
Shrinking Budgets

Need to do more with less

Climate Boogeyman

Onus?

Weight of world



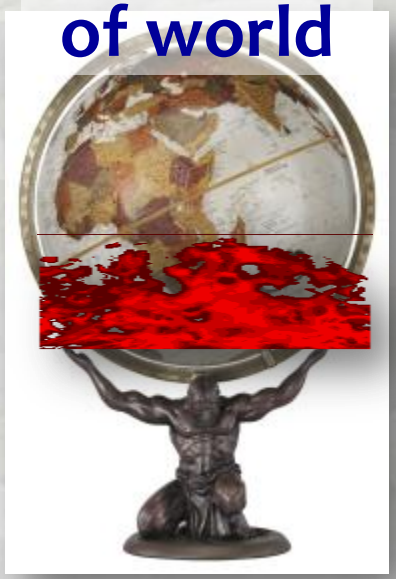
Climate Boogeyman

Opportunity?

Analytical Capacity

- Remote sensing/GIS
- Georeferenced, corporate databases
- Computational capacity
- Spatial models

Weight of world



Interagency Collaboration

IDAHO FISH & GAME

USGS science for a changing world

BONNEVILLE POWER ADMINISTRATION

FOREST SERVICE U.S. DEPARTMENT OF AGRICULTURE

CLIMATE IMPACTS GROUP

U.S. FISH & WILDLIFE SERVICE

CENTER FOR ECOHYDRAULICS RESEARCH University of Idaho

TROUT UNLIMITED

NOAA Fisheries

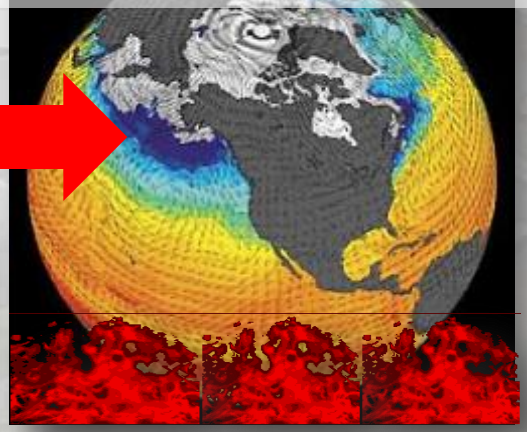
All agencies under pressure to "do something"…

Geospatial Technologies & Spatial Analyses Translate Science to "Real-World" Coordinates

Remote Sensing

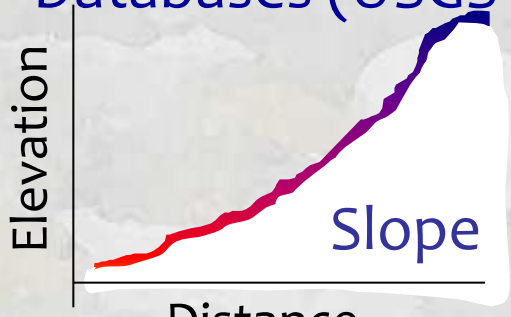
GIS / Computing Capacity

Climate, weather, GCM data online



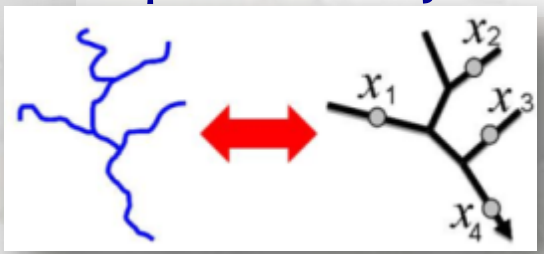
Visualization

Nationally Consistent Hydrology Databases (USGS NHD+)



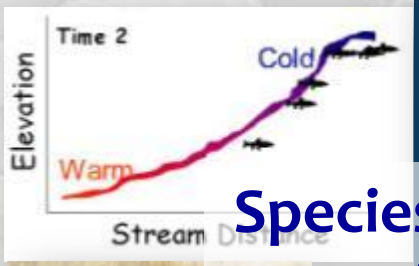
Drainage Area

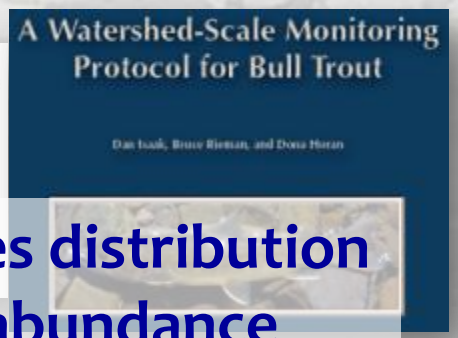
Spatial analyses



Local Measurements Provide Model Calibration

Standard Protocols, Inexpensive Sensors/Bioassays



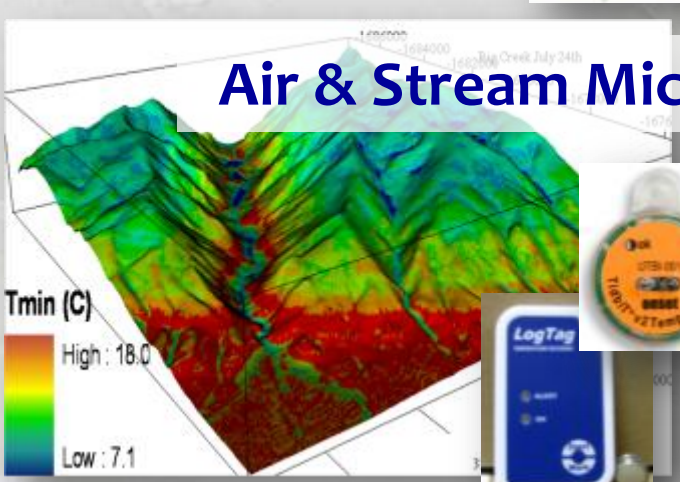


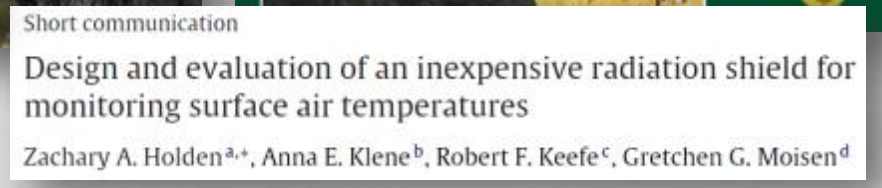
Species distribution & abundance

Stream discharge

Tissue Samples & DNA barcoding

Air & Stream Microclimates





Huge Potential Synergies Between Researchers, Managers, & the Public

Huge Land Base

NOAA Fisheries

+

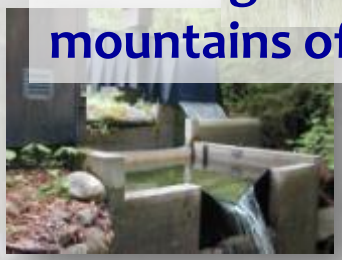
"Boots-on-the-Ground"

USFS has ~600 fish bios/hydros.
(That's an aquatics army!)

+

+

Managers collecting mountains of useful data



+

+

Researchers can develop information & connect people

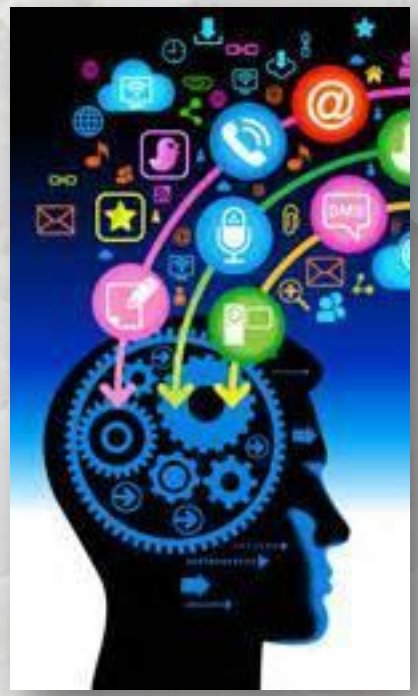
Information Development & Dissemination Has Been Revolutionized

Top-Down Control Has Evolved to Open Networks

Access to "Free" & Ubiquitous Information is a Game Changer

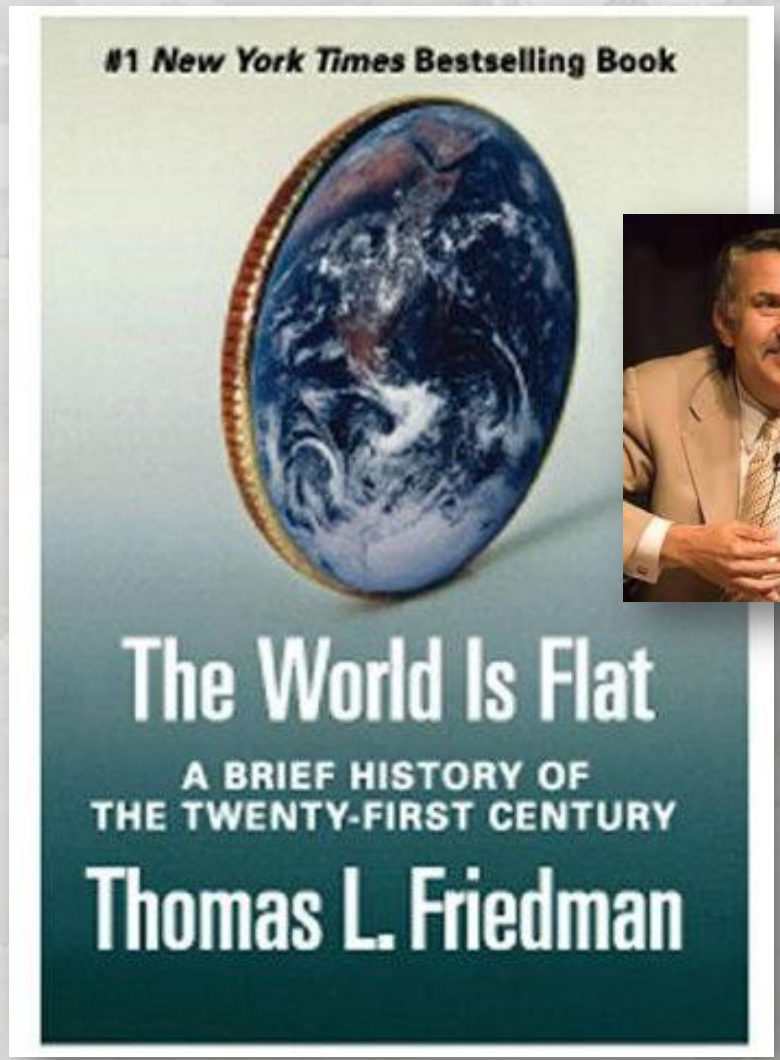
Proliferation of Digital Media Types

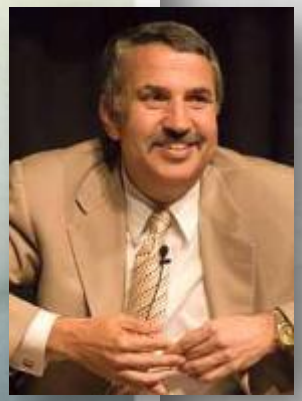
Low- or no-cost to use



If you can think it, you can create it…

Good Ideas & Tools Can Spread Rapidly



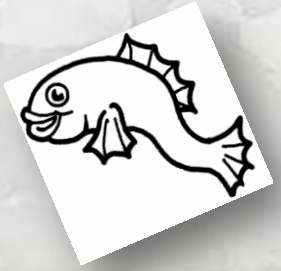


What-else explains twenty-something billionaires?

A digital meritocracy with low barriers to entry & the playing field is more level

Examples: Climate-Aquatics Blog

- Digest & transfer latest/greatest science rapidly
- Facilitate global discussion & community building
- Blog mailing list grows from <500 to >5,500 in 2.5 years



Google groups Discussion site

Map shows locations where blog website was accessed in last month

Google "Climate-Aquatics Blog"

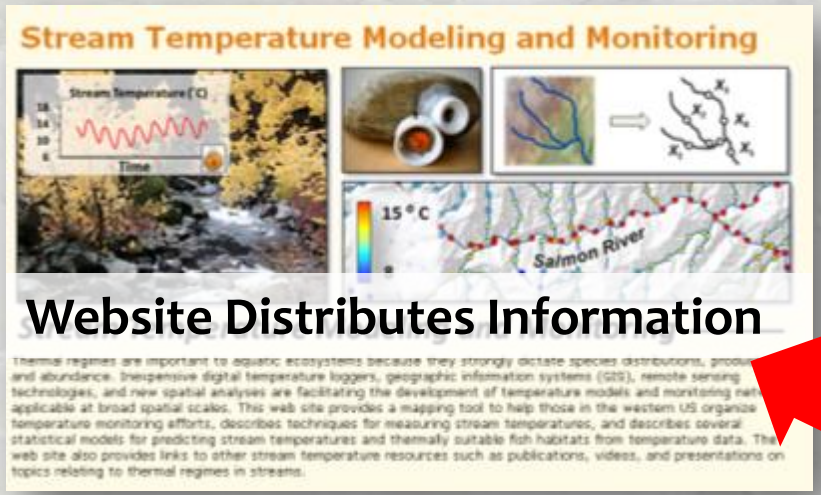
Distributing New Temperature Monitoring Protocol

Annual Flooding Concerns Limit Data Collection

Solution: Glue sensors to large boulders & permanent cement structures

$130 = 5 years of data

Isaak & Horan 2011. *NAJFM* 31:134-137

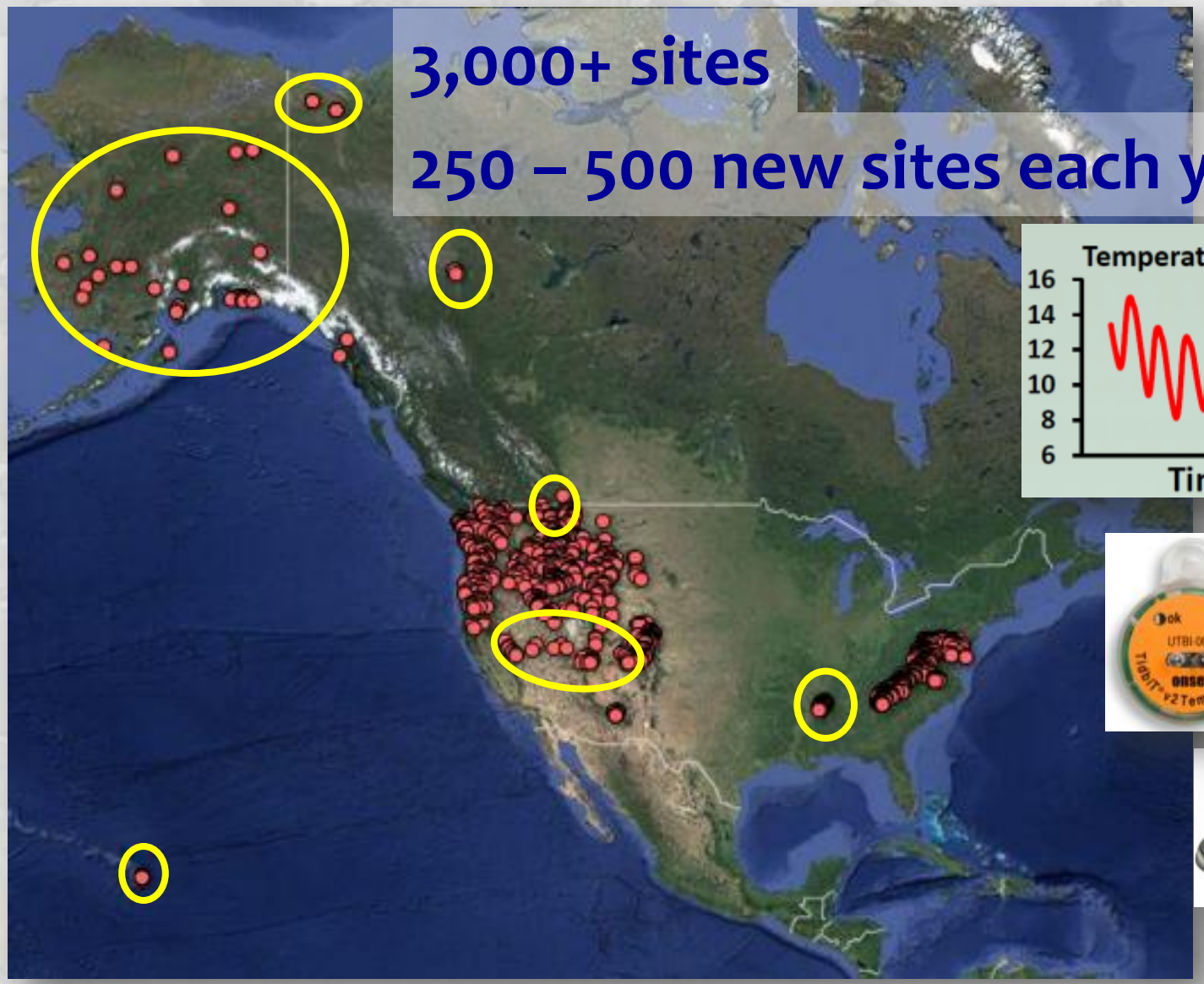


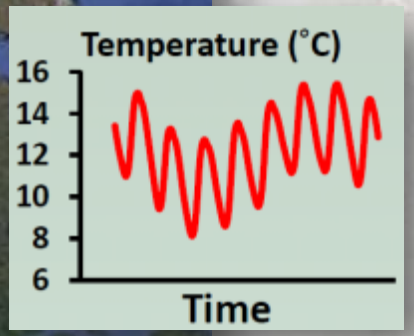
Website Distributes Information

Training Video & Manual

Google "**Stream temperature Forest Service**"

Rapid Protocol Adoption & Emergence of Annual Temperature Monitoring Network





GoogleMap Tool Shows Monitoring Locations Across Agencies to Coordinate Efforts

Regional Sensor Network

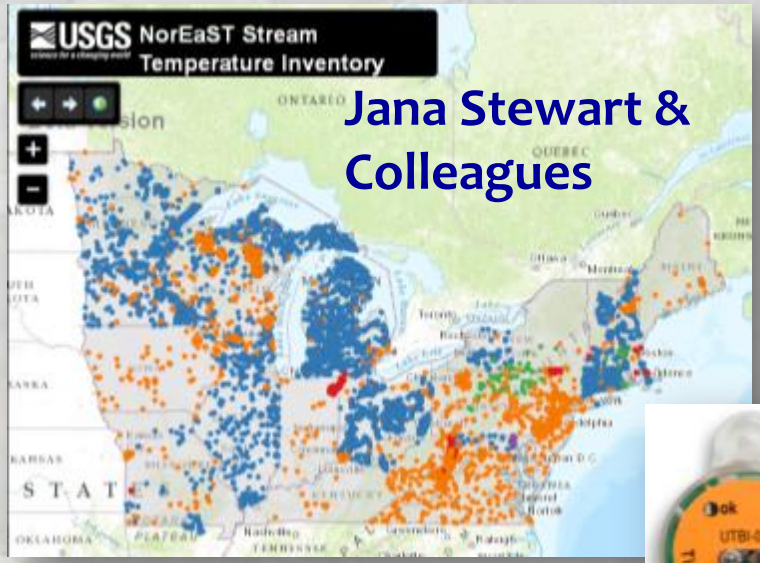
Site Information

- Stream name
- Data steward contact information
- Agency
- Site Initiation Date

Query Individual Sites

Crowd-Sourced Temperature Databases

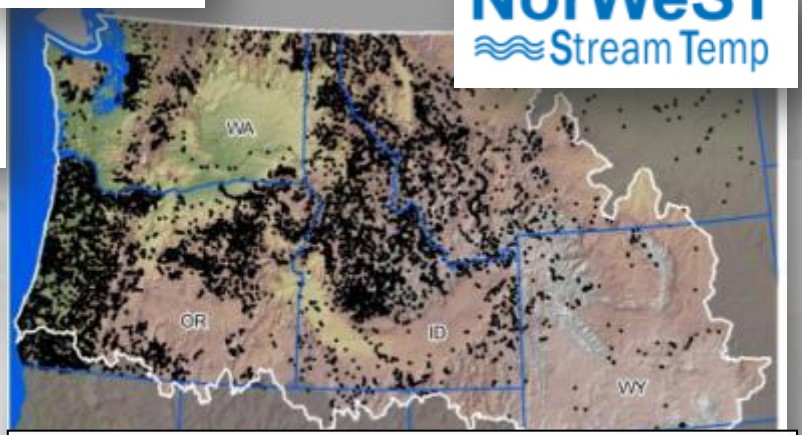
Regional projects developing massive databases



Jana Stewart & Colleagues

Free millions!

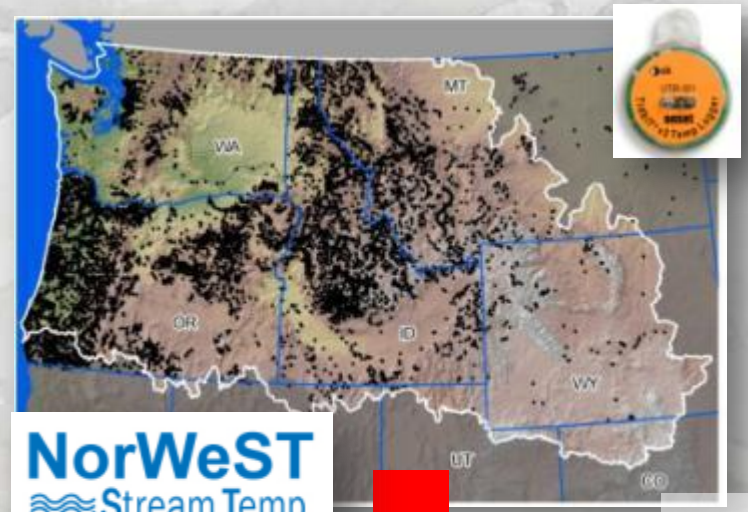
NorWeST Stream Temp



Small teams linked through virtual networks organize data

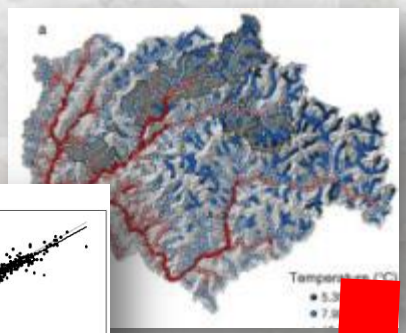
>60 agencies
>45,000,000 hourly records
>15,000 unique sites

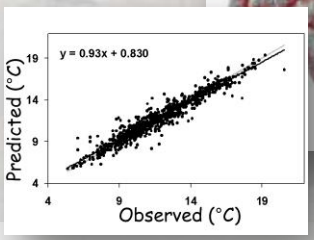
Regional Stream Temp Model



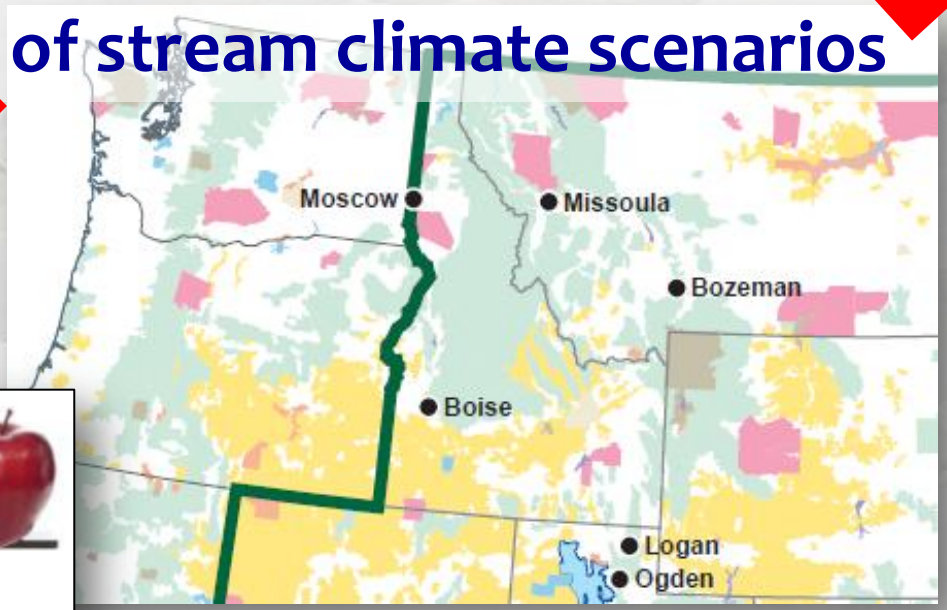
NorWeST Stream Temp

Accurate stream temp model

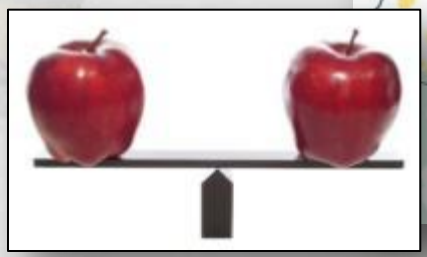




Cross-jurisdictional "maps" of stream climate scenarios



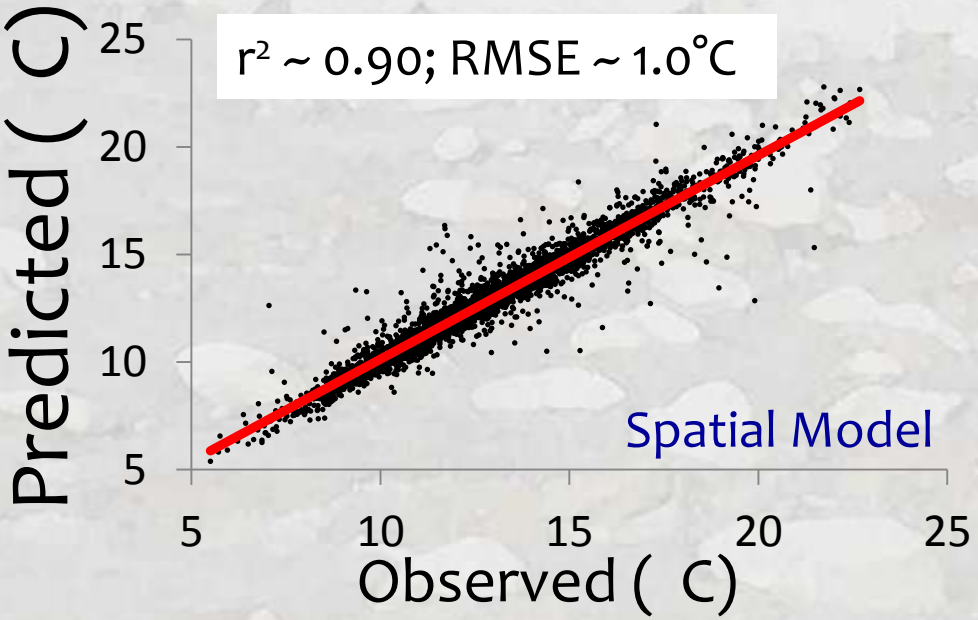
Consistent datum for strategic assessments across 400,000 stream kilometers



NorWeST Model Predictors are from National GeoSpatial Layers (NHD+, NLCD, etc.)

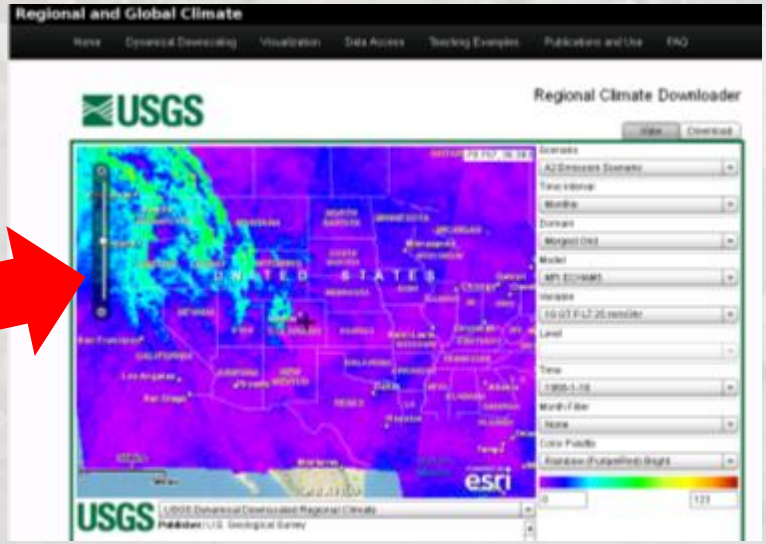
Spatial Predictors

1. Elevation (m)
2. Canopy (%)
3. Stream slope (%)
4. Ave Precipitation (mm)
5. Latitude (km)
6. Lakes upstream (%)
7. Baseflow Index
8. Watershed size (km²)

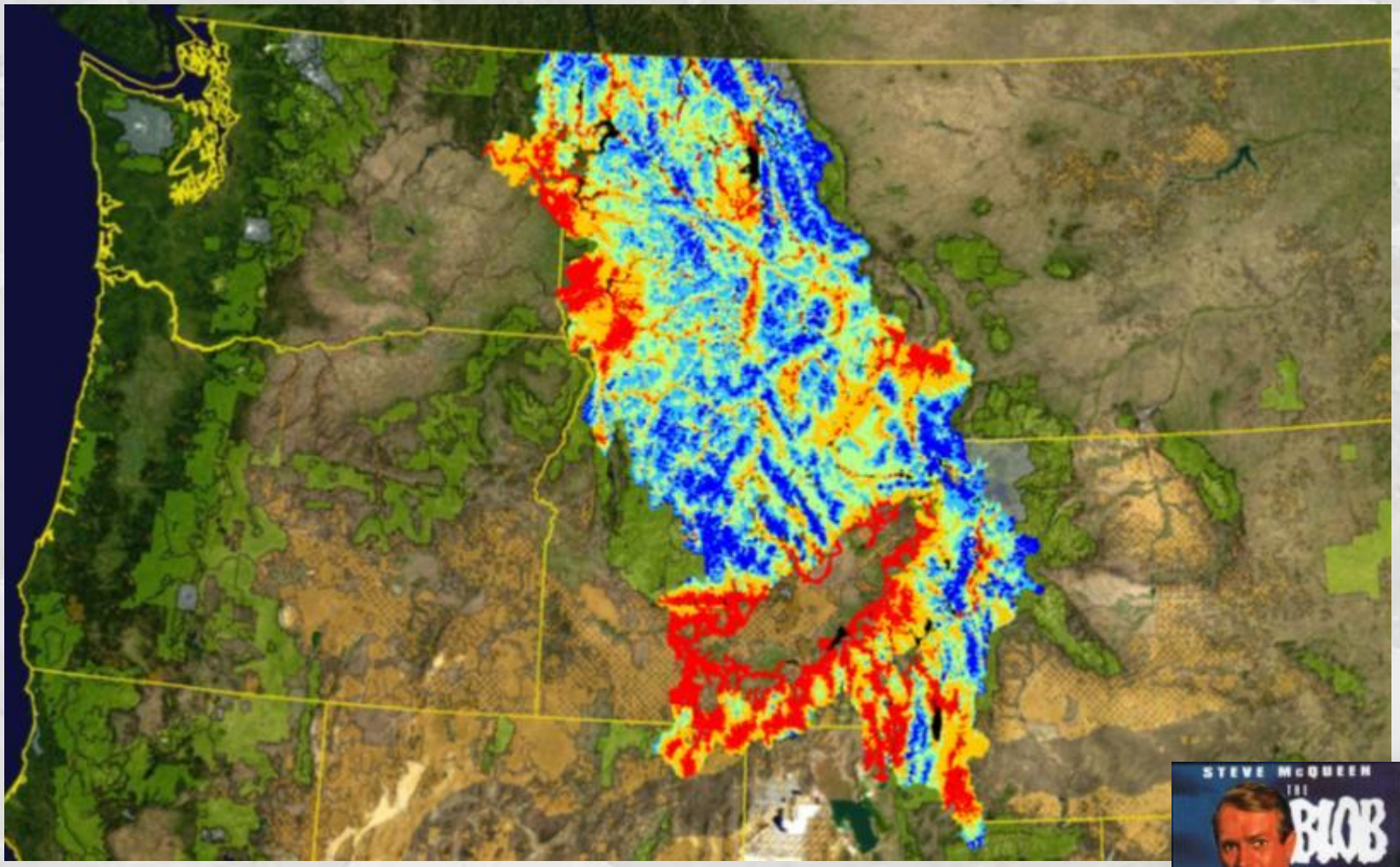


Climate Predictors

9. Discharge (m³/s)
   - **USGS gage data**
10. Air Temperature (°C)
    - **RegCM3 NCEP reanalysis**
    - **Hostetler et al. 2011**



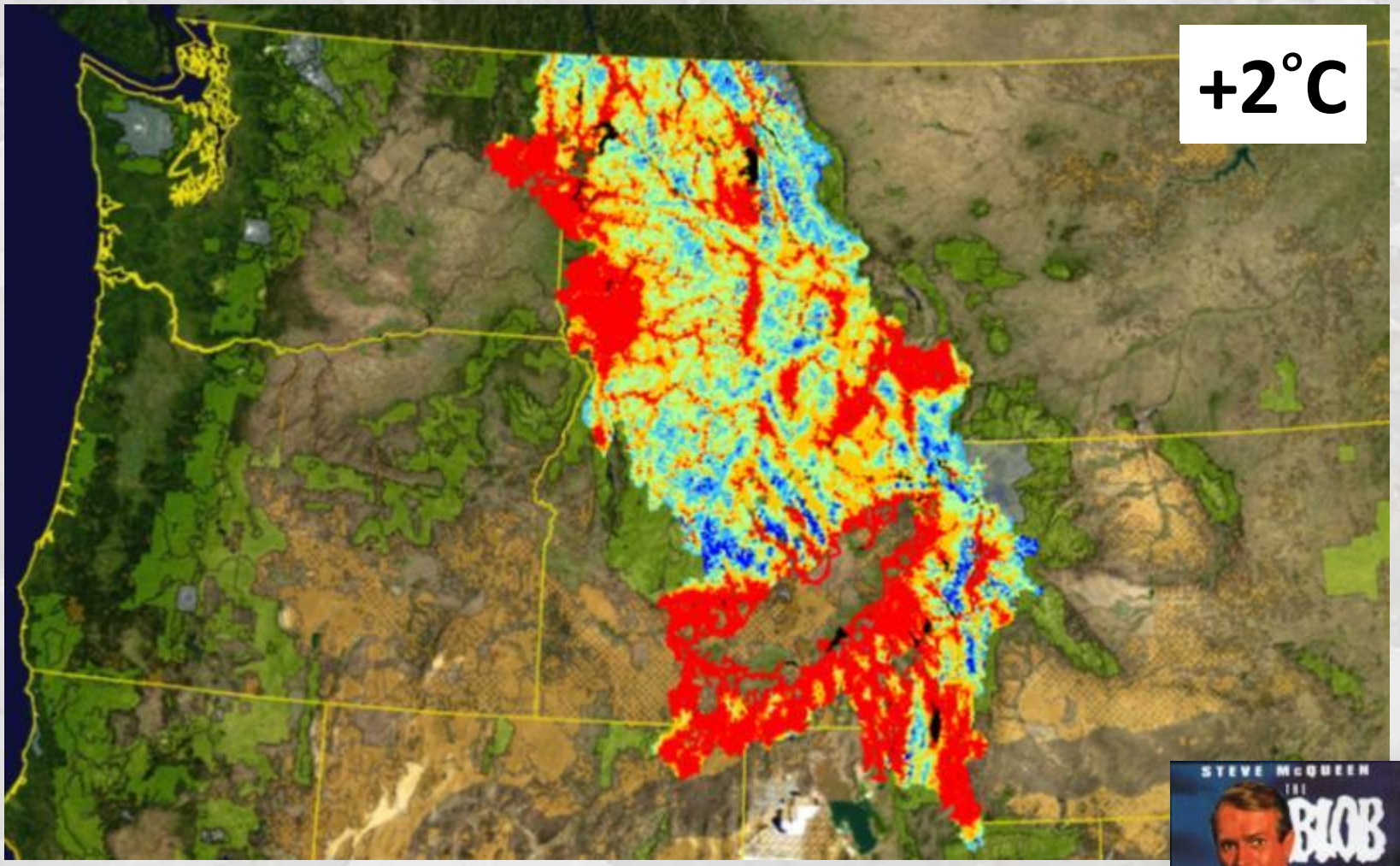
Stream Thermalscape so far…



The BLOB… it just keeps growing…

- 171,000 stream kilometers of thermal ooze
- 16,688 summers of data swallowed

Stream Thermalscape so far…



The BLOB… it just keeps growing…

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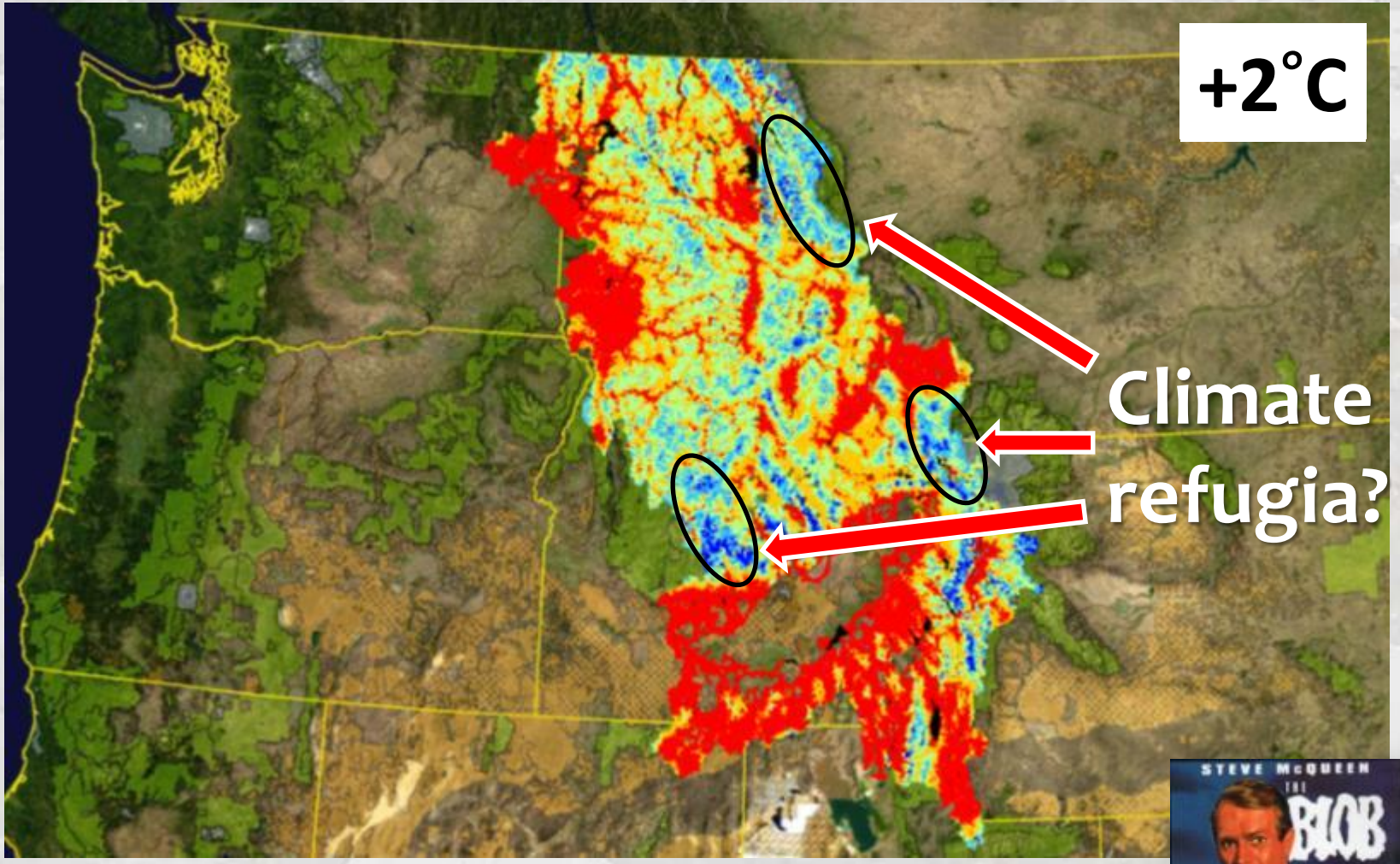
Stream Thermalscape so far…



The BLOB… it just keeps growing…

- 171,000 stream kilometers of thermal ooze
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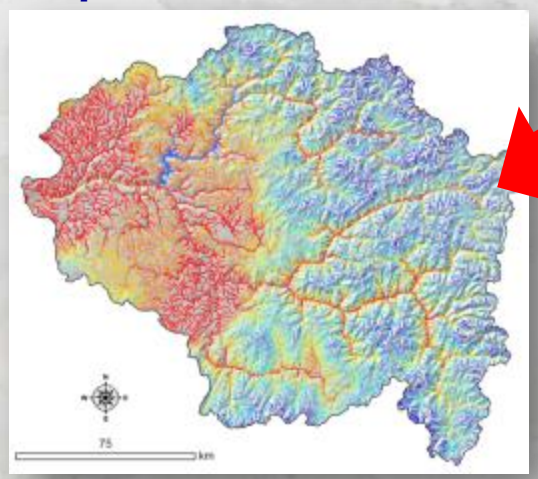
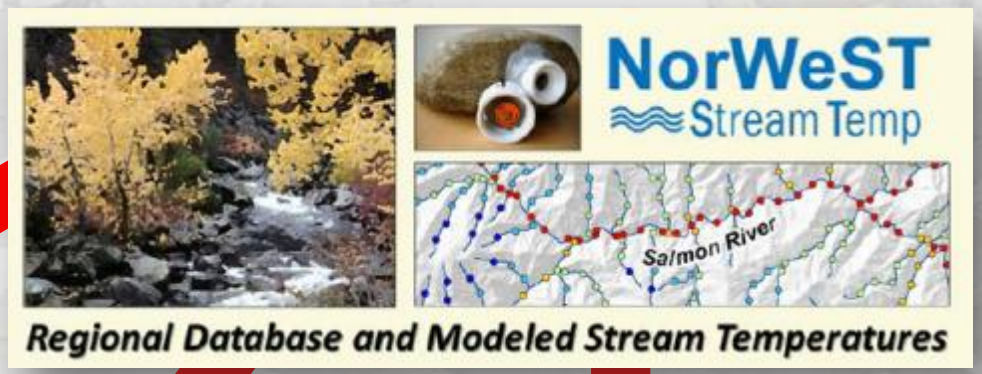
Website Provides Easy Data Access

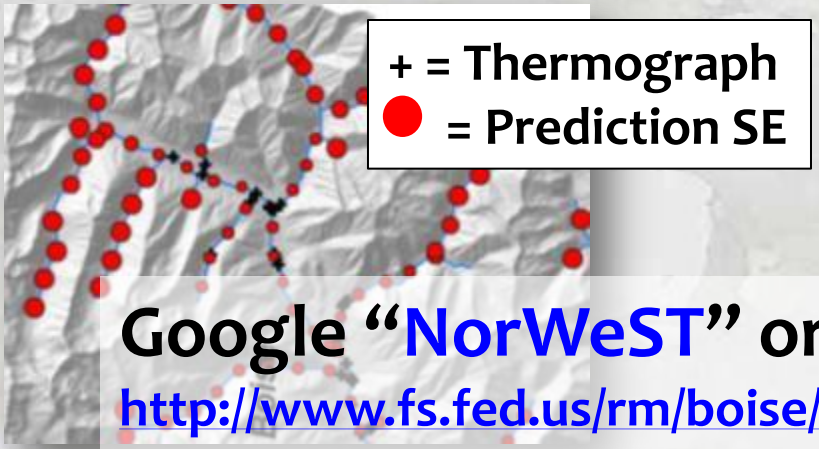
1) GIS shapefiles of stream temperature scenarios





3) Temperature data summaries

2) GIS shapefiles of stream temperature model prediction precision

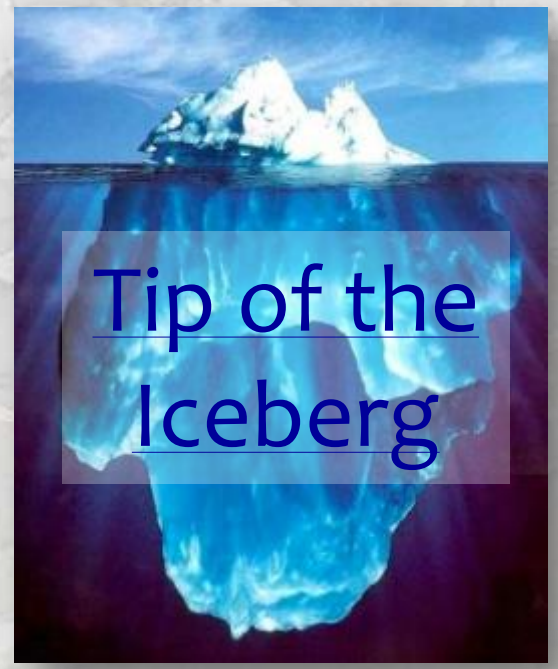


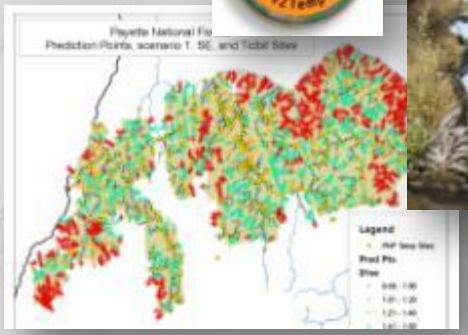
Google "NorWeST" or go here…

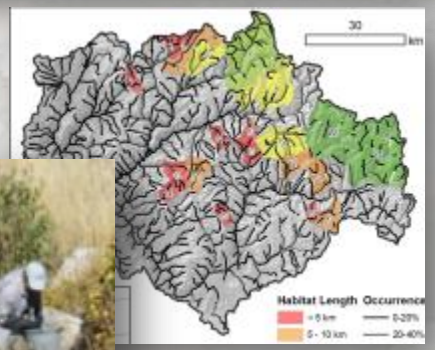
http://www.fs.fed.us/rm/boise/AWAE/projects/NorWeST.shtml

NorWeST Facilitating Related Projects

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

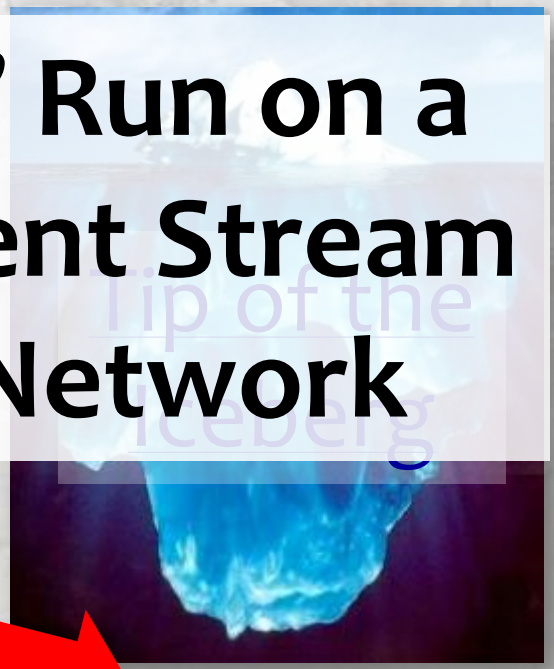


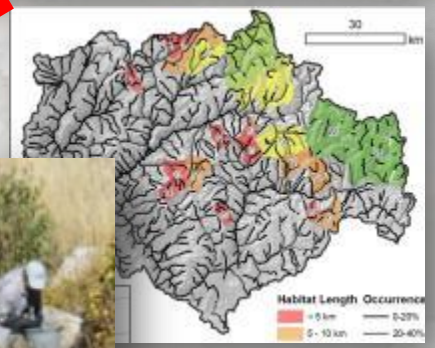


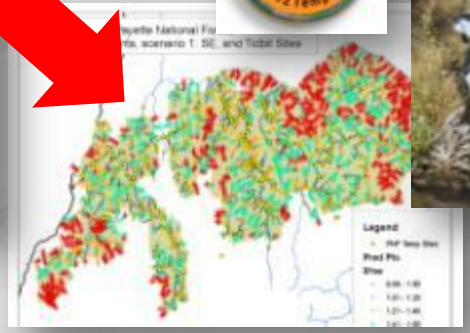


NorWeST Facilitating Related Projects

"Apps" Run on a Consistent Stream Data Network

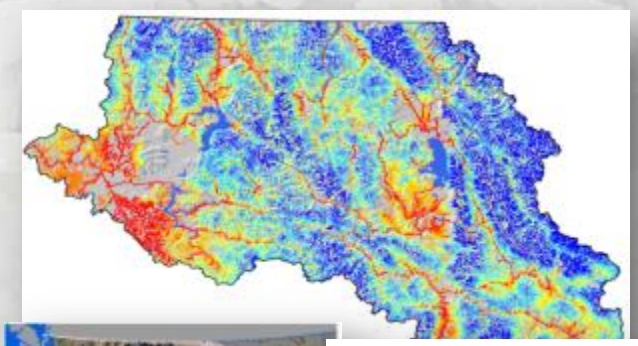


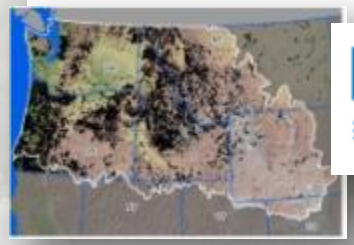




BIG fish DATA for Regionally Consistent Thermal Habitat Definitions

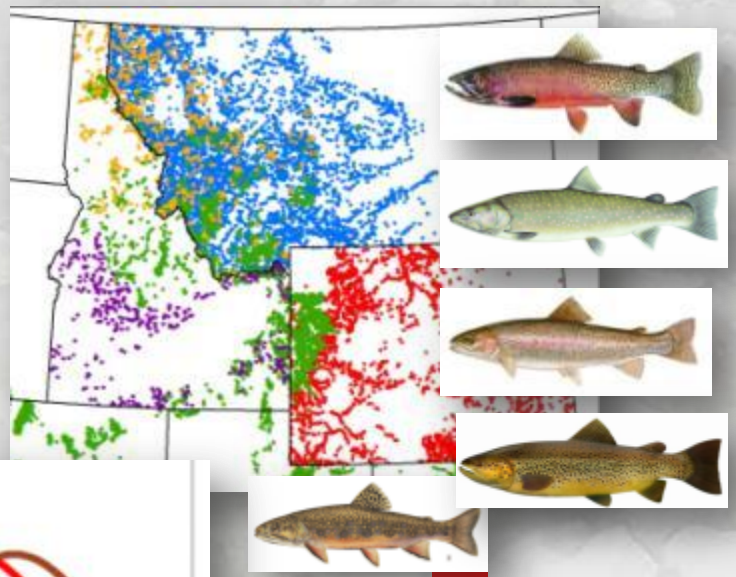
Stream temperature maps

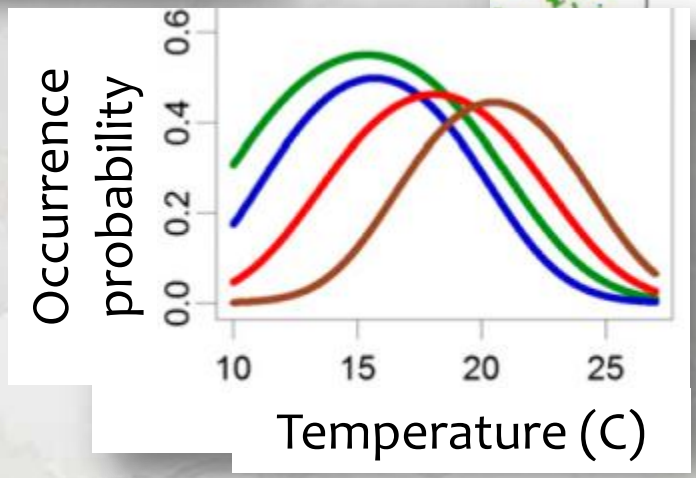




NorWeST Stream Temp

Regional fish survey databases (n ~ 30,000)



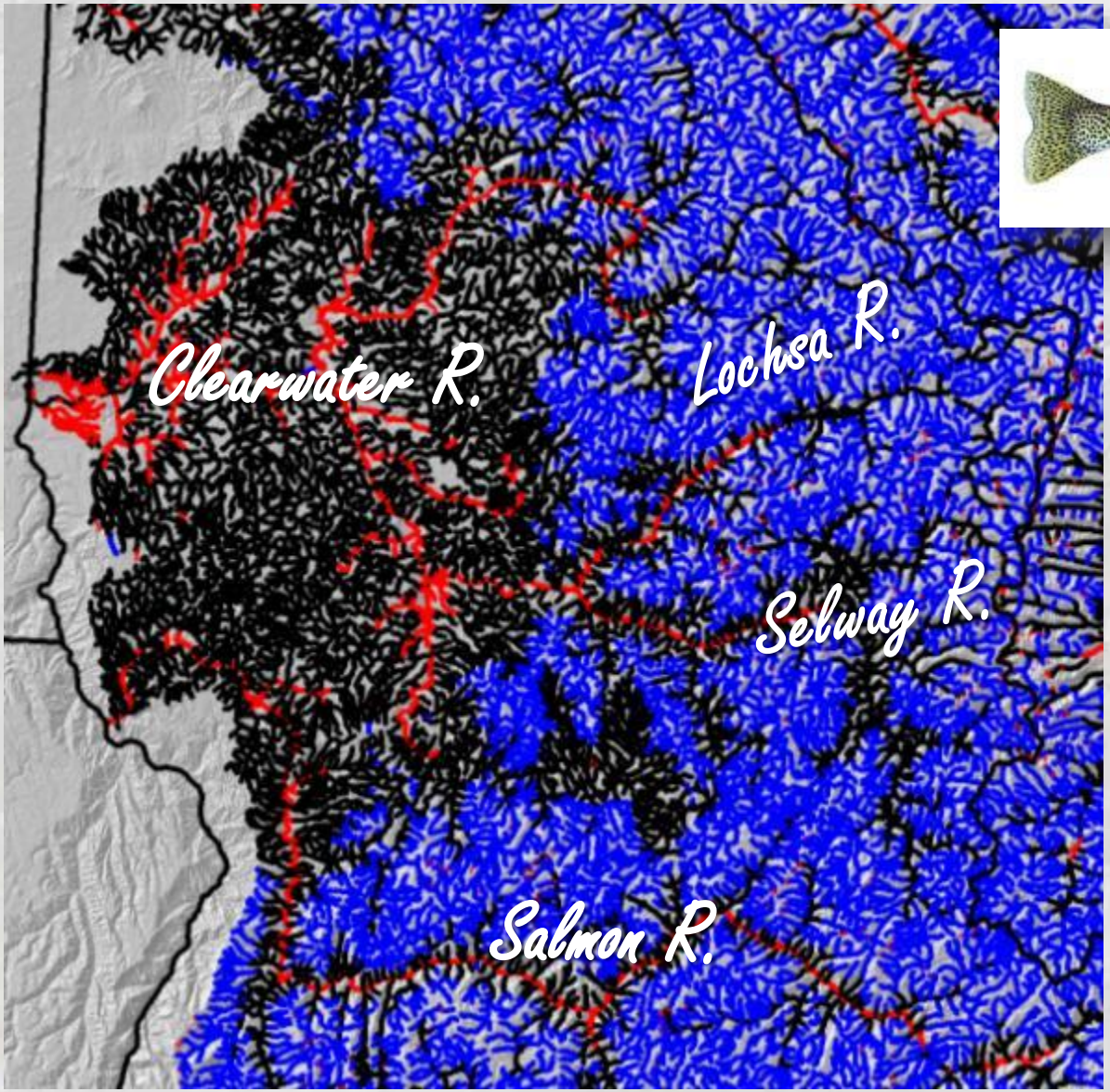


Wenger et al. 2011a. *PNAS* **108**:14175-14180

Wenger et al. 2011b. *CJFAS* **68**:988-1008; Wenger et al., *In Preparation*

Risk Varies by Species & Landscape Position

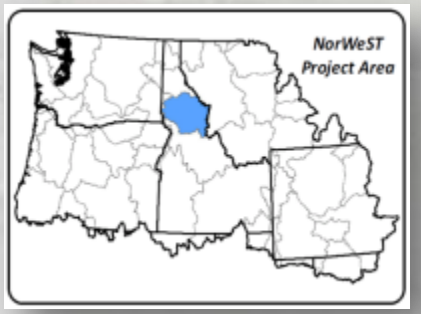
Historic (1993-2011 Average August)



Suitable

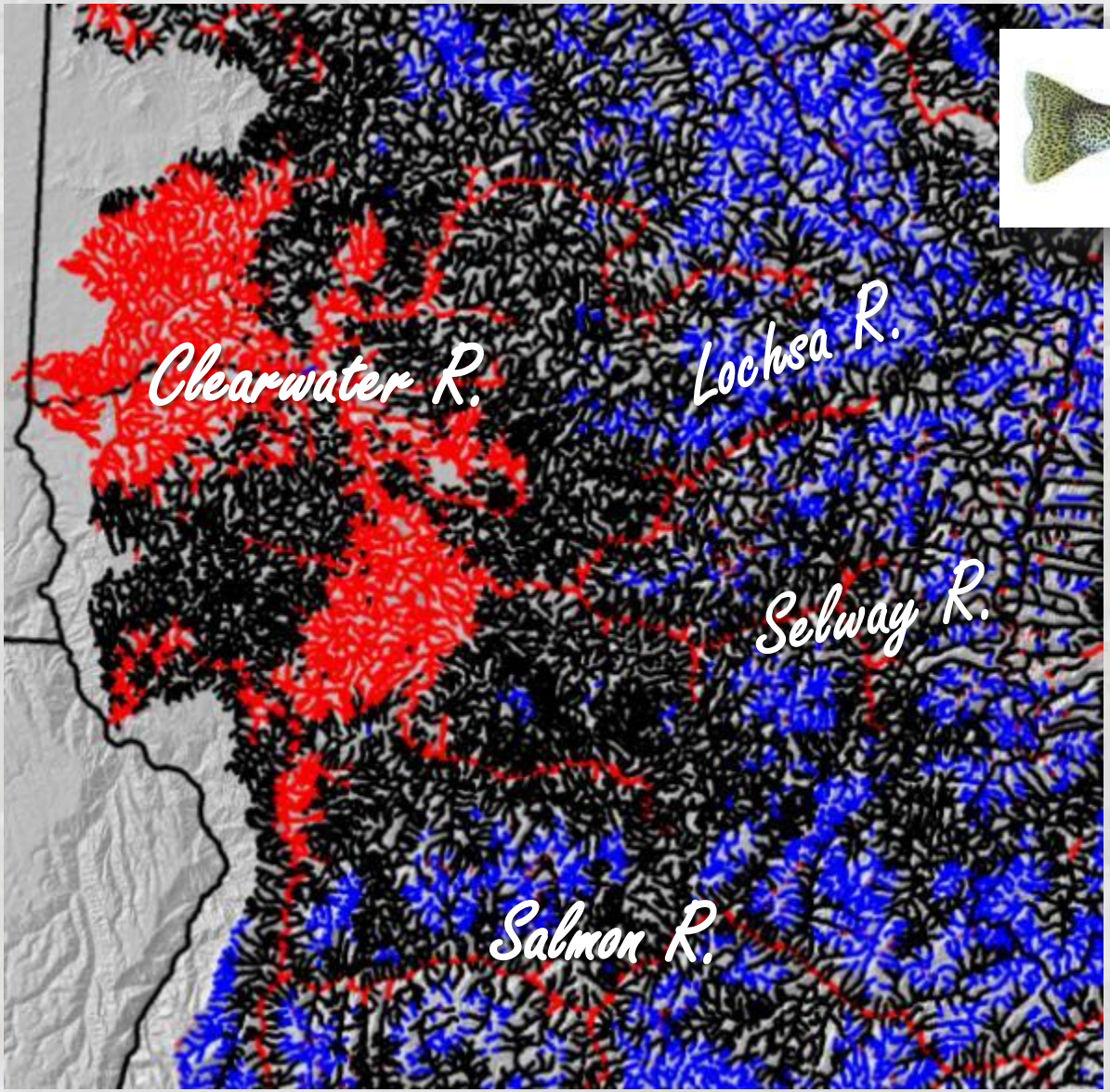
Too Hot

Too Cold



Risk Varies by Species & Landscape Position

+2.00˚C Stream Temp (~2080s)



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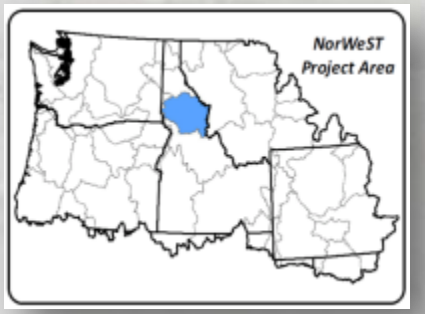

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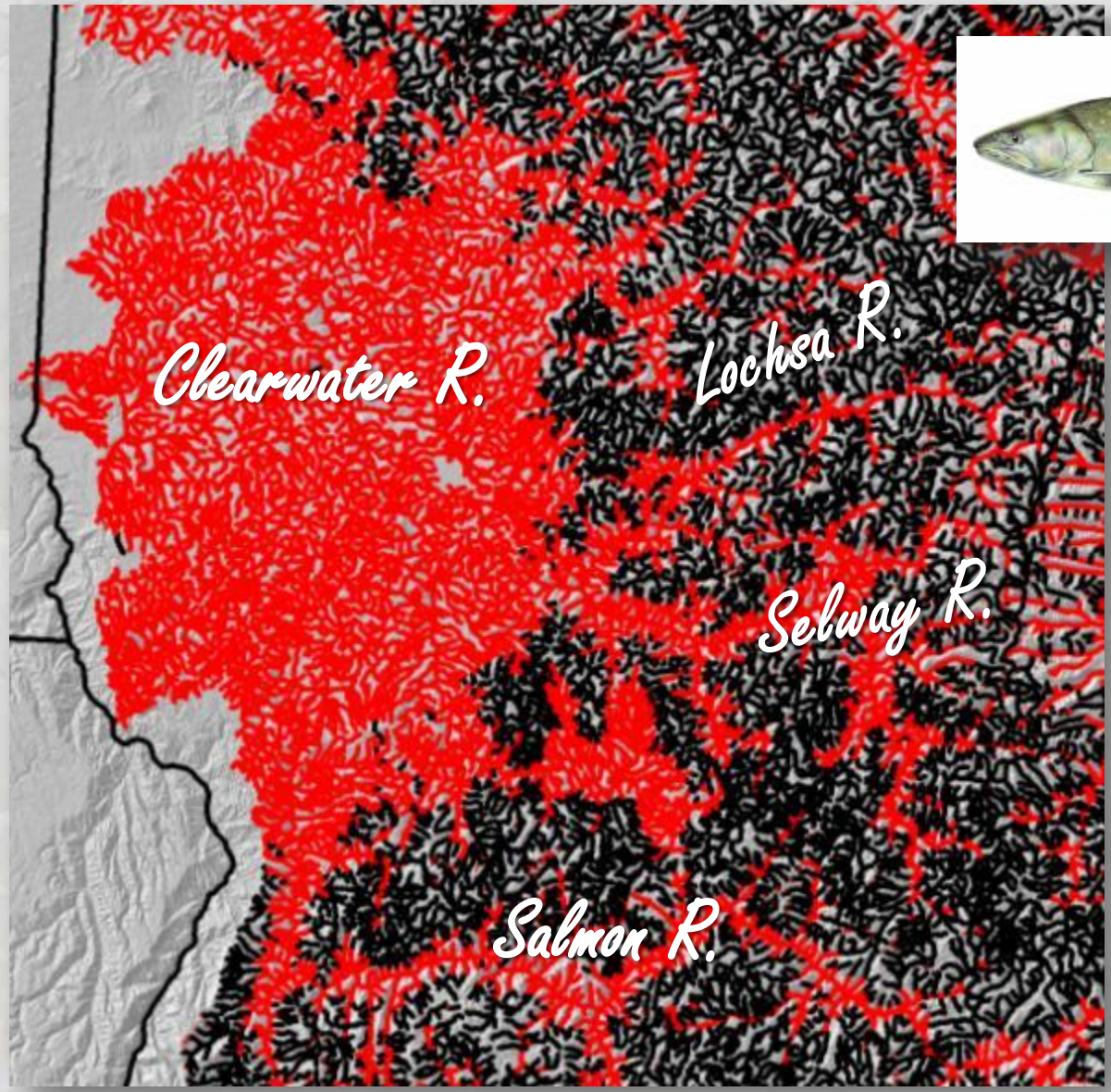
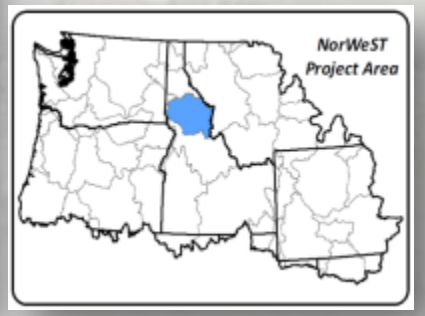


11.0°C Isotherm

Suitable

Unsuitable



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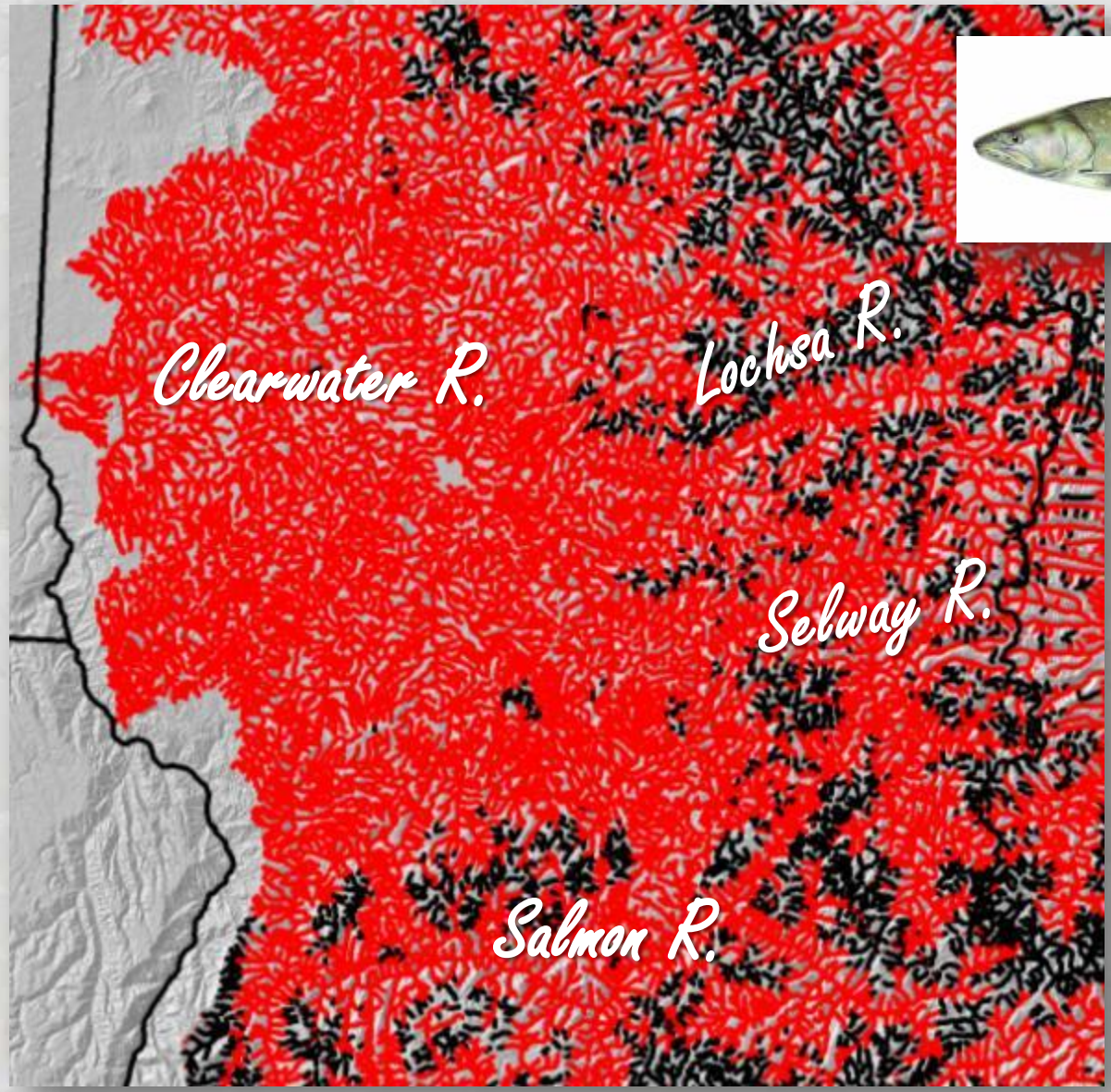

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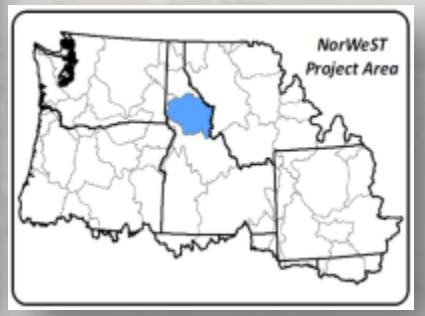
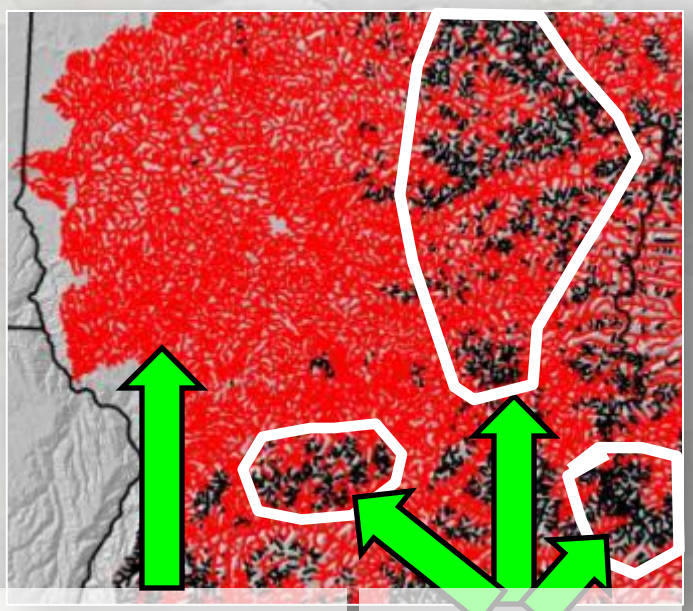


Climate-Smart Strategic Prioritization of Restoration

Lots of things we can do…

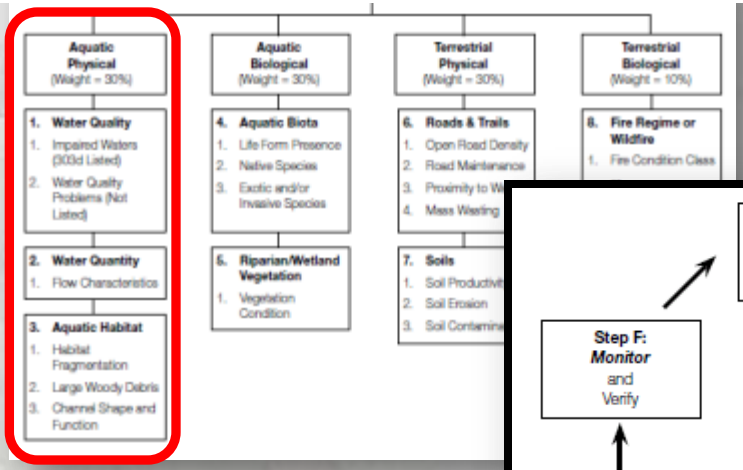
- Maintaining/restoring flow…
- Maintaining/restoring riparian…
- Restoring channel form/function…
- Prescribed burns limit wildfire risks…
- Non-native species control…
- Improve/impede fish passage…

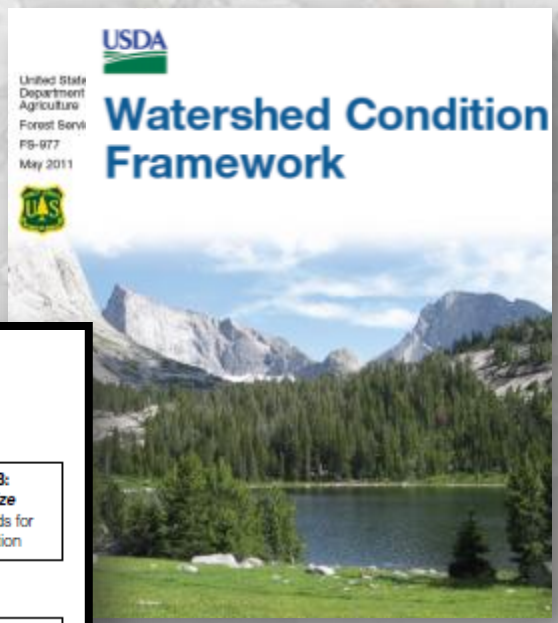


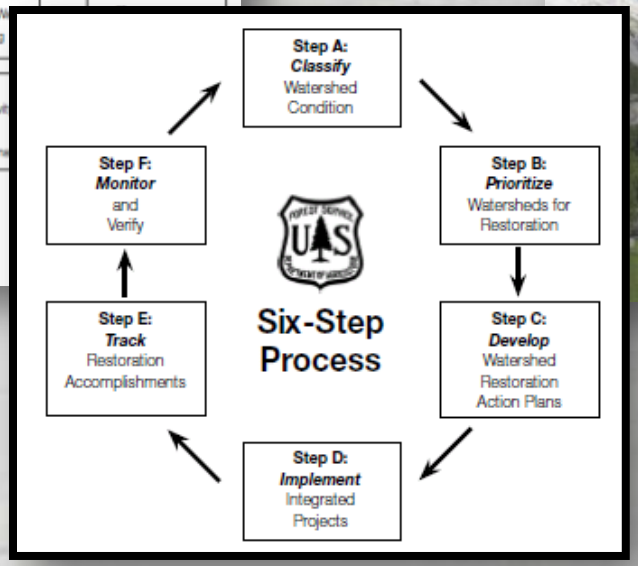
Low Priority | **High Priority**

Integration with Land-management Planning is Beginning…

Watershed Condition Indicators







Forest Plan Revisions

USDA United States Department of Agriculture

Forest Service

Northern Region

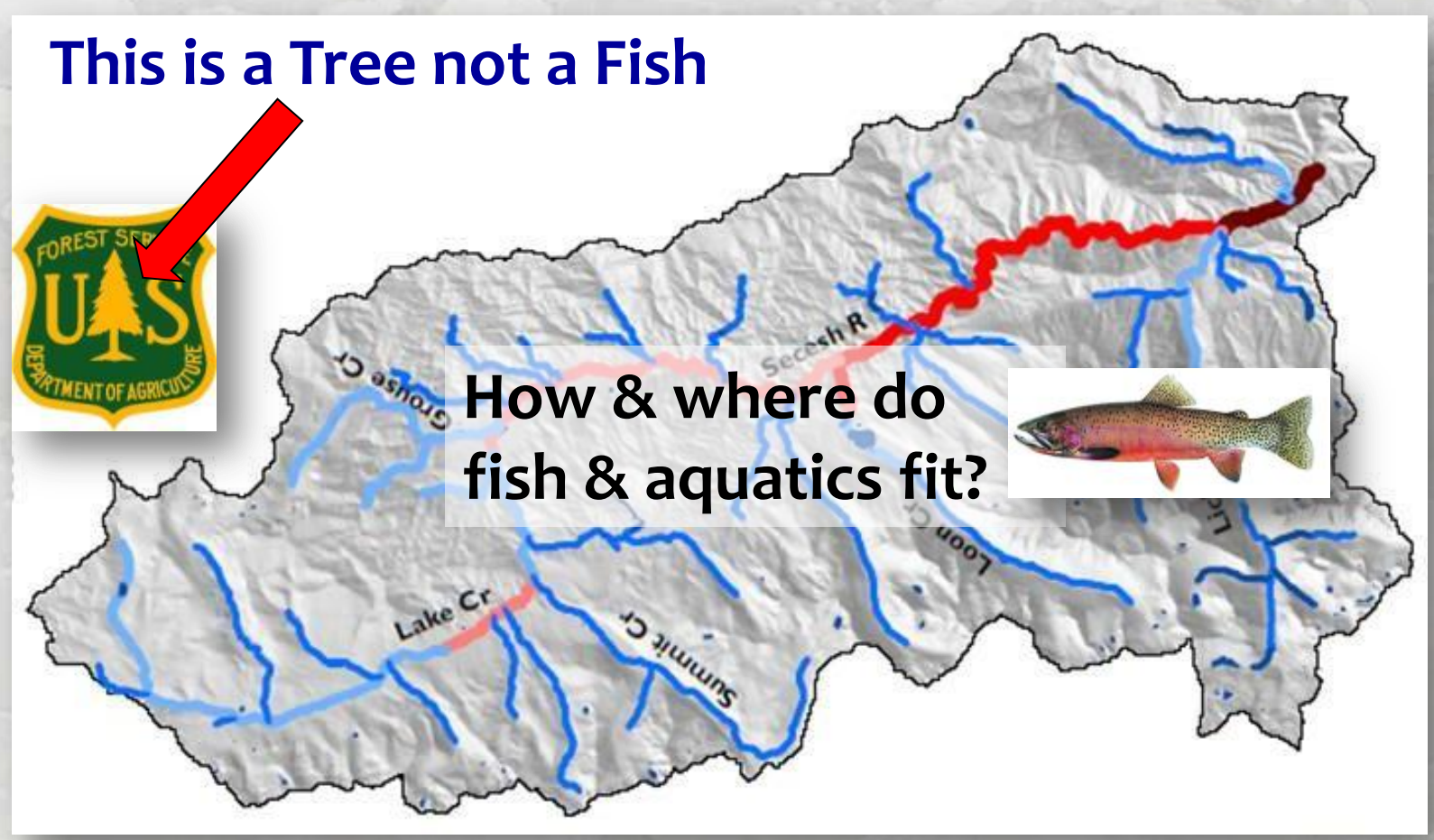
March 2007

Proposed

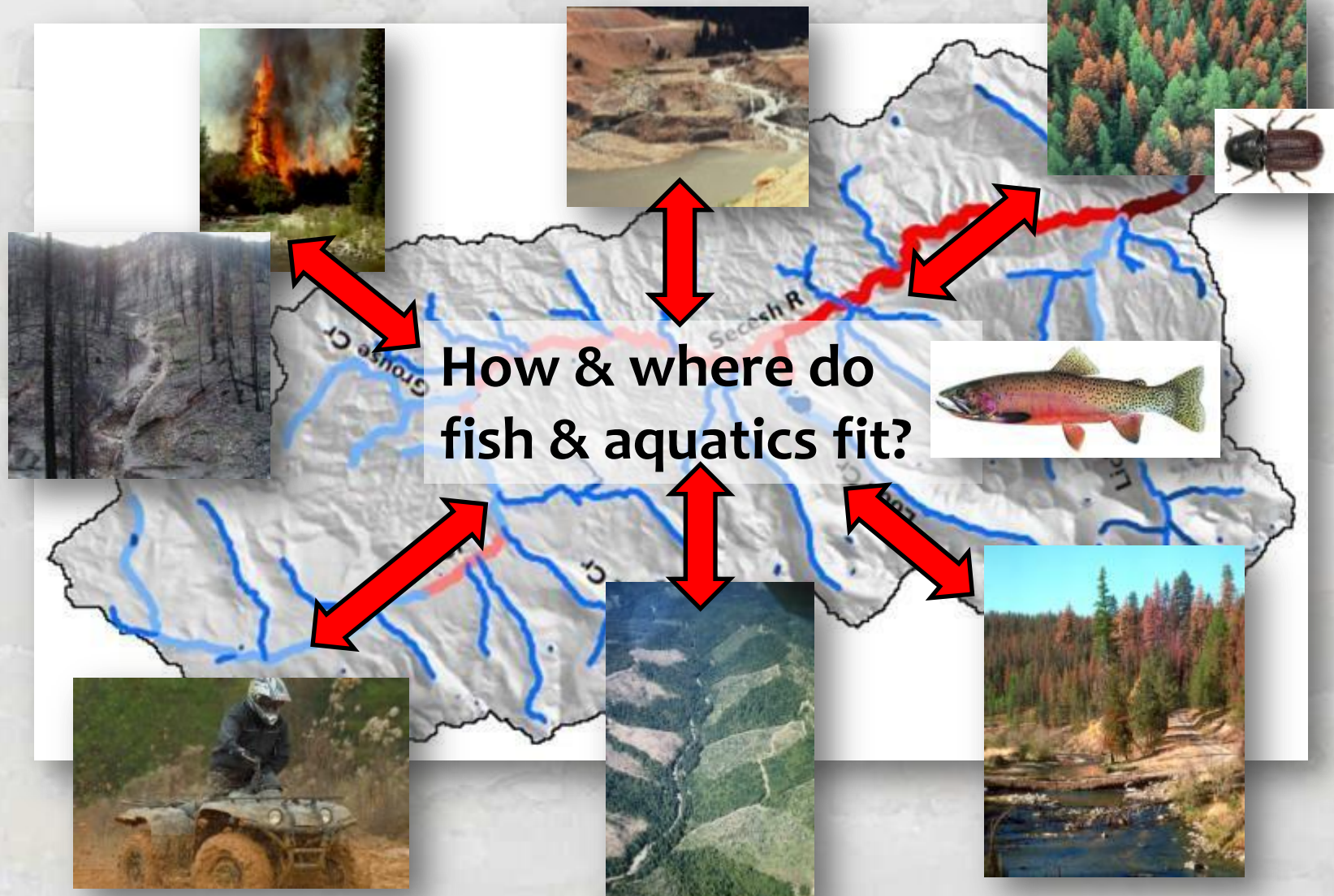
Land Management Plan

Clearwater National Forest

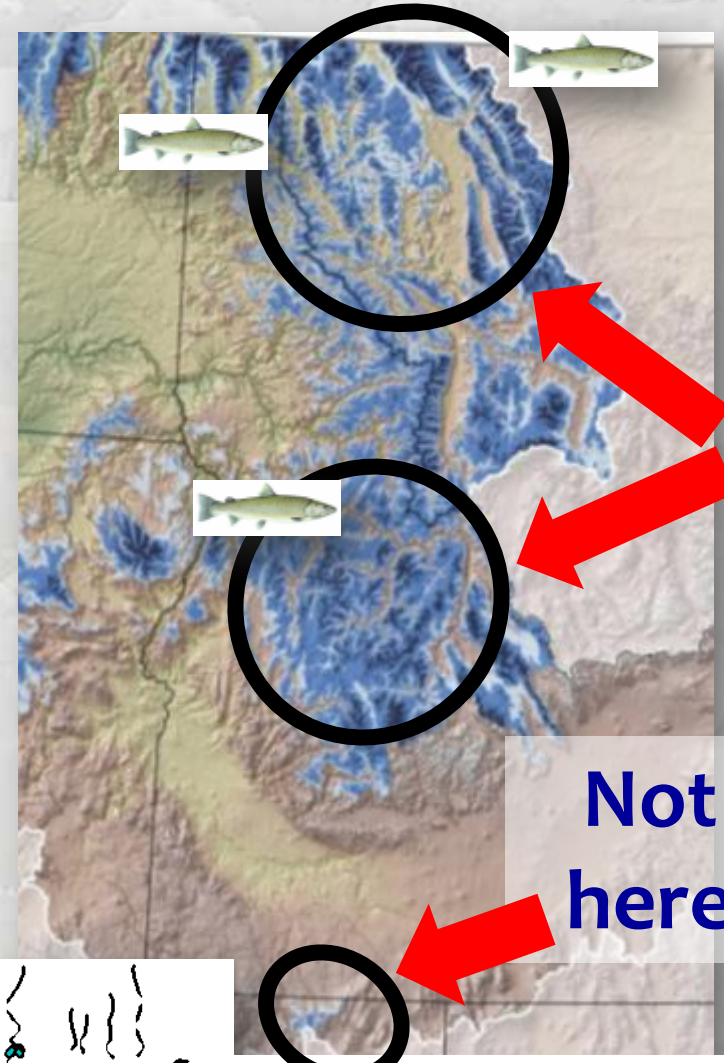
Continuous Maps of Aquatic Resource Priority Areas Could Facilitate Integrated Landscape Management



Continuous Maps of Aquatic Resource Priority Areas Could Facilitate Integrated Landscape Management



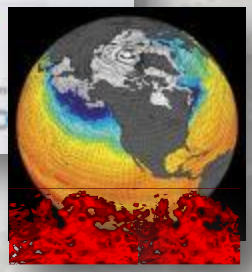
Good Information, Shared Broadly, Should Enable Good Community Decision Making



Invest Here

Not here

Sorry Charlie



HENRY'S FORK FOUNDATION

NEZ PERCE TRIBE TREATY OF 1855

IDAHO FISH & GAME

KOOTENAI TRIBE OF IDAHO

KALISPEL TRIBE OF INDIANS

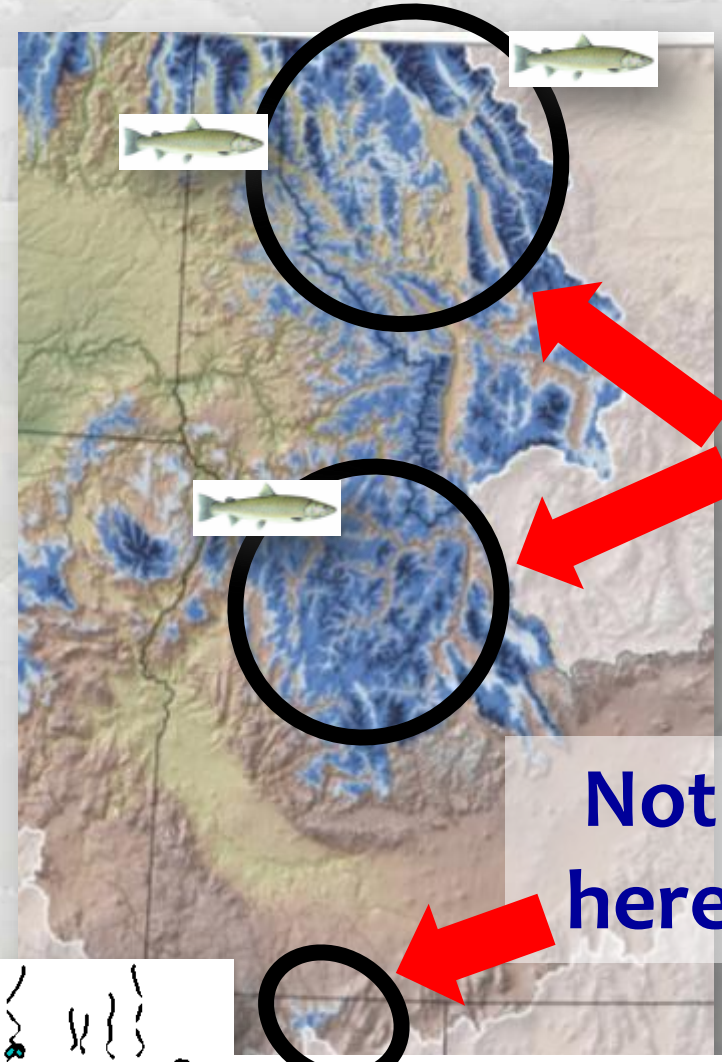
FOREST SERVICE US DEPARTMENT OF AGRICULTURE

USGS science for a changing world

NOAA Fisheries

IDAHO POWER.

Developing Good Scientific Information is the Easy Part, butt…



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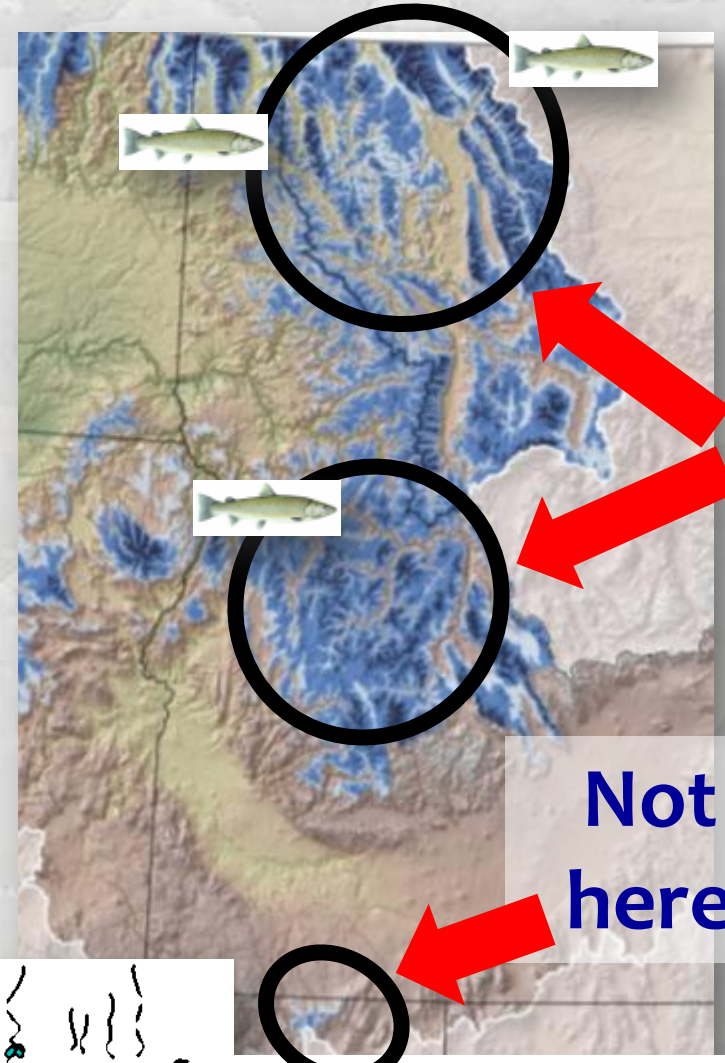


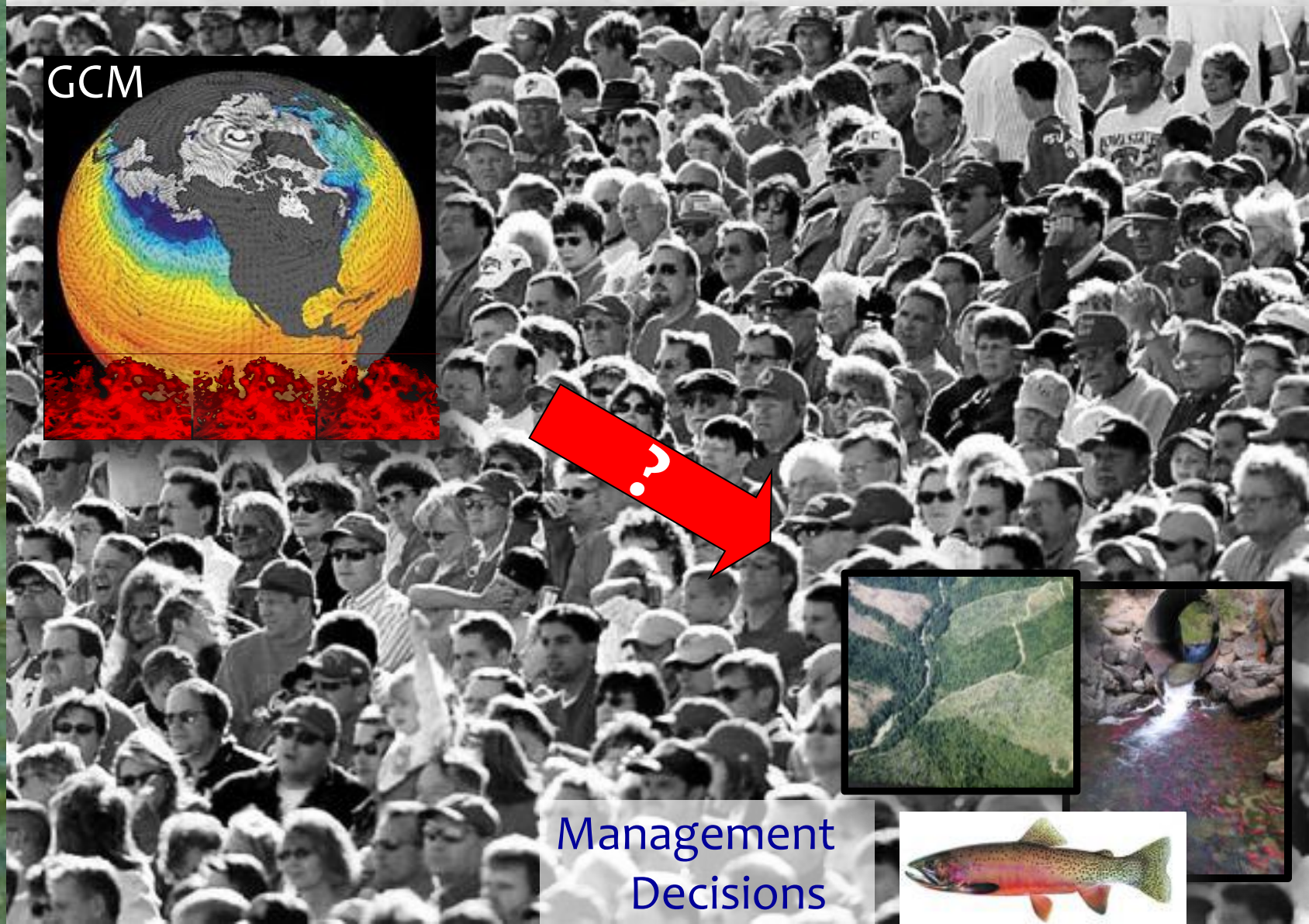
Invest Here

Not here

Sorry Charlie

…we're not dealing with rational creatures here

Building Consensus is Critical
"Crowd-Sourcing" is an Important Tool



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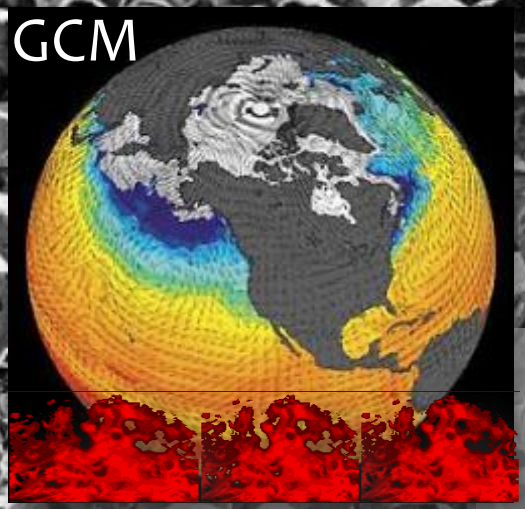
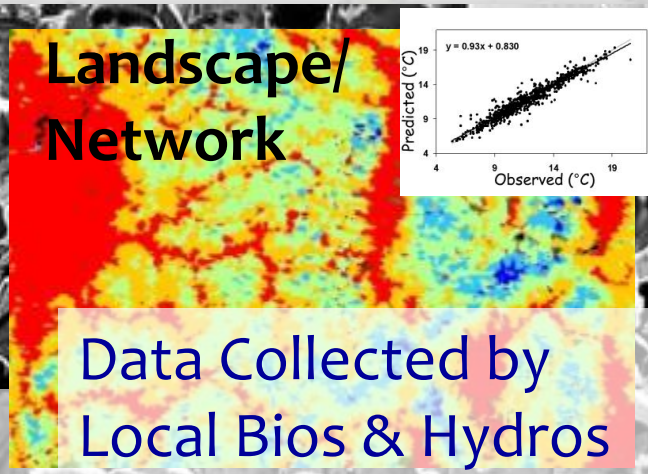




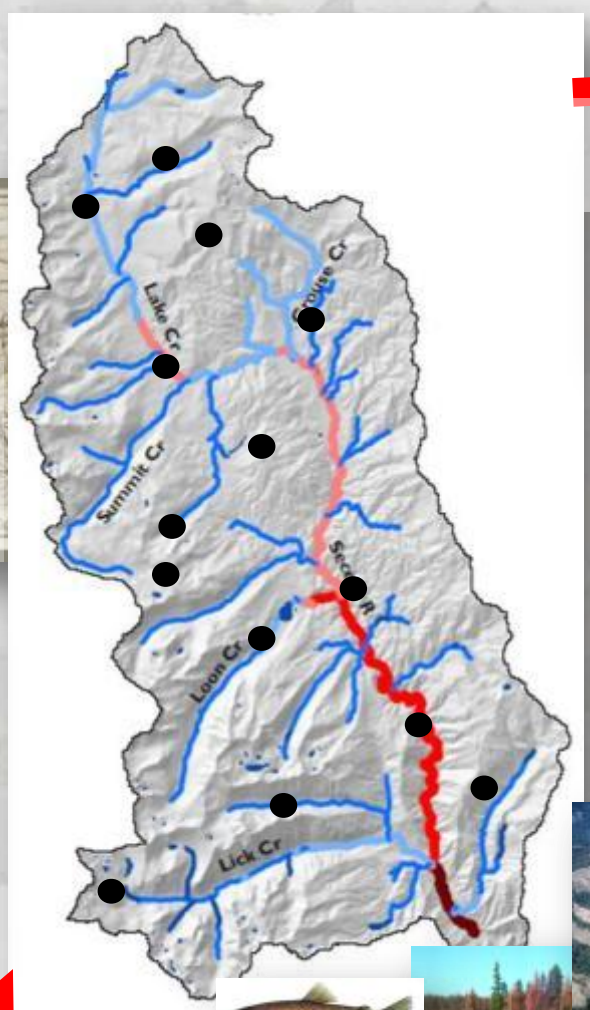
Coordinated Management Responses?

Management Decisions

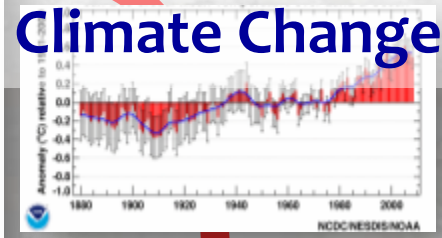
Connect the Dots to Map the Future

& the People & the Agencies

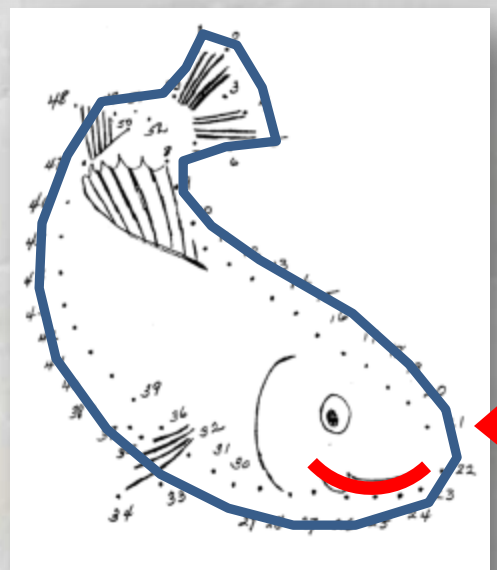
Creating resource status maps



Climate Change

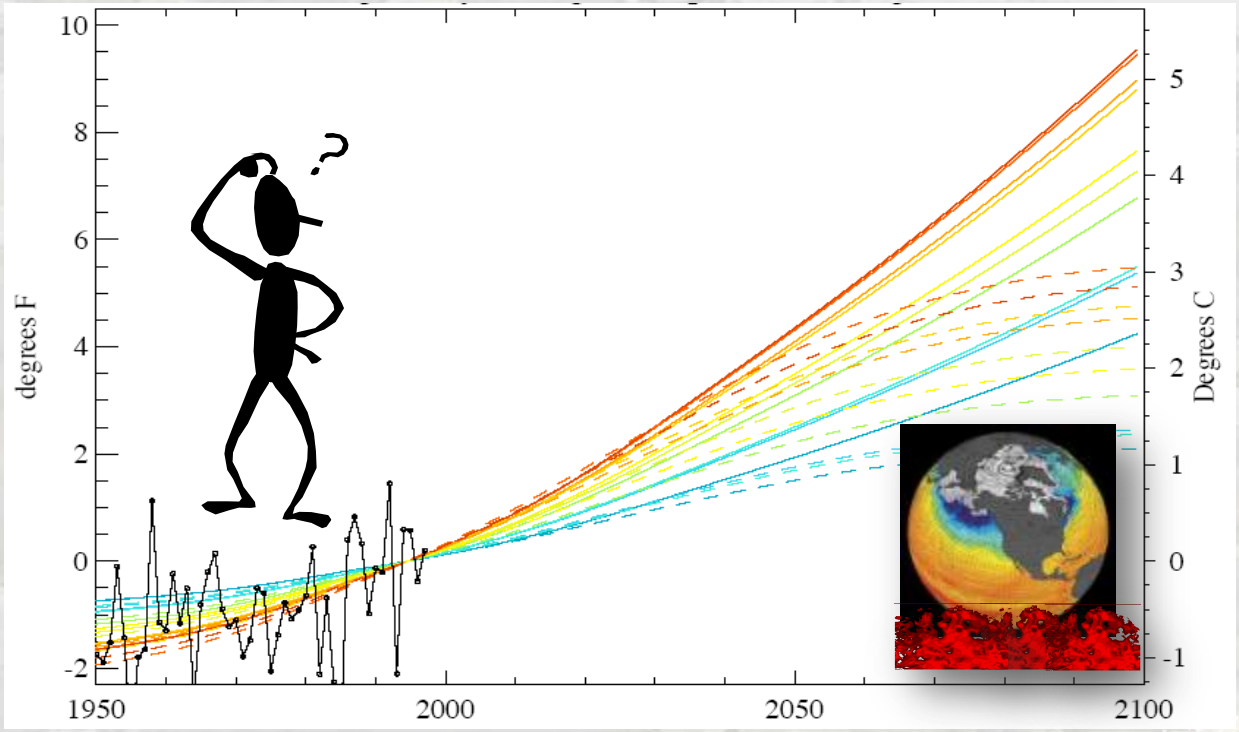


Urbanization & Population Growth



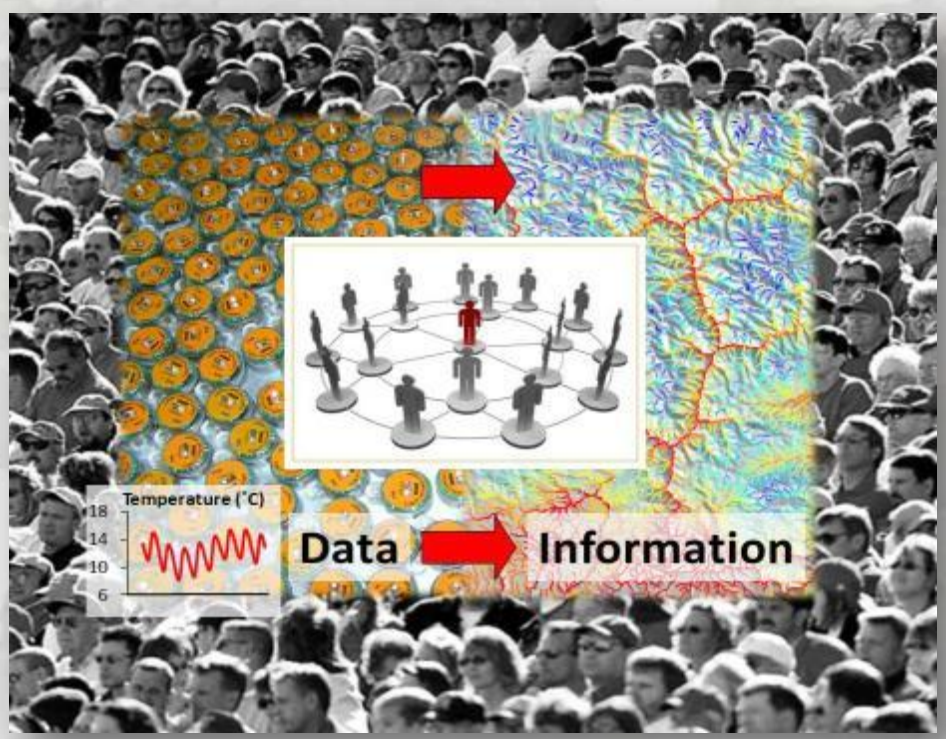
Land & Species Management

The Sooner (& Smarter) We Act, The Bigger the Long-term Impact…



~~facebook~~

stream



Crowd-Sourcing, Digital Media, & Building Social Networks for Landscape Conservation of Native Trouts in the Climate Change Era

Dan Isaak, US Forest Service

Rocky Mountain Research Station

disaak@fs.fed.us; 208-373-4385