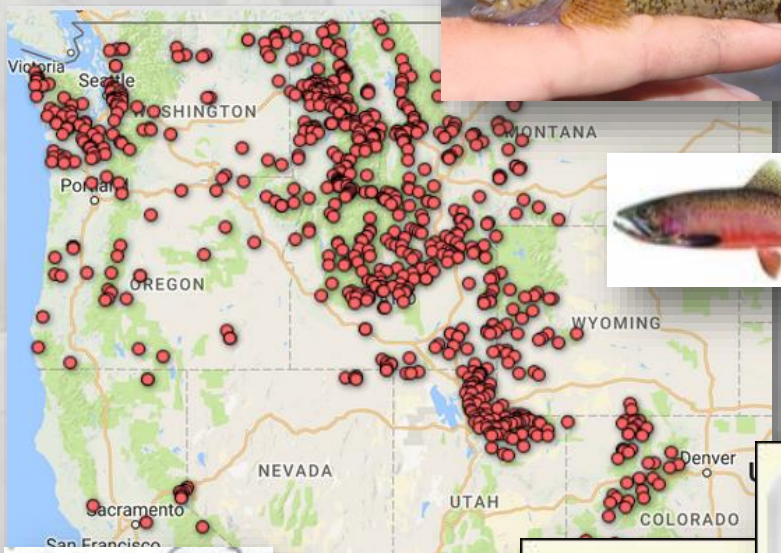
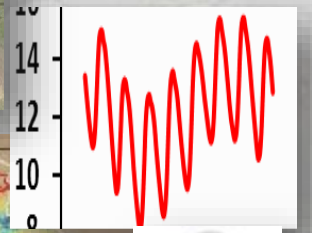
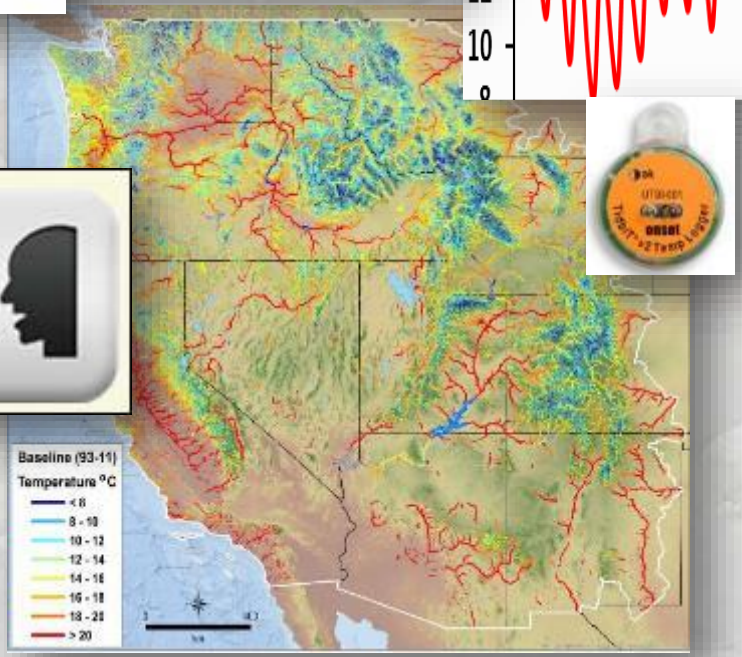
Heating Up & Scaling Up: How a Few Temperature Sensors & Tissue Clips Begat A West-wide Conversation & Collaboration Between Researchers & Managers

Dan Isaak, Mike Young, Dan Shively*, and John Rothlisberger

U.S. Forest Service







Parallel Paths or Confluencing Flows?

A Flowchart for Success

Easily Said, Hardly Done…

1. Select a good research topic
- a. Practical benefits to managers
- b. Stokes researcher's interest/passion
- c. Opportunities exist for tangible scientific contributions

2. Pick topics where data already exist and/or can be routinely collected by managers
- a. Low startup cost
- b. Low additional data collection costs
- c. Use of manager's datasets ensures relevance & ongoing dialogue

3. Conduct & publish proof-of-concept pilot study
- a. Develop and/or apply novel technical and/or analytical techniques to learn something new & valuable
- b. Formulate & describe a subsequent research agenda
- c. Demonstrates researcher's commitment to a topic

4. Scale up & elaborate research agenda
- a. Obtain funding via external grants or internal agency funds
- b. Conduct related studies using existing datasets

Lather, rinse, repeat…

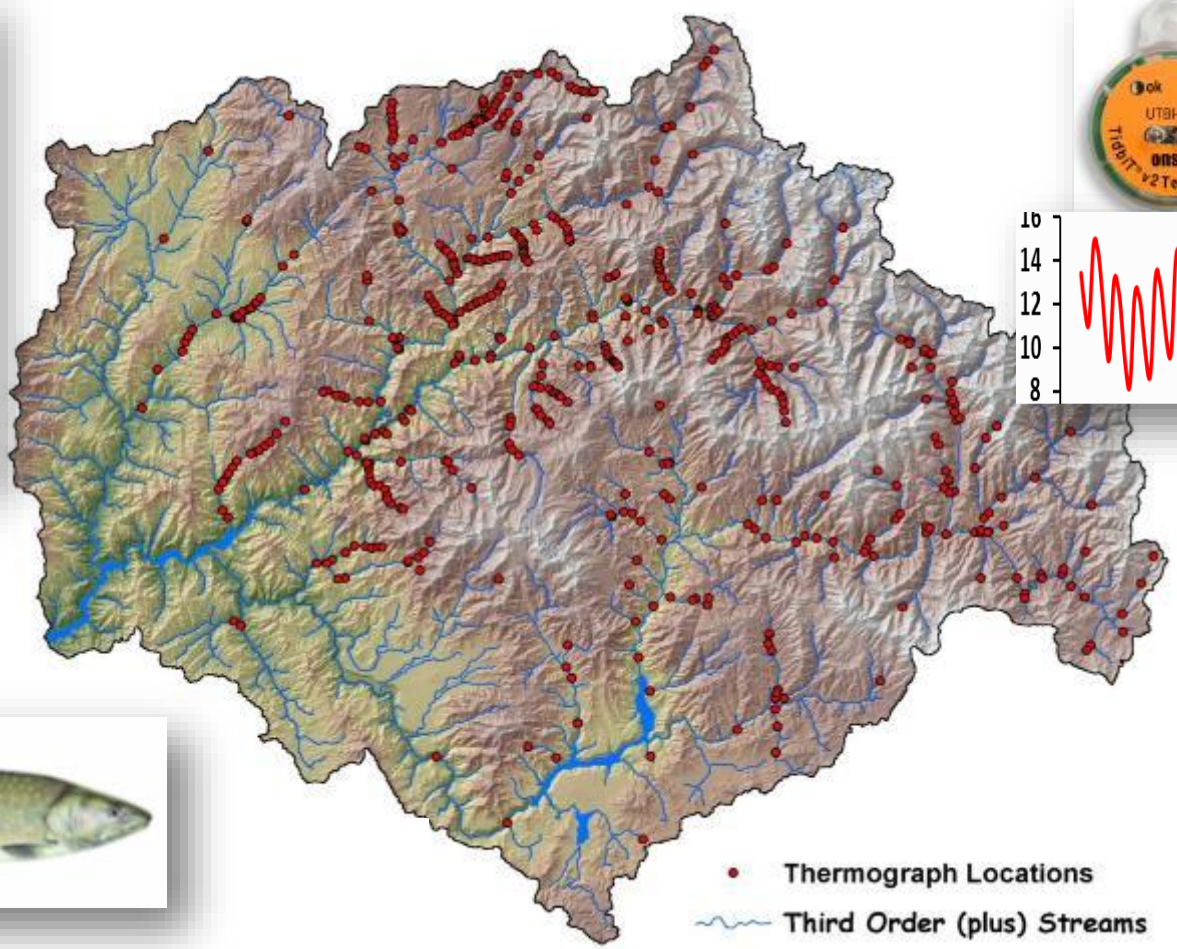
Example #1: Stream Temperature Research

"Found" data in the Boise River basin

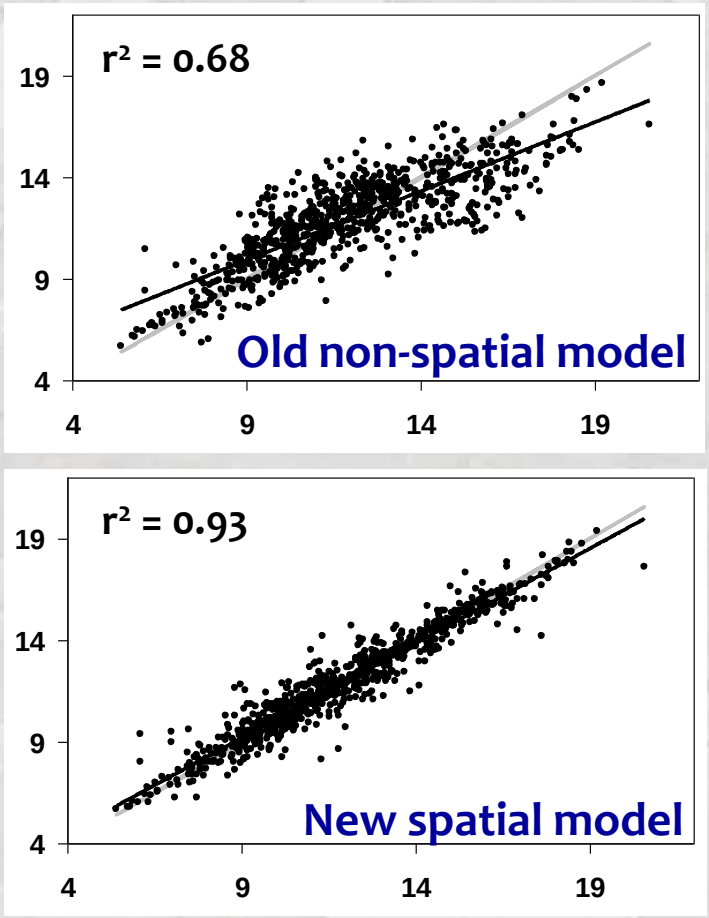
780 summers of data @ 518 unique locations

Sawtooth National Forest & Boise National Forest

NF Fish biologists: John Chatel, Dan Kenney, Mike Kellett

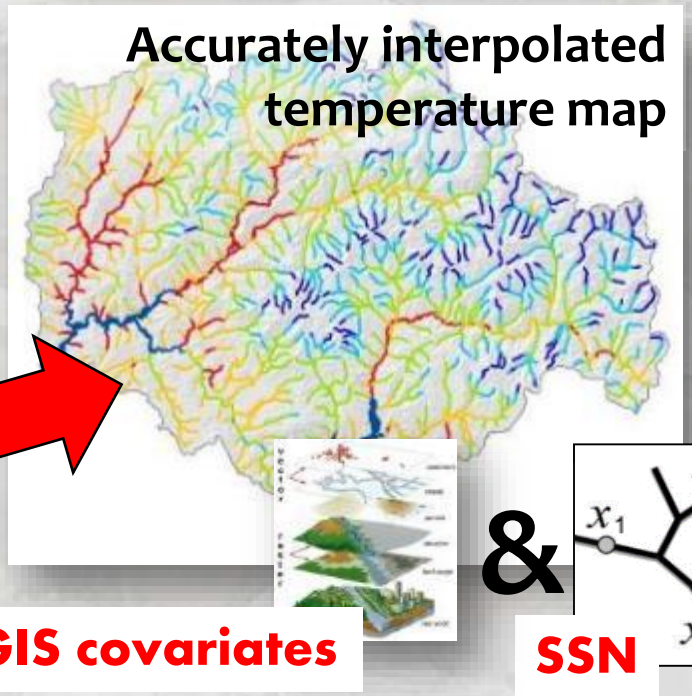


Novel Analysis & Useful Information Created



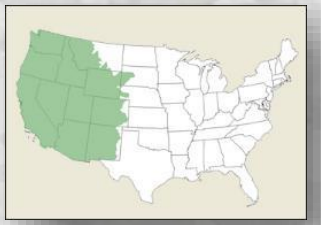
Manager's response:

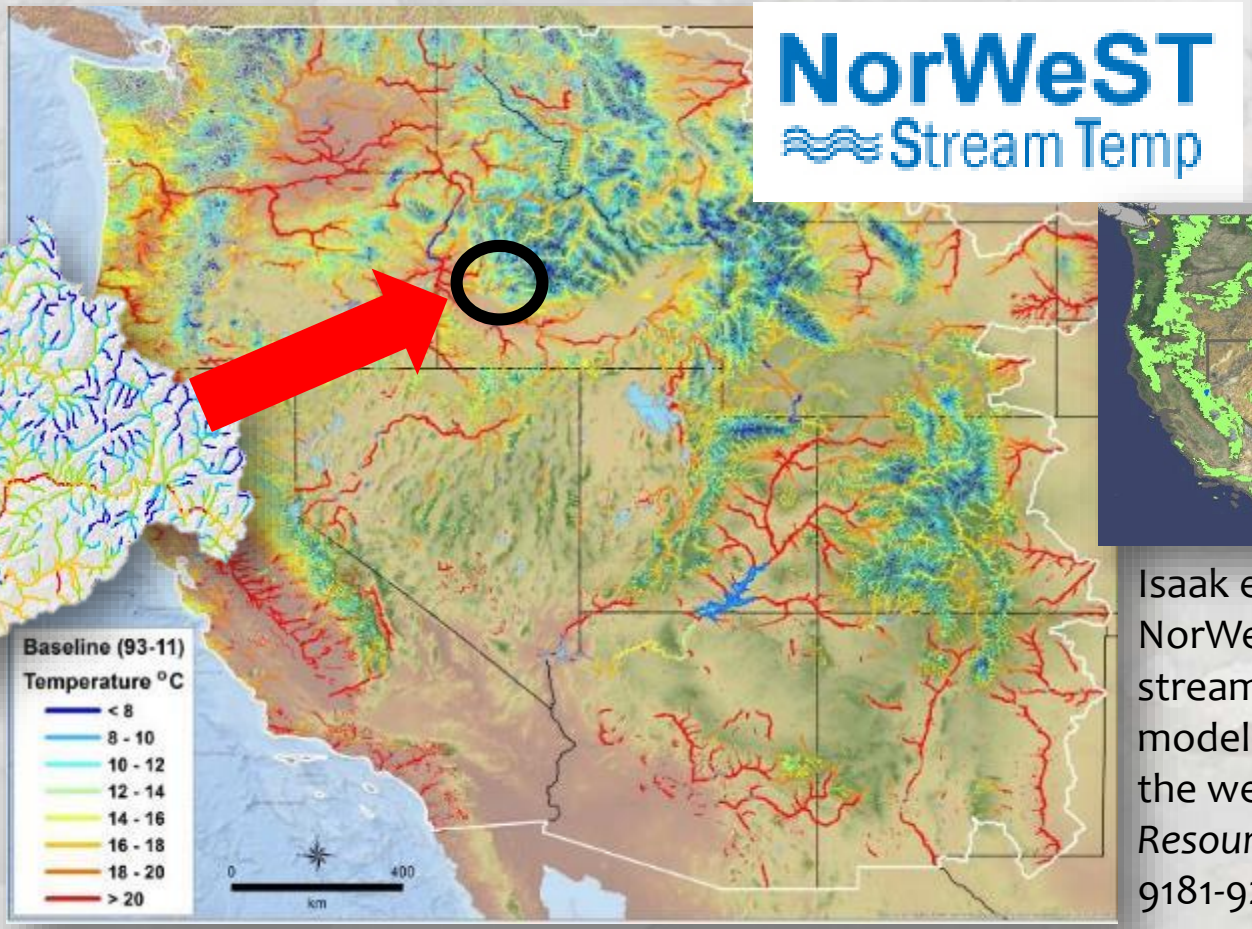
- Organized disparate datasets & facilitated information sharing
- Provided new information at unsampled locations



Isaak et al. 2010. Effects of climate change and wildfire on stream temperatures and salmonid thermal habitat in a mountain river network. *Ecol. Apps.* **20**:1350-1371

Same Approach Throughout the West & 101 National Forests





Isaak et al. 2017. The NorWeST summer stream temperature model & scenarios for the western U.S. *Water Resources Research* **53**: 9181-9205

External Grantors:

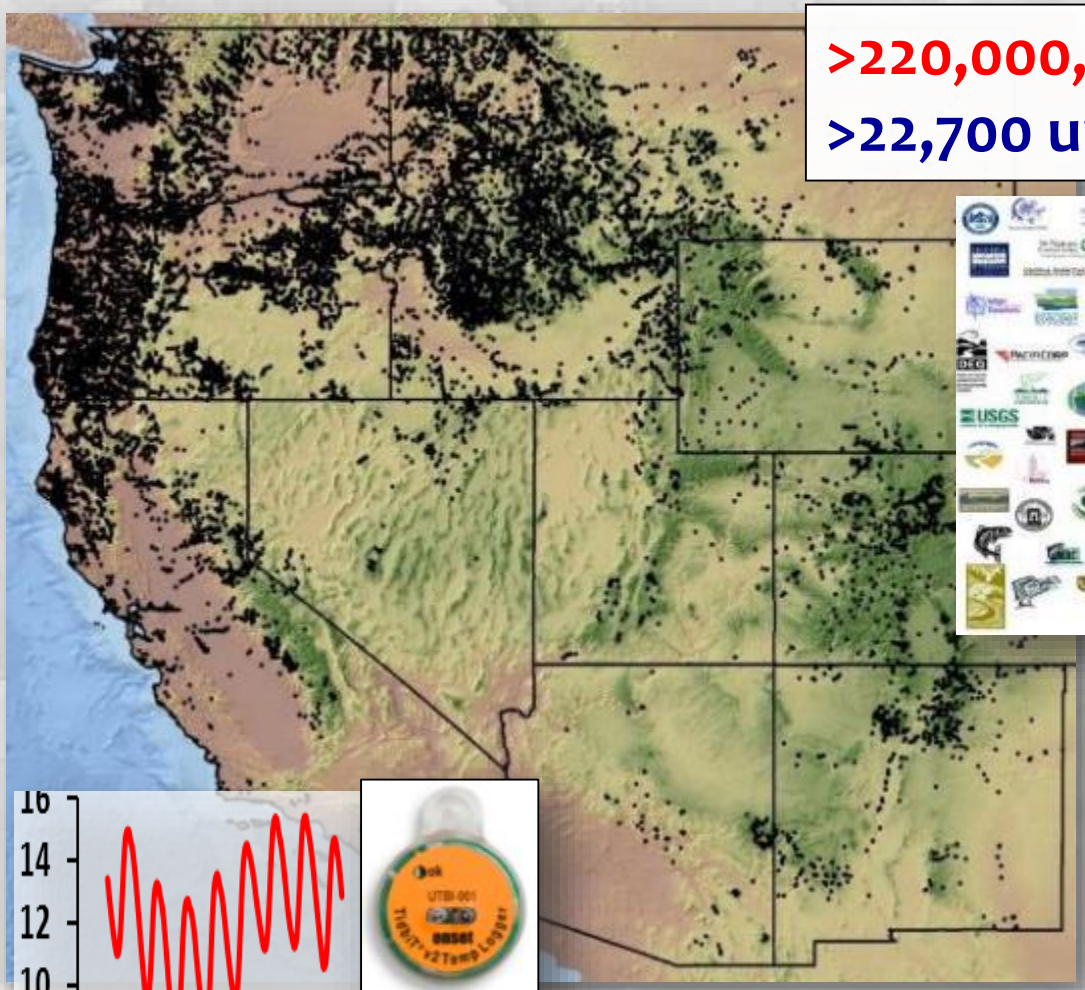
NORTH PACIFIC LANDSCAPE CONSERVATION COOPERATIVE

Great Northern LANDSCAPE CONSERVATION COOPERATIVE

USGS science for a changing world

NASA

NorWeST Data Contributed by >100 Agencies



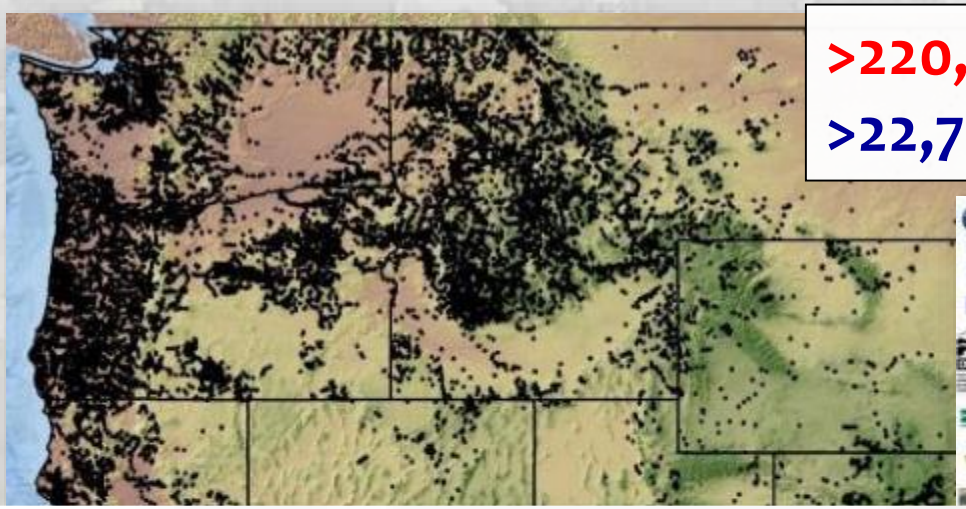
>220,000,000 hourly records

>22,700 unique stream sites

50% of data were from…

FOREST SERVICE
US
DEPARTMENT OF AGRICULTURE

NorWeST Data Contributed by >100 Agencies



>220,000,000 hourly records

>22,700 unique stream sites

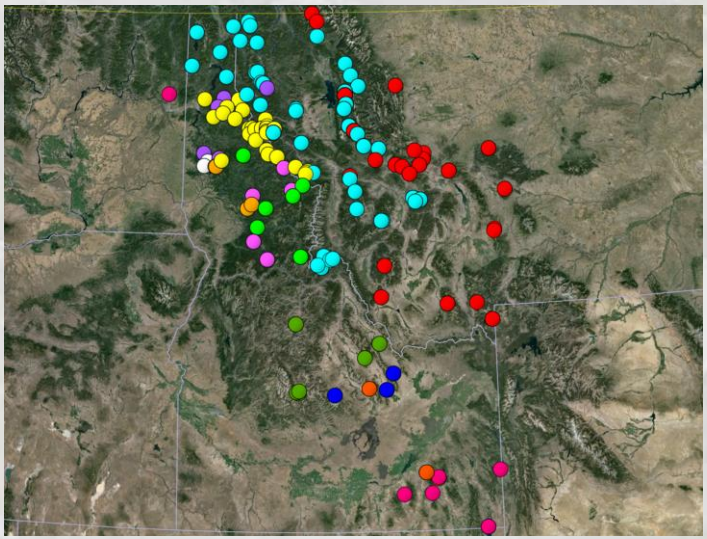
=

USFS Region	Amphibian	Lake-Pond	Stream-River	Spring-Wetland	Passage	Temperature	Valley Segment
Northern (R1)	0	848	20,566	0	5,034	9,280	0
Rocky Mountain (R2)	695	102	4,774	0	400	519	116,877
Southwestern (R3)	85	16	1,358	11	20	152	0
Intermountain (R4)	57	305	15,057	0	2,941	3,199	0
Pacific Southwest (R5)	20,635	16,231	18,083	262	2,172	7,160	0
Pacific Northwest (R6)	0	32	23,505	0	2,149	17,779	0
Southern (R8)	0	0	10,333	0	339	0	0
Eastern (R9)	0	354	19,114	0	10,561	3,042	0
Alaska (R10)	0	192	7,058	0	6	438	0
Totals:	21,472	18,080	119,848	273	23,622	41,569	116,877

Example #2: Fish Phylogeography Research

Electrofishing is a common sampling technique

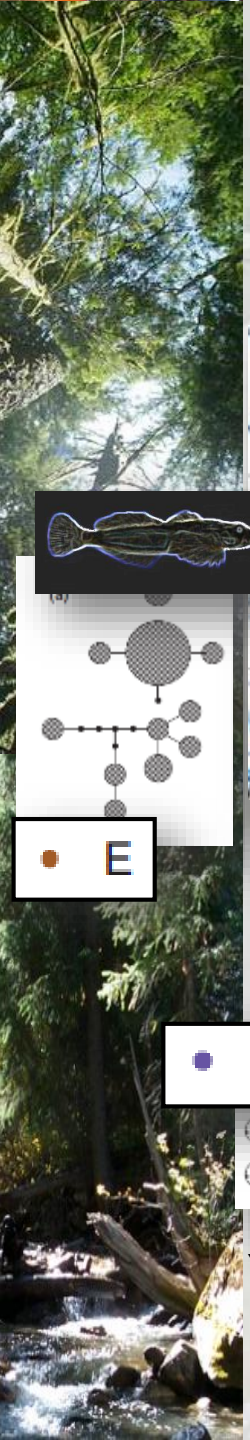
Fin tissues easily collected & preserved while handling fish

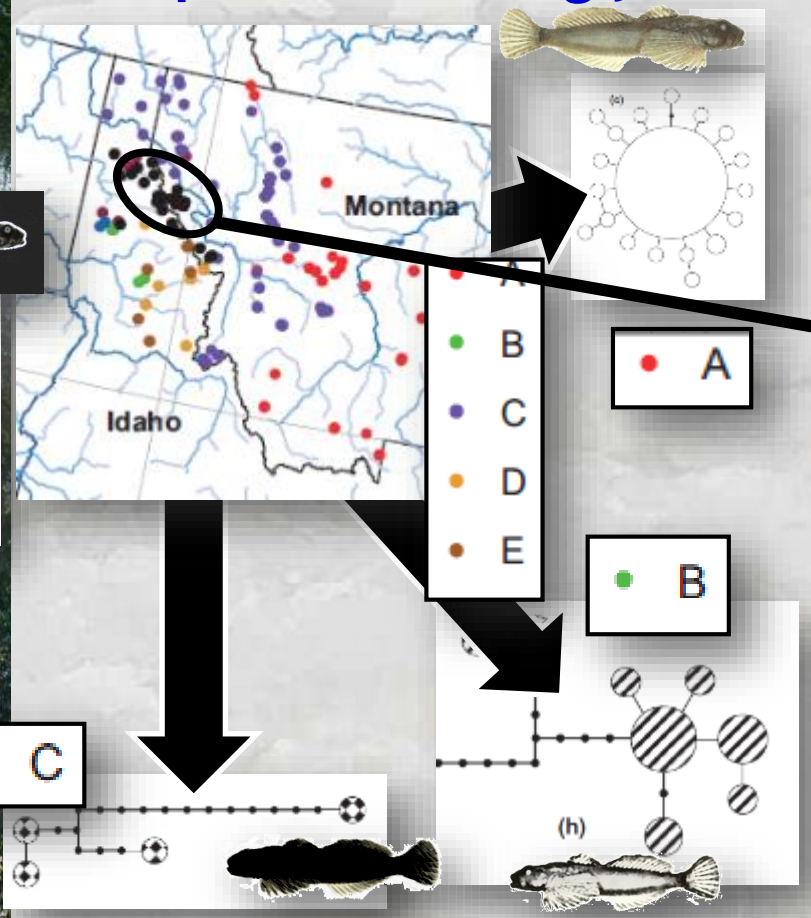


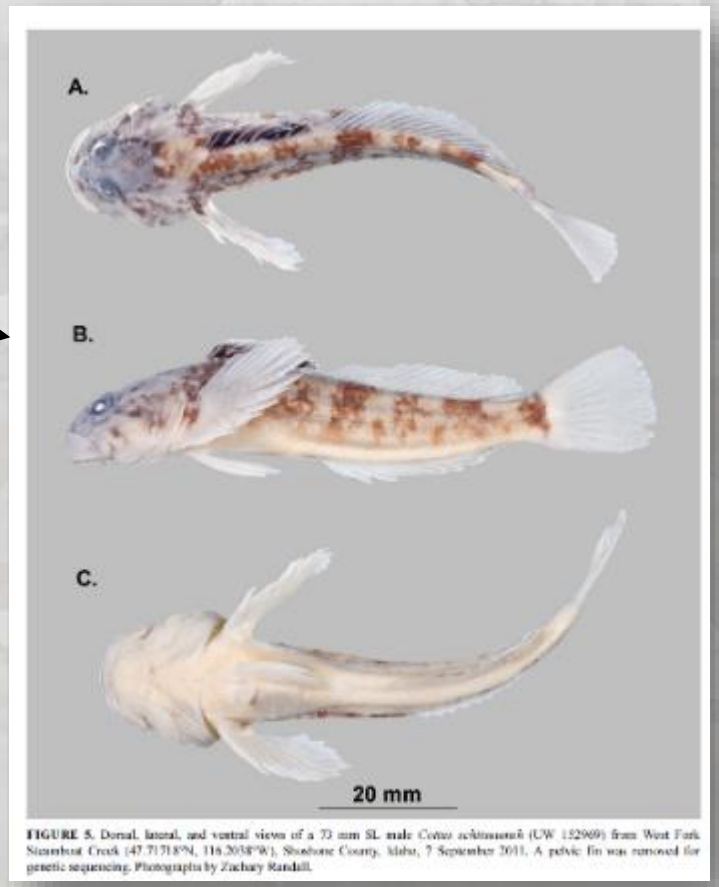
Spatially extensive genetic archives can be amassed to ask: what are the units of conservation?

DNA Barcoding Reveals Detailed Phylogeography in Cryptic Cottids

Sculpins are amazingly diverse...and some are new to science





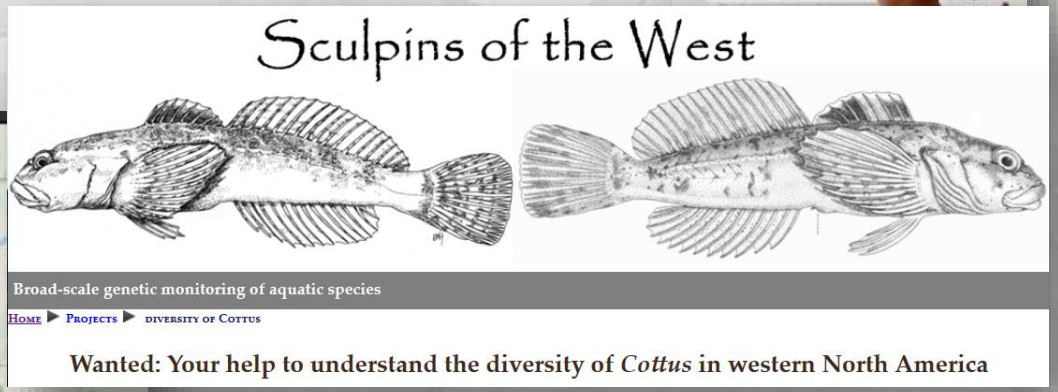


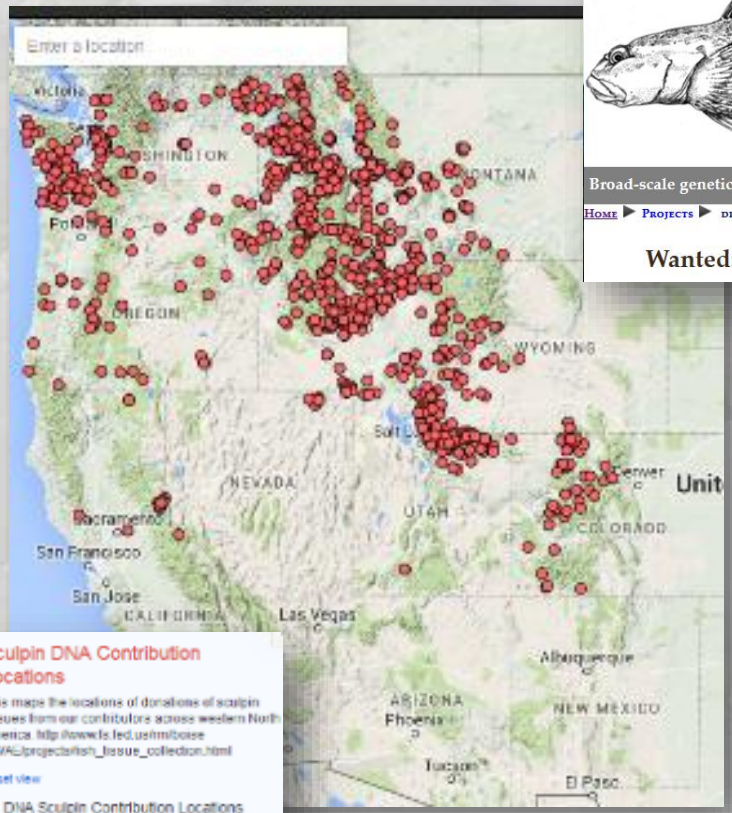
Young et al. 2013. DNA barcoding at riverscape scales: assessing biodiversity among fishes of the genus *Cottus* in northern Rocky Mountain streams. *Molecular Ecology Resources* **13**:583-595.

Lemoine et al. 2014. *Cottus schitsuumsh*, a new species of sculpin in the Columbia River basin, Idaho-Montana, USA. *Zootaxa* **3755**:241-258

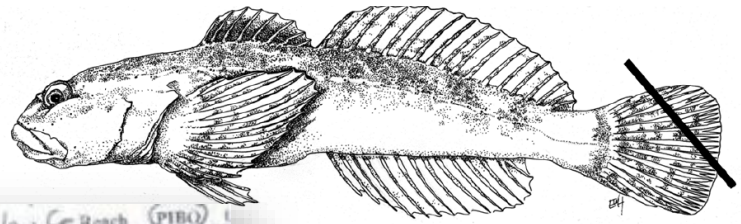
Same Approach, Bigger Scope: Sculpin Qwest

- Sculpins of the West project initiated & website designed to host research materials
- Crowd-sourced tissue request sent via email
- 7,258 tissue samples received
- Googlemap tool shows sample metadata





Description of tissue sampling protocol

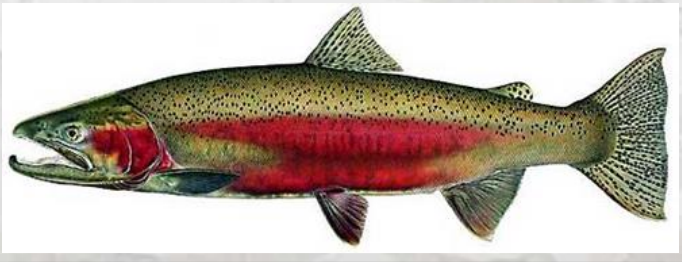


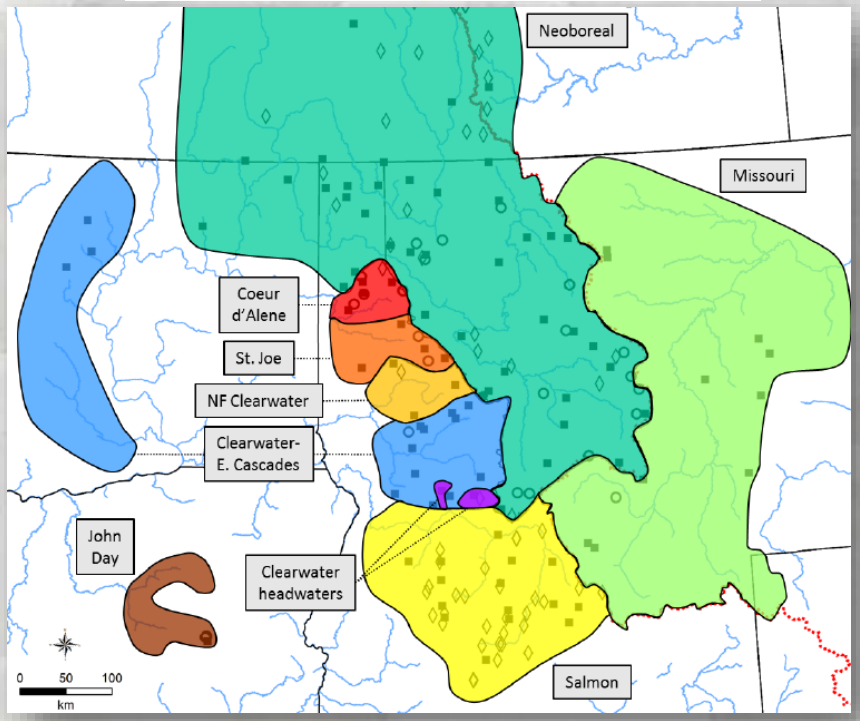
NA barcoding to identify and locate potential conservation
stocks, or species new to science—of sculpins from throughout
lp is sought to obtain:

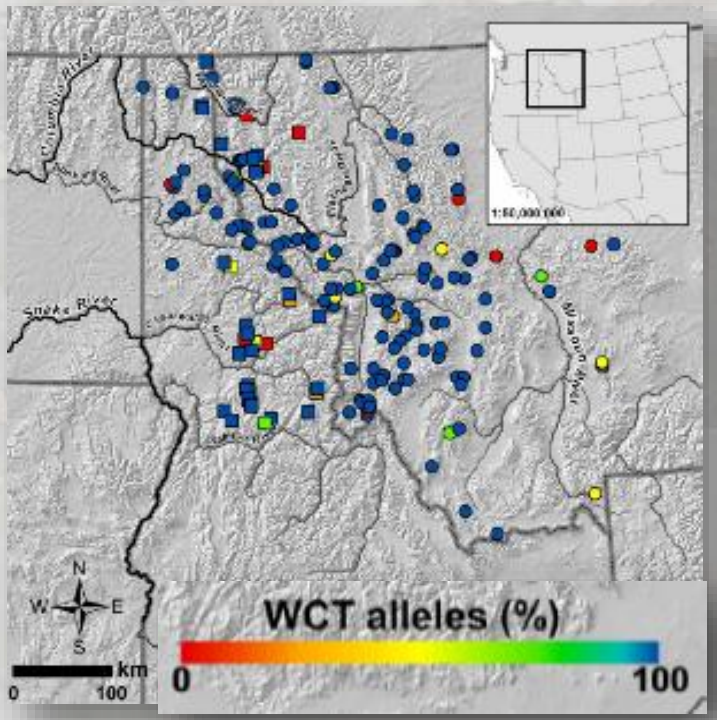
uals (or even 1–2) of all sculpin species (see page 2) from
asin in the western North America—the Columbia, Colorado,
s, and the Great Basin.

th-code (HUC-12) subwatershed, which is equivalent to a
l stream on a USGS 1:24000 topo map. Ultimately, I'd like to
de watersheds in each major river basin i.e., a 4th-code (HUC-8)
ov/GIS/wbd_huc8.pdf), but will gladly take more sites.

Once more to the tissues: Westslope cutthroat trout diversity and the risks of hybridization







Young et al. 2017. The phylogeography of westslope cutthroat trout. bioRXiv preprint of AFS book chapter. DOI: https://doi.org/10.1101/213363

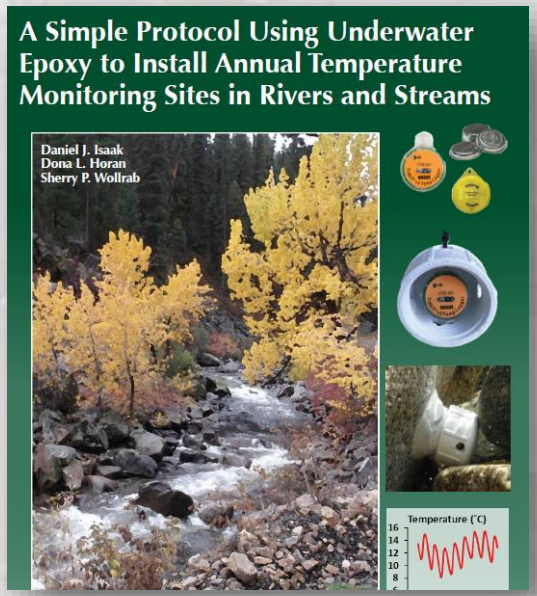
Young et al. 2016. Climate, demography, and zoogeography predict introgression thresholds in salmonid hybrid zones in Rocky Mountain streams. PLoS ONE, e0163563.

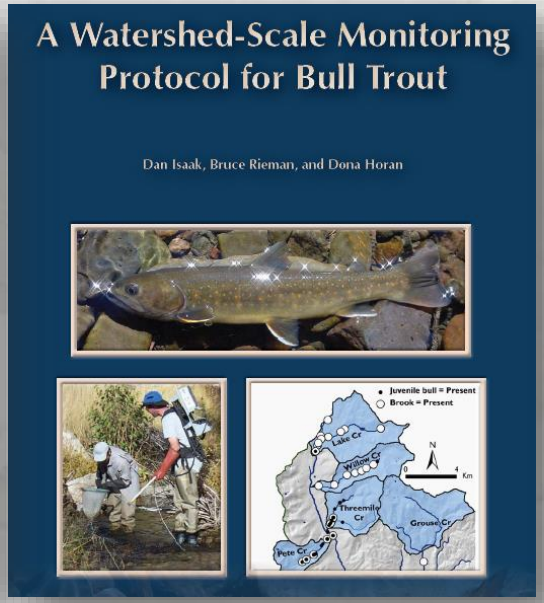
Essential Tools for Scaling Up…

A) Low cost digital media for advertising & interacting

- Websites
- Tweets
- Blogs
- Email chat
- Videos

B) Easy-to-follow data collection protocols



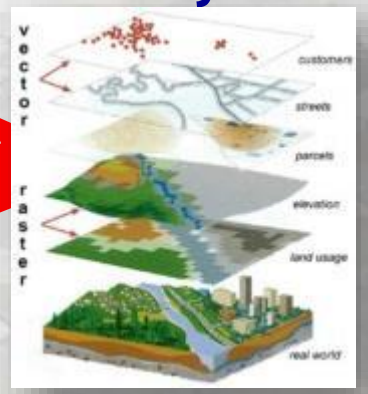


Essential Tools for Scaling Up…

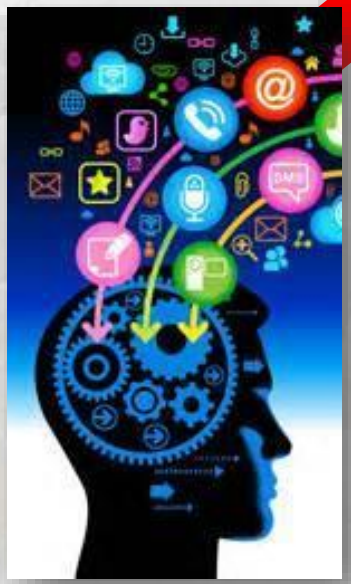
C) Teams of collaborating scientists, managers, & professionals

Managers

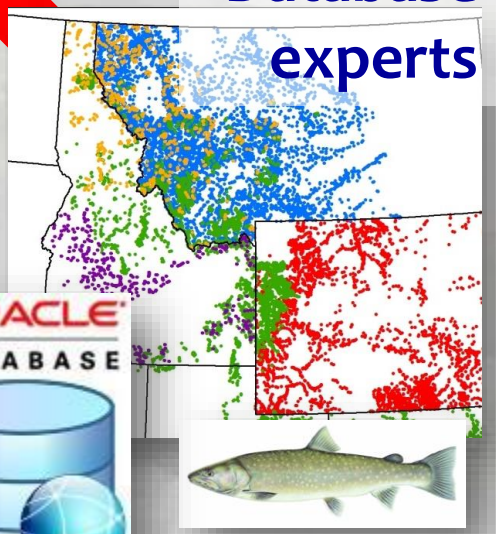
GIS analysts



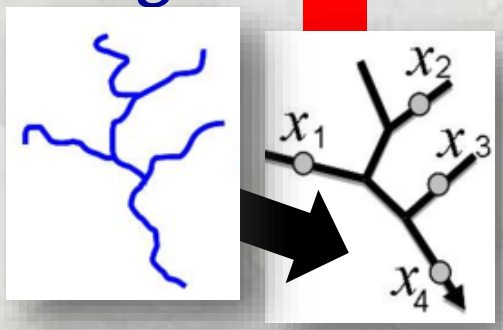
Scientists



Database experts



Ecological Modelers



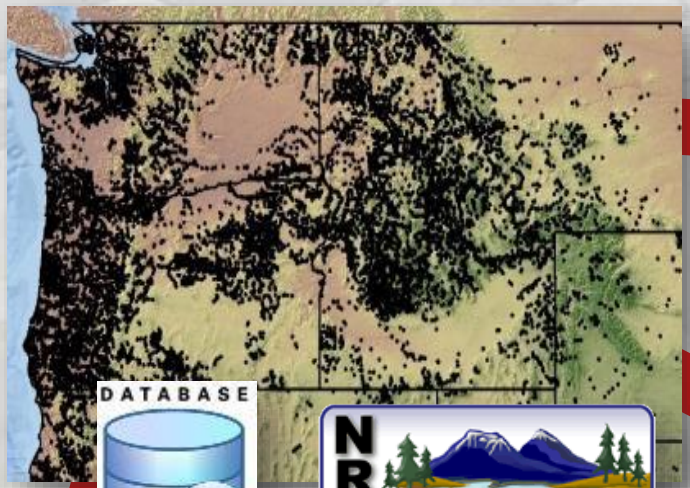
Online eDNA Databases to Describe Species Distributions & Distribute Data

The eDNA Alliance

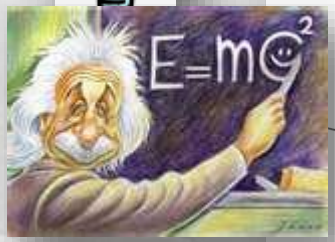
BLM
Bureau of Reclamation
Chehalis Tribe
Clark Fork Coalition
Coeur d'Alene Tribes
Great Northern LCC
Idaho Conservation League
Idaho DEQ
Idaho Fish and Game
Idaho Power Company
Kalispel Tribes
Montana Dept. Natural Resources Conservation
Montana Fish, Wildlife & Parks
National Fish & Wildlife Foundation
The Nature Conservancy

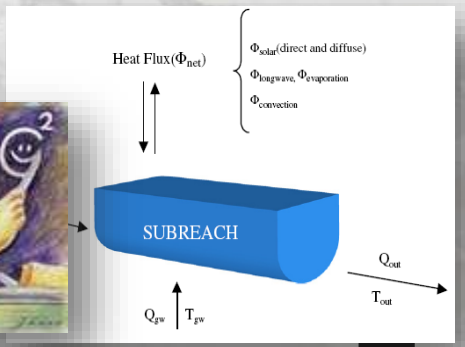
National Park Service
Oregon Dept. Fish & Wildlife
Shoshone-Bannock Tribes
Trout Unlimited
University of Washington
U.S. Fish and Wildlife Service
USFS National Forests: Beaverhead-Deer Lodge, Boise, Colville, Deschutes, Flathead, Helena, Idaho Panhandle, Lolo, Mount Baker-Snoqualmie, Nez Perce-Clearwater, Payette, Salmon-Challis, Sawtooth, Wallowa-Whitman, Wenatchee
USFS Regions 1, 4, and 6
Washington Dept. Fish & Wildlife
Yakama Nation

Data Archiving & Access Catalyze the Process



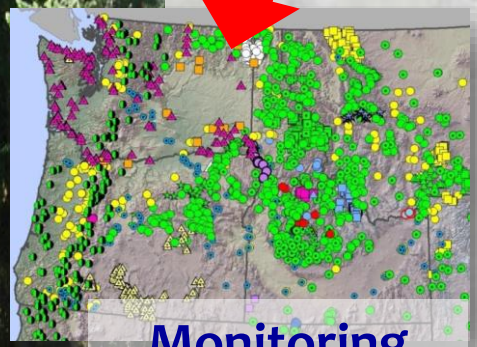
New research is accelerated





Protocols are developed

Better ecological status & trend assessments & understanding



Monitoring networks are improved

Better Forest Planning

USDA United States Department of Agriculture

Forest Service

Northern Region

March 2007

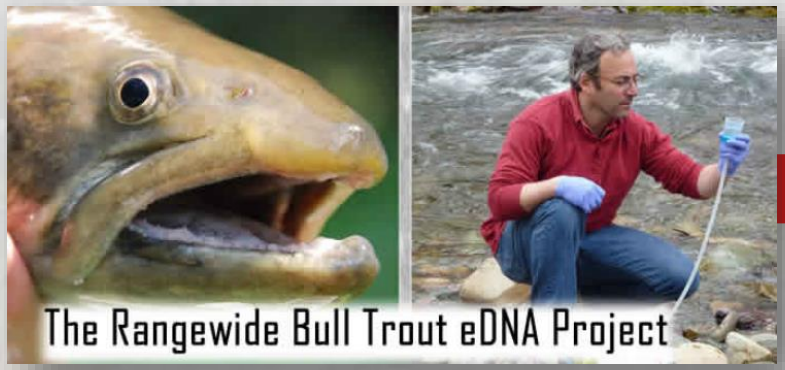
Land Management Plan

Clearwater National Forest

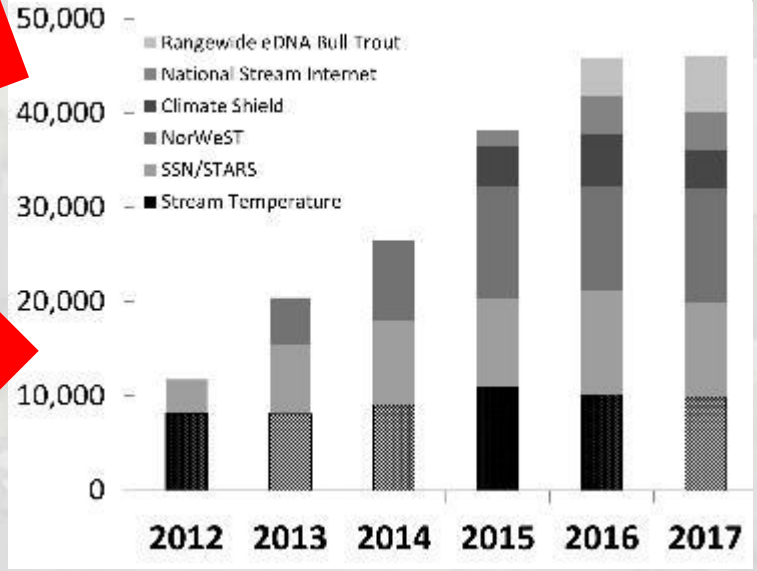
Once Snowball Rolls, Mass & Energy are Gained

Same recipe works with many ingredients…

Climate Shield Cold-Water Refuge Streams for Native Trout



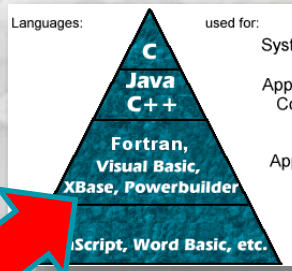
Annual visits to project websites

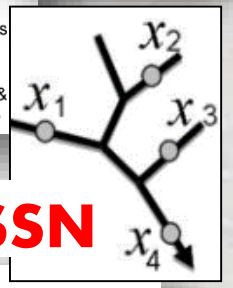


Take Home #1: Old Research Dogs Must Learn New Tricks or May be Put to Sleep

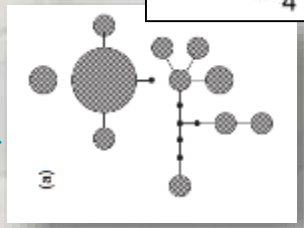
Original skills

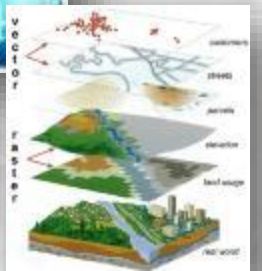
Current skills





SSN





University of Wyoming

Take Home #2: Cycle Starts with Good Communication between Researchers & Managers

1. **Select a good research topic**
   a. Practical benefits to managers
   b. Stokes researcher's interest/passion
   c. Opportunities exist for tangible scientific contributions

2. **Pick topics for which data already exist and/or can be routinely collected by managers**
   a. Low startup cost
   b. Low additional data collection costs
   c. Use of manager's datasets ensures relevance & ongoing dialogue

nduct & publish proof-of-concept study
a. Develop and/or apply novel technical and/or analytical techniques to learn something new & valuable
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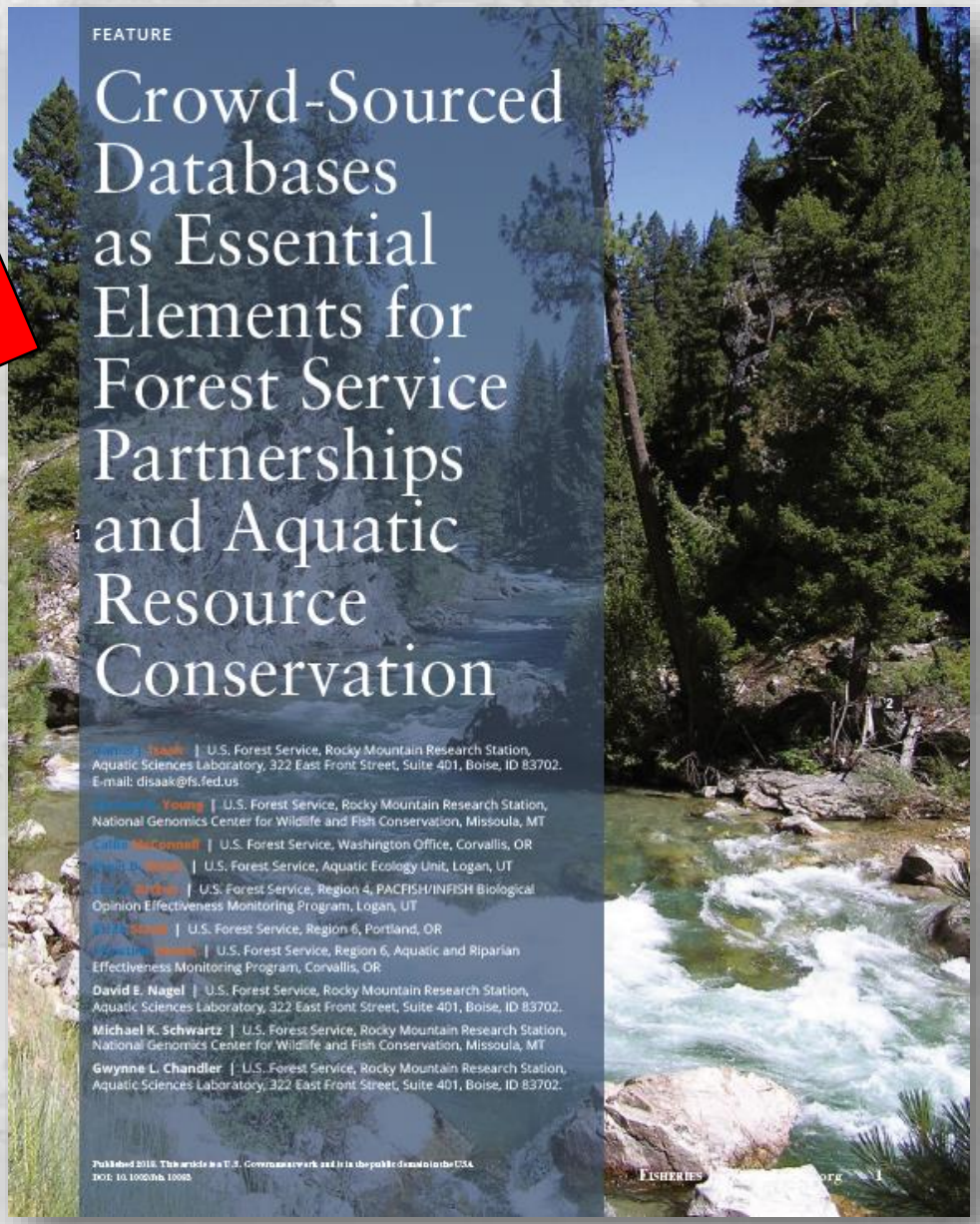
4. **Scale up & elaborate research agenda**
   a. Obtain funding via external grants or internal agency funds
   b. Conduct related studies using existing datasets

Perhaps also Relevant…



Isaak, D.J., M. Young, C. McConnell, B. Roper, E. Archer, B. Staab, C. Hirsch, D. Nagel, M. Schwartz, G. Chandler. 2018. Crowd-sourced databases as essential elements for forest service partnerships and aquatic resource conservation. *Fisheries* **43**, doi: 10.1002/fsh.10083