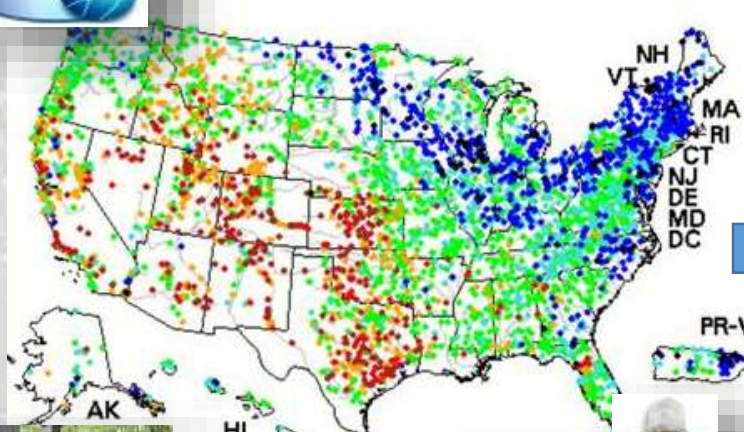


# Workshop: Reducing uncertainties about drought and river ecosystems during times of rapid environmental change: Mining available resources and developing new information cost effectively

Dan Isaak and Daniel Wieferich



INSTREAM FLOW COUNCIL  
**FLOW 2018**  
SCIENCE • LAW • POLICY • PUBLIC DIALOGUE



## Agenda (3 hours)

I. Introductions

II. An organizing framework: The National Hydrography Dataset (30 minutes)

III. Datasets, data products, and tools for use with NHD streams and rivers

a. Example databases and data products (15 minutes)

b. Geospatial tools for linking data to NHD reaches (15 minutes)

IV. Using inexpensive sensing technologies with the NHD geospatial framework to create new datasets and models cost effectively (30 minutes)

**20 minute break**

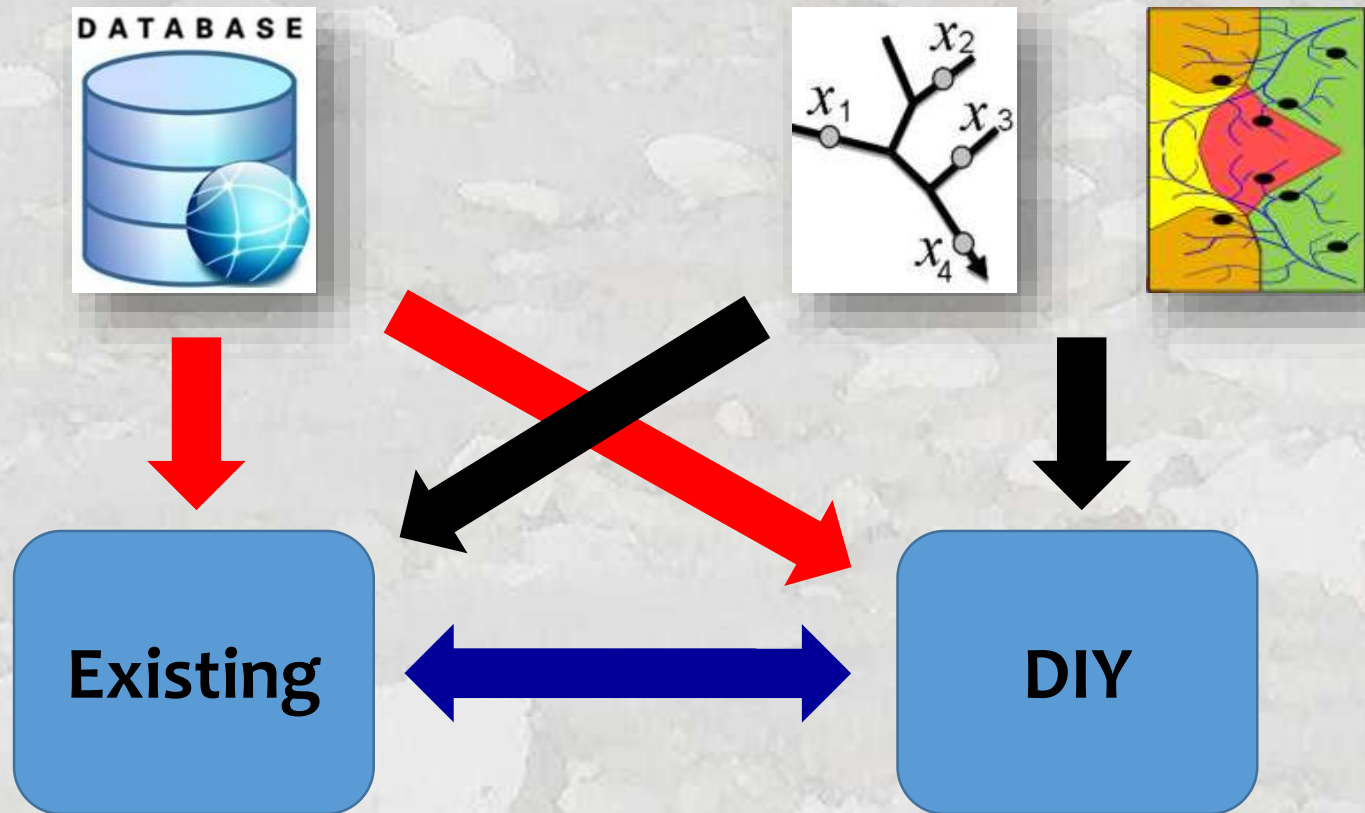
V. Existing assessments that bring it all together

a. NFHP National Assessment (30 minutes)

b. Using crowd-sourced datasets and NHD resources to prioritize flow restoration efforts throughout a species' range (30 minutes)

A) Databases of in-stream measurements (water quality, discharge, biological surveys, habitat)

B) Data products for streams (network representations, watershed & reach attributes)



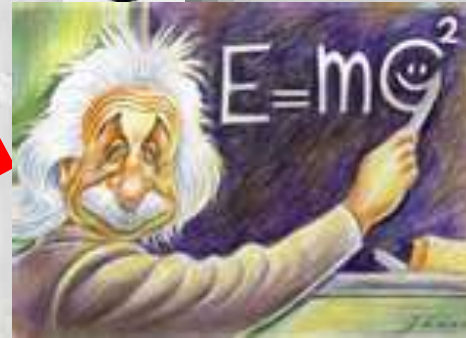
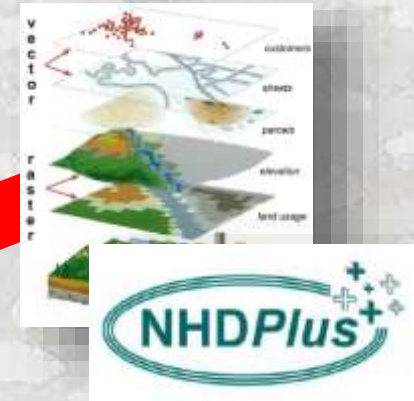
# Synthetic Analyses to Develop New Information

Managers

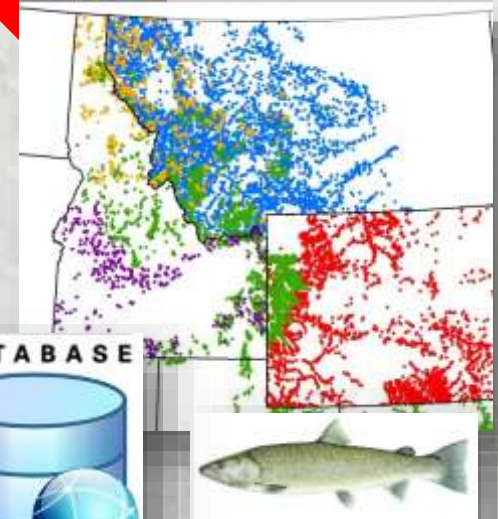


*Eureka!*

Spatial analyses



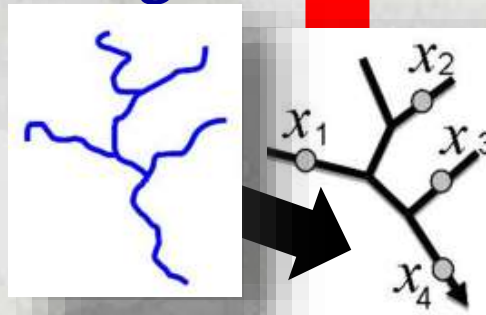
Databases



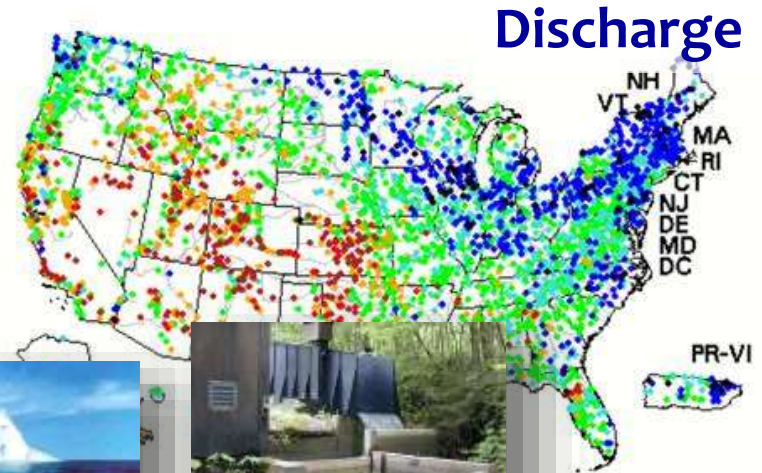
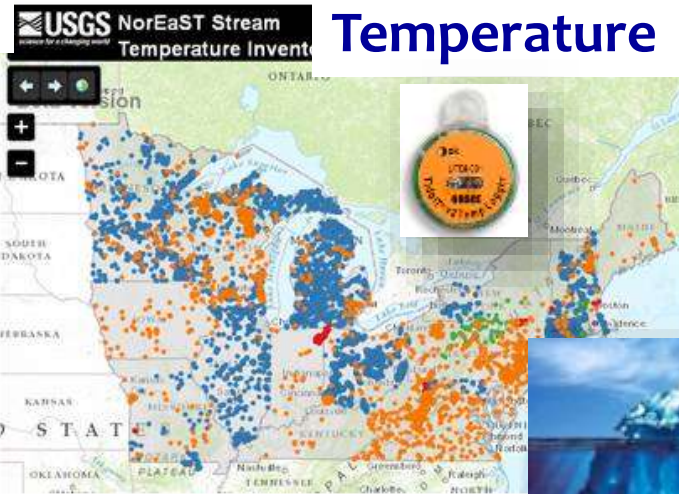
Scientists



Ecological Modelers



# Existing Stream Databases



**Species distributions**



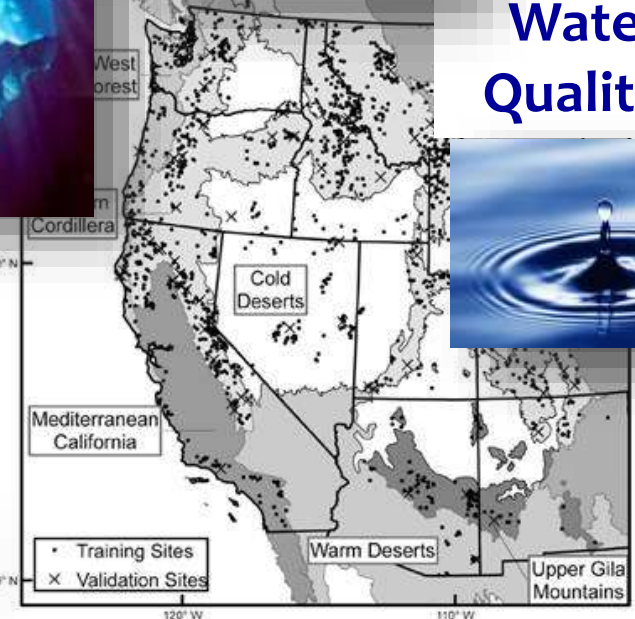
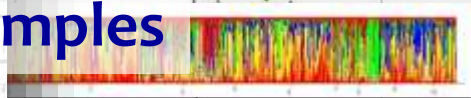
**Water Quality**



**Genetic Samples**

Genetic Samples

Site	Sample ID	Species	Genotype
110	110	14C	14C
113	113	14C	14C
116	116	14C	14C
119	119	14C	14C



**DATABASE**



# National Water Information System (NWIS)

Discharge, water quality, temperature

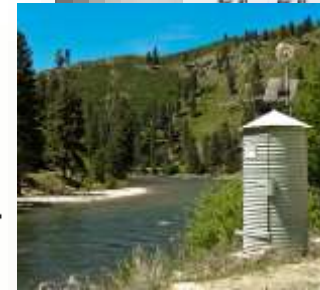
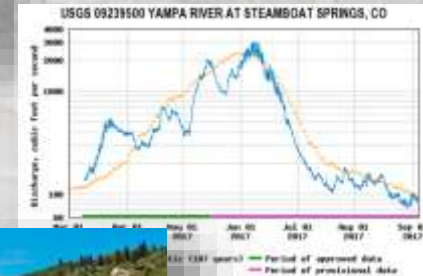
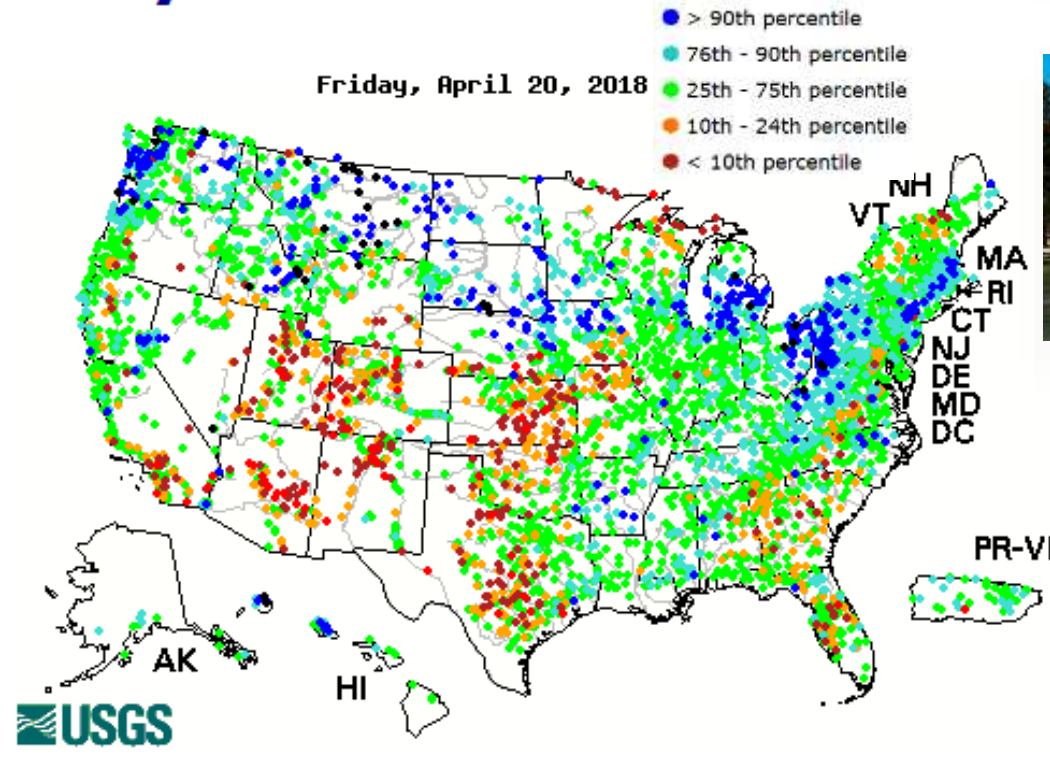
1.9 million sites, billions of records

Rapid online searches & data downloads

Real-time & historical data



## Daily Streamflow Conditions



Surface Water

Groundwater

Water Quality

Water Use

Website: <https://waterdata.usgs.gov/nwis>

DATABASE



# Point of Diversion & Water Rights Databases

The screenshot displays the Idaho Department of Water Resources website. At the top, the logo for IDAHO Department of Water Resources is visible, along with a search bar and navigation links for Water Rights, Wells, Streams/Dams/Floods, Forms, Water Data, Maps/Spatial Data, Legal Actions, and Water Resource. Below the navigation bar, there are two main sections: Research Hub and Map Hub. The Research Hub includes links for Water Rights Search, New Water Right Applications, New Water Right Transfers, River Flow Data, Snow Water Equivalency, and Water Measurement Information System. The Map Hub includes links for General Map, Find a Well, Dams of Idaho Map, Evapotranspiration Viewer, Irrigation Rights Finder, Recreational Mining Map, Water Measurement Map, Water Rights Accounting Map, Water Supply Bank Lease Search, Wild and Scenic Watersheds Map, and Create and Print a Map for. A red arrow points from the left map to the right map.

**Water Right Locator** Address or W

Spokane

Helena

Boise Idaho Idaho Falls

Water Right Locator Address or W

Water Right Locator

Water Right Locator

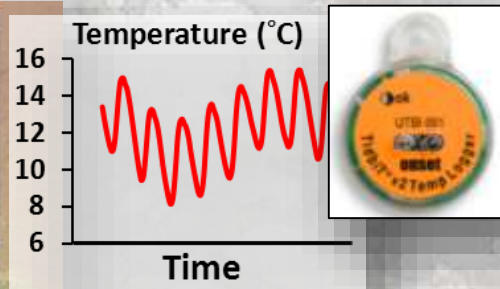


DATABASE



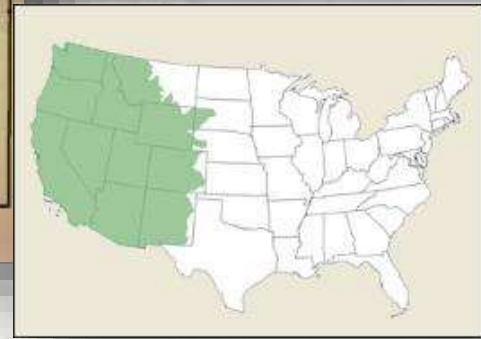
Website: <https://www.idwr.idaho.gov/>

# Western Stream Temperature Database



**>100 agencies**

**>300,000,000 hourly records**  
**>22,700 unique stream sites**

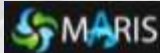




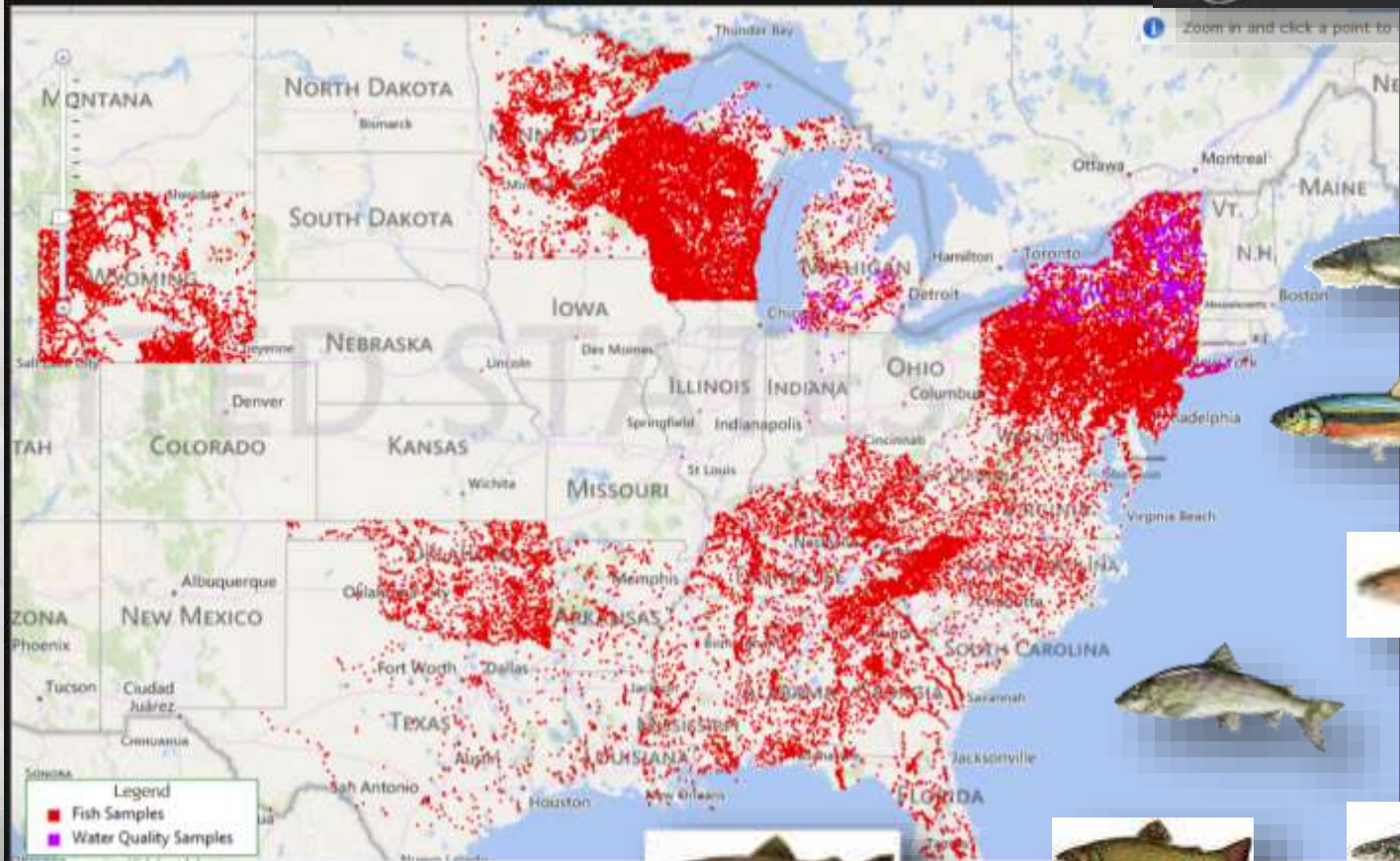
# Multistate Aquatic Resources Information System

>1,000,000 fish sampling records

>1,000 fish species (primarily eastern U.S.)



Browse all survey locations in the MARIS database

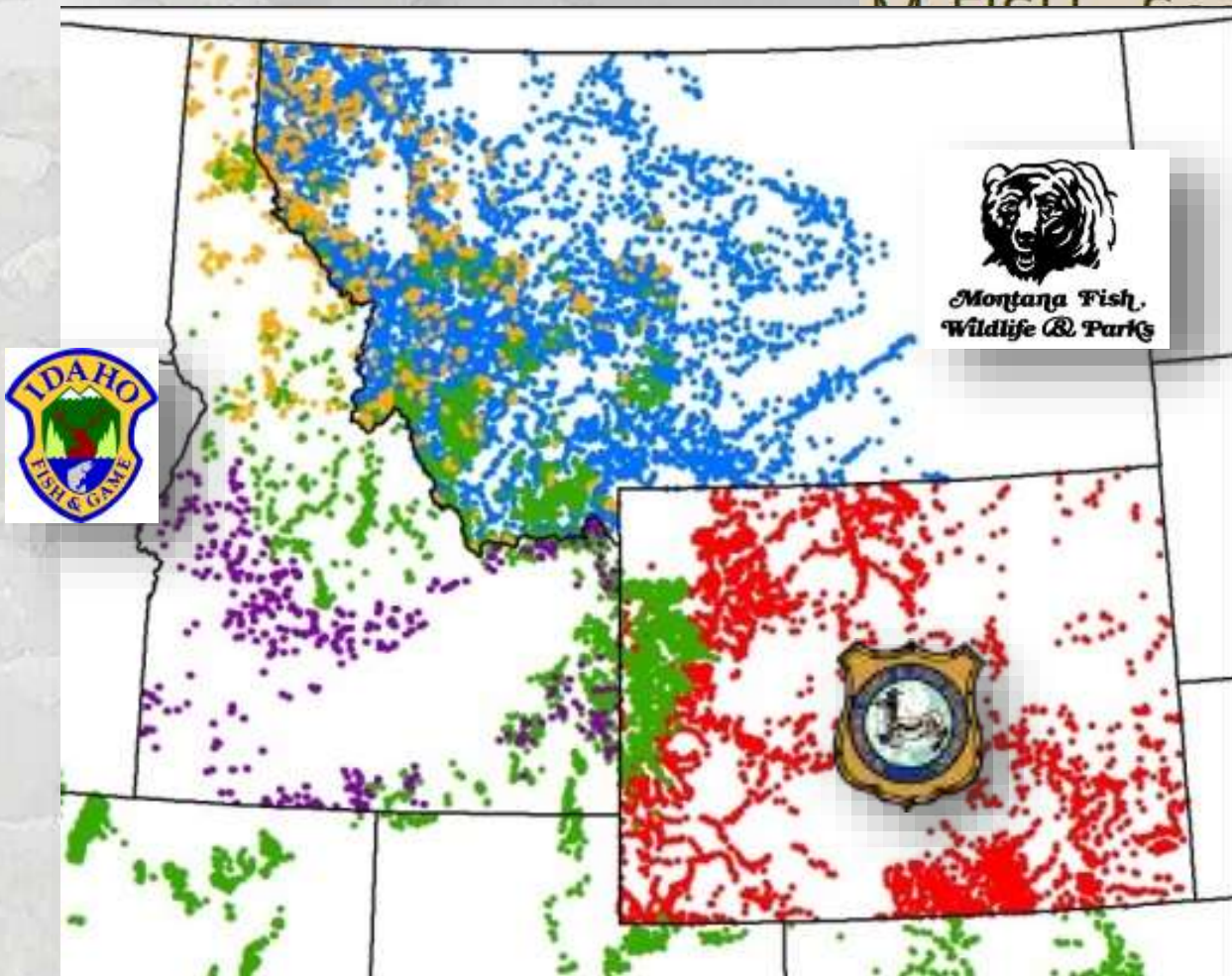


Website:

<https://www.sciencebase.gov/catalog/folder/51c45ef1e4b03c77dce65a84>

# State Fish Databases

>20,000 river & stream survey sites in northern Rockies



M. FISH Search  
Information System



Isaak et al. 2017. Big biology meets microclimatology. Ecological Applications. 27:977-990.  
Dryad Digital Repository <http://dx.doi.org/10.5061/dryad.dos7k>

# National Aquatic Resource Surveys Data

## Macroinvertebrates, fish, habitat, water quality



- Random sample within ecoregions
- 1,900 stream sites
- Repeated periodically

Website: <https://aquatic.biodata.usgs.gov/landing.action>

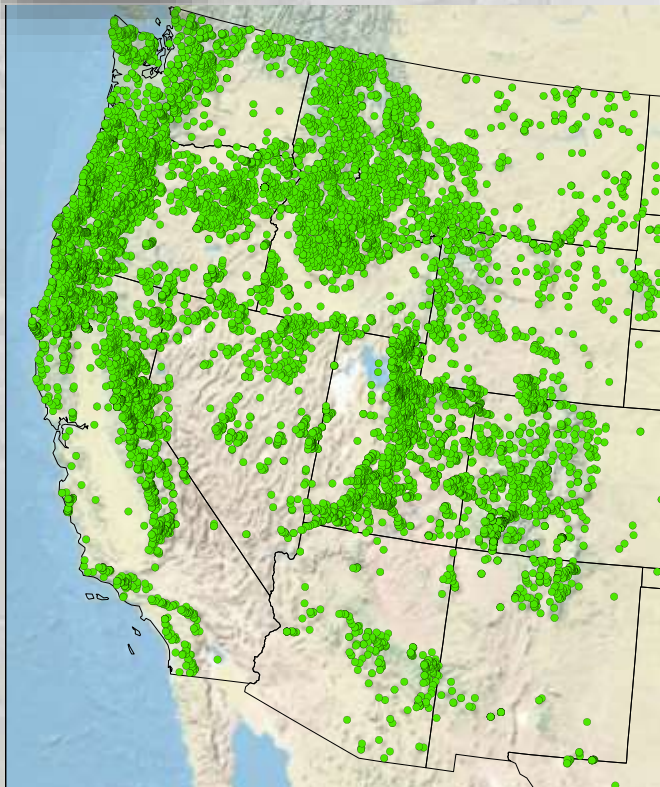
DATABASE





# Western Center for Monitoring & Assessment of Freshwater Ecosystems

15,279 stream and river sites  
1.5 million records for >5,000 taxa



**BUGLAB** BLM/USU National Aquatic Monitoring Center

HOME SAMPLE PROCESSING MONITORING RESOURCES PROJECTS PHOTOS MEET THE STAFF LINKS CONTACT US

## Welcome to the BugLab

**Our Mission**

The National Aquatic Monitoring Center is a cooperative venture between Utah State University and the U.S. Bureau of Land Management. Our purpose is to encourage and foster scientifically sound watershed monitoring programs on public lands. Our goals are to increase the consistency and quality of aquatic resource assessments and provide clear, accurate, and timely information to resource managers and the public. A primary focus of our laboratory is the processing of aquatic invertebrate samples. Please contact us if you are in need of our assistance.

**New Developments**

- **Online Sample Submission:** Submit your samples online. Our new online submission process helps organize and eliminate errors in sampled data. Try it now!
- **Bug Data Mapping and Retrieval:** The new Bug Data Mapping and Retrieval site is now online. The tool allows you to search our database for bugs at the location level and view them on a map. Please visit and give us feedback.

**Upcoming Developments**

- We are constantly trying to improve our website and provided feedback to you.

Website: <http://www.qcncr.usu.edu/wmc/>



# Aquatic eDNA Atlas Database & Longterm Archive

10,000 samples online in 2018

Updated with thousands of new samples annually



## Partner Agencies

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



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Idaho Power Company  
Kalispel Tribes  
Montana Dept. Natural  
Resources Conservation  
Montana Fish, Wildlife & Parks  
National Fish & Wildlife  
Foundation  
The Nature Conservancy

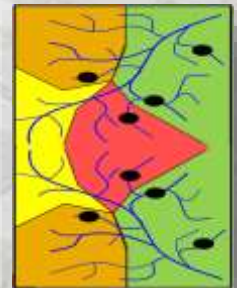
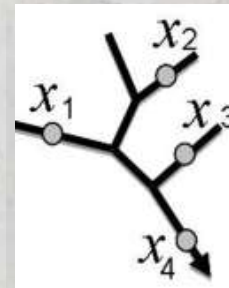
National Park Service  
Oregon Dept. Fish & Wildlife  
Shoshone-Bannock Tribes  
Trout Unlimited  
University of Washington  
U.S. Fish and Wildlife Service  
USFS National Forests:  
Beaverhead-Deer Lodge, Boise,  
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Salmon-Challis, Sawtooth,  
Wallowa-Whitman, Wenatchee  
USFS Regions 1, 4, and 6  
Washington Dept. Fish & Wildlife  
Yakama Nation



A) Databases of in-stream measurements (water quality, discharge, biological surveys, habitat)

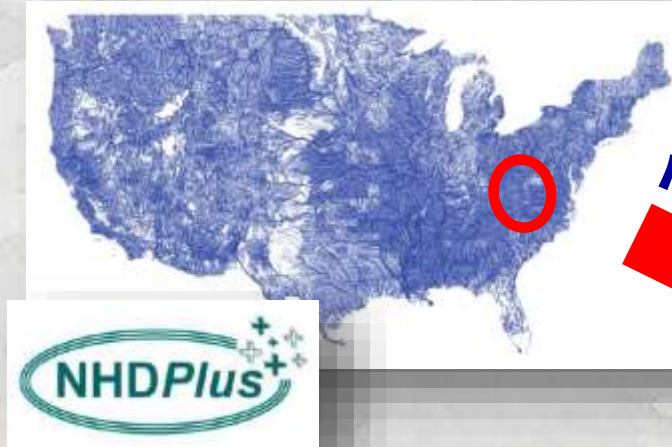


B) Data products for streams (network representations, watershed & reach attributes)



# The “PLUS” part of NHDPlus (Stream Reach Descriptors)

Exists for all reaches of streams & rivers



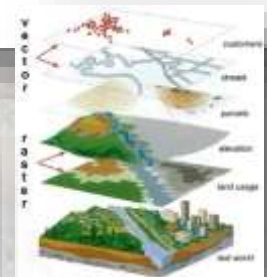
Unique reach IDs

Reach descriptors

For example:

- Elevation
- Slope
- %Canopy
- Precipitation
- Drainage area
- Upstream lake %
- Etc...

ArcGIS table attributes for vector shapefiles



Website: [http://www.horizon-systems.com/NHDPlus/NHDPlusV2\\_home.php](http://www.horizon-systems.com/NHDPlus/NHDPlusV2_home.php)



# Stream-Catchment (StreamCat) Dataset of Watershed Characteristics



Unique reach IDs

513 additional reach descriptors!



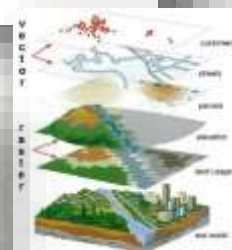
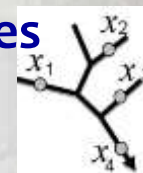
Reach descriptors

For example:

- Geology
- Urbanization
- Soil depth
- Land cover

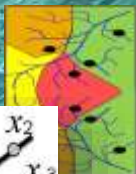
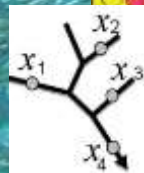
Calculated along buffer or watershed area

ArcGIS table attributes for vector shapefiles

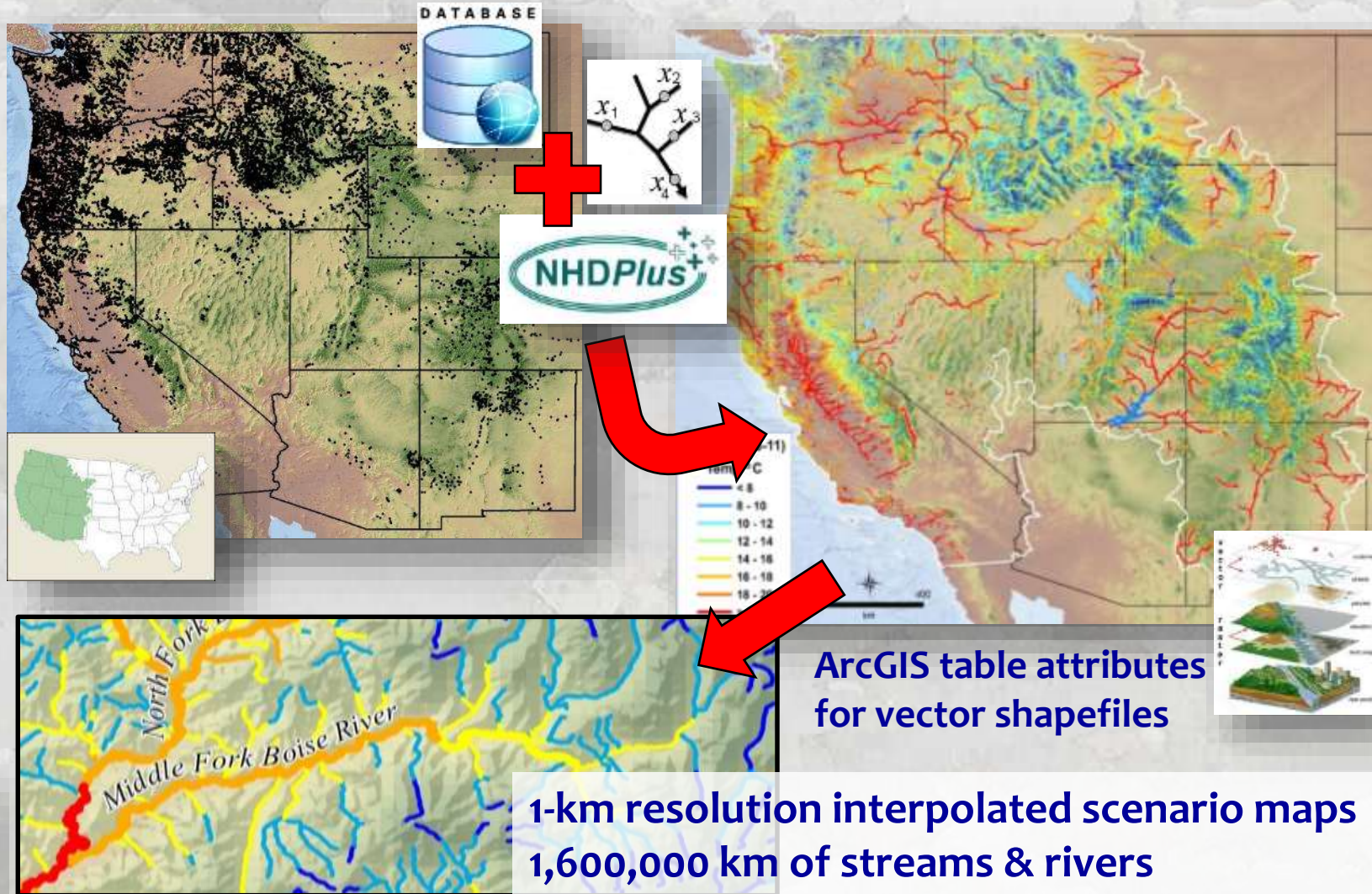


Website: <https://www.epa.gov/national-aquatic-resource-surveys/streamcat>

Hill et al. 2016. The stream-catchment (StreamCat) dataset: A database of watershed metrics for the conterminous USA. *Journal of the American Water Resources Association* 52: 120-128.

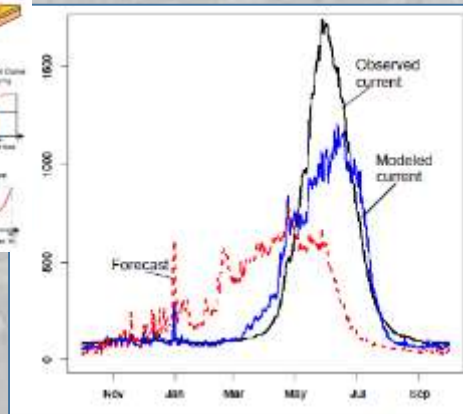
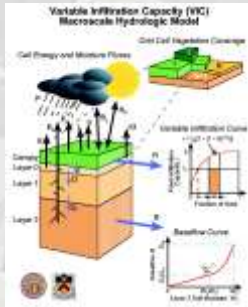


# Interpolated Stream Temperature Scenarios



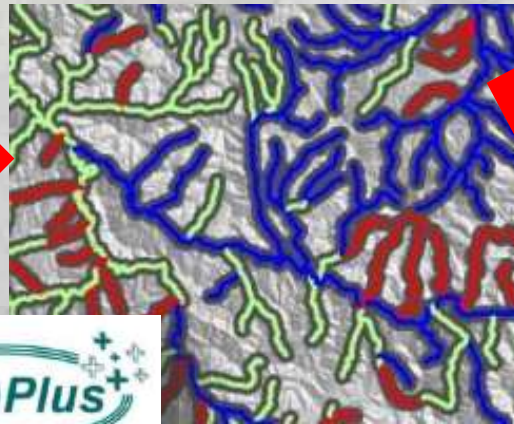
Isaak et al. 2017. The NorWeST summer stream temperature model & scenarios for the western U.S. *Water Resources Research* 53: 9182-9205.

# VIC Ecological Streamflow Metrics Dataset



- Mean flow, summer flow, peak flow
- Winter high flow events
- Median flow date
- Historical & future climate scenarios

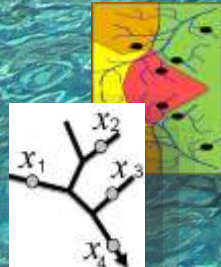
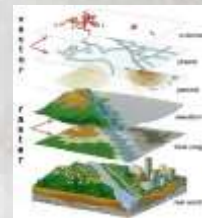
NHD+ stream segment resolution



ArcGIS table attributes for vector shapefiles



Website: [http://www.fs.fed.us/rm/boise/AWAE/projects/modeled\\_stream\\_flow\\_metrics.shtml](http://www.fs.fed.us/rm/boise/AWAE/projects/modeled_stream_flow_metrics.shtml)

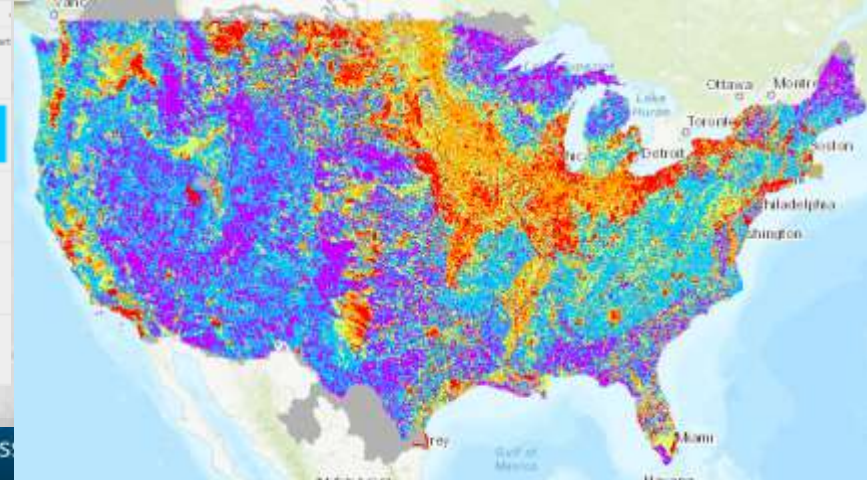
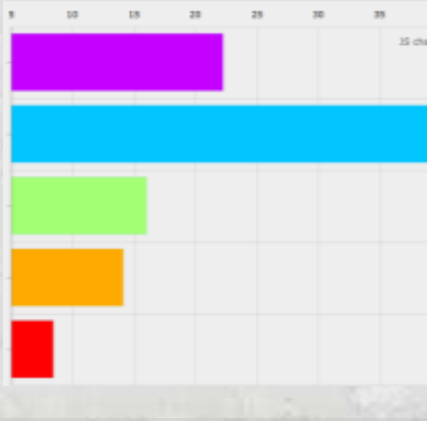




# National Assessments (2010, 2015)

## National Overview: Habitat Degradation

Very Low  
Low  
Moderate  
High  
Very High



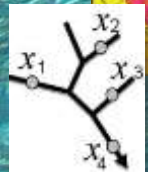
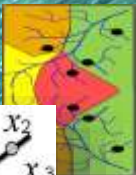
### NATIONAL FISH HABITAT PARTNERSHIP Information Products From National Assessments



#### Data

- Alaska Inland Assessment of Streams Habitat Condition and Disturbance Indices (HUC12s) - [click here to download](#)
- Alaska Inland Assessment of Streams Disturbance Data (HUC12s) - [click here to download](#)
- SE Alaska Inland Assessment of Streams Habitat Condition and Disturbance Indices (Catchments) - [click here to download](#)
- SE Alaska Inland Assessment of Streams Disturbance Data (Catchments) - [click here to download](#)
  
- Contiguous U.S. Inland Assessment of Streams Habitat Condition Index and Limiting Disturbances - [click here to download](#)
- Contiguous U.S. Inland Assessment of Streams Disturbance Data - [click here to download](#)
- Contiguous U.S. Inland Assessment of Streams Buffer Polygons - [click here to download](#)
- Contiguous U.S. Stream Fragmentation and Flow Alteration Statistics - [click here to download](#)
  
- Hawaii Inland Assessment of Streams Habitat Condition and Disturbance Indices - [click here to download](#)
- Hawaii Inland Assessment of Streams Disturbance Data - [click here to download](#)
  
- NFHP 2015 National Estuary Assessment Results - [click here to download](#)
- Regional Estuary Assessment for the Northern Gulf of Mexico Results - [click here to download](#)

Website: <http://www.fishhabitat.org/>



## Additional Stream Measurement Databases:

National Water-Quality Assessment Program (NAWQA)

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

USGS Aquatic Bioassessment Data (BioData)

Website: <https://aquatic.biodata.usgs.gov/landing.action>

USFS Aquatic Surveys Module in Natural Resource Monitor

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



## Additional Stream Data Products:

Southeast Aquatic Connectivity Assessment Project fish passage barriers (SEACAP): <http://maps.tnc.org/seacap/>

USGS StreamStats Version 4 website: [http://www.horizon-systems.com/NHDPlus/NHDPlusV2\\_home.php](http://www.horizon-systems.com/NHDPlus/NHDPlusV2_home.php)

Stream Gage Locations for NHDPlus:

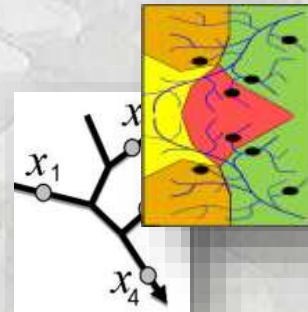
<https://www.epa.gov/waterdata/nhdplus-national-data>

FishVis Midwest fish models, stream temp and flow models website:

<https://ccviewer.wim.usgs.gov/FishVis/>

Additional NHD related products website:

<https://nhd.usgs.gov/data.html>



**Many more...**

# Website: The National Stream Internet Project



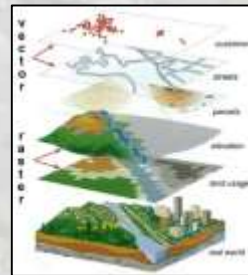
## NSI Resources



Workshop & presentations



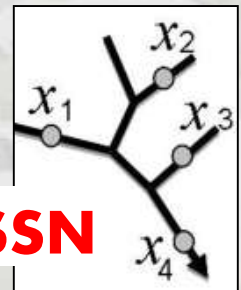
NSI hydrography network (shapefiles)



Databases of stream reach descriptors



Databases of stream measurements



**SSN**

Spatial stream-network models

Ideas



Data



Analysis



Information