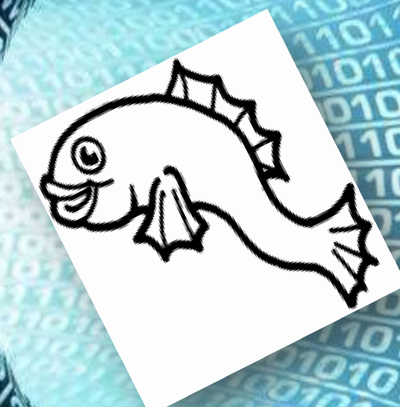
BIG DATAbases for Streams



Part 1a: Designed databases

NAWQA

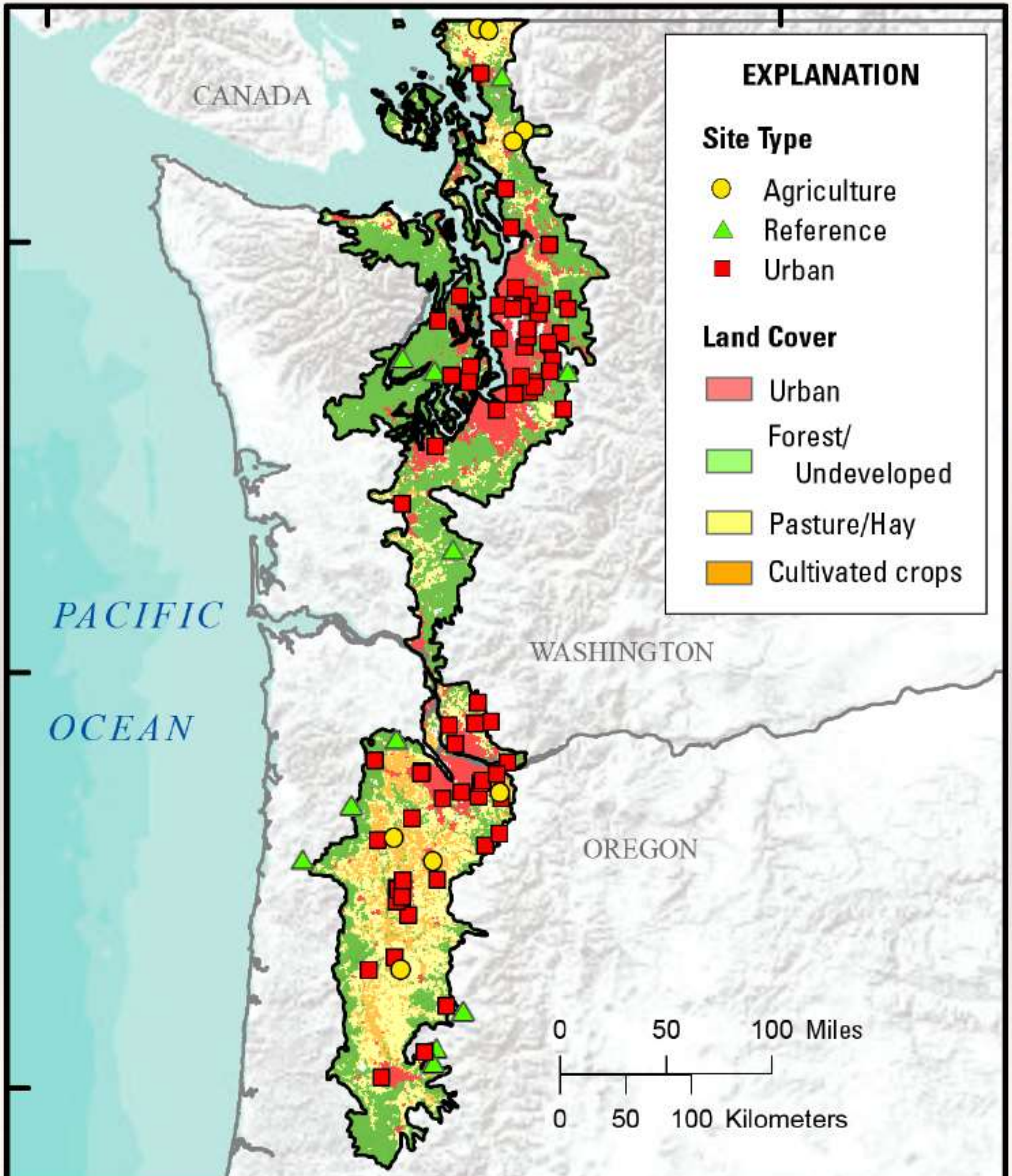
Stream Internet Workshop
Boise, ID

Daren Carlisle, Ecological Studies Coordinator,
National Water-Quality Assessment Program,
US Geological Survey

Website: http://water.usgs.gov/nawqa/

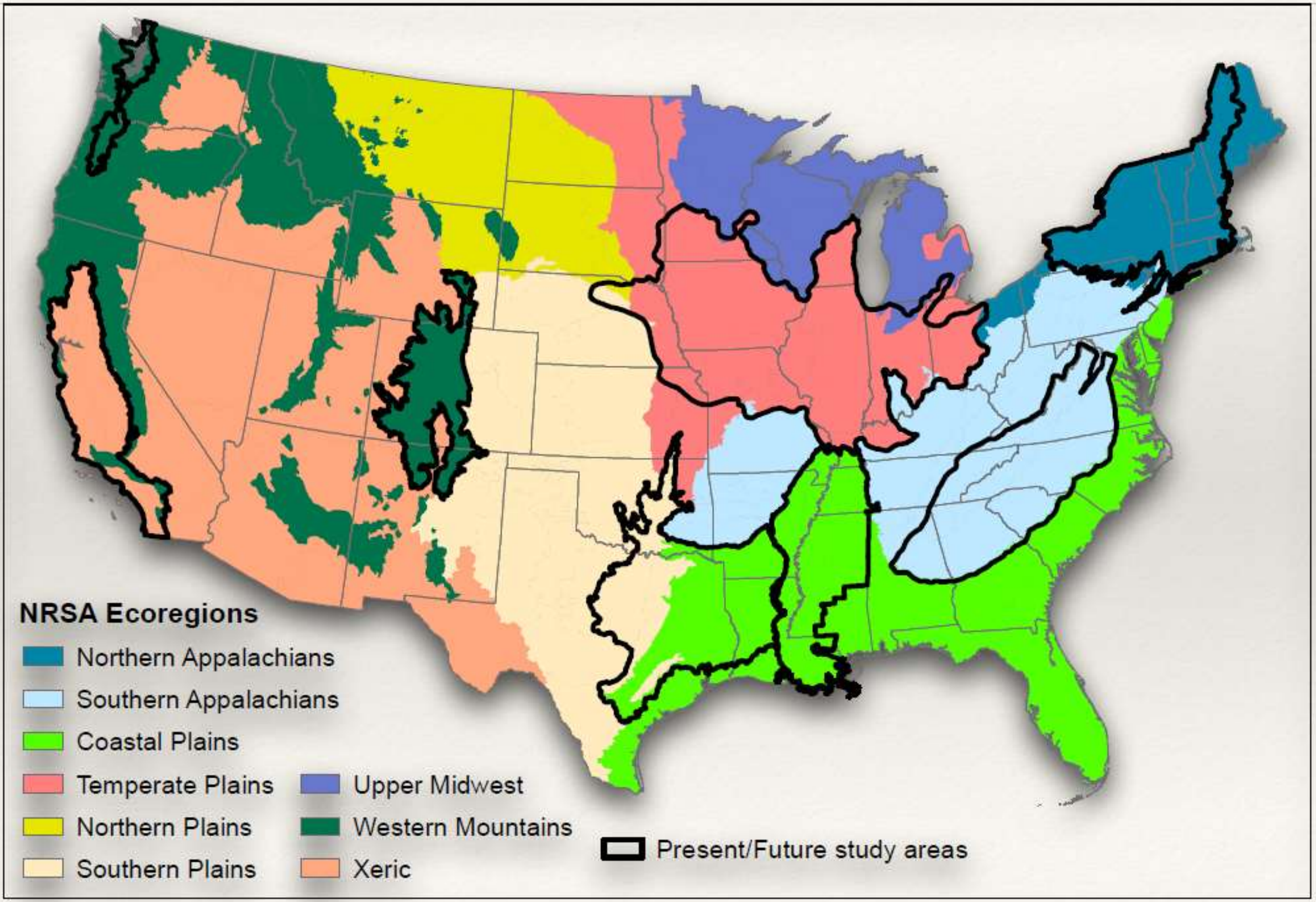
NAWQA Regional Assessments

- GOAL: Assess stream health and the potential stressors that affect it
- 90-130 stream sites
- Gradient of anthropogenic stressors
- Characterize chemical & physical stressors for 10 weeks
- Characterize physical & biological conditions during week 10 of chemical sampling



Pacific Northwest Stream-Quality Assessment

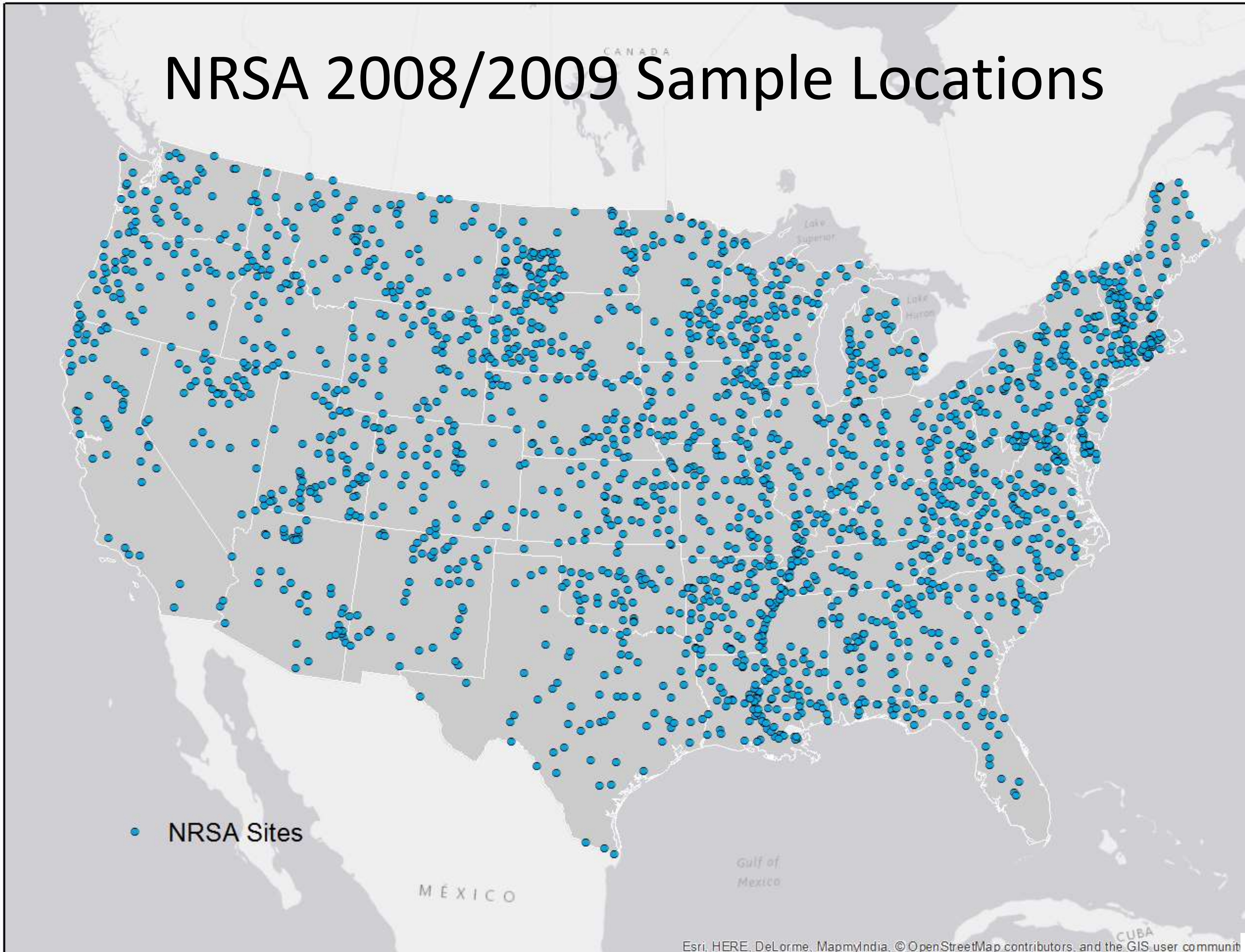
Regional Assessments



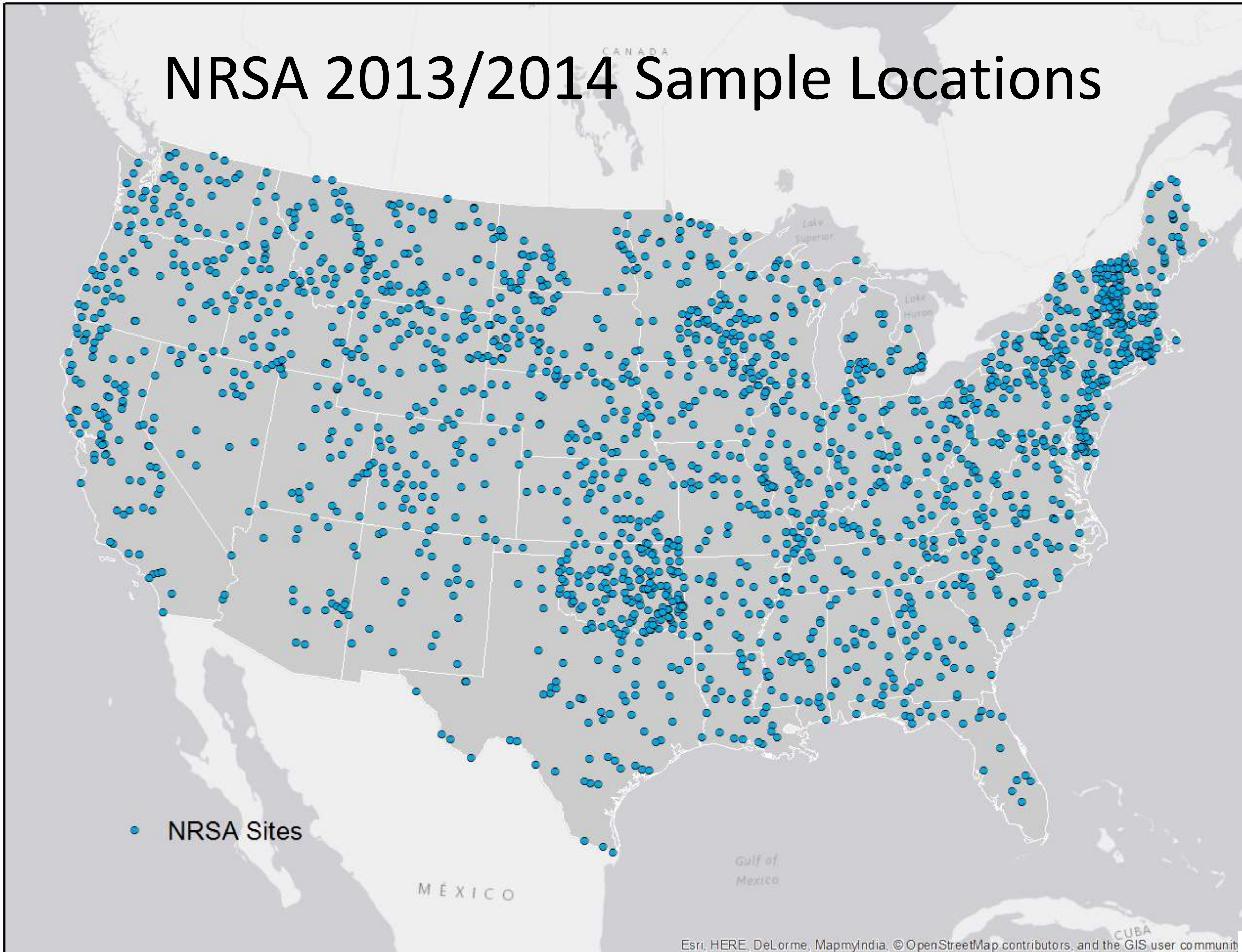
Richard Mitchell - EPA

Website: http://water.epa.gov/type/watersheds/monitoring/aquaticsurvey_index.cfm

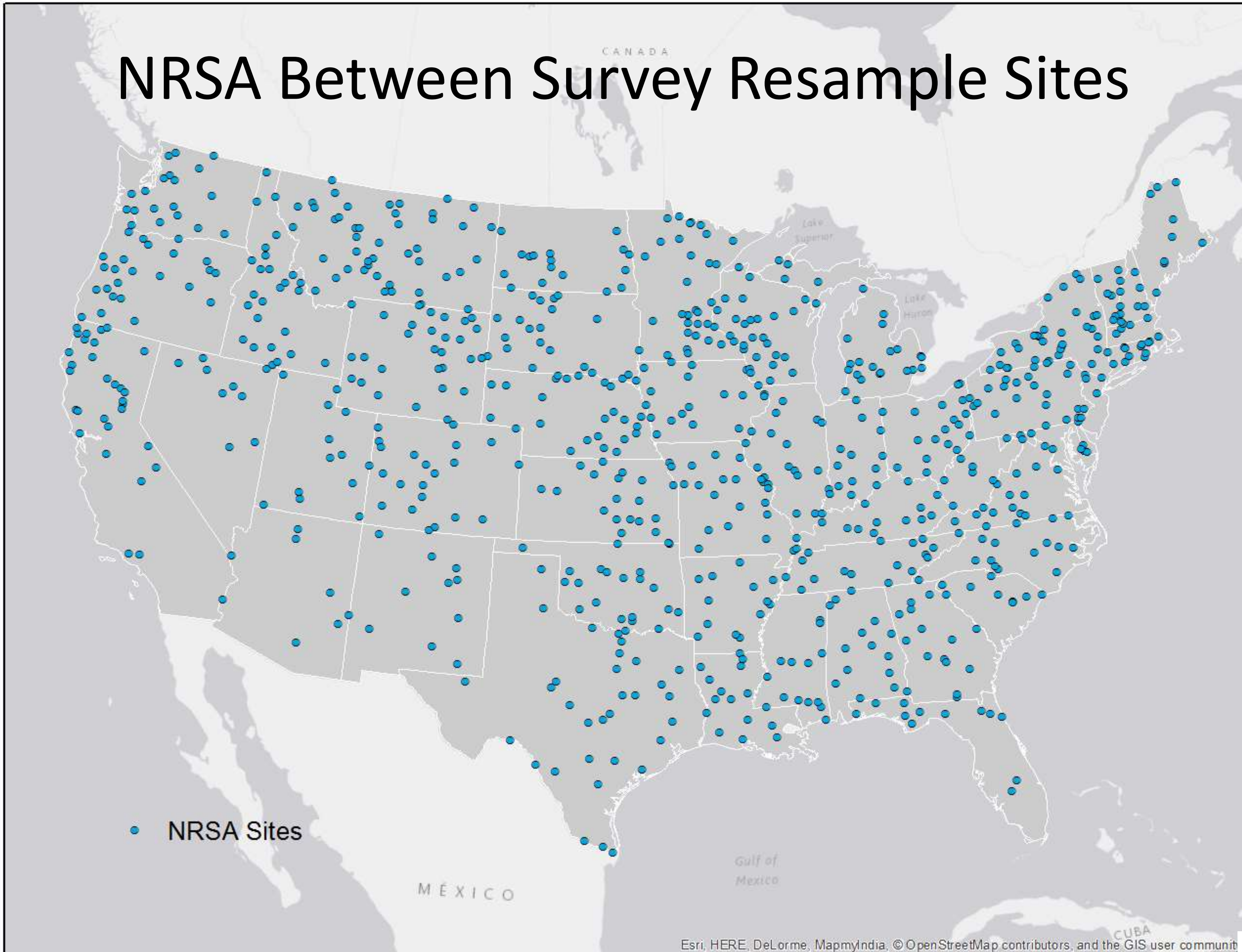
NRSA 2008/2009 Sample Locations



NRSA 2013/2014 Sample Locations



NRSA Between Survey Resample Sites



BugLab & WMC

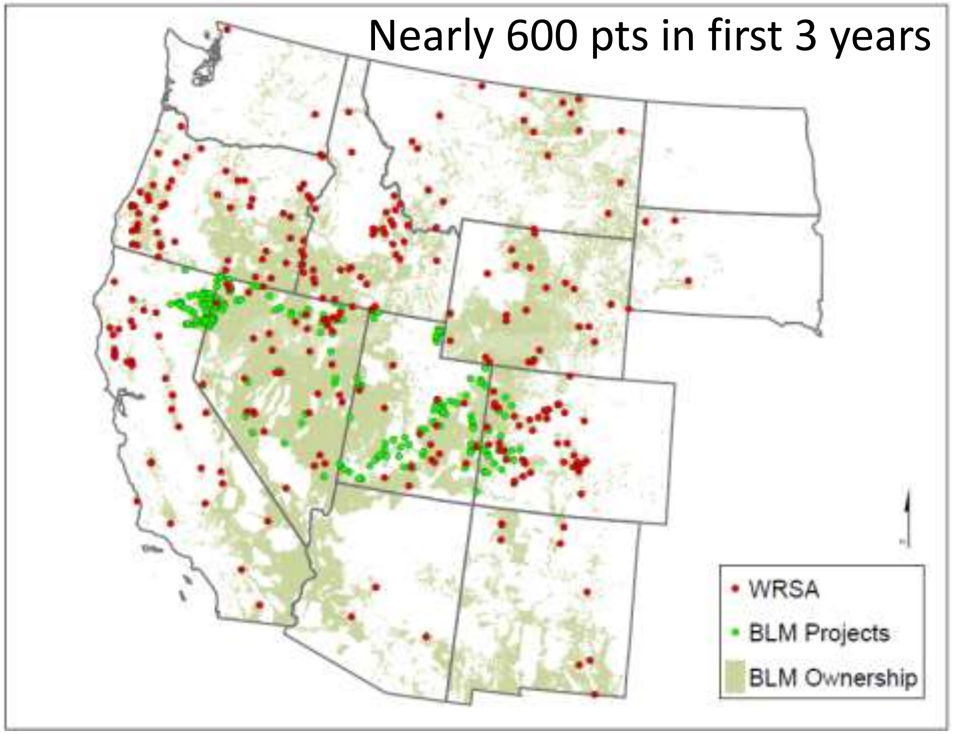
Scott Miller, Chuck Hawkins – USU/BLM

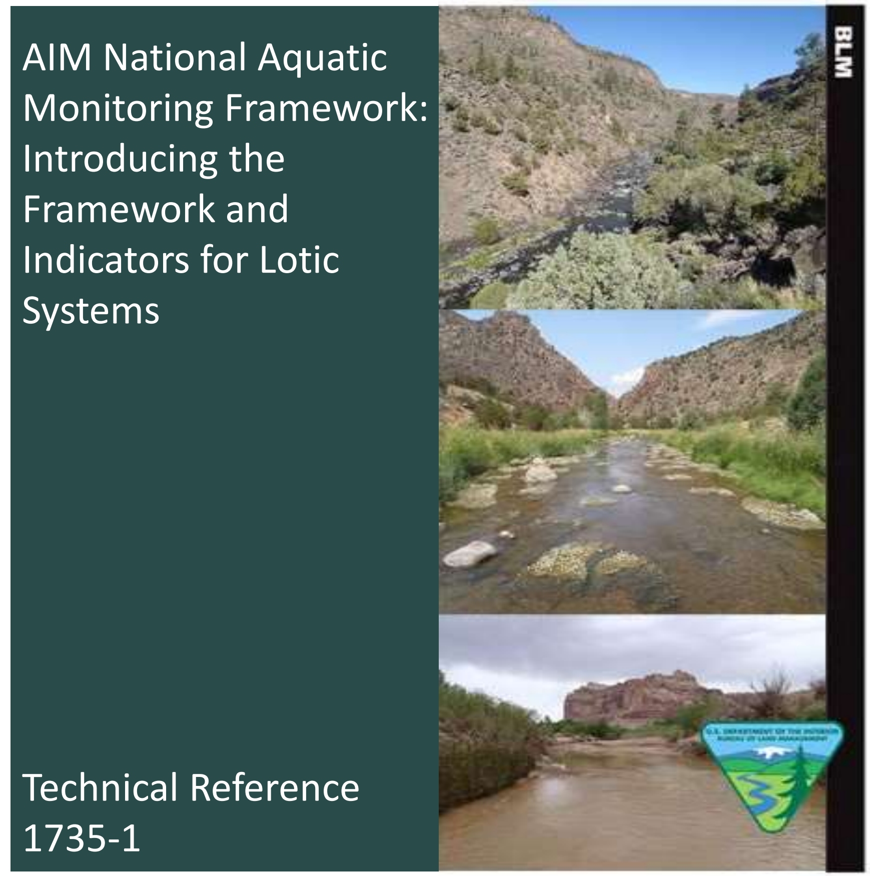
BugLab Website: http://www.usu.edu/buglab/
WMC Website: http://www.cnr.usu.edu/wmc/

NAMF (National Aquatic Monitoring Framework)

Lotic ecosystem monitoring (started 2013)

- Standardized methods for chemical, physical and biological indicators
- Statistically valid sample designs
- Collaborations with EPA, USFS, States

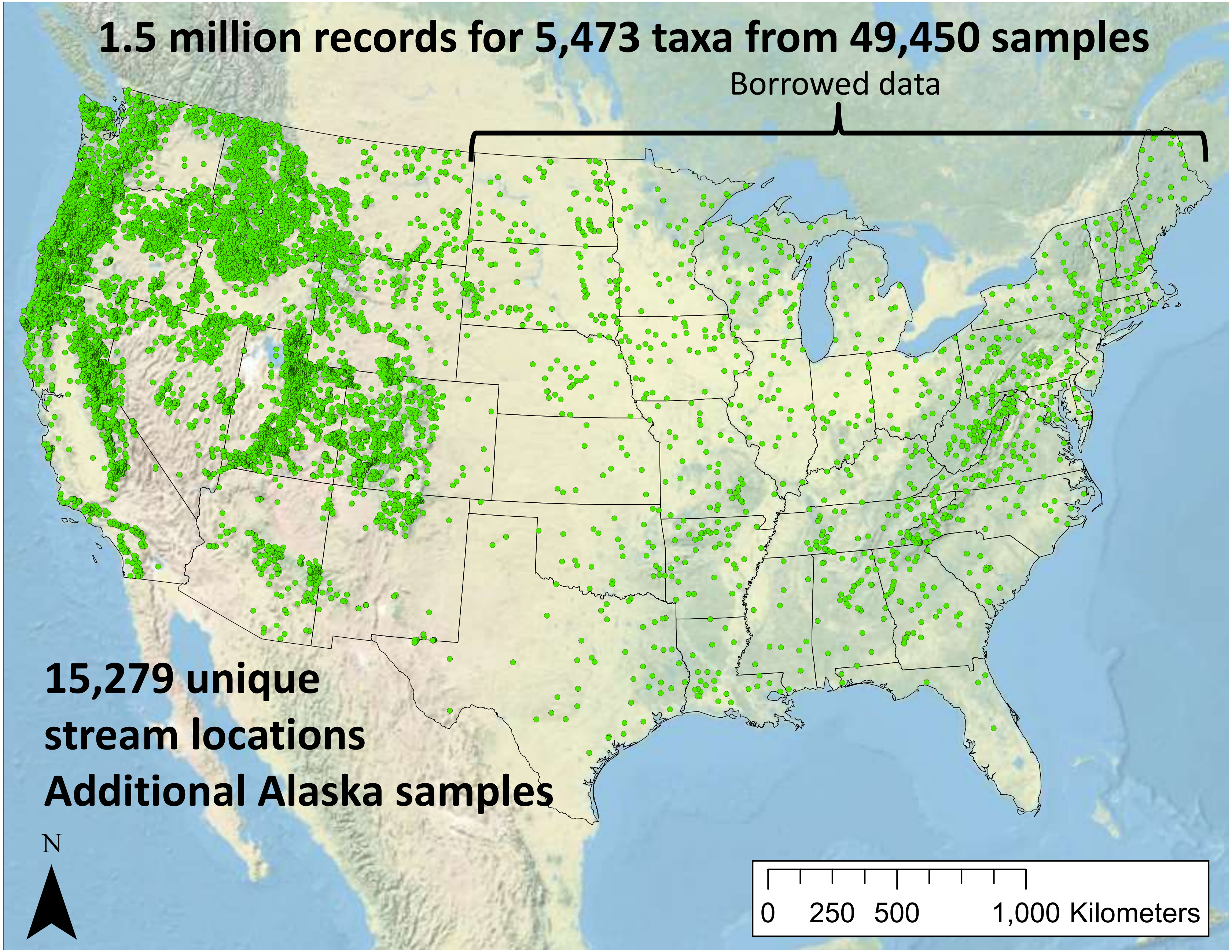




Scott Miller (BLM/USU)

Website: http://www.usu.edu/buglab/Projects/CurrentProjects/

WMC/BugLab Invertebrate Spatial Database



MAPIT website: http://www.cnr.usu.edu/wmc/htm/data

Western Center for Monitoring & Assessment of Freshwater Ecosystems

Utah State University

BLM/USU National Aquatic Monitoring Center

BugLab

MAPIT - a **M**apping **App**lication for Freshwater **I**nvertebrate **T**axa

Type in a taxon's name

Caudatella | Site Clusters ○ Pins ● | Search | Home

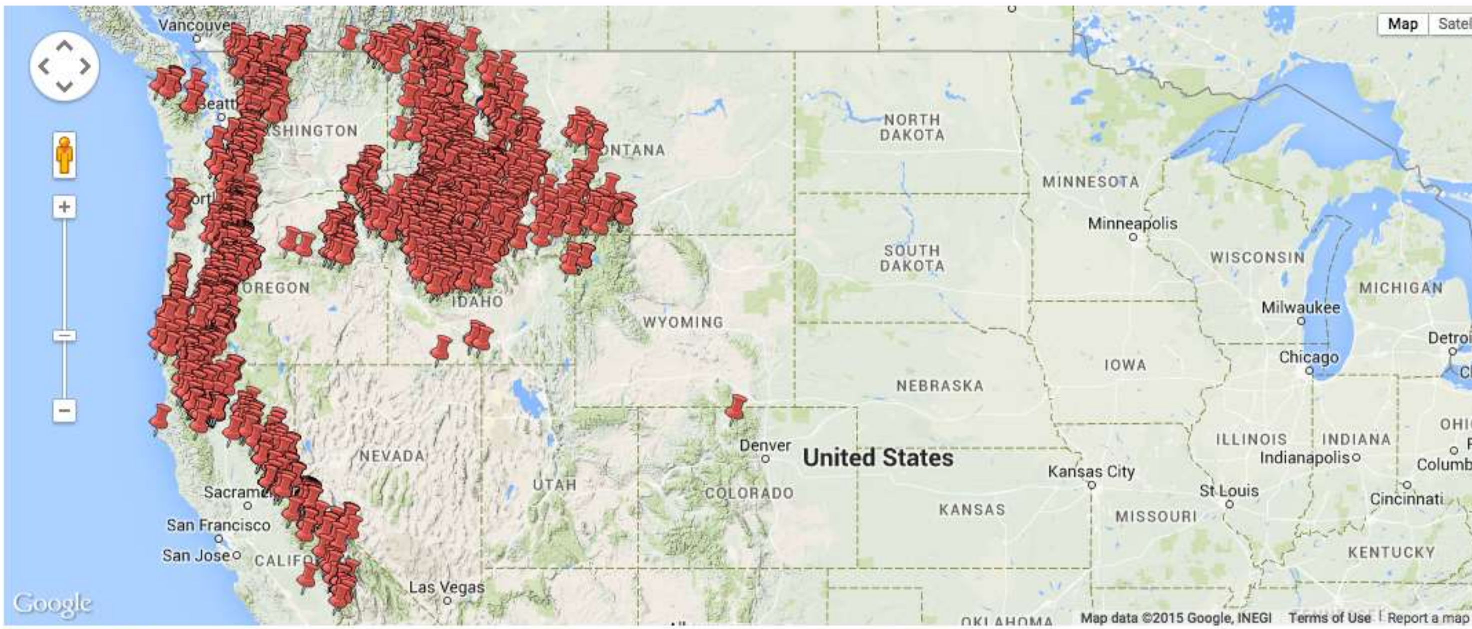
Read Me First!

Results **1** - **2000** of **4468**

ProjectName
- + AREMP (422)
- + CA-R5 (91)
- + EMAP-WEST (304)
- + HAWKINS-CWE (139)
- + NAQWA-REF (41)
- + PIBO (1088)
- + R6-USU-EAST (10)
- + R6-USU-WEST (286)
- + USU-STAR-I (38)
- + USU-STAR-II (8)
- + USU/BLM-BUGLAB (2041)

State
- + CA (1370)
- + CO (2)
- + ID (1034)
- + MT (595)
- + NV (17)
- + OR (998)
- + UT (1)
- + WA (430)
- + WY (21)

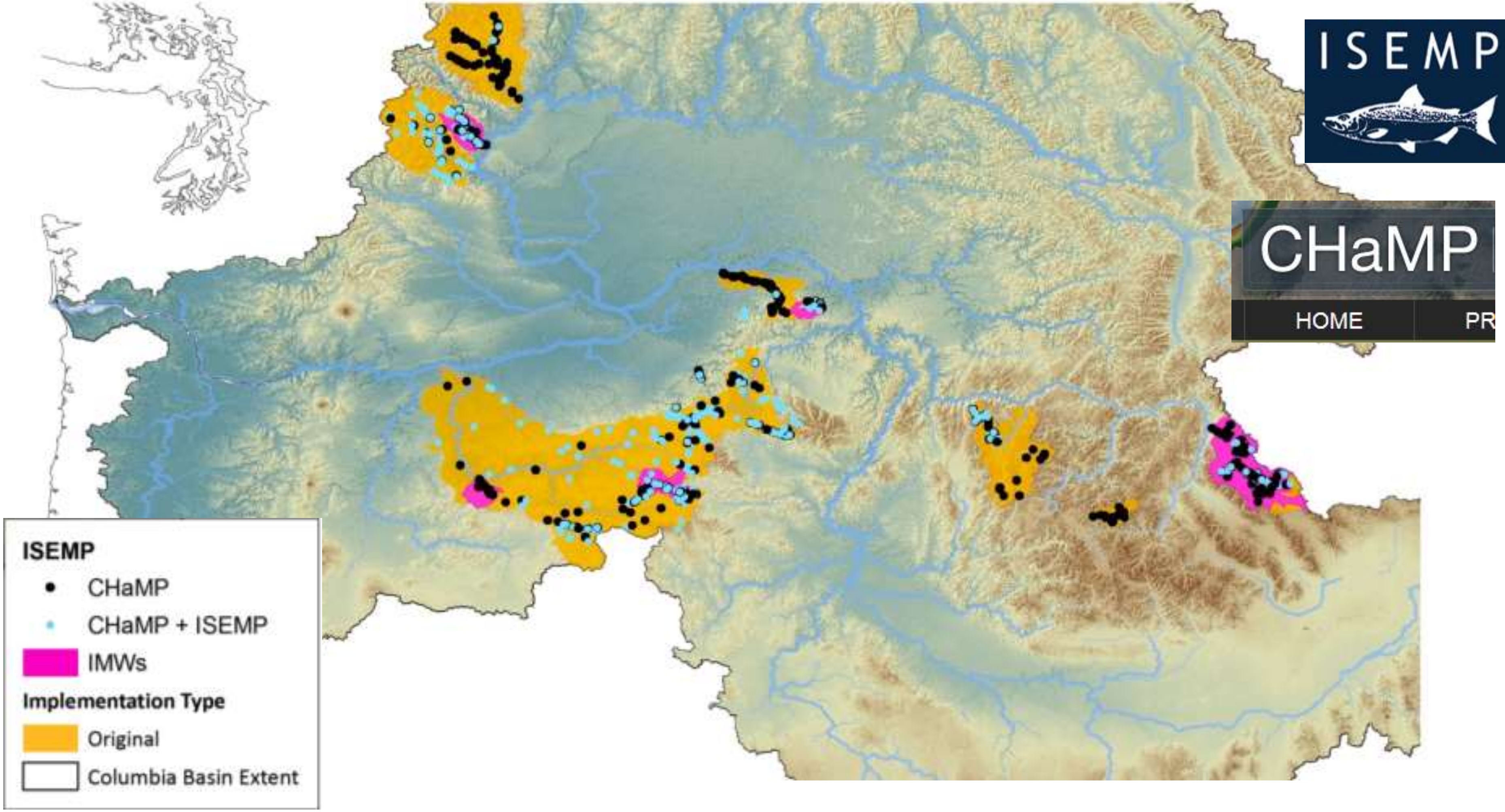
SampleDate
- + 1981 (1)
- + 1984 (4)
- + 1987 (4)
- + 1988 (49)
- + 1989 (82)
- + 1990 (4)
- + 1991 (8)
- + 1992 (11)
- + 1993 (19)
- + 1994 (63)
- + 1995 (33)
- + 1996 (45)
- + 1997 (75)
- + 1998 (308)
- + 1999 (226)
- + 2000 (270)
- + 2001 (249)
- More ...



Download all data   Results Page: *1* 2 3 Next

Sampleid	Station	ProjectName	Method	Habitat	Area	LabSplit	Qualitative	Mesh	SampleDate
148461	CSNM_11	USU/BLM-BUGLAB	Surber net	Targeted Riffle	0.74	7.81	N		2011/08/29 00:00:00
151068	2013CAEIN1003	USU/BLM-BUGLAB	Surber net	Targeted Riffle	0.74	62.5	N		2013/06/25 00:00:00
151090	2013CAIND1008	USU/BLM-BUGLAB	Surber net	Targeted Riffle	0.74	100	N		2013/05/15 00:00:00
151098	2013CALIN1007	USU/BLM-BUGLAB	Surber net	Targeted Riffle	0.74	100	N		2013/07/03 00:00:00
151099	WCAP99-R037	USU/BLM-BUGLAB	Surber net	Targeted Riffle	0.74	100	N		2013/07/03 00:00:00
151100	2013CALIN1009	USU/BLM-BUGLAB	Surber net	Targeted Riffle	0.74	100	N		2013/07/03 00:00:00

Columbia Habitat Monitoring Program & Integrated Status and Effectiveness Monitoring Program



Website: https://www.champmonitoring.org/

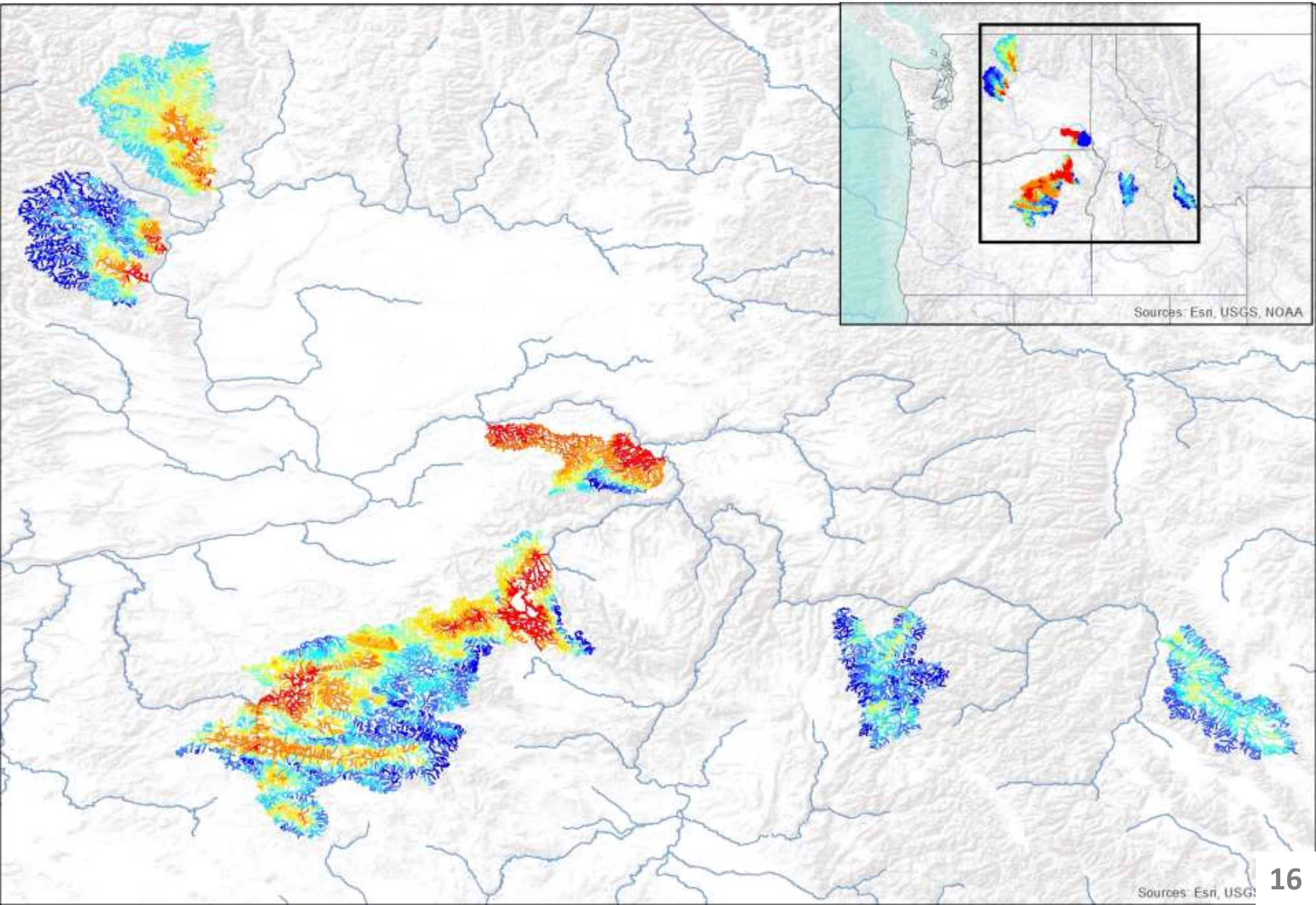
Chris Jordan - NOAA

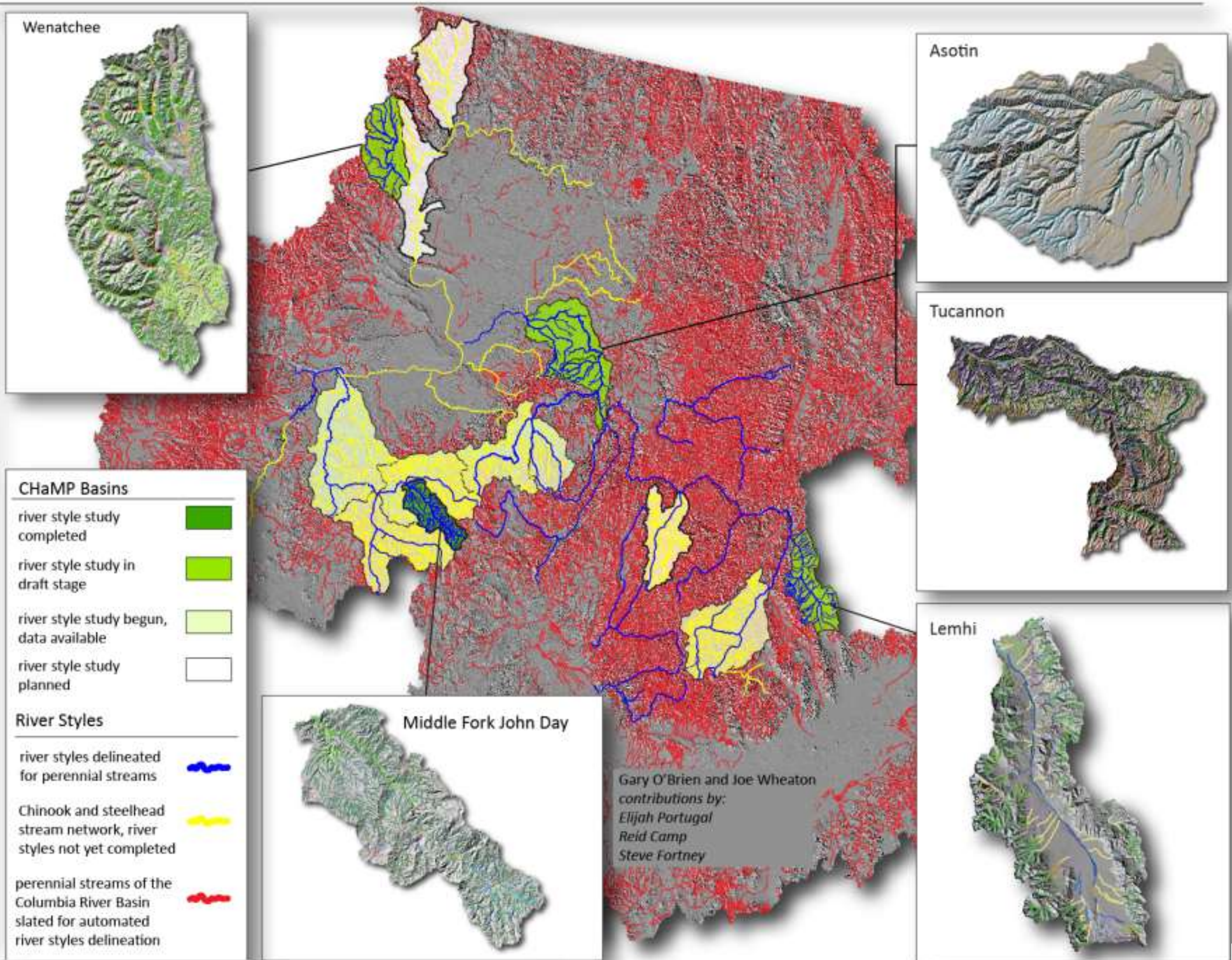
Website: http://isemp.org/

CHaMP and ISEMP

- CHaMP samples stream habitat conditions at ~500 unique locations in PNW, paired with ISEMP sampling stream fish (salmonids) at 250 CHaMP sample sites annually.
- Goals
  - Developing fish-habitat relationships across all CHaMP sampling sites
  - Developing generalized fish-habitat relationships across all CRB salmonid domain
  - Distributing metric data from sampling sites
- Need help thinking about
  - Distributing derived metrics
  - Distributing network-scale data products

Spatially and Temporally Continuous Predictions of Stream Temperature




Wenatchee
Asotin
Tucannon
Lemhi
Middle Fork John Day
CHaMP Basins
river style study completed
river style study in draft stage
river style study begun, data available
river style study planned
River Styles
river styles delineated for perennial streams
Chinook and steelhead stream network, river styles not yet completed
perennial streams of the Columbia River Basin slated for automated river styles delineation
Gary O'Brien and Joe Wheaton
contributions by:
Elijah Portugal
Reid Camp
Steve Fortney

File Edit View History Bookmarks Tools Help

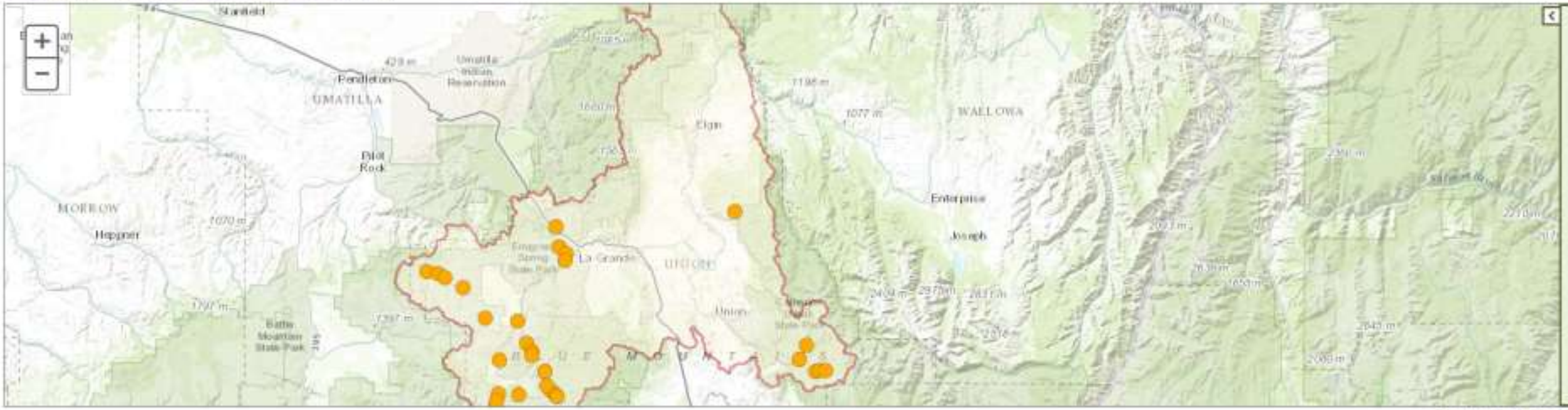
National Oceanic and Atm... | Watershed: Upper Grande ...

https://www.champmonitoring.org/Watershed/Details/12#tab-visits

NWFSC | Inside NWFSC | ISEMP | Google Maps | Doodle | SDM_WebApps | Calendar | CHaMPMonitoring | Dropbox | xkcd | AmeriGas | Weather | TripCheck | NWFSC Weekly

Home > Watersheds > Upper Grande Ronde > Details

Watershed: Upper Grande Ronde (ID: 12)



Reset Map Hide Map

Overview | Study Design | Field Support | Visits | Measurements | Metrics | Status

Year: 2014

Visits Tab

Below are the site visits where monitoring data has been received and loaded to the database in preparation for the quality assurance (QA) process. show more

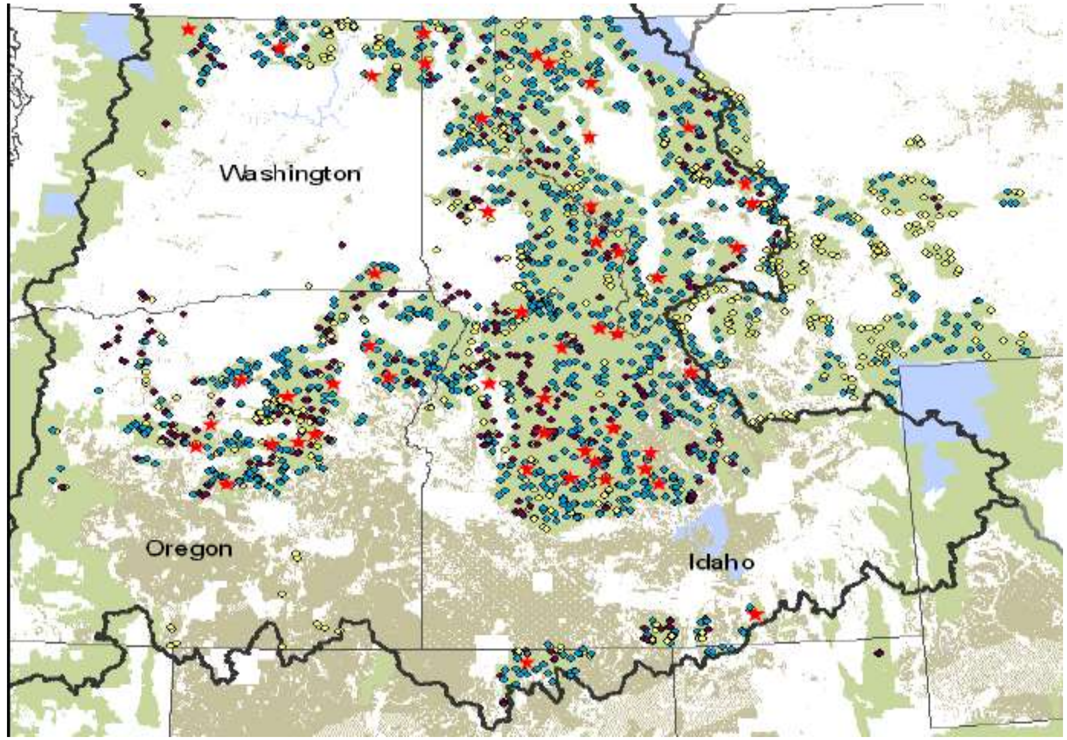
Currently viewing 75 of 75 visits

Download Data

Rele	Site ID	Sample Date	Organization	Use Order	Protocol	Hitch Date	Hitch	Crew	Visit Phase	Visit Status	Visit ID	Panel	Category	Stream Name	Edit Purpose of Visit	CHaMP Core
	CBW05583-013882	06/30/2014	Oregon Department	1	CHaMP 2014	06/15/2014	ODFW Small Sites	Chris Horn Crew	Data Approved	Released to Public	2272	Annual	Grande Ronde Stee	Peet Creek		Yes
	CBW05583-090282	07/15/2014	Oregon Department	10	CHaMP 2014	07/31/2014	ODFW Big Sites	Chris Horn Crew	Data Approved	Released to Public	2142	Rotating Panel 1	Catherine Creek Chi	Catherine Creek		Yes
	CBW05583-092986	07/15/2014	Oregon Department	1	CHaMP 2014	06/30/2014	ODFW Medium Streams	Chris Horn Crew	Quality Assurance	In QA	2136	Rotating Panel 1	Grande Ronde Stee	Fly Creek		Yes
	CBW05583-095642	06/17/2014	Oregon Department	1	CHaMP 2014	06/15/2014	ODFW Small Sites	Chris Horn Crew	Data Approved	Released to Public	2123	Annual	Grande Ronde Stee	McCoy Creek		Yes
	CBW05583-108818	06/19/2014	Columbia River Inter	10	CHaMP 2014	06/18/2014	CRITFC Upper Grande Ronde	Monica Crew	Data Approved	Released to Public	2014	Rotating Panel 1	Upper Grande Rond	Limber Jim Creek		Yes
	CBW05583-142496	07/14/2014	Oregon Department	3	CHaMP 2014	06/30/2014	ODFW Medium Streams	Chris Horn Crew	Data Approved	Released to Public	2137	Annual	Grande Ronde Stee	Clark Creek		Yes
	CBW05583-148970	07/09/2014	Columbia River Inter	6	CHaMP 2014	06/18/2014	CRITFC Upper Grande Ronde	Monica Crew	Data Approved	Released to Public	2015	Rotating Panel 1	Upper Grande Rond	Grande Ronde Rive		Yes
	CBW05583-135815	07/09/2014	Oregon Department	2	CHaMP 2014	06/15/2014	ODFW Small Sites	Chris Horn Crew	Data Approved	Released to Public	2159	Annual	Grande Ronde Stee	Gordon Creek		Yes
	CBW05583-136554	06/21/2014	Columbia River Inter	2	CHaMP 2014	06/18/2014	CRITFC Upper Grande Ronde	Monica Crew	Data Approved	Released to Public	2016	Rotating Panel 1	Upper Grande Rond	Sheep Creek		Yes
	CBW05583-138866	09/18/2014	Columbia River Inter	6	CHaMP 2014	06/18/2014	CRITFC Catherine Creek 2014	Monica Crew	Data Approved	Released to Public	2004	Rotating Panel 1	Catherine Creek Chi	North Fork Catherin		Yes
	CBW05583-155818	09/22/2014	Columbia River Inter	8	CHaMP 2014	06/18/2014	CRITFC Catherine Creek 2014	Monica Crew	Data Approved	Released to Public	2005	Rotating Panel 1	Catherine Creek Chi	Little Catherine Cree		Yes
	CBW05583-149594	06/30/2014	Oregon Department	3	CHaMP 2014	06/15/2014	ODFW Small Sites	Chris Horn Crew	Data Approved	Released to Public	2124	Rotating Panel 1	Grande Ronde Stee	Dark Canyon Creek		Yes

PIBO (PacFish/InFish Biological Opinion)

AREMP (Aquatic & Riparian Effectiveness Monitoring Program)



<u>Rotating panel designs</u>

250 sites/year

1,500 sites total

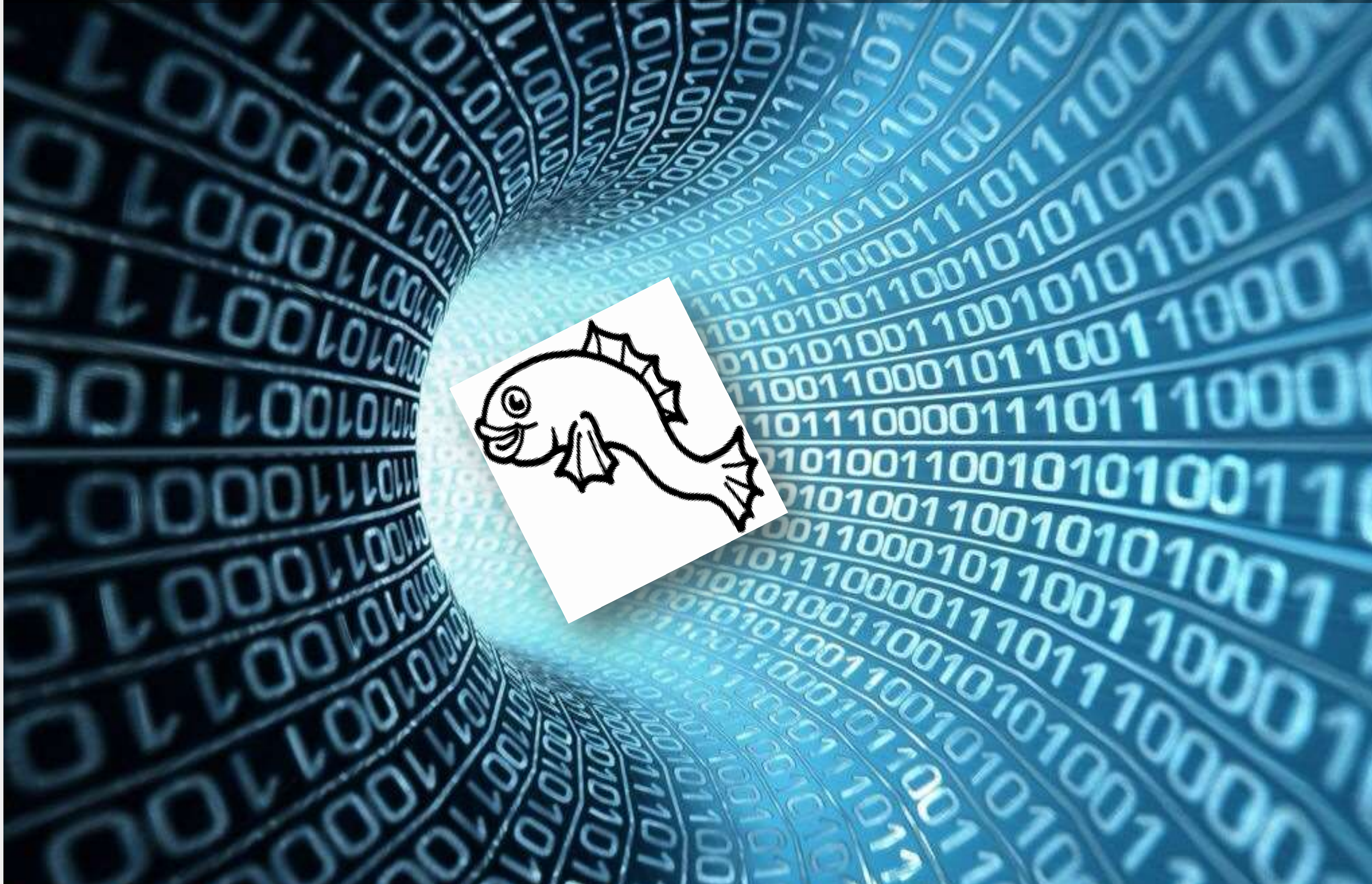
- Habitat
- Macroinvertebrates
- Stream temperature

Jeff Kershner, Brett Roper, Stephanie Miller (USFS)

PIBO Website: http://www.fs.fed.us/biology/fishecology/emp/index.html

AREMP Web: http://reo.gov/monitoring/reports/watershed/aremp/Welcome.htm

BIG DATAbases for Streams



Part 1b: Aggregated databases

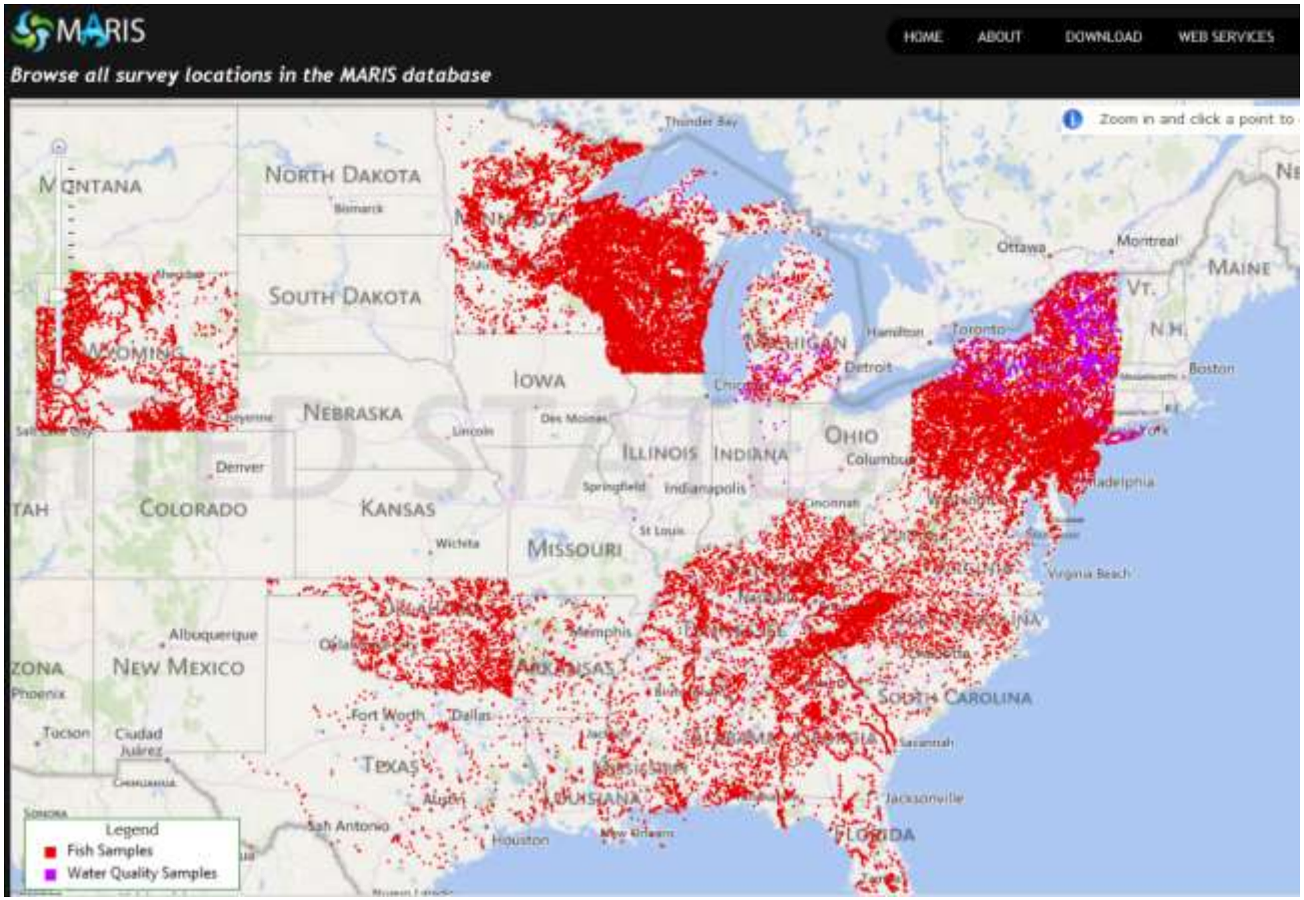
MARIS (Multistate Aquatic Resources Information System)

Andy Loftus (Natural Resources Consultant)

Website: http://www.marisdata.org/

MARIS (Multistate Aquatic Resources Information System)

"contains over one million fish sampling and water quality records for over one thousand fish species compiled from state fish and wildlife agency and other sampling programs."

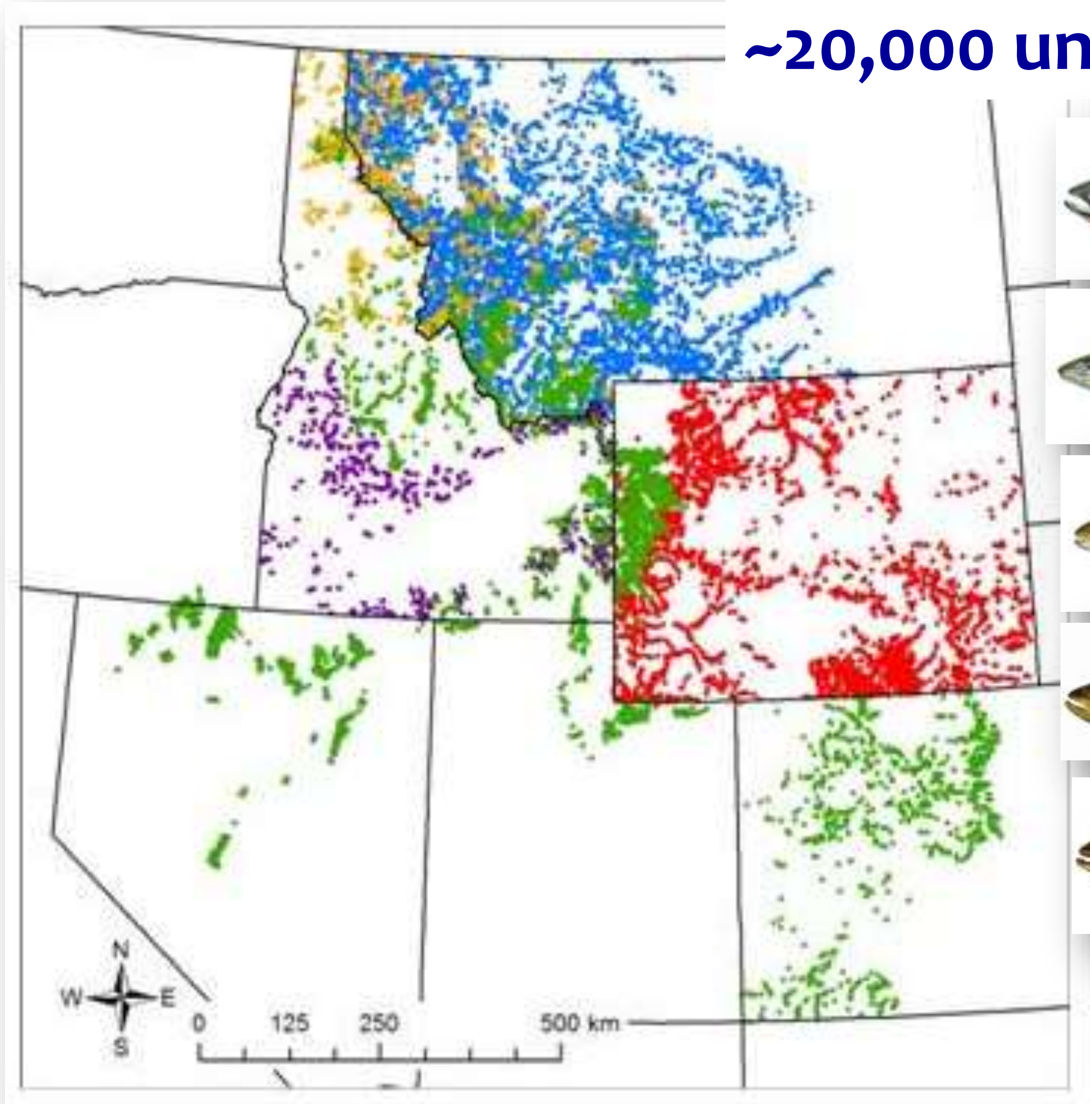


Andy Loftus (Natural Resources Consultant)

Website: http://www.marisdata.org/

Western Trout Interagency Database Compilation

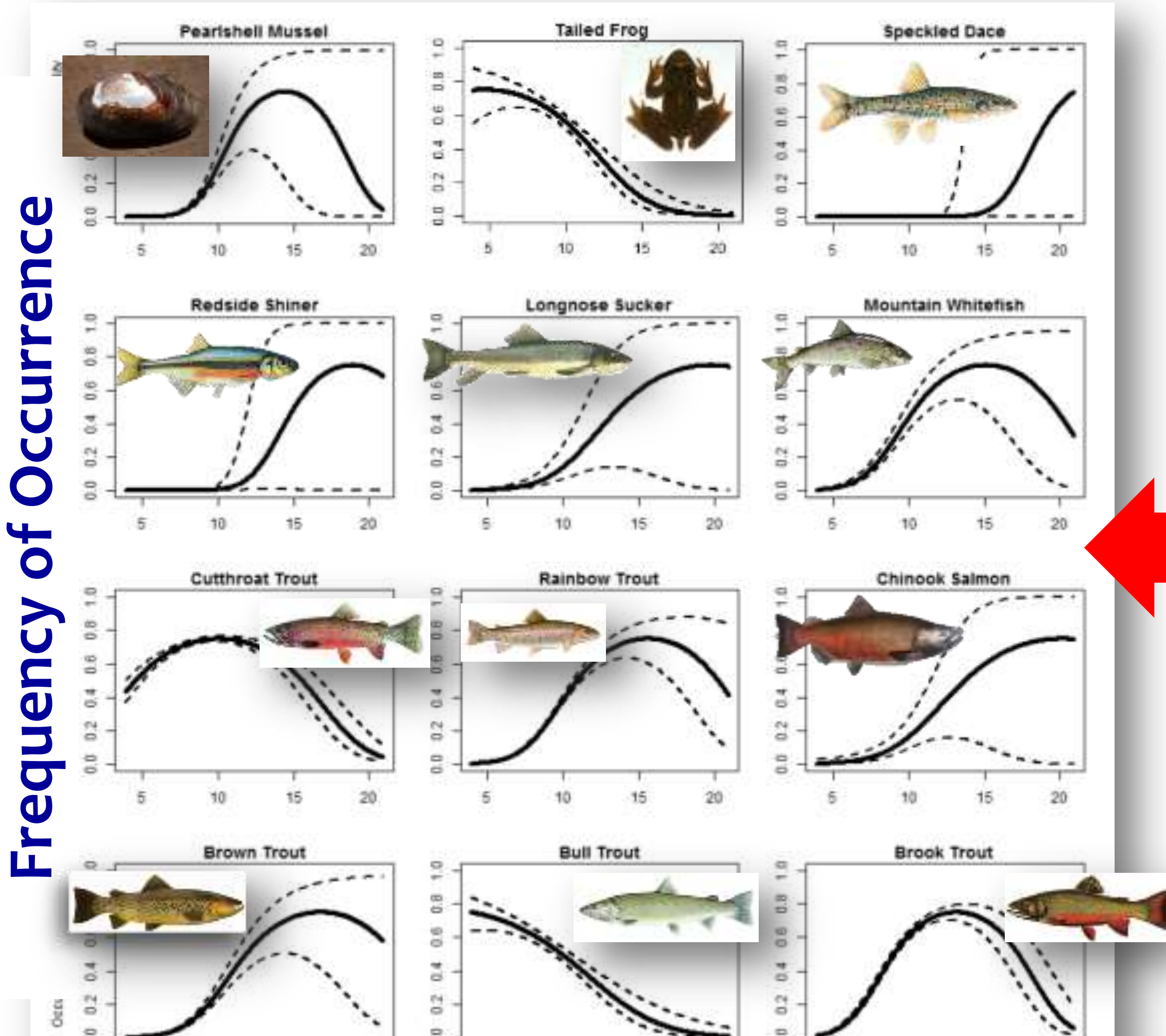
~20,000 unique sites



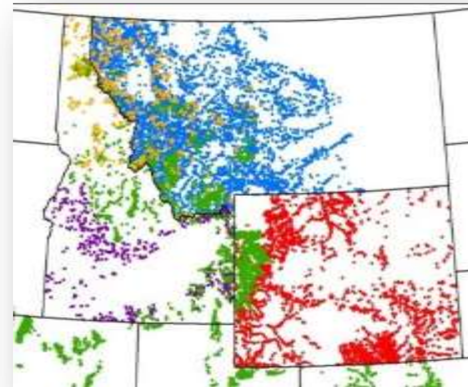
Seth Wenger

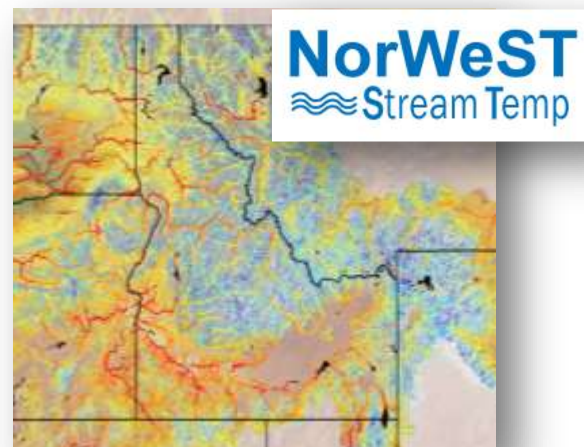
(Wenger et al. 2011a; 2011b; In preparation)

Thermal Criteria in Batch Mode… BIG FISH



NorWeST Stream Temperature (S1)

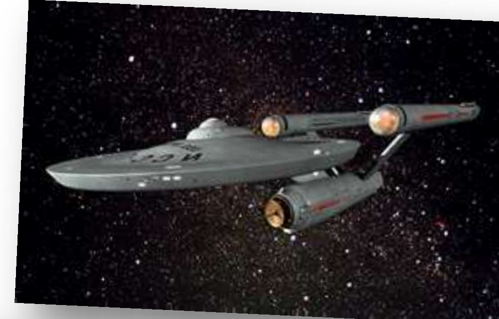


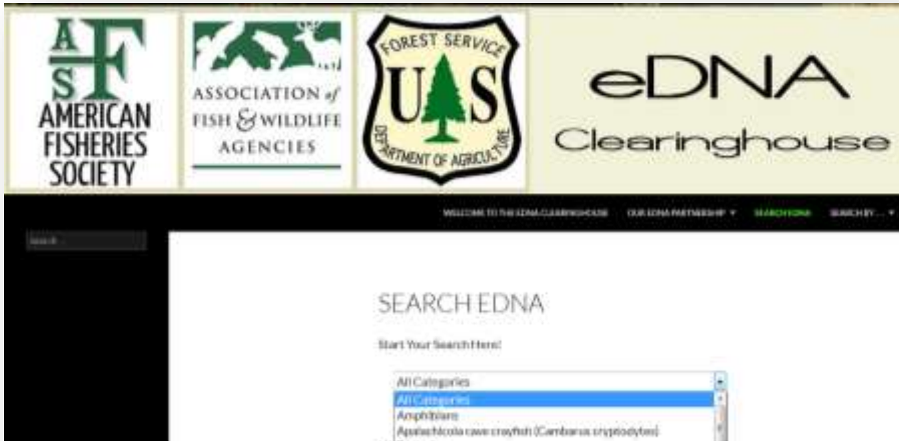


Wenger et al. *In Preparation.* Description of realized thermal niches using massive biological and temperature databases.

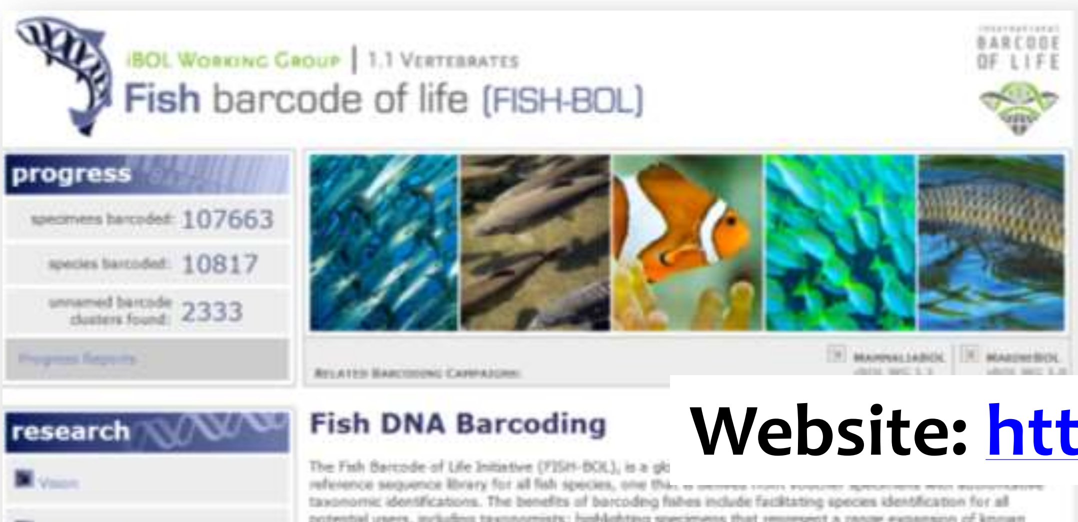
Genomics Frontier

eDNA, DNA Barcoding, etc.

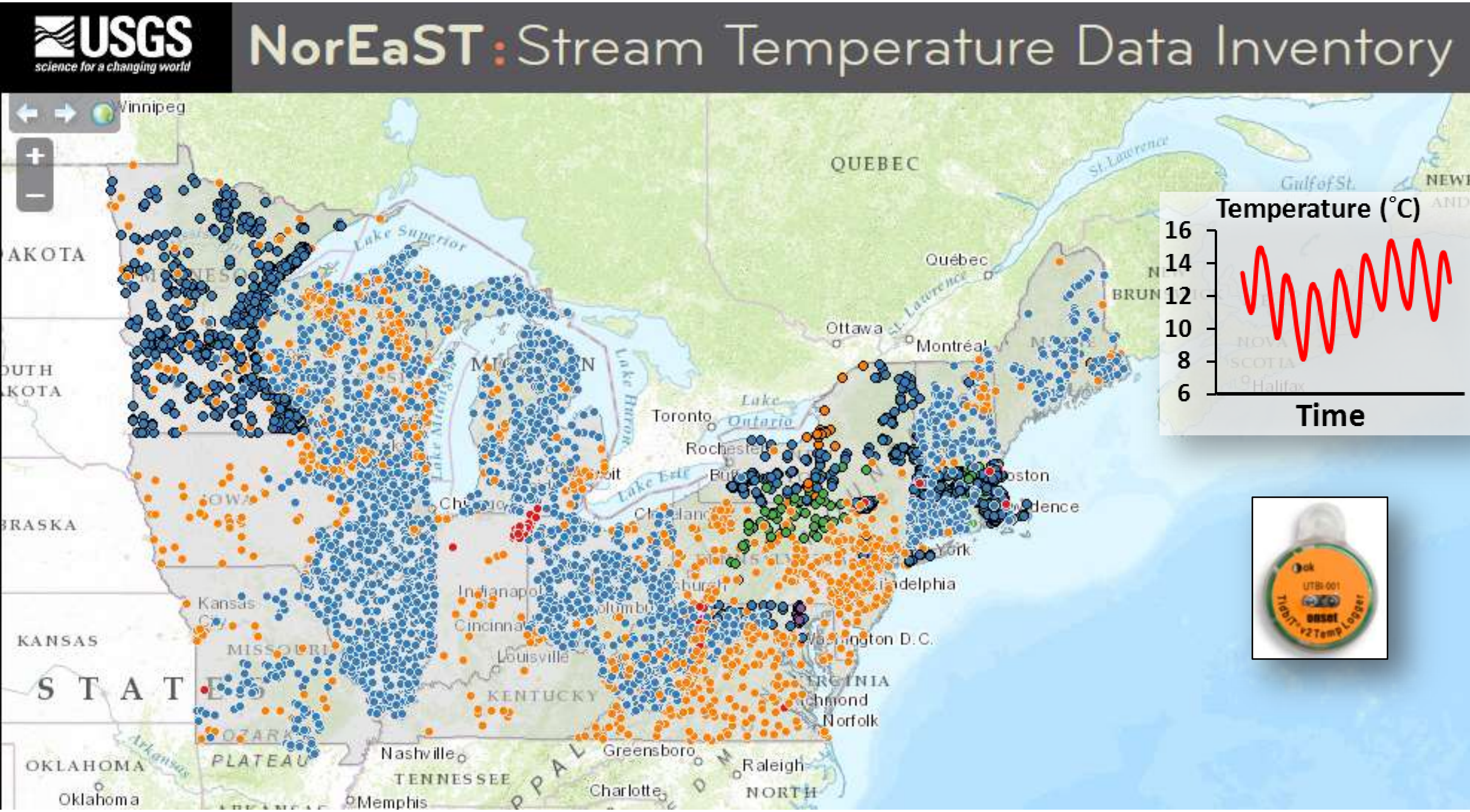




Website: http://edna.fisheries.org/



Website: http://www.fishbol.org/

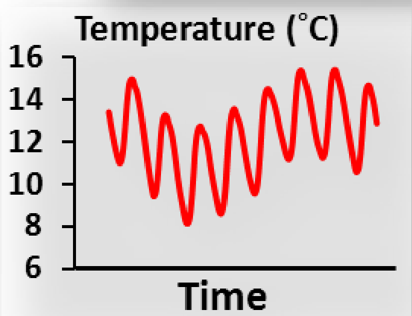


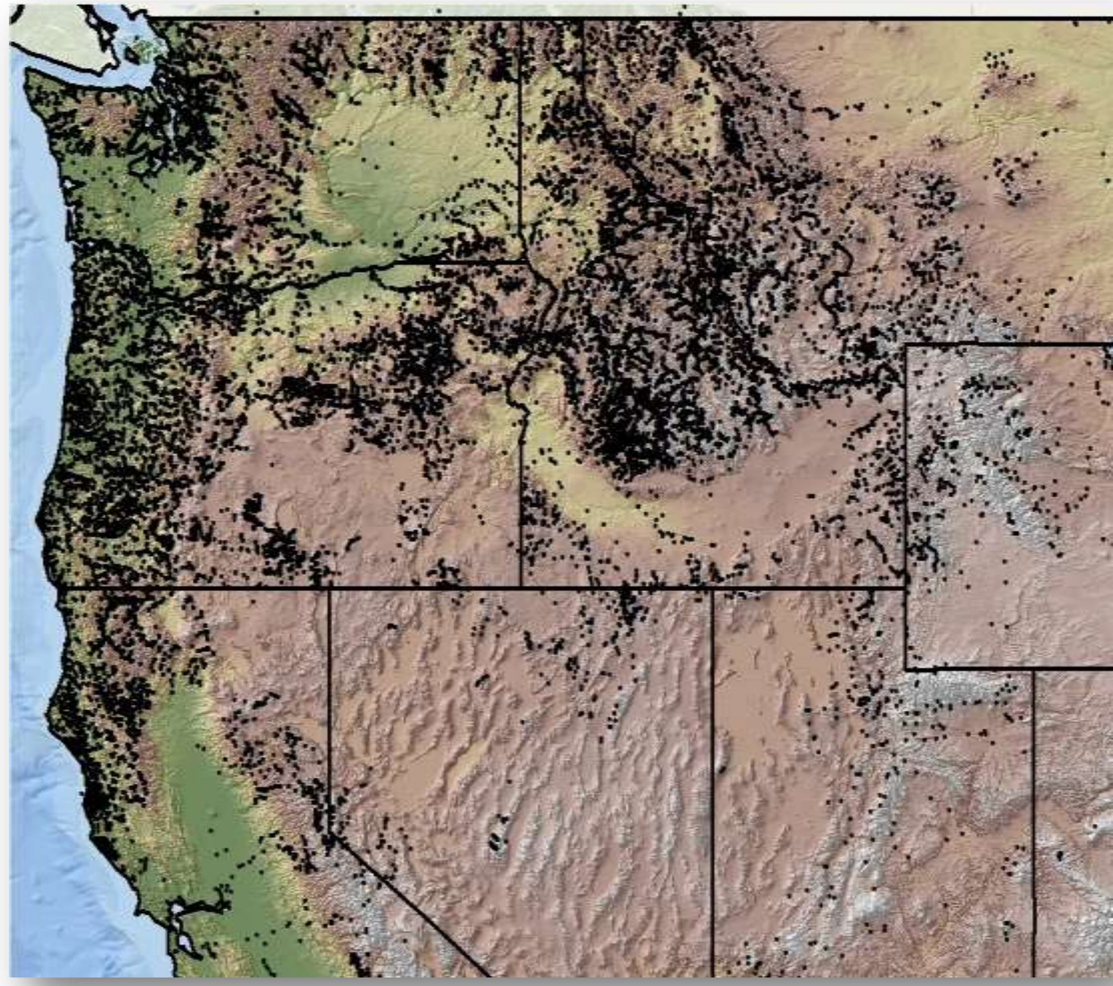
Dana Infante

Website: http://wim.usgs.gov/NorEaST/

NorWeST Stream Temp

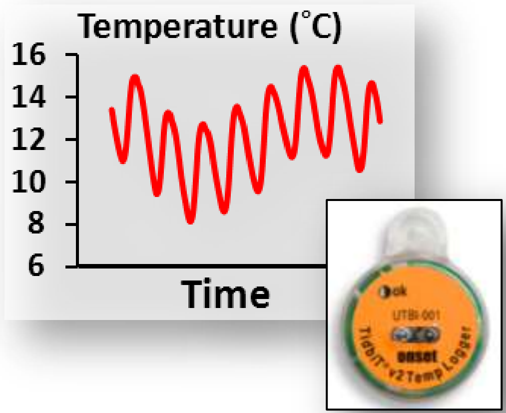
>50,000,000 hourly records
>15,000 unique stream sites
>80 resource agencies

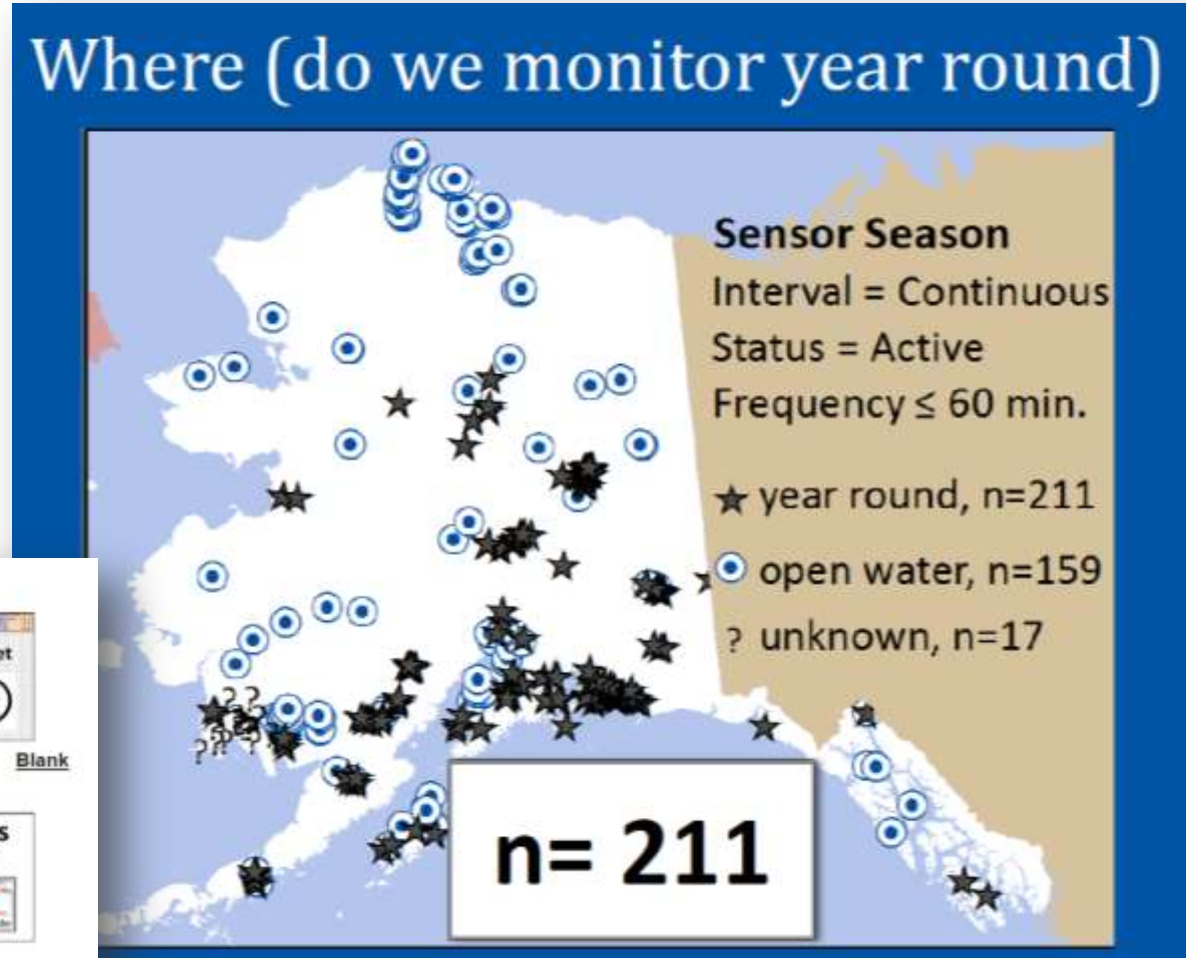




Dan Isaak Website:
http://www.fs.fed.us/rm/boise/AWAE/projects/NorWeST.html

AKOATS (Alaska Online Aquatic Temperature Sites)





Joel Reynolds – FWS, Western Alaska LCC

Website: http://aknhp.uaa.alaska.edu/aquatic-ecology/akoats/#content

ALASKA'S WATER

> 3,000,000
Mapped Lakes and Ponds

> 847,000
Length of Mapped Streams and Rivers in miles

47,000
Length of Mapped Coastline in miles

1,980
Length of the longest river, the Yukon, in miles

616
Named Glaciers

40%
Share of the Nation's Surface Water

Lucinda - Lakes?

Dan Magoulick – SE additions?

Update: Open Water Data Initiative

Stream Internet Workshop

April 23, 2015

Al Rea, USGS National Geospatial Program

Ed Clark, NOAA National Weather Service

Subcommittee on Spatial Water Data

Open Water Data Initiative

Water Data **Catalog**	Water Data **As a Service**	**Enriching** Water Data	Water Data and Tools **MarketPlace**
Find Source Data	Consensus standards	River routing	Community exercise of tools & data
Create water & climate themes	Water Map Themes	Coupling with models	Data usage tracking
Recruit/engage partners	High performance data delivery	Grounded to geofabric	Community-built extensions

Technical: National Water Data Infrastructure

Social: Open Water Web

OWDI Activities To Date

- **FGDC** Steering Committee (6/26) and **ACWI** (8/19) voted unanimously to revitalize and charge the Subcommittee on Spatial Water Data to scope and design a national Open Water Data Infrastructure
- **AWRA**
  - National Meeting (Nov 3-6, 2014) special track on OWDI
  - JAWRA special collection OWDI/NFIE (source: http://www.awra.org/jawra/jawra-owdi-call.html)
  - National Meeting, Denver (Nov 16-19, 2015) proposed special track
- **Subcommittee on Spatial Water Data** (SSWD)
  - Monthly meetings since August
  - 40+ regular attendees, mailing list of 80+
  - > 30 organizations represented
  - Applying “Lean Startup” principles
  - Three initial use cases
  - Four data work groups
  - Technology/standards work group

OWDI Use-Case Working Groups

Work Group 1:

National Flood Interoperability Experiment

Identify flood data including stream-flow observations, forecasts and impacts

Developing *Hydrofabric* v 0.1* and exploring data conflation

*Supported by 3 sub-teams

Work Group 2:

Drought Decision Support System

Identify water resources data including natural flow, reservoir storage and drought impacts

Explore visualization of drought in Lower Colorado

Work Group 3:

Spill Response Tool

Identify water quality data including potential points sources and impacts

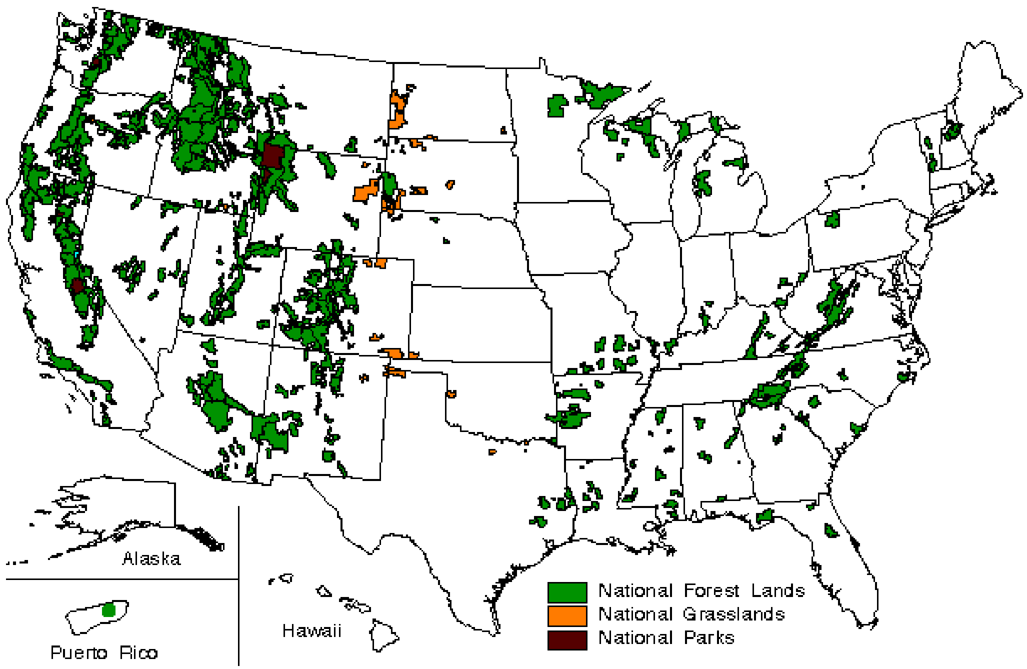
Exploring requirements for new/additional data (e.g. velocity forecasts and reservoir residence times)

Hydro Event Services

- Hydro Event Data Catalog (HEDC)
  - Open – federated catalog
  - Web-service based
  - Starting with USGS ScienceBase platform for ESRI services, USGS CIDA group will host open (GeoServer) services
  - Intent is to complement, not replace WATERS web services
  - Iterative approach, will seek feedback

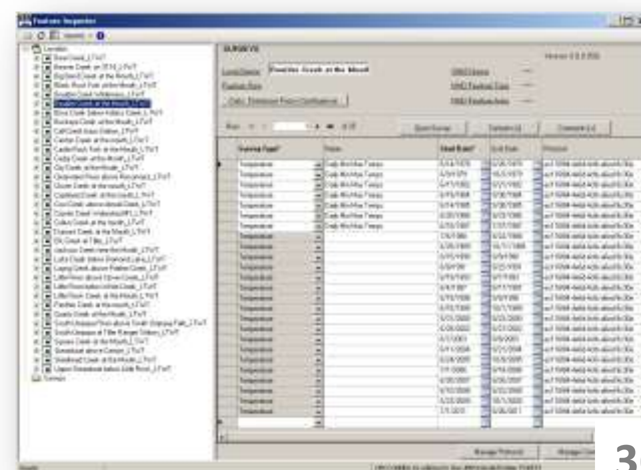
Aquatic Surveys Module in Natural Resource Monitor

Corporate database for National Forests & Grasslands



Survey Type Modules

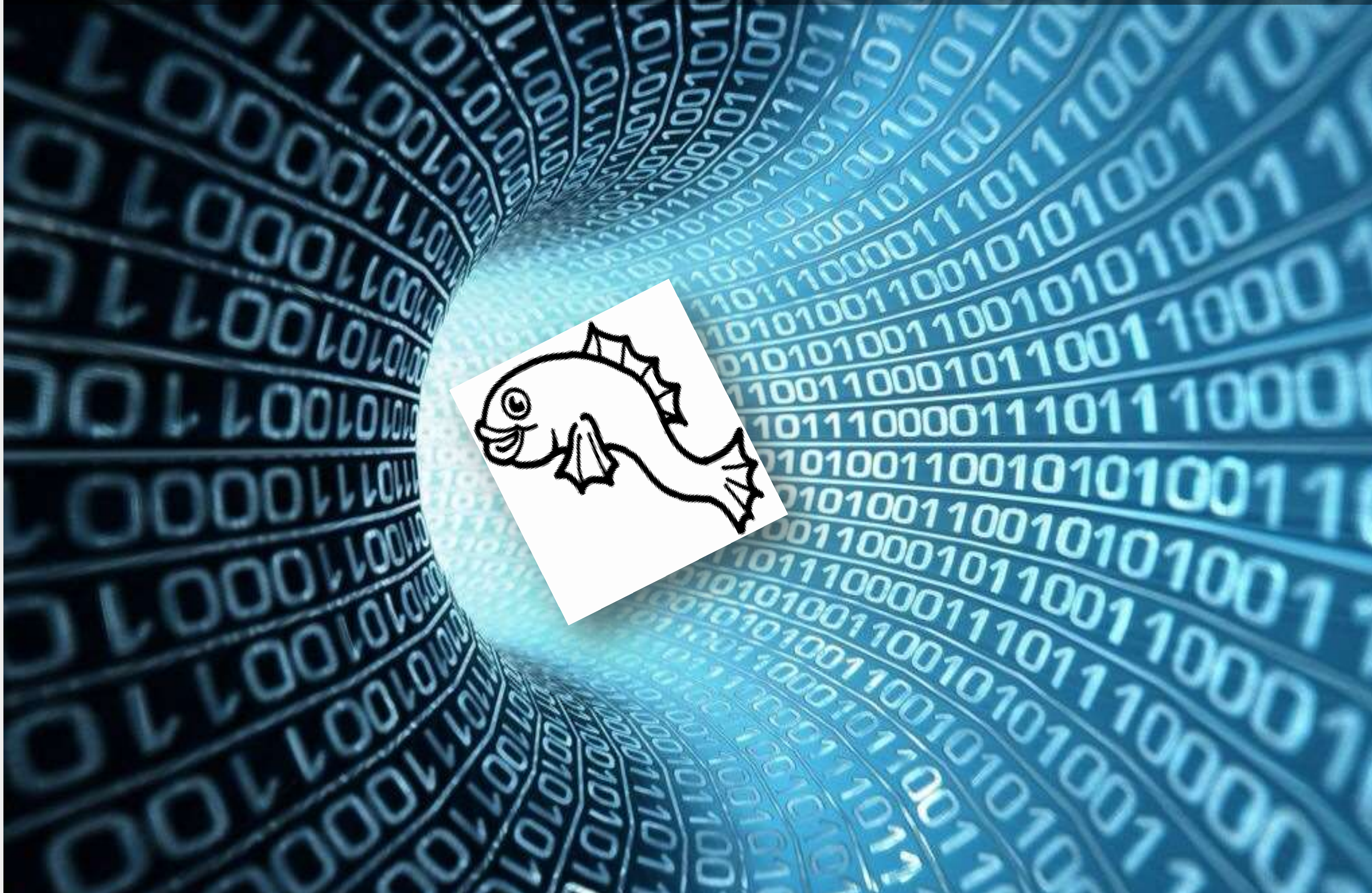
- Stream temperature
- Fish, amphibian
- Reach habitat
- Passage conditions



Callie McConnell, Brian Sanborn

Website: http://www.fs.fed.us/nrm/index.shtml

BIG DATAbases for Streams



Part 2: Environmental predictors

Wang et al. (2011) Environmental predictors

NATIONAL FISH HABITAT PARTNERSHIP

A Hierarchical Spatial Framework and Database for the National River Fish Habitat Condition Assessment

Lizhu Wang

Institute for Fisheries Research, Michigan Department of Natural Resources and University of Michigan, 212 Museums Annex, Ann Arbor, MI 48109. E-mail: wangl@michigan.gov

Dana Infante

Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI 48824

Peter Esselman

Institute for Fisheries Research, Michigan Department of Natural Resources and University of Michigan, 212 Museums Annex, Ann Arbor, MI 48109; and Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI 48824

Arthur Cooper

Institute for Fisheries Research, Michigan Department of Natural Resources and University of Michigan, 212 Museums Annex, Ann Arbor, MI 48109; and Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI 48824

Dayong Wu

Department of Life Science, Hengshui University, Hengshui, Hebei, China 053000

William Taylor

Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI 48824

Doug Beard

National Climate Change and Wildlife Science Center, U.S. Geological Survey, 12201 Sunrise Valley Drive, Reston, VA 20192

Gary Whelan

Fisheries Division, Michigan Department of Natural Resources, 530 West Allegan, Lansing, MI 48909

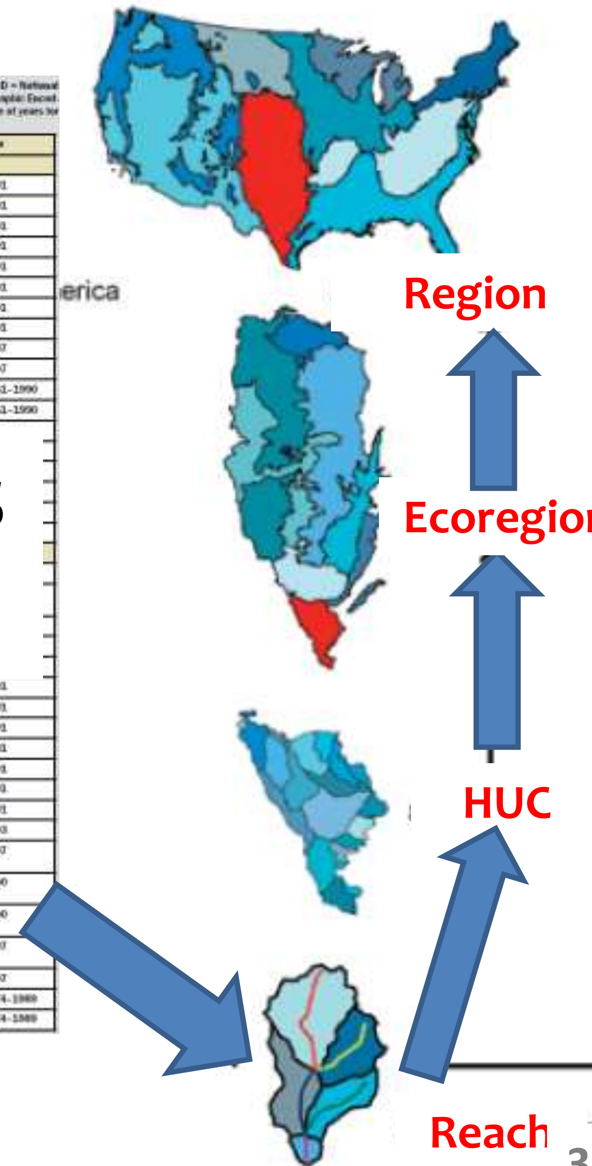
Andrea Ostroff

National Climate Change and Wildlife Science Center, U.S. Geological Survey, 12201 Sunrise Valley Drive, Reston, VA 20192

TABLE 1. Summary of natural and human disturbance data sources that were attributed to each of the river reaches and included in our database. NLCD = National Land Cover Database; NHDPlus = National Hydrography Dataset Plus; STATSGO = State Soil Geographic Database; TIGER = Topologically Integrated Geographic Encoding and Referencing System; SPARROW = Spatially Referenced Regressions on Watershed Attributes; HUC = Hydrologic Unit Code. Date = year or range of years for each data source.

Description	Source	Resolution	Date
Natural variables			
Land cover—Deciduous forest	NLCD (http://www.mrlc.gov/)	30 m	2001
Land cover—Evergreen forest	NLCD (http://www.mrlc.gov/)	30 m	2001
Land cover—Mixed forest	NLCD (http://www.mrlc.gov/)	30 m	2001
Land cover—Open water	NLCD (http://www.mrlc.gov/)	30 m	2001
Land cover—Shrub/scrub	NLCD (http://www.mrlc.gov/)	30 m	2001
Land cover—Grassland/herbaceous	NLCD (http://www.mrlc.gov/)	30 m	2001
Land cover—Woody wetlands	NLCD (http://www.mrlc.gov/)	30 m	2001
Land cover—Open wetlands	NLCD (http://www.mrlc.gov/)	30 m	2001
Local catchment area	NHDPlus (http://www.horizon-systems.com/nhdplus)	1:100,000	2007
Network catchment area	NHDPlus (http://www.horizon-systems.com/nhdplus)	1:100,000	2007
Mean annual air temperature	NHDPlus (http://www.horizon-systems.com/nhdplus)	4 km	1961–1990
Mean annual precipitation	NHDPlus (http://www.horizon-systems.com/nhdplus)	4 km	1961–1990
Imperviousness	NLCD (http://www.horizon-systems.com/nhdplus)	30 m	2001
Land use—Pasture/hay	NLCD (http://www.horizon-systems.com/nhdplus)	30 m	2001
Land use—Cultivated crops	NLCD (http://www.horizon-systems.com/nhdplus)	30 m	2001
Land use—Open space urban	NLCD (http://www.horizon-systems.com/nhdplus)	30 m	2001
Land use—Low intensity urban	NLCD (http://www.horizon-systems.com/nhdplus)	30 m	2001
Land use—Medium intensity urban	NLCD (http://www.horizon-systems.com/nhdplus)	30 m	2001
Land use—High intensity urban	NLCD (http://www.horizon-systems.com/nhdplus)	30 m	2001
Mining density	USGS Active Mines (http://tin.er.usgs.gov/mineplant/)	Point data	2003
National Pollutant Discharge Elimination System Density	EPA Geodata Shapefile (http://www.epa.gov/enviro/geo_data.html)	Point data	2007
Road crossing density	Census 2000 TIGER Roads (http://www.esri.com/data/download/census2000-tigerline/index.html)	1:100,000	2000
Road length density	Census 2000 TIGER Roads (http://www.esri.com/data/download/census2000-tigerline/index.html)	1:100,000	2000
Superfund National Priority List Density	EPA Geodata Shapefile (http://www.epa.gov/enviro/geo_data.html)	Point data	2007
Toxics Release Inventory density	EPA Geodata Shapefile (http://www.epa.gov/enviro/geo_data.html)	Point data	2007
Total phosphorus yield	USGS SPARROW (http://water.usgs.gov/nawqa/sparrow/wrr97/results.html)	8-Digit HUC	1974–1989
Total nitrogen yield	USGS SPARROW (http://water.usgs.gov/nawqa/sparrow/wrr97/results.html)	8-Digit HUC	1974–1989

Many databases in one



Dana Infante, Gary Whelan

StreamCat: Watershed Variables for Predicting Aquatic Condition and Watershed Integrity

Phase 1 Indicators

Phase 2 Indicators

Examples of possible Phase 2 indicators:

- Topographic Wetness Index
- Mean summer temperature/precip
- Functional Process Zone (e.g., valley floor width, channel belt width and sinuosity)
- Pesticide applications rates
- Agricultural fertilizer application rates
- Recent forest loss

Tony Olsen (EPA)

StreamCat: Watershed Variables for Predicting Aquatic Condition and Watershed Integrity

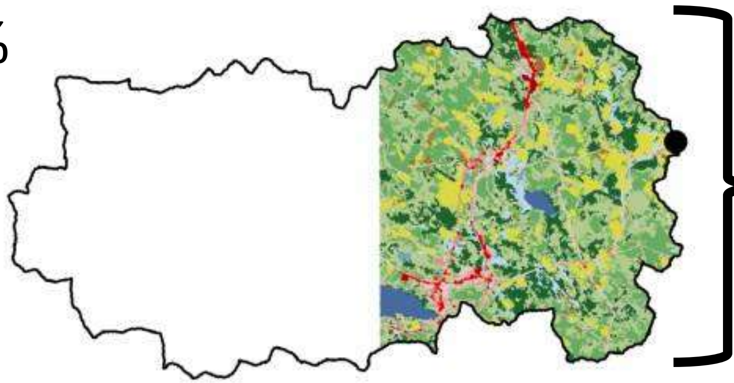
Quality Assurance

Landscape layers (LL)

(CONUS-wide layers of climate, geology, soils, land cover/land use, and others)

Problem – Most Landscape Layers do not cross international boundaries or have missing values in some locations

Solution – Calculate the % completeness of each Landscape Layer within each watershed



48% complete

Tony Olsen (EPA)

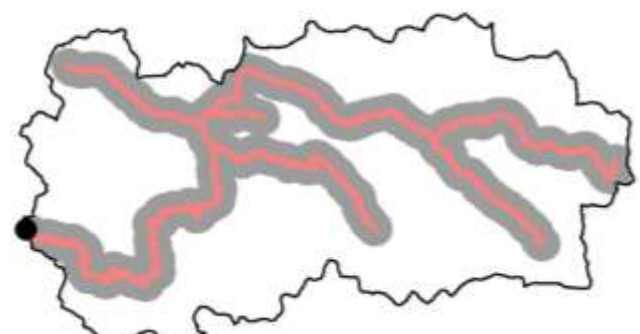
StreamCat: Watershed Variables for Predicting Aquatic Condition and Watershed Integrity

Data Assembly Products

- 30 landscape layers with QA documentation
- 84 initial watershed metrics for:
  - 2.7 million NHD watersheds
  - 1,883 NRSA watersheds
- Data dictionary for 84 watershed metrics
- Python and R code for each step in metric calculation process
- 7 page description of methods

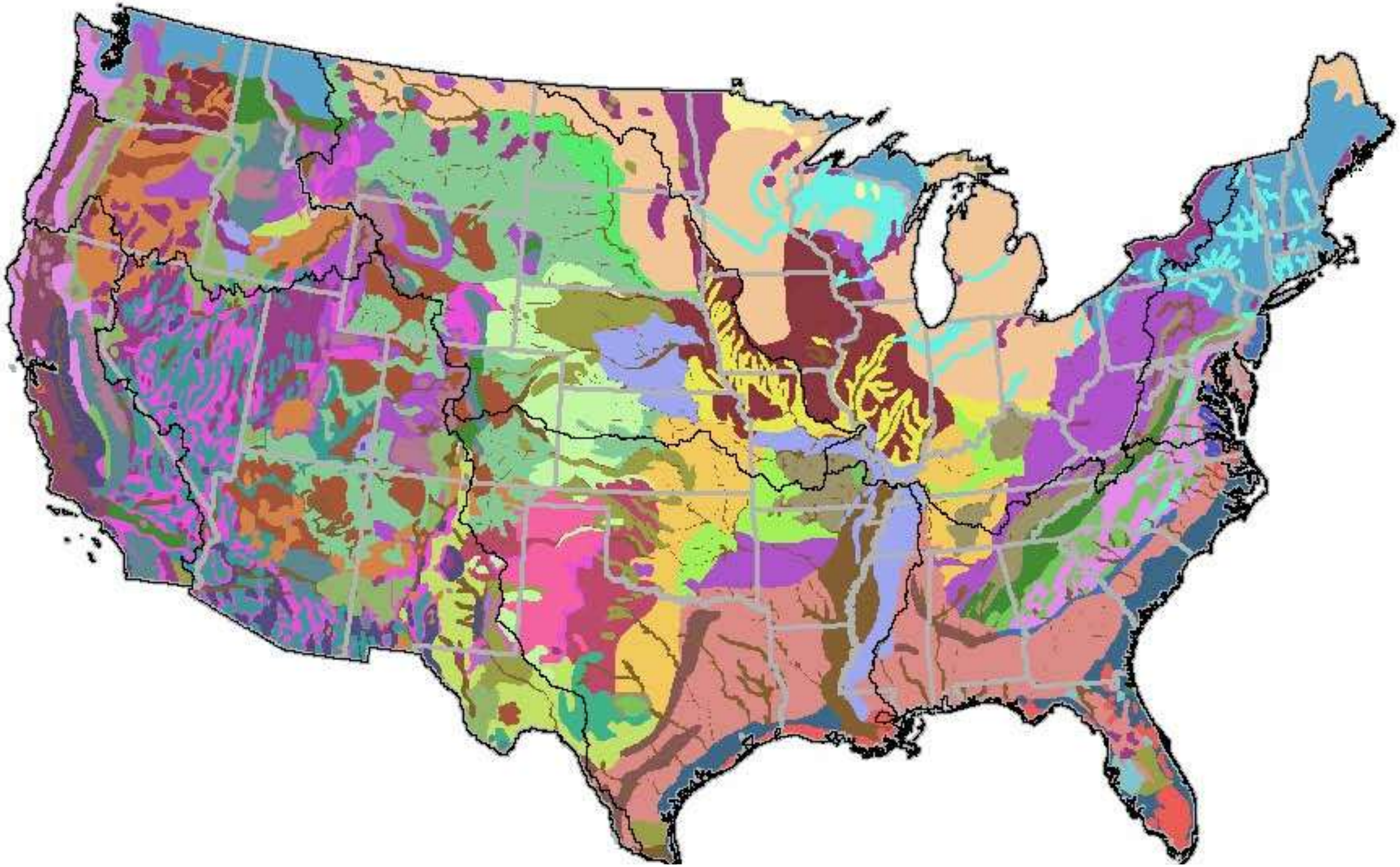
Multiple Versions of Some Variables

- Watershed-level
- Within 100-m buffer
- Within 600-m buffer



Tony Olsen (EPA)

Not very useful for ecologists
Surficial Geology maps

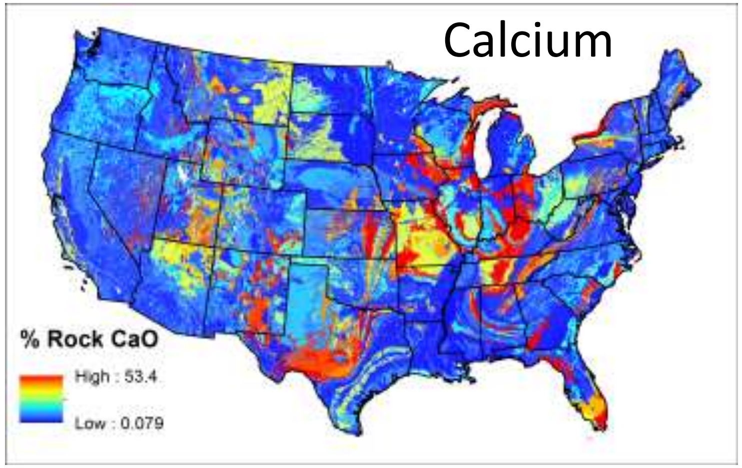


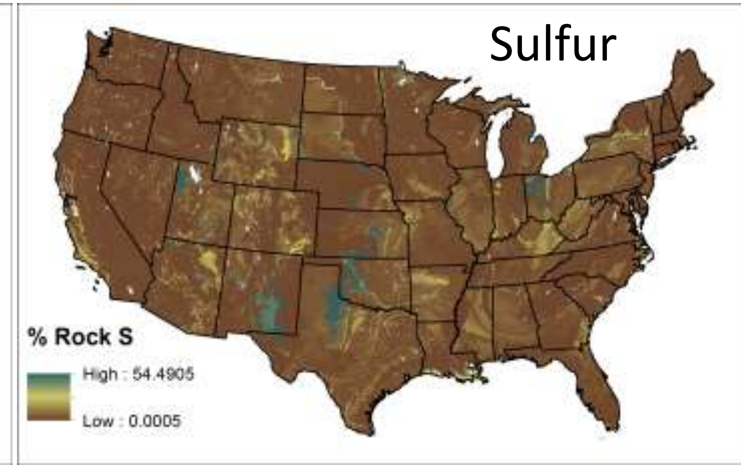
John Olson/Chuck Hawkins (USU)

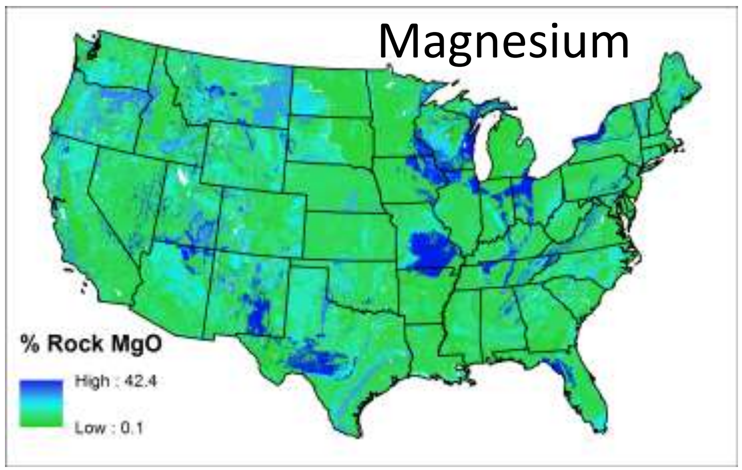
John Olson translations

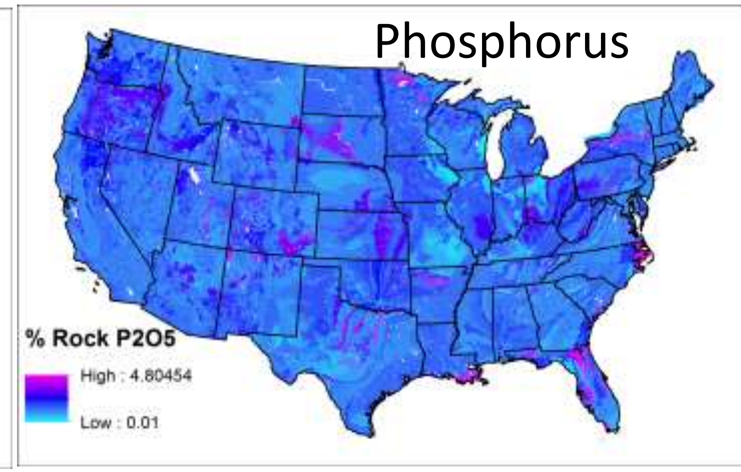
Derived from Integrated Geologic Maps Databases and other sources

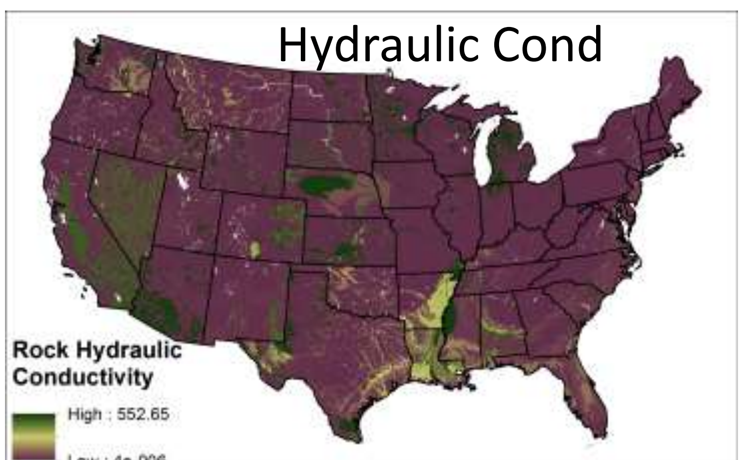
www.sciencebase.gov

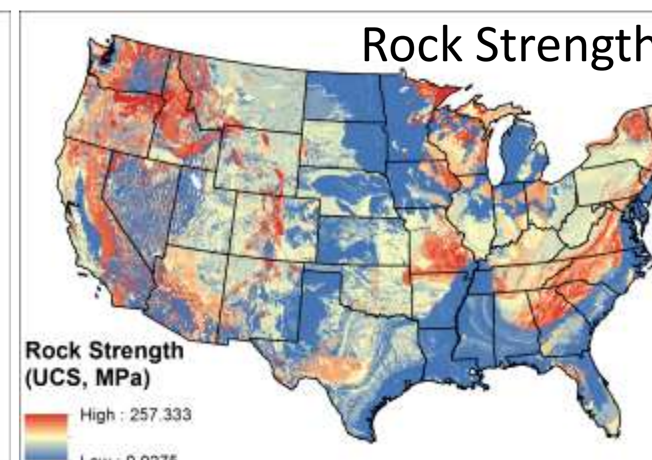


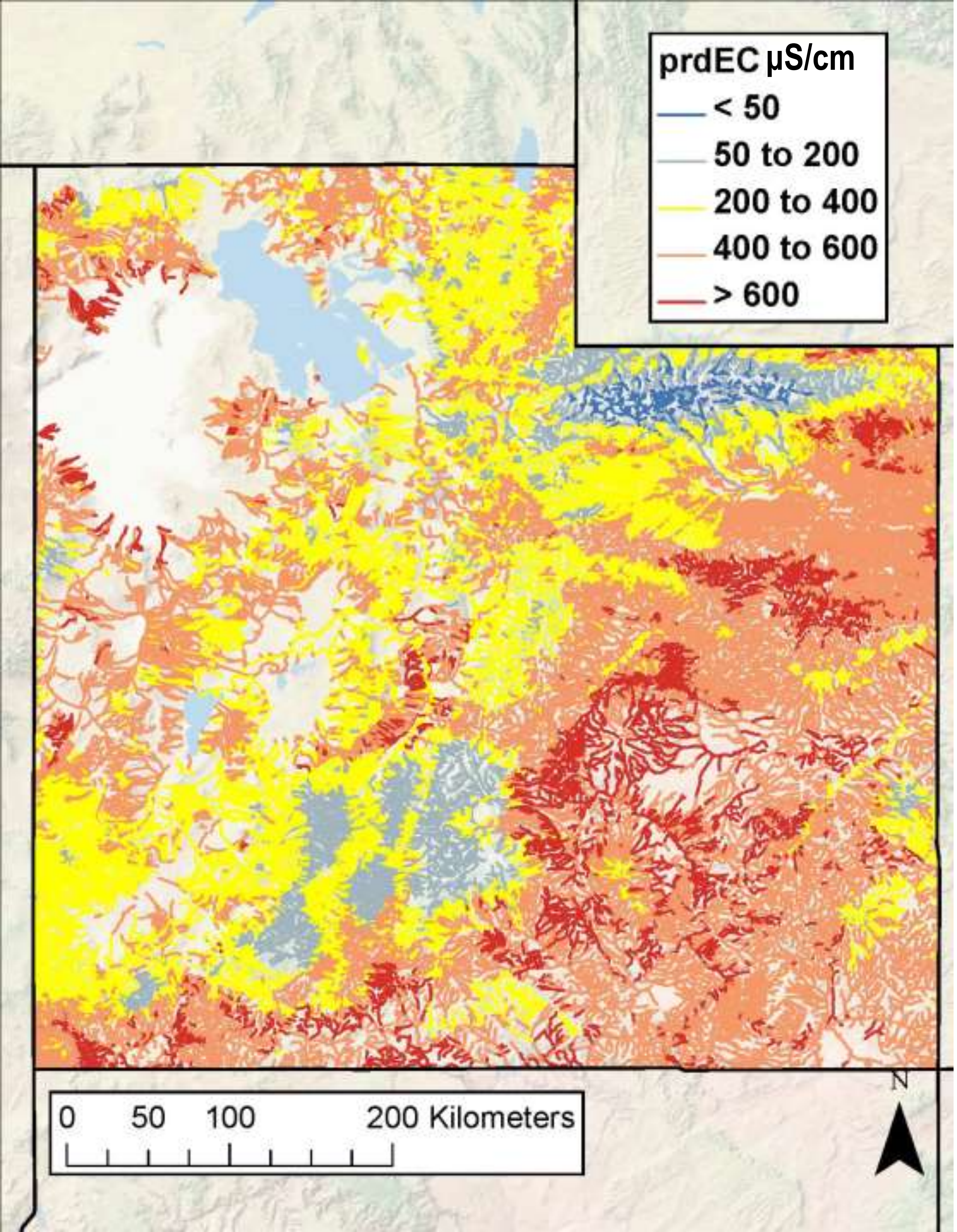










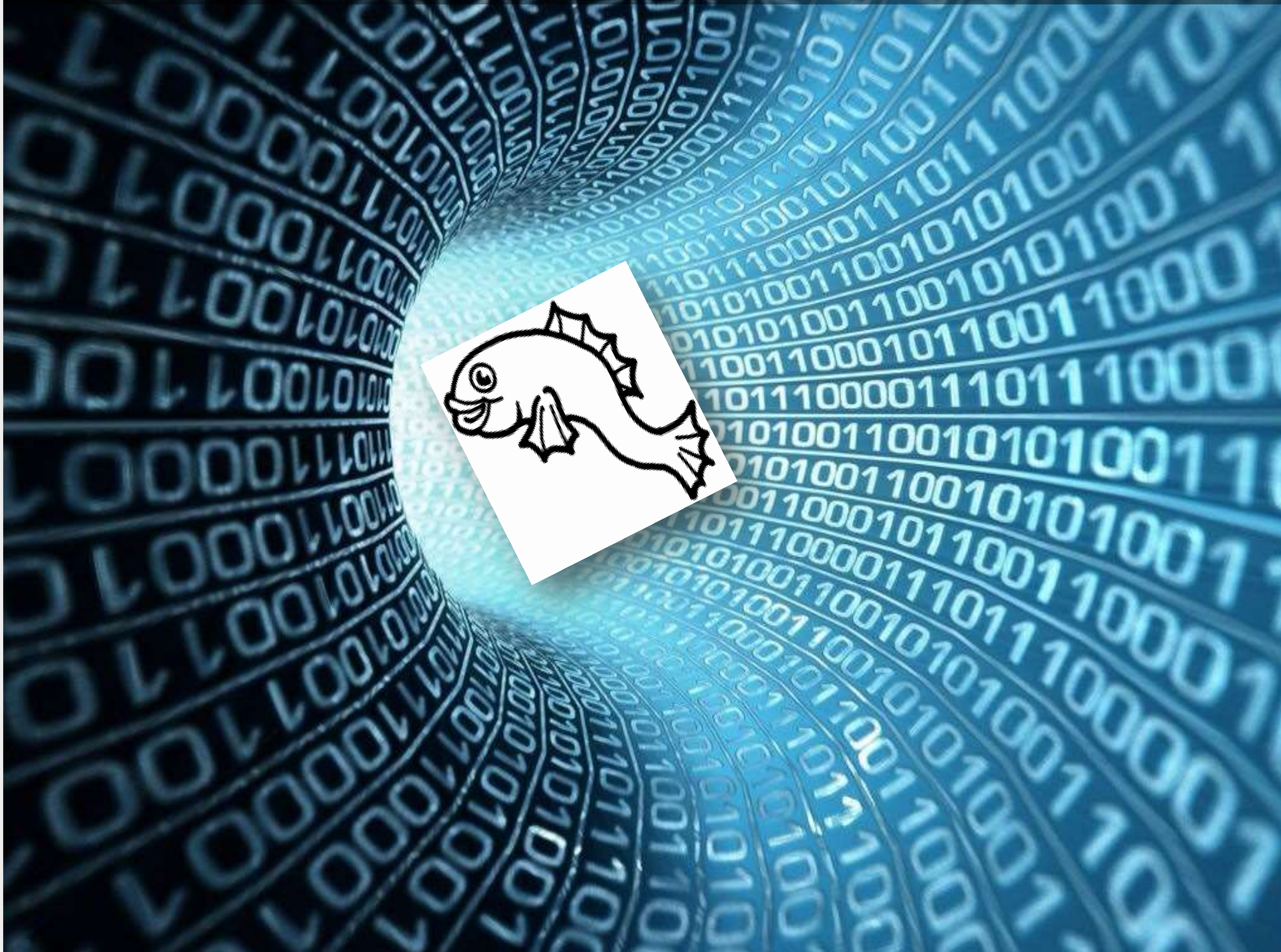


Use derived geology to model water chemistry

Predicted spatial variation in natural base flow salinity (µS/cm) in Utah streams

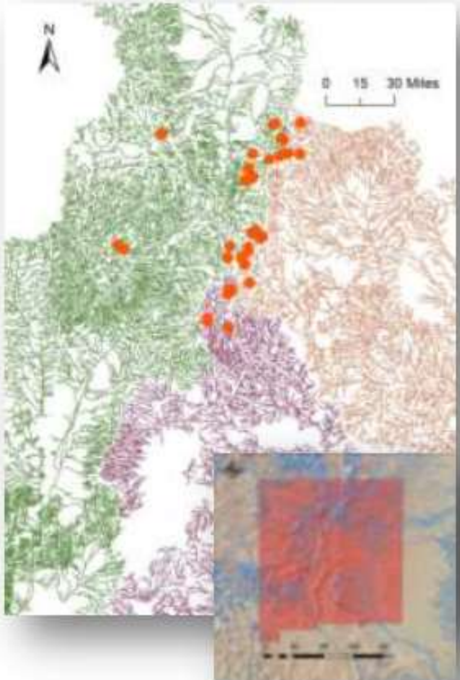
John Olson's nationwide model

Some new spatial analyses



POPULATION GENETICS & SSN

David Cowley, Sabela Lois, Erin Peterson, Dan Isaak et al.



Canadian, 7 streams, N=160
Rio Grande, 26 streams N=757
Pecos, 9 streams, N=254

Georeference Genetic Samples

GIS: spread individual genotypes @ 50 m

Create network outlets @

Format Genetic Data (0, 1, 2)

Sample	allele 1	allele 2
1 (heterozy.)	1	1
2 (homozy.)	0	2

PCA on allele-count data

PC scores for each individual

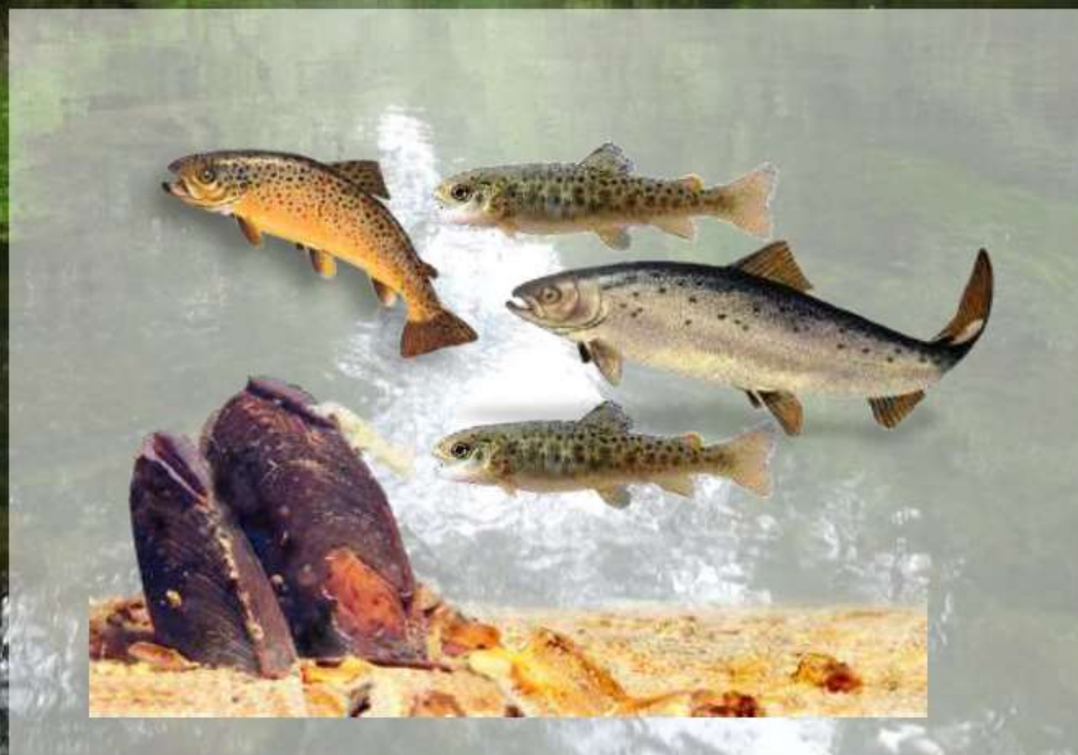
Separate SSN Analyses on “Important” PCs

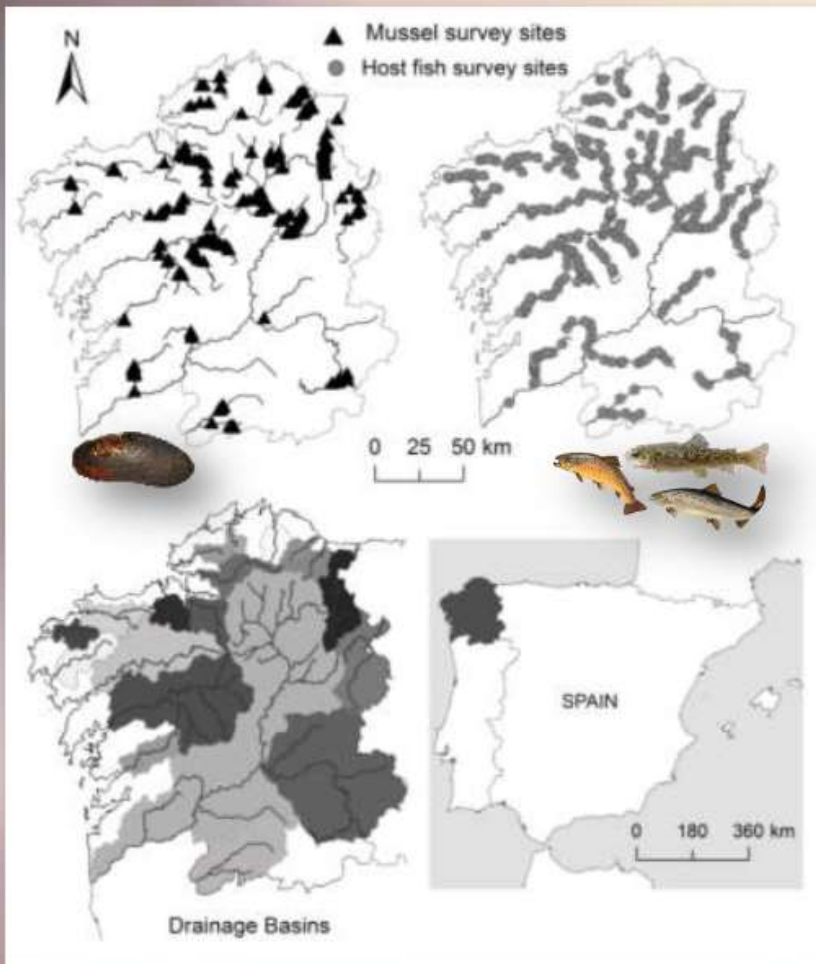
Select Weighting & Fixed Effects

Simulation of Genetics on SSNs

Multi-Species Conservation Using SSNs

Sabela Lois & David Cowley

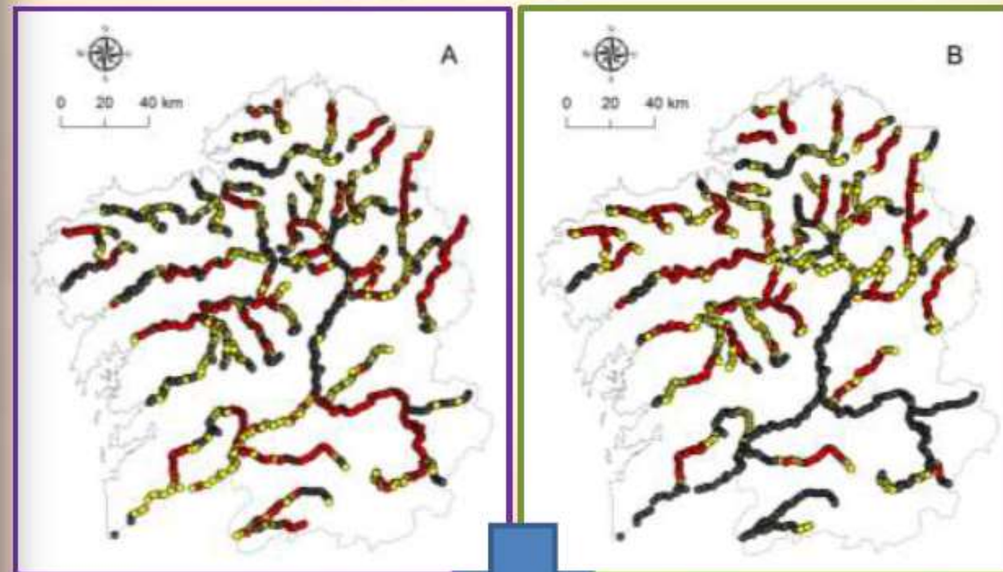




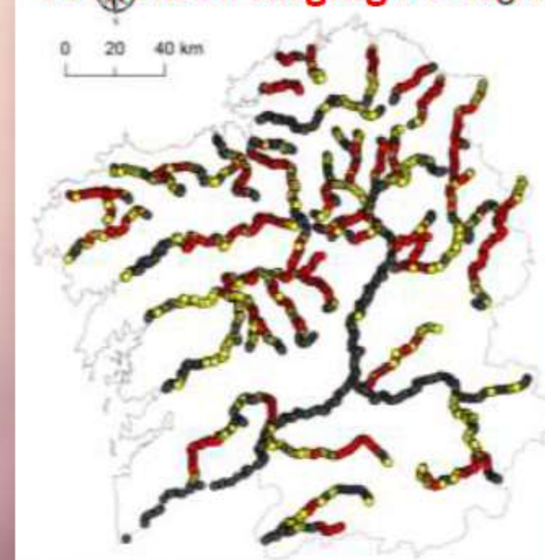
CLIMATE
HOST FISH
GEOLOGY
LANDFORM
LAND USE

+

SSN with
Tail-up &
Tail-down



Combined Kriging Predictions



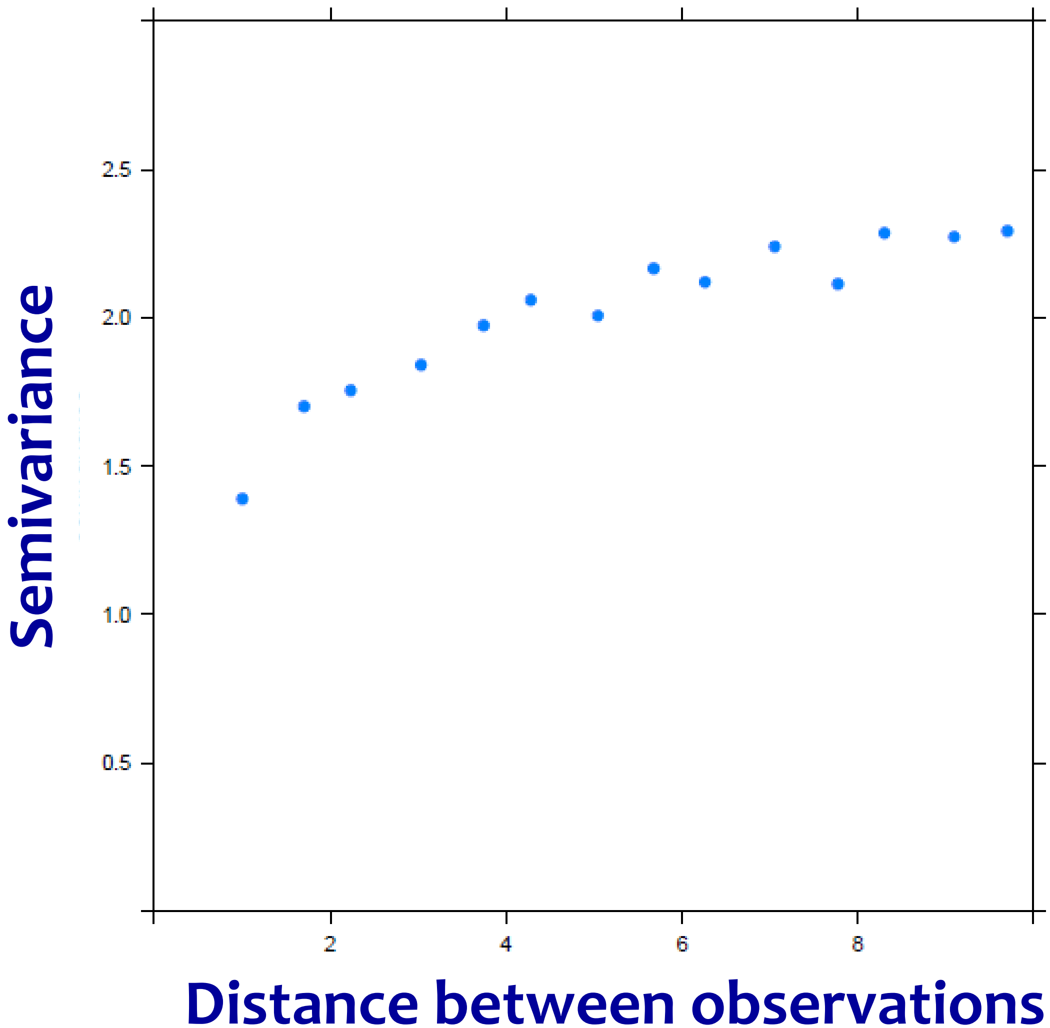
Conservation

Restoration

Recovery

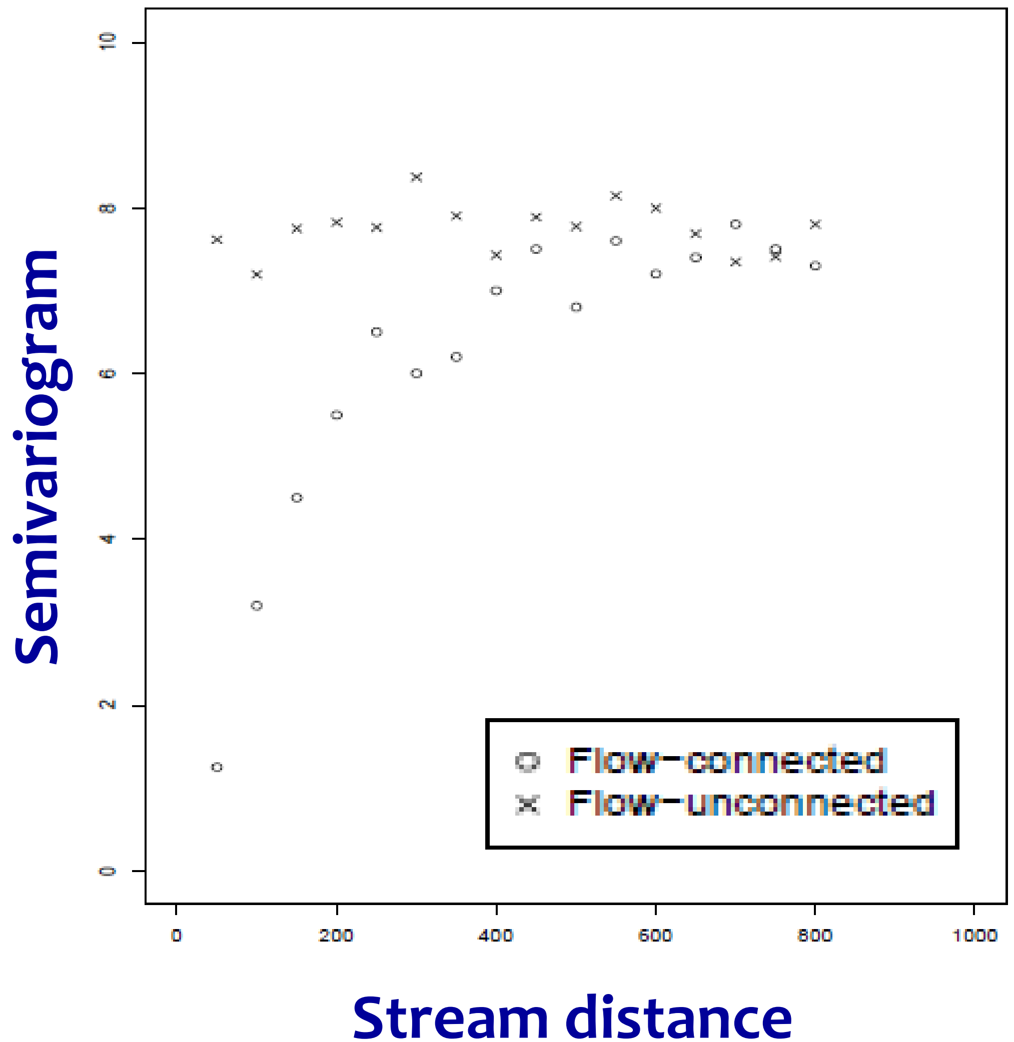
Characterizing spatial dependence on streams

A "typical" empirical semivariogram (in Euclidean space):



Dale Zimmerman (University of Iowa)

A Torgegram (empirical stream-network semivariogram) consists of separate semivariograms for flow-connected and flow-unconnected sites, and may also account for flow volume:



- The Torgegram has tremendous diagnostic value, and for very large stream datasets may be the only estimate of spatial dependence that is feasible to compute

- I'm developing formal hypothesis testing methods which use the Torgegram to determine whether the best model for a given stream dataset is tail-up, tail-down, or a hybrid

- I'm also developing methods for testing for (spatial) stationarity based on comparisons of watershed-specific Torgegrams

- Jay and I plan to extend the Torgegram to space-time and multivariate data

- Reference for our working paper:
  Zimmerman, D.L. and Ver Hoef, J. (2015). The Torgegram for fluvial variography: Characterizing spatial dependence on stream networks. In progress.

Introduction

- **Associate Professor (CSU)**

  Fish, Wildlife, and Conservation Biology

  Statistics

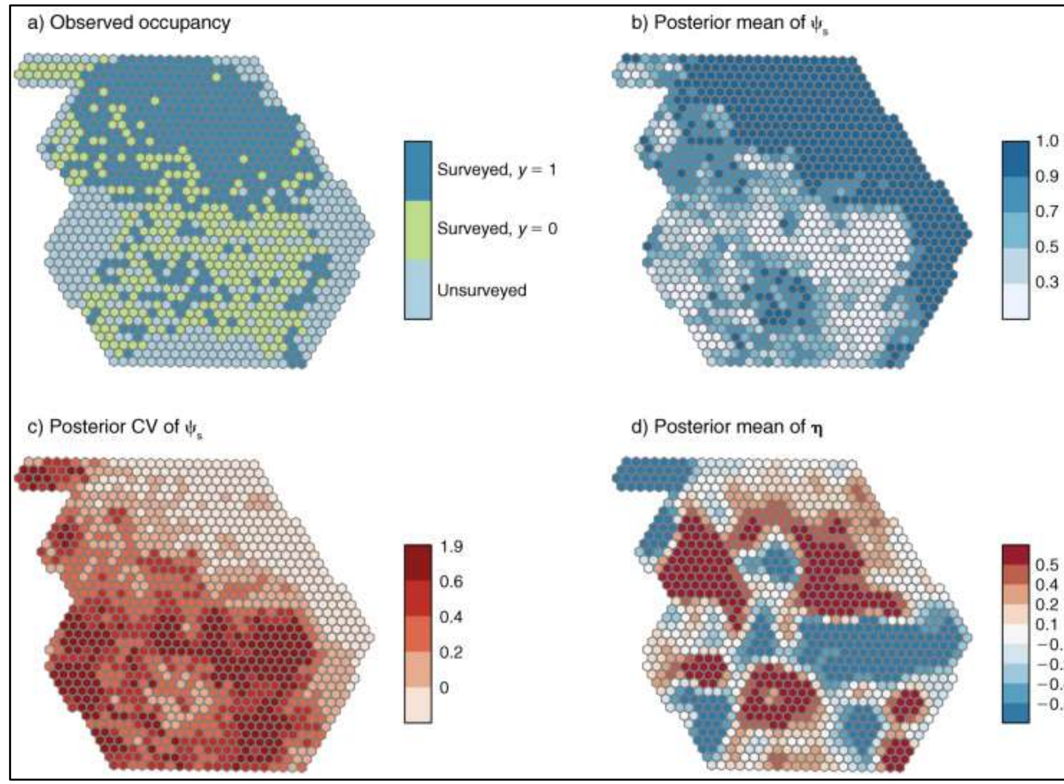
- **Assistant Unit Leader (USGS)**

  Colorado Cooperative Fish and Wildlife Research Unit

Spatial Occupancy Models

Spatial occupancy models for large data sets

Reports



Colorado Plains Fish


Methods in Ecology and Evolution

Accounting for imperfect detection in Hill numbers for biodiversity studies

Kristin M. Broms[1*], Mevin B. Hooten[1,2,3] and Ryan M. Fitzpatrick[4]

Summary

Key-words:

Introduction

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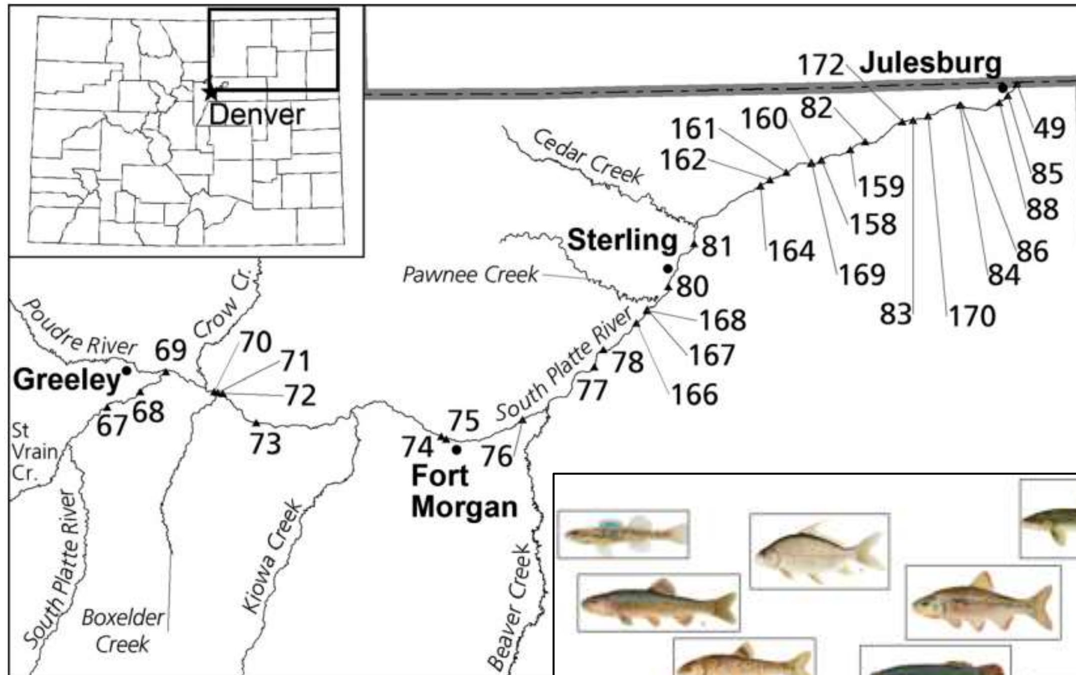
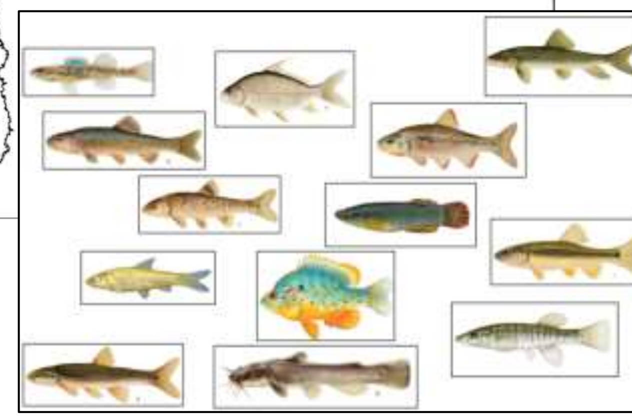




Mevin Hooten

Fish, Wildlife, & Conservation Biology and Statistics
Colorado State University
Colorado Cooperative Fish and Wildlife Research Unit
U.S. Geological Survey

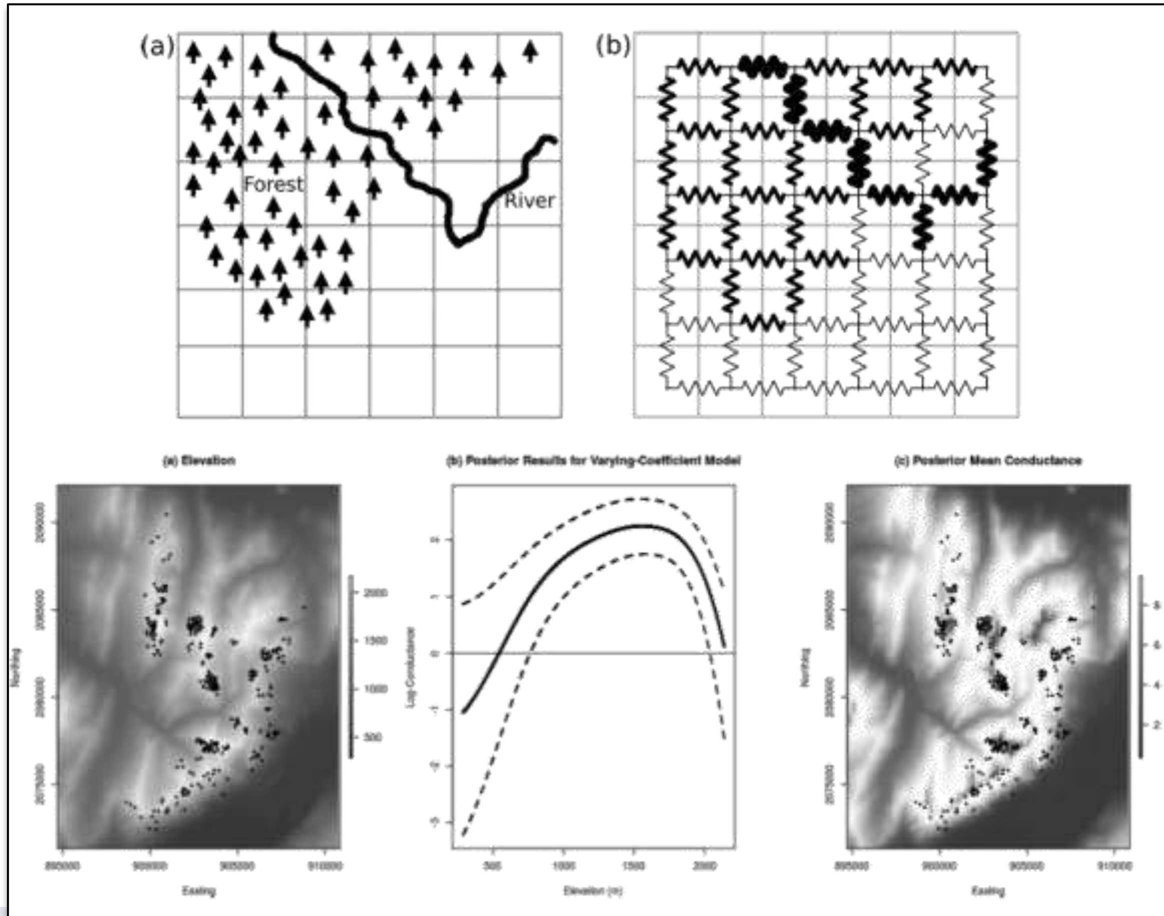
Landscape Genetics

Circuit Theory and Model-Based Inference for Landscape Connectivity

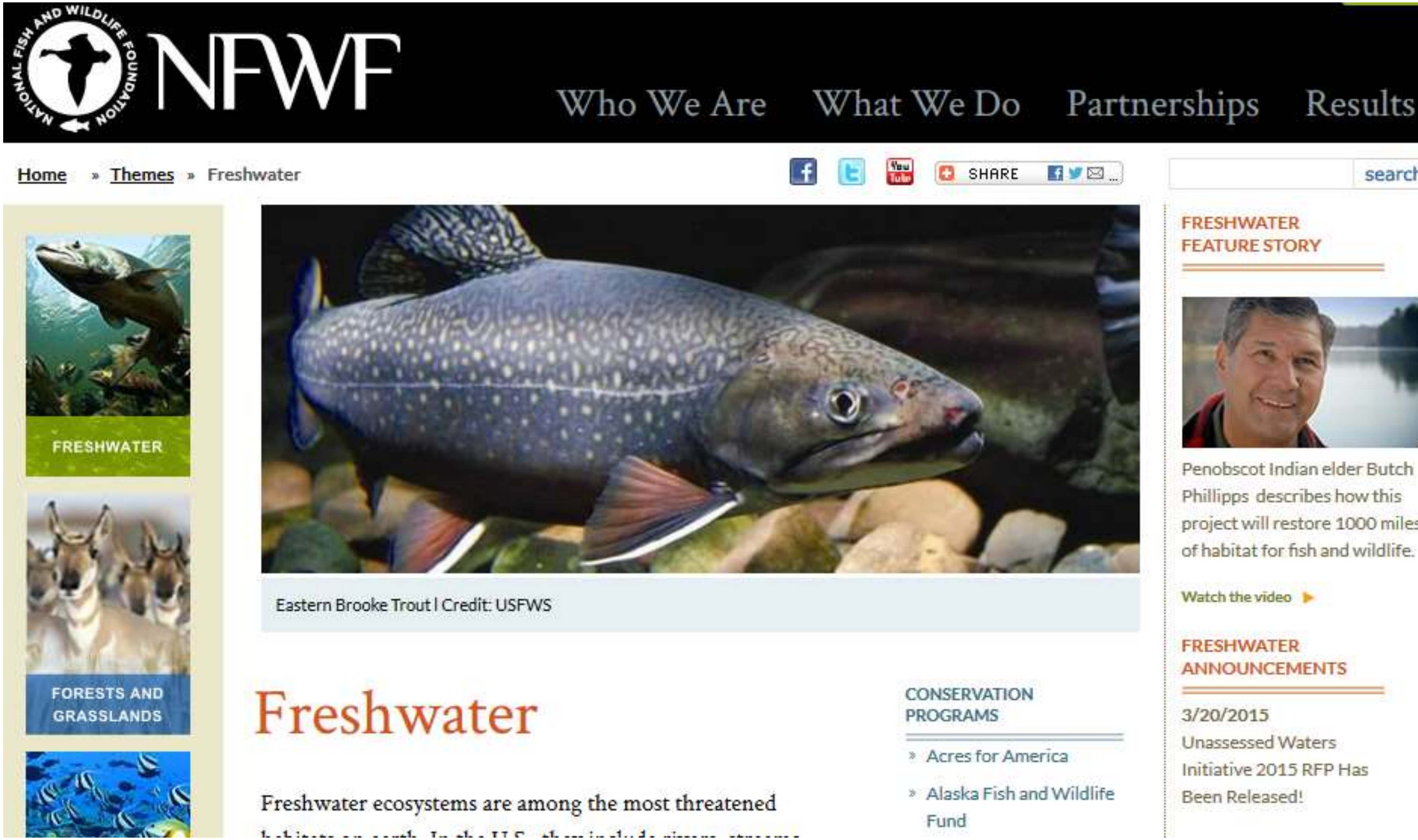
Ephraim M. Hanks and Mevin B. Hooten

1. INTRODUCTION

In the Public Domain
Journal of the American Statistical Association
March 2013, Vol. 108, No. 501, Applications & Case Studies



NFWF (National Fish & Wildlife Foundation)



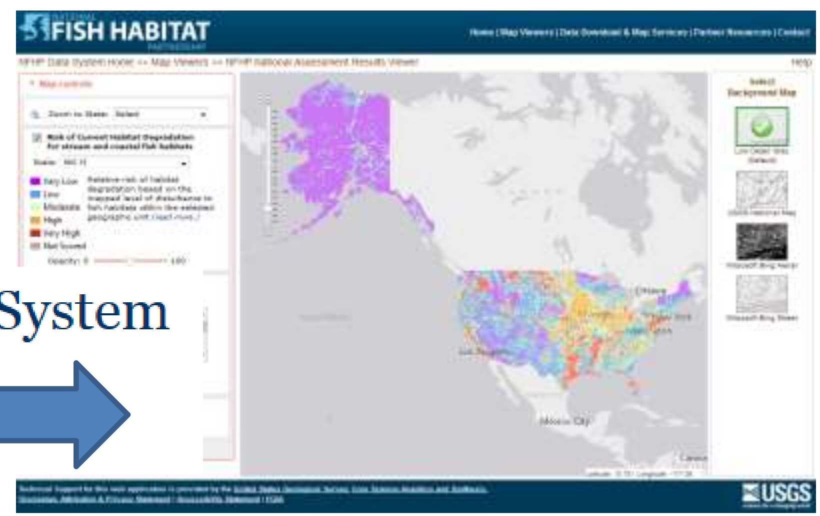
Dave Lawrence

Website: http://www.nfwf.org/

NFHP (National Fish Habitat Partnership)

National Fish Habitat Partnership Data System

The National Fish Habitat Partnership (NFHP) Data System supports coordinated efforts of scientific assessment and data exchange among the partners and



Gary Whelan **Website: http://www.fishhabitat.org/**

Anything else?