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Congressional Briefing:

Ecological Health in the Nation's Streams

Speakers:

Daren Carlisle, U.S. Geological Survey
David McKinney, Tennessee Wildlife Resources
Peter Ode, California Department of Fish and Wildlife

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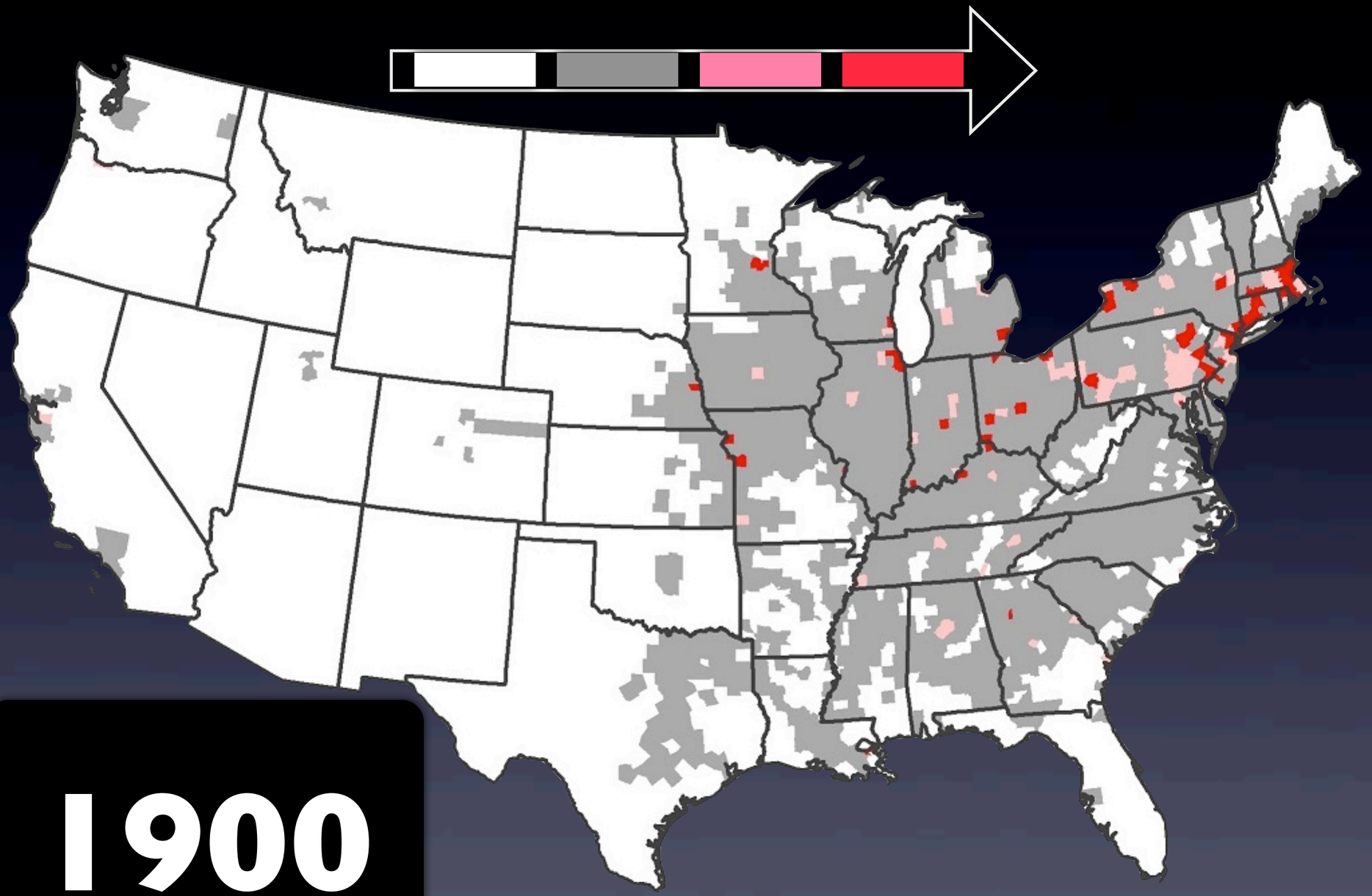
ECOLOGICAL HEALTH in the NATION'S STREAMS

National Water-Quality Assessment Program (NAWQA)

U.S. Department of the Interior
U.S. Geological Survey

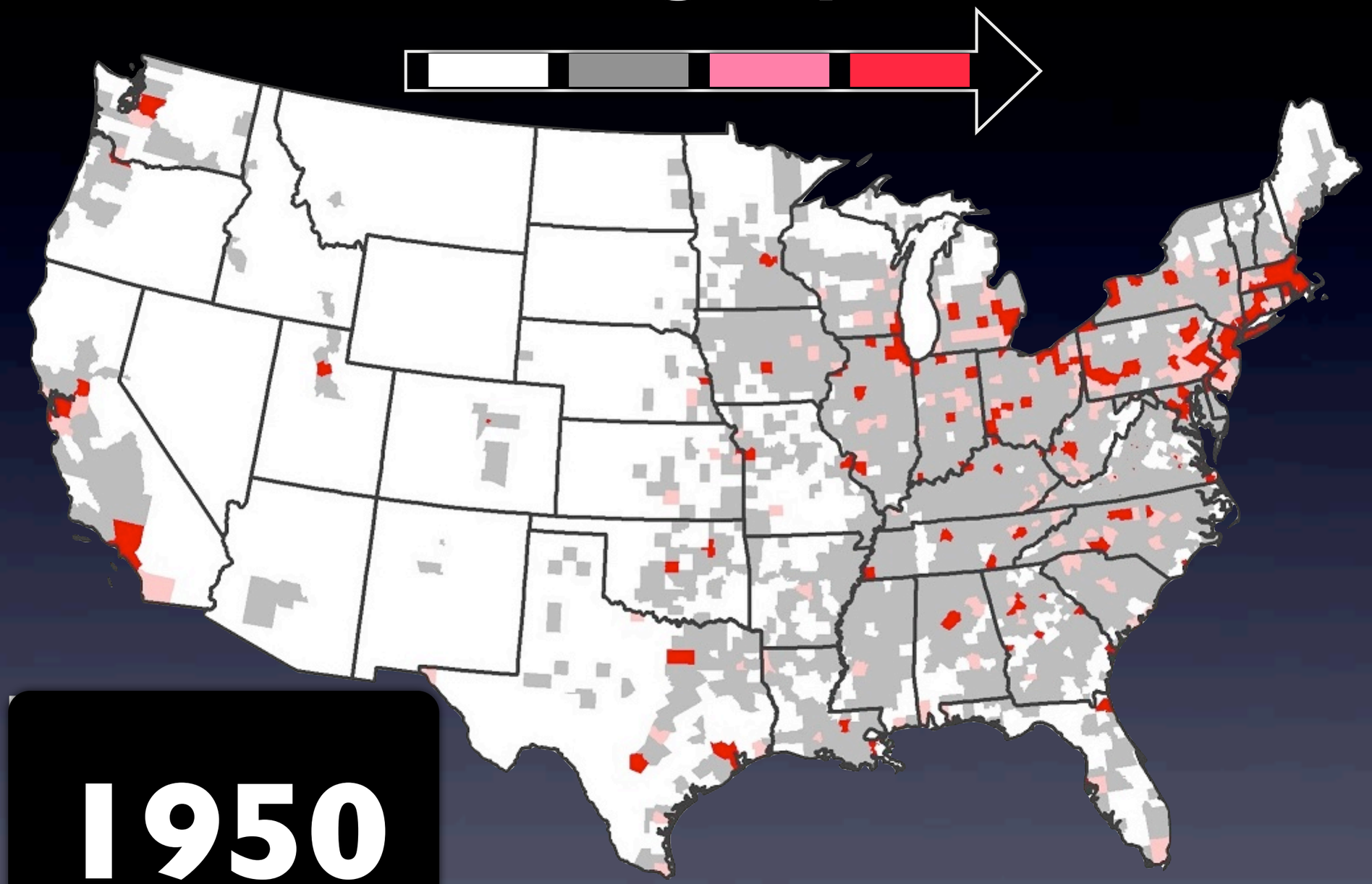
Increasing Population



1900

USGS

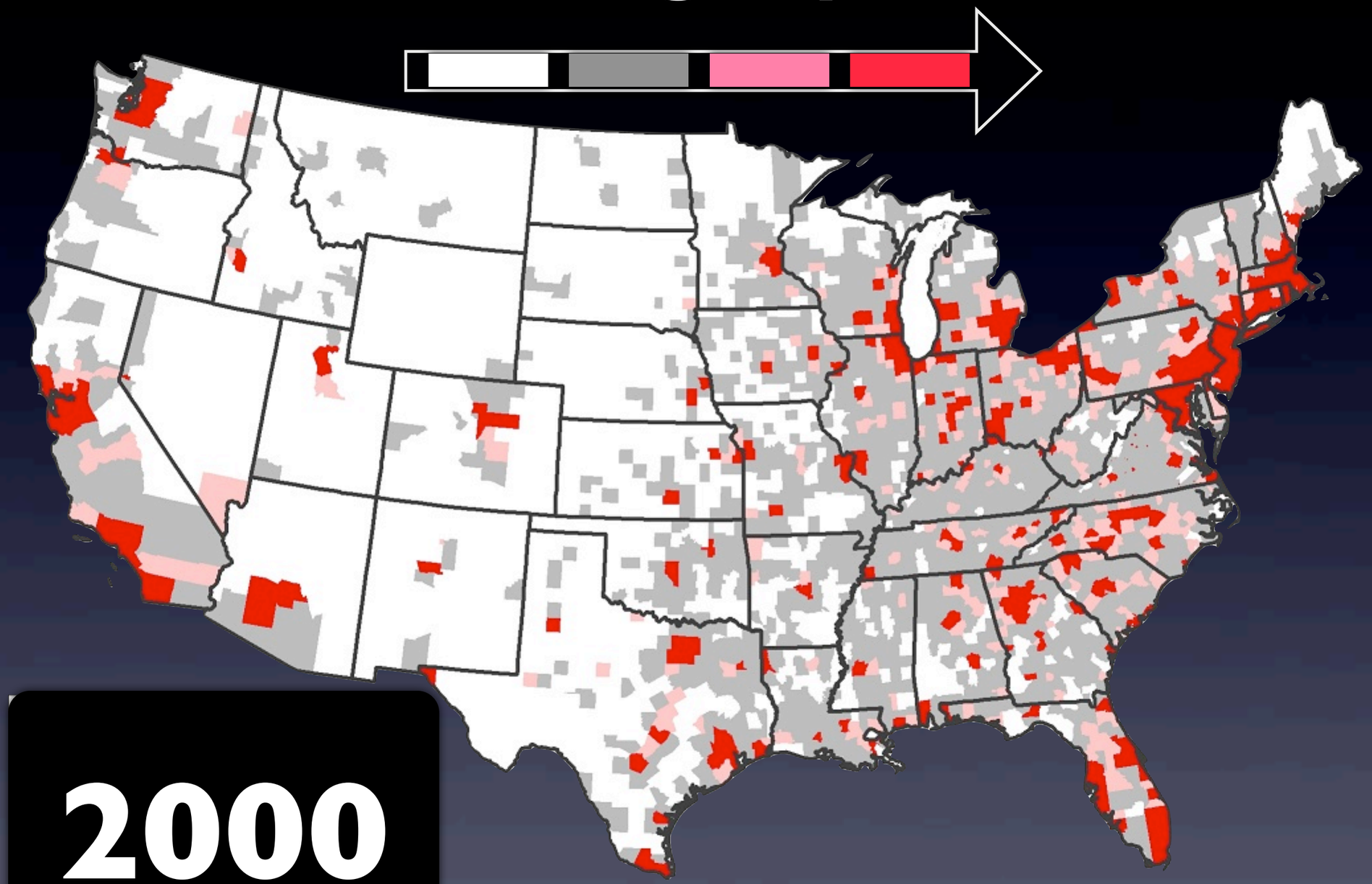
Increasing Population



1950

USGS

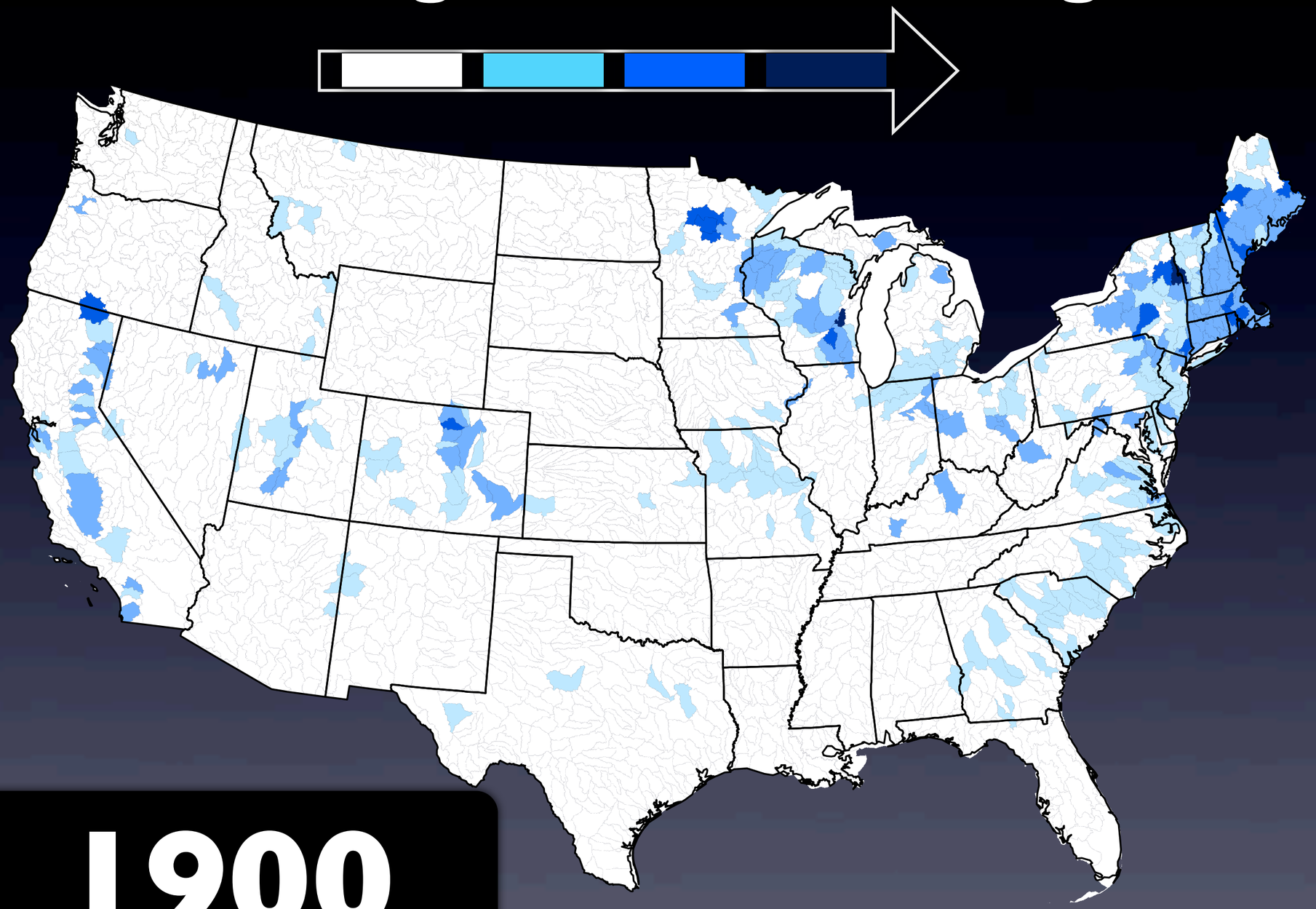
Increasing Population



2000

USGS

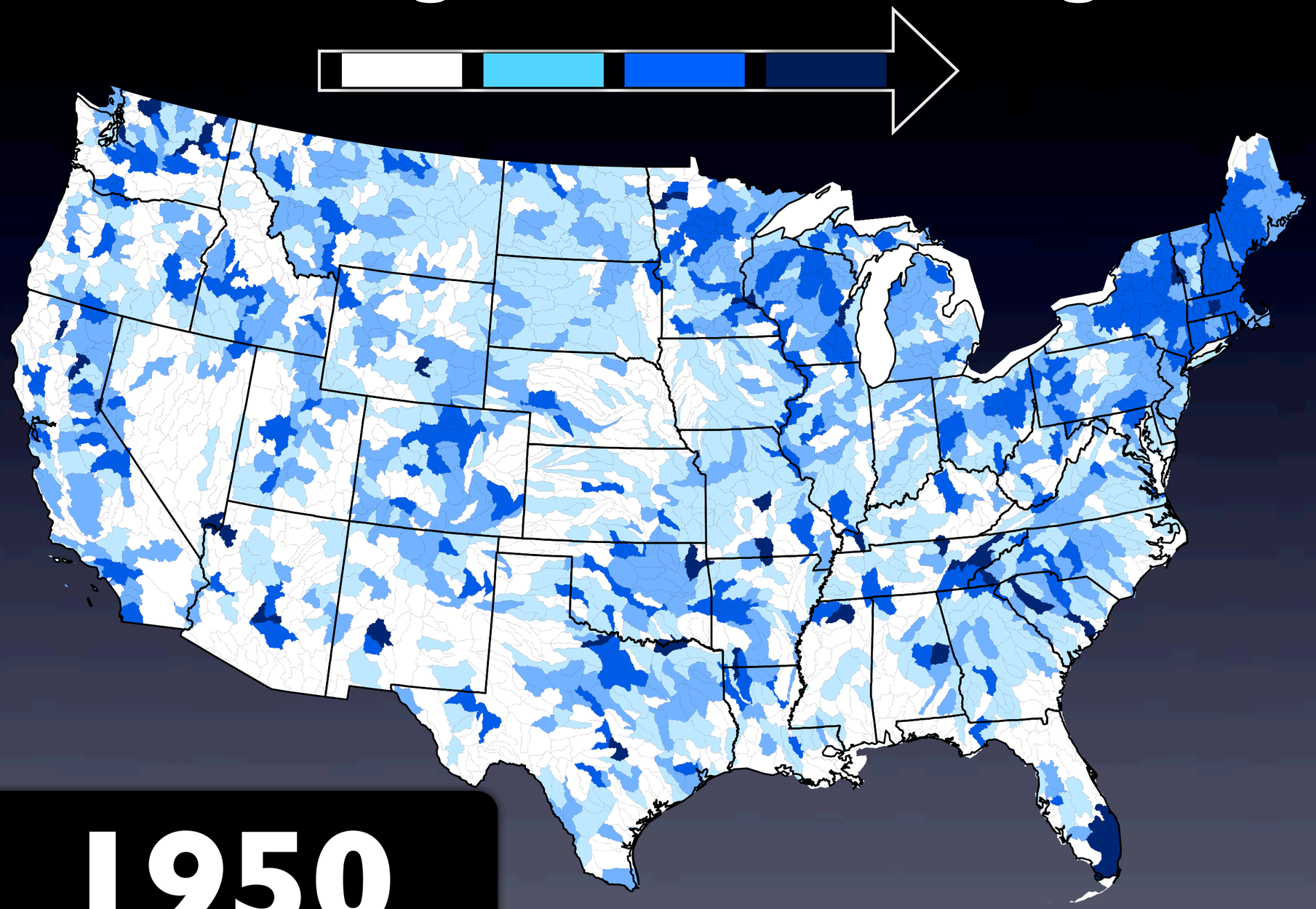
Increasing Reservoir Storage



1900

USGS

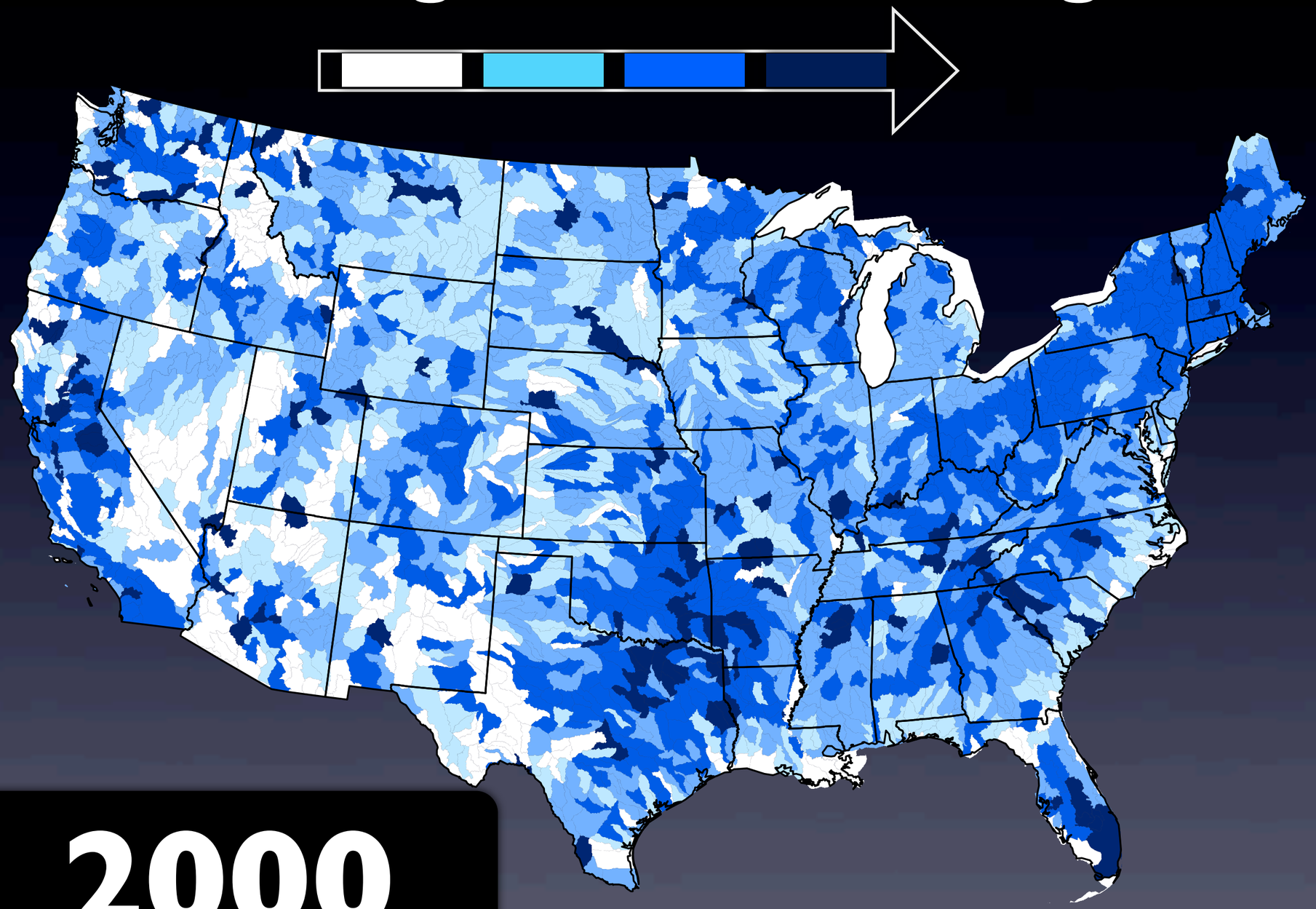
Increasing Reservoir Storage



1950

USGS

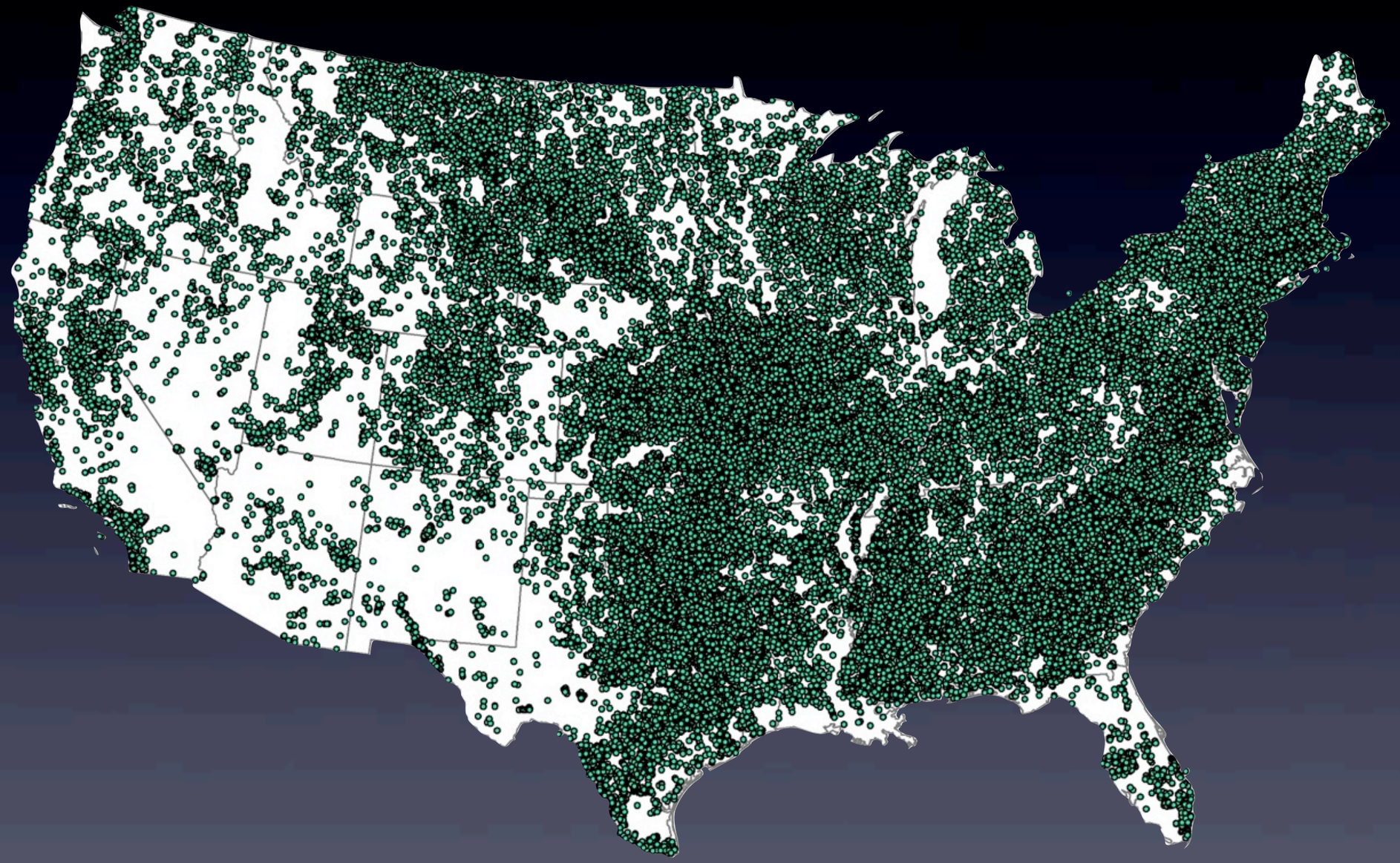
Increasing Reservoir Storage



2000

USGS

More than 80 thousand dams...

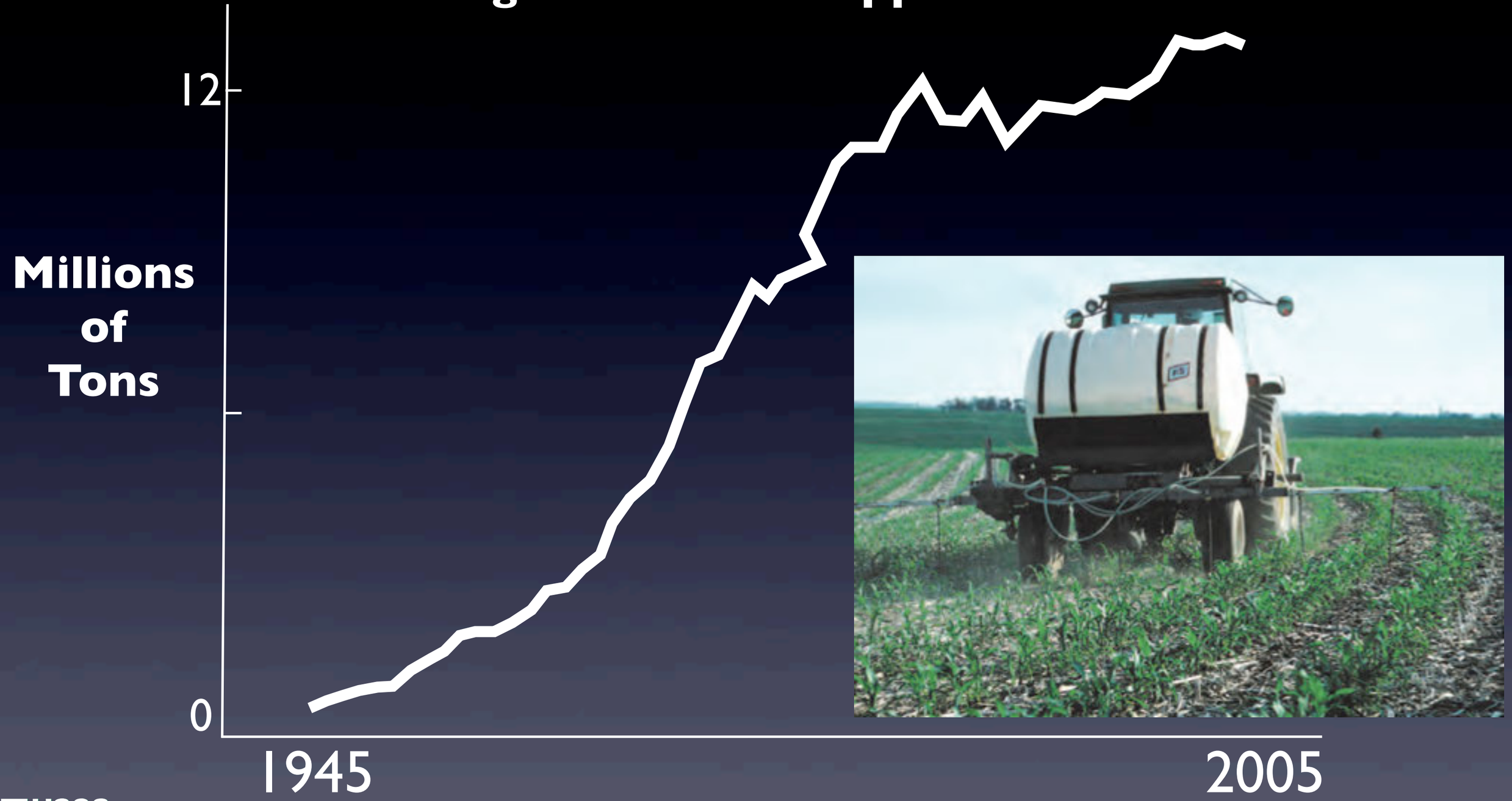


20%

stream miles modified by reservoirs

USGS

Nitrogen Fertilizer Application



USGS

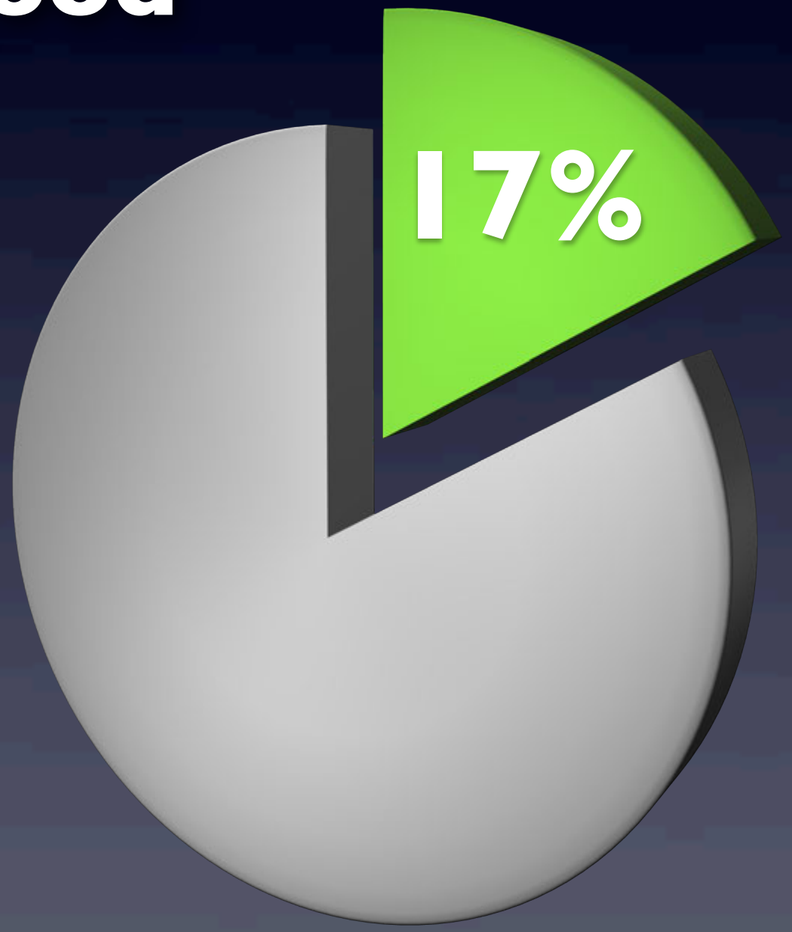
USGS

USGS

USGS

17 Percent

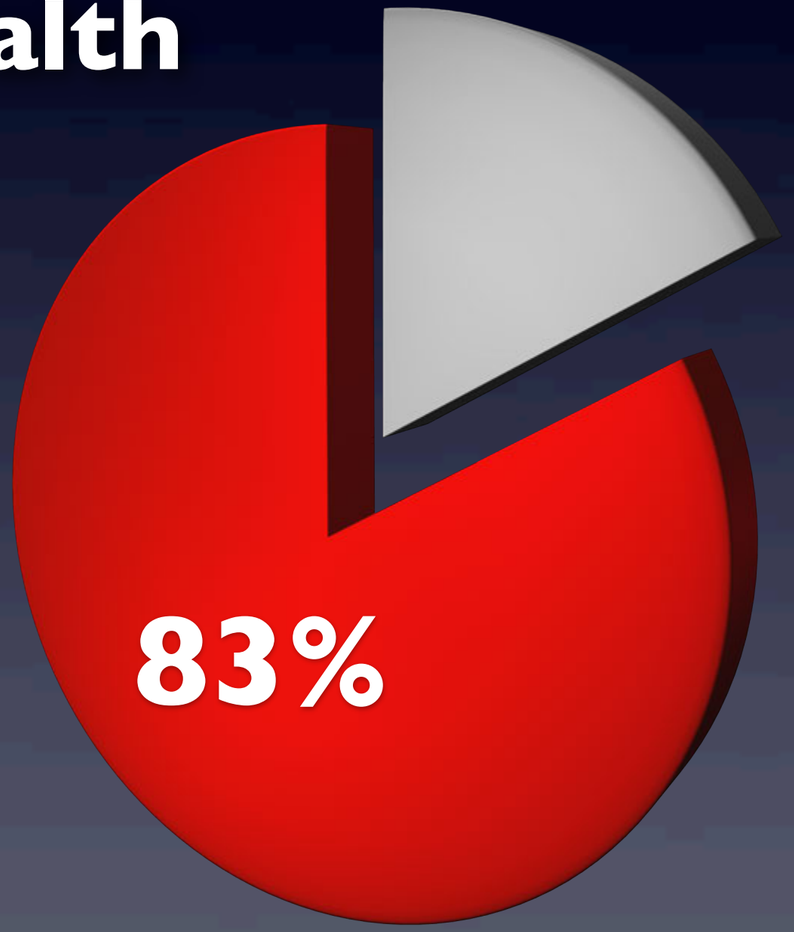
Streams with relatively good health



USGS

83 Percent

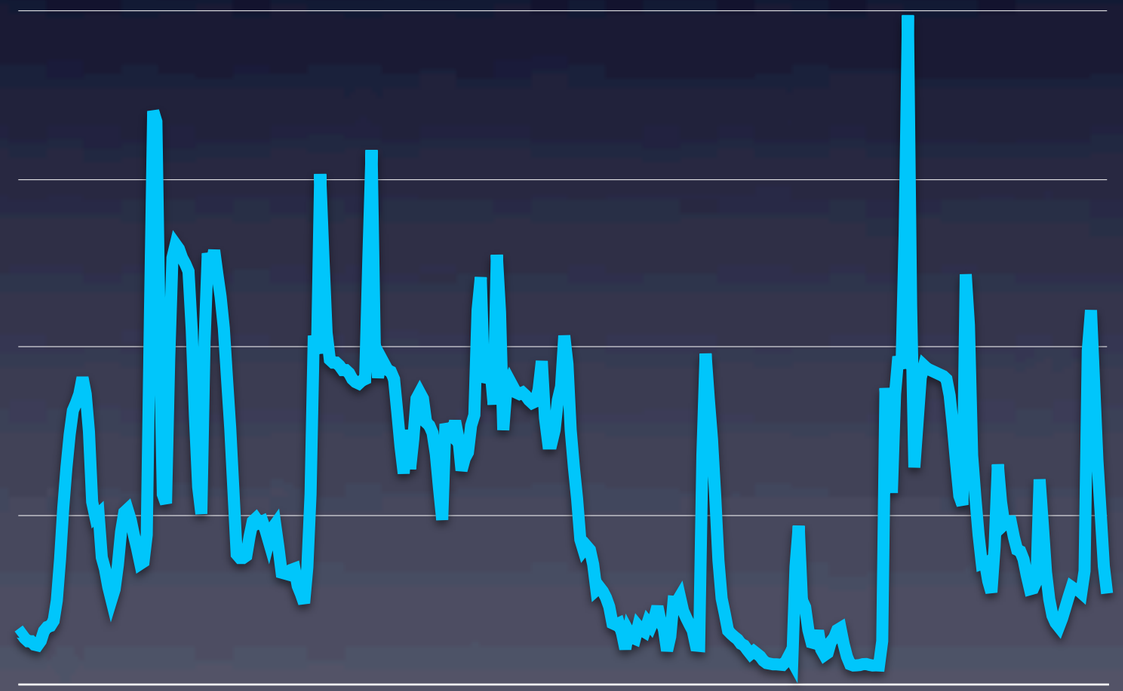
Streams with reduced health



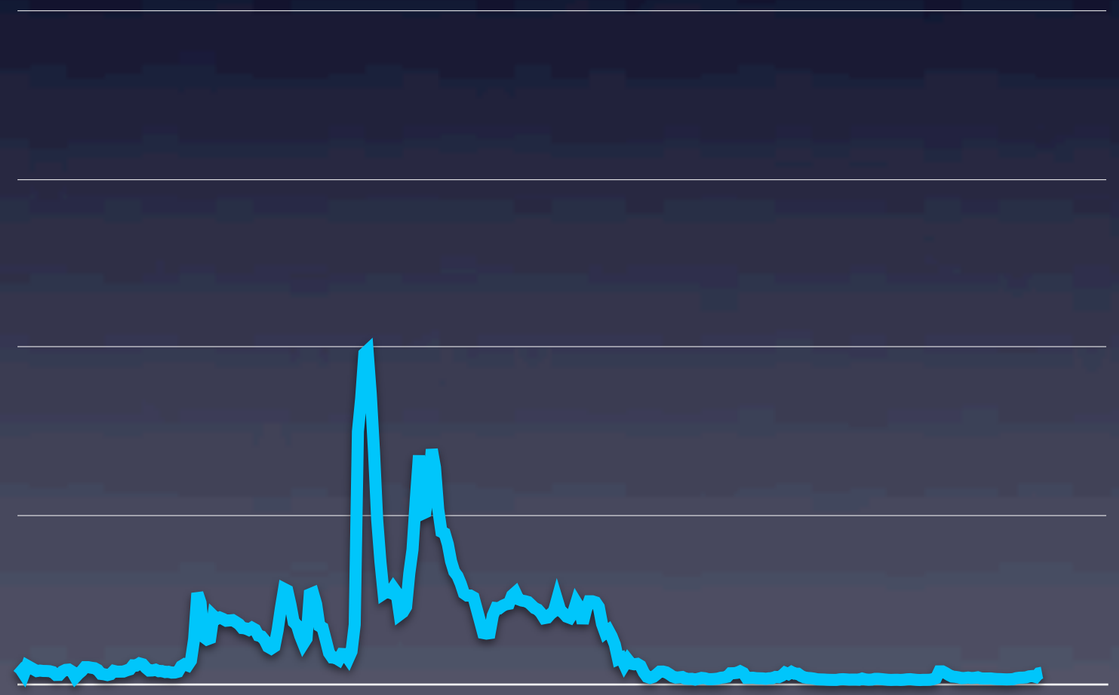
USGS

= Streamflow

2009



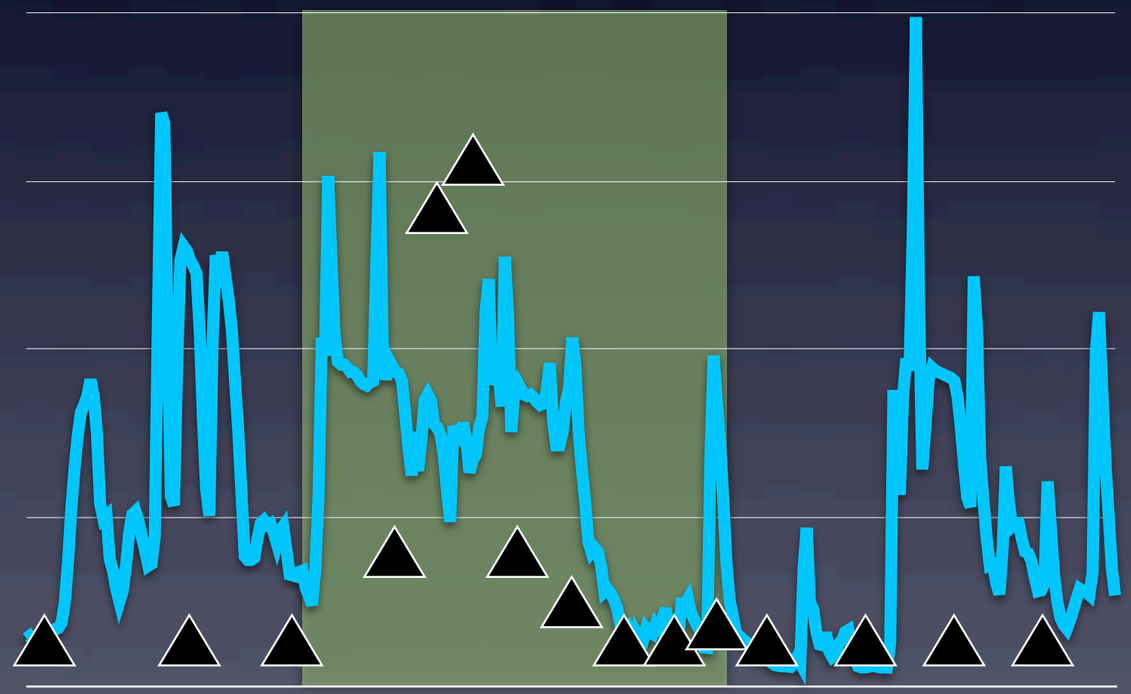
2012



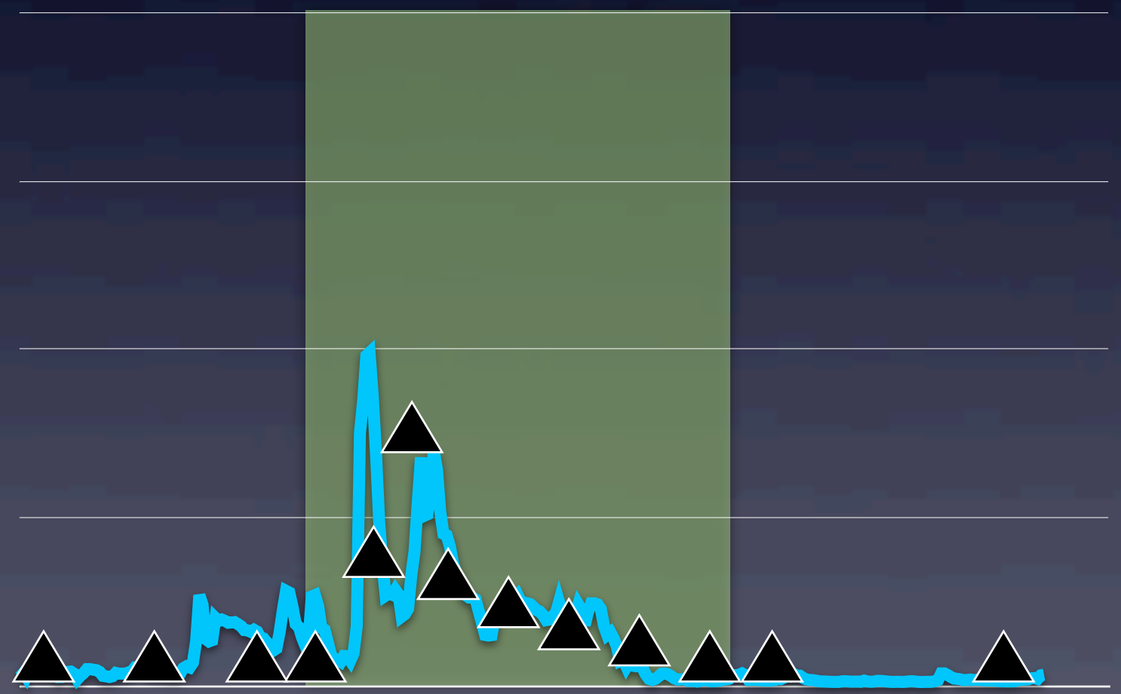
= Streamflow

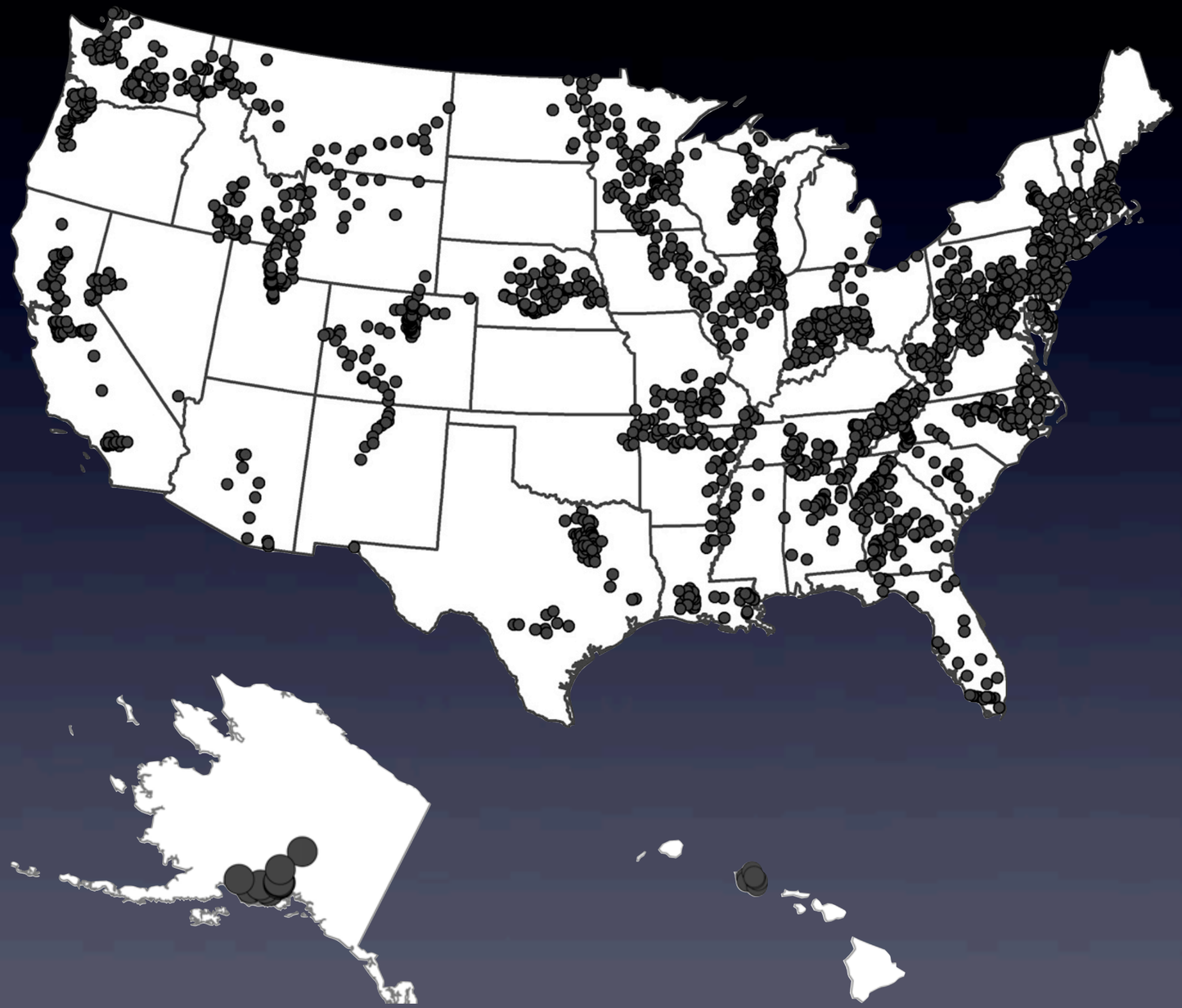
= Atrazine

2009

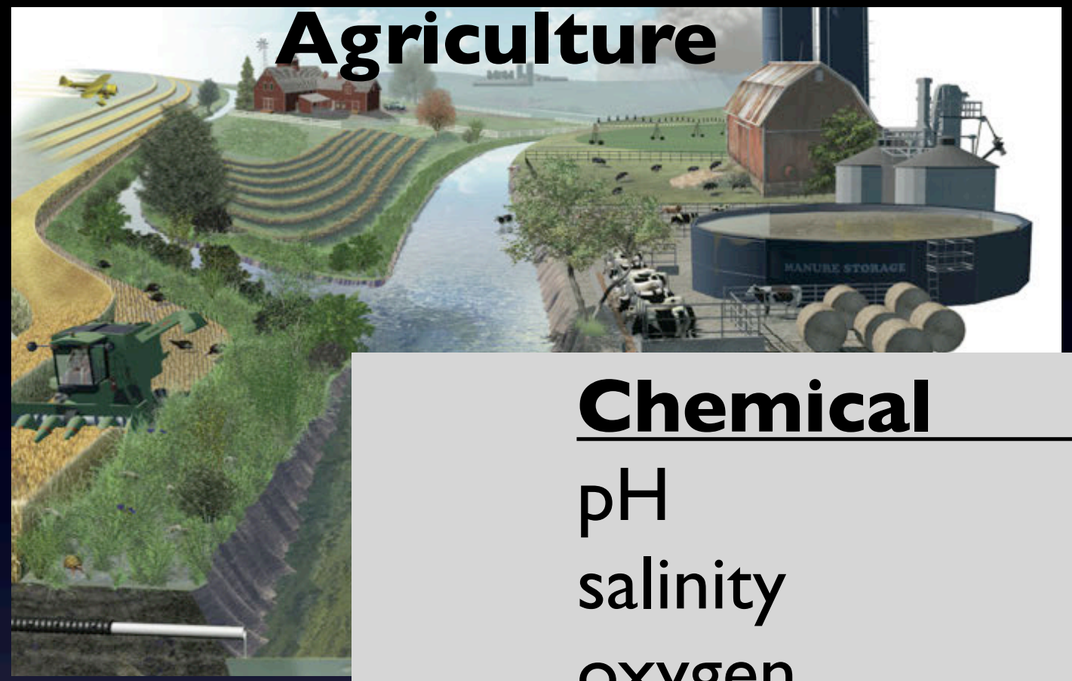


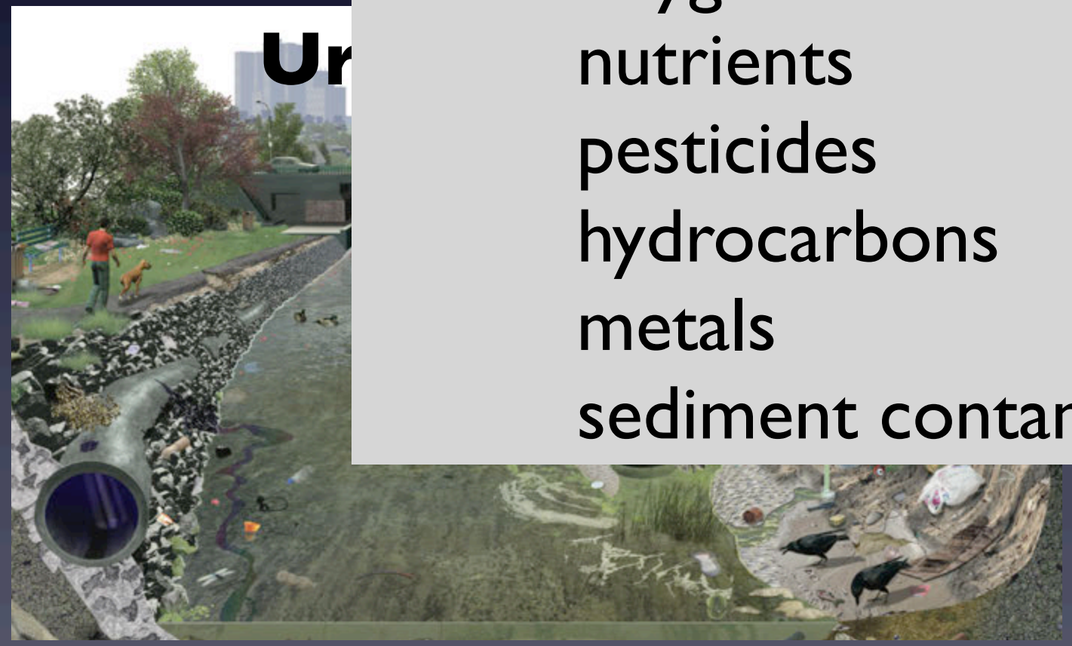
2012



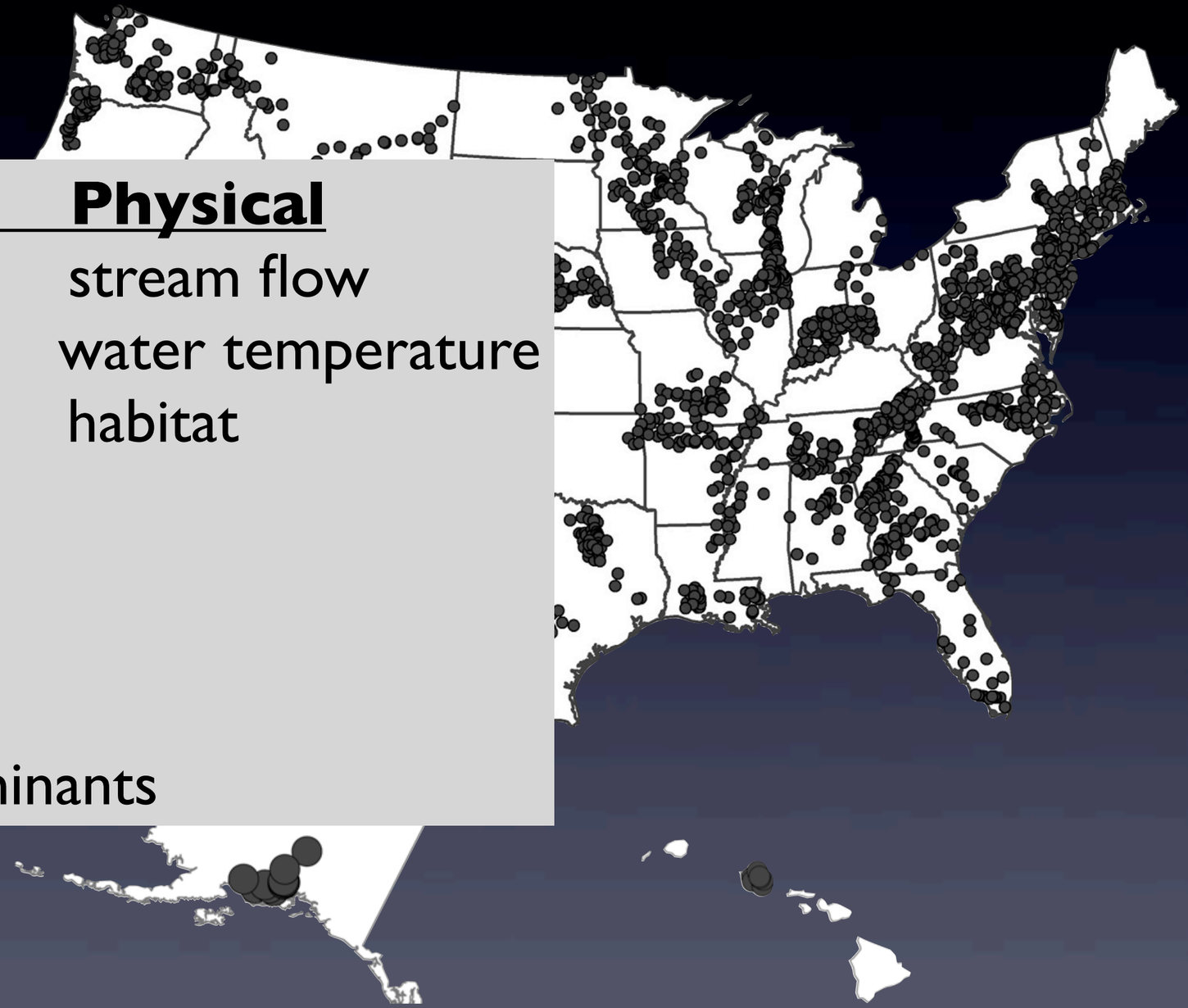


USGS

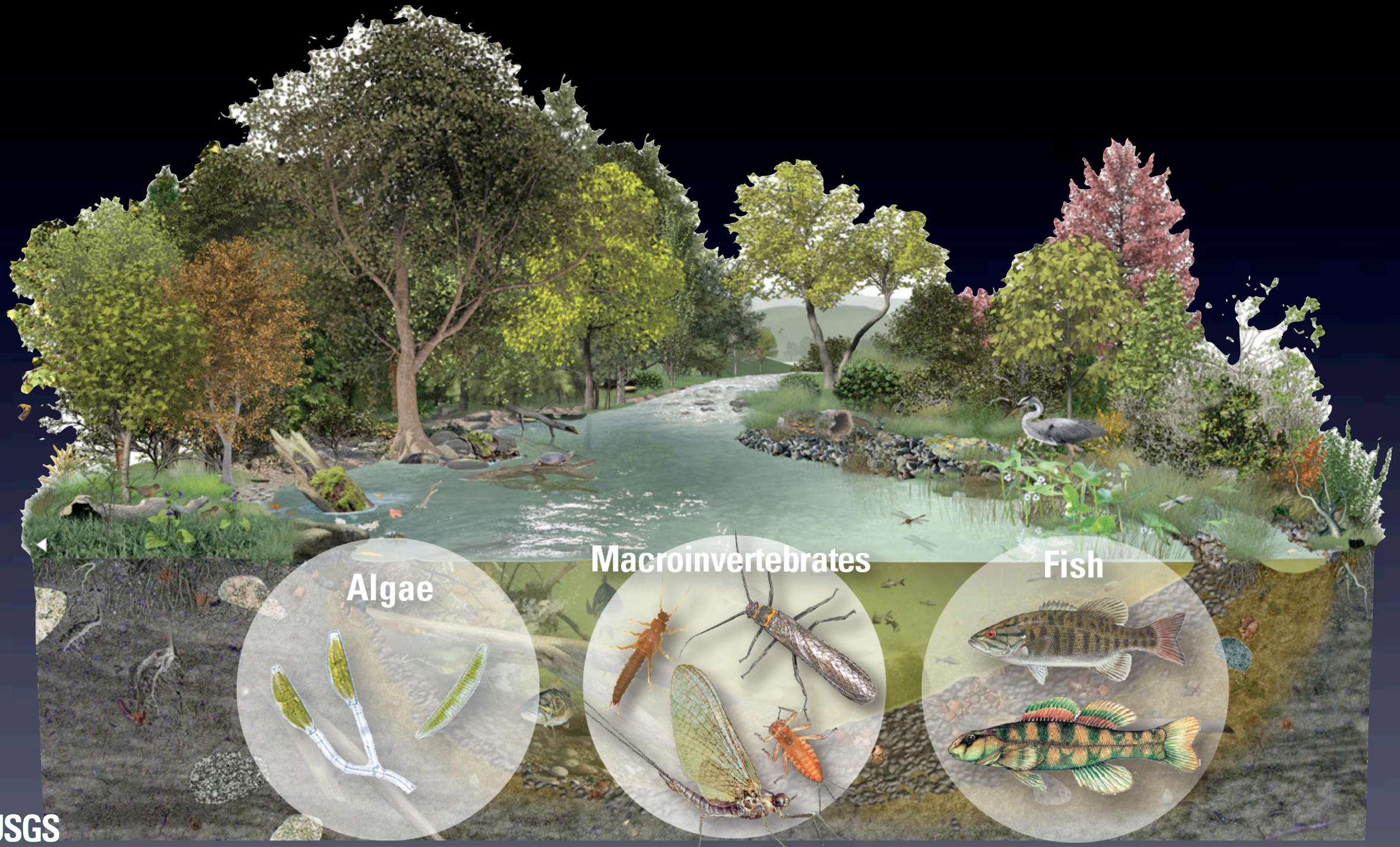




Chemical	Physical
pH	stream flow
salinity	water temperature
oxygen	habitat
nutrients	
pesticides	
hydrocarbons	
metals	
sediment contaminants	



USGS

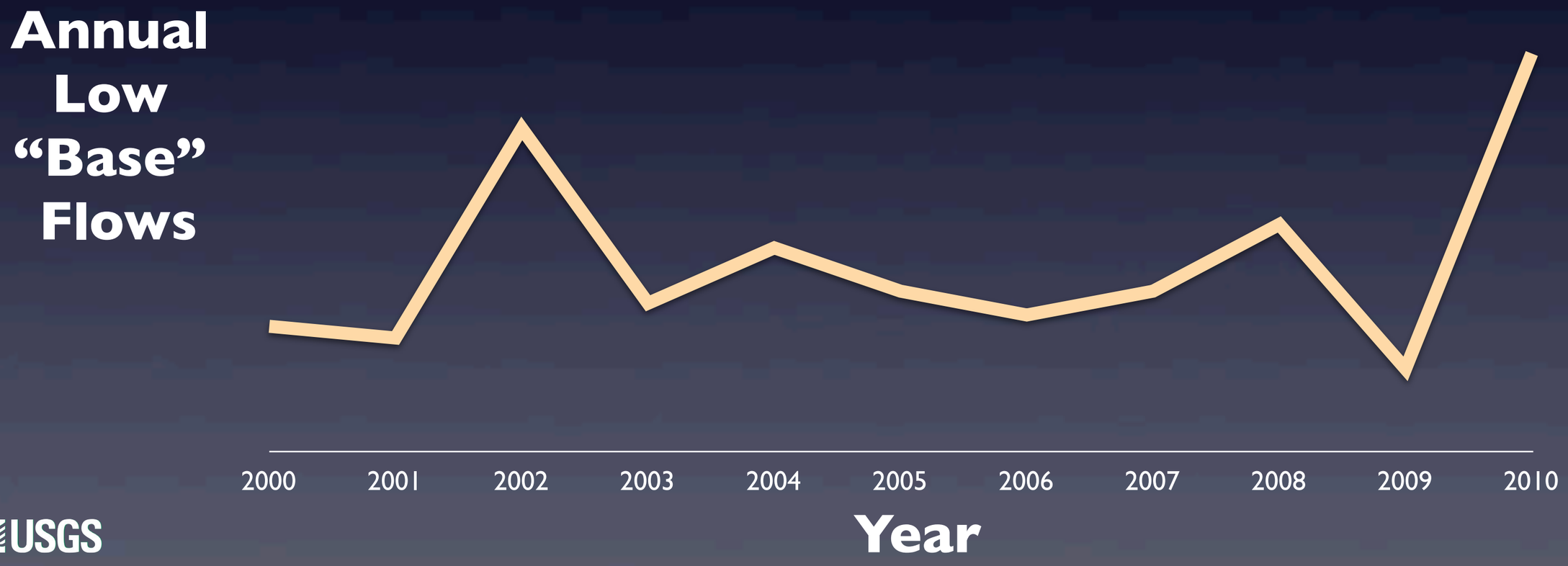


USGS

86 percent of assessed streams had modified flows

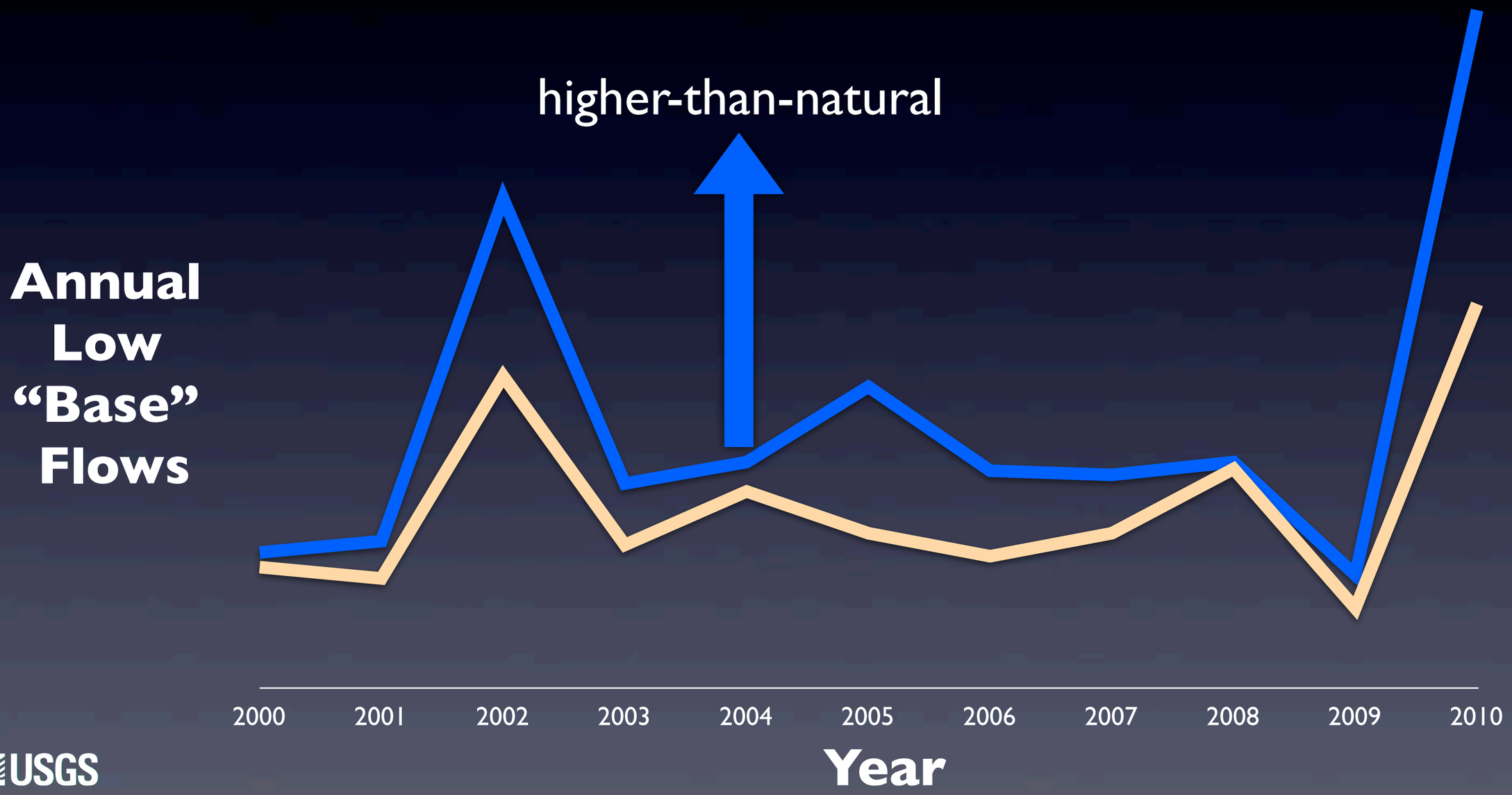
USGS

Streamflow Modification



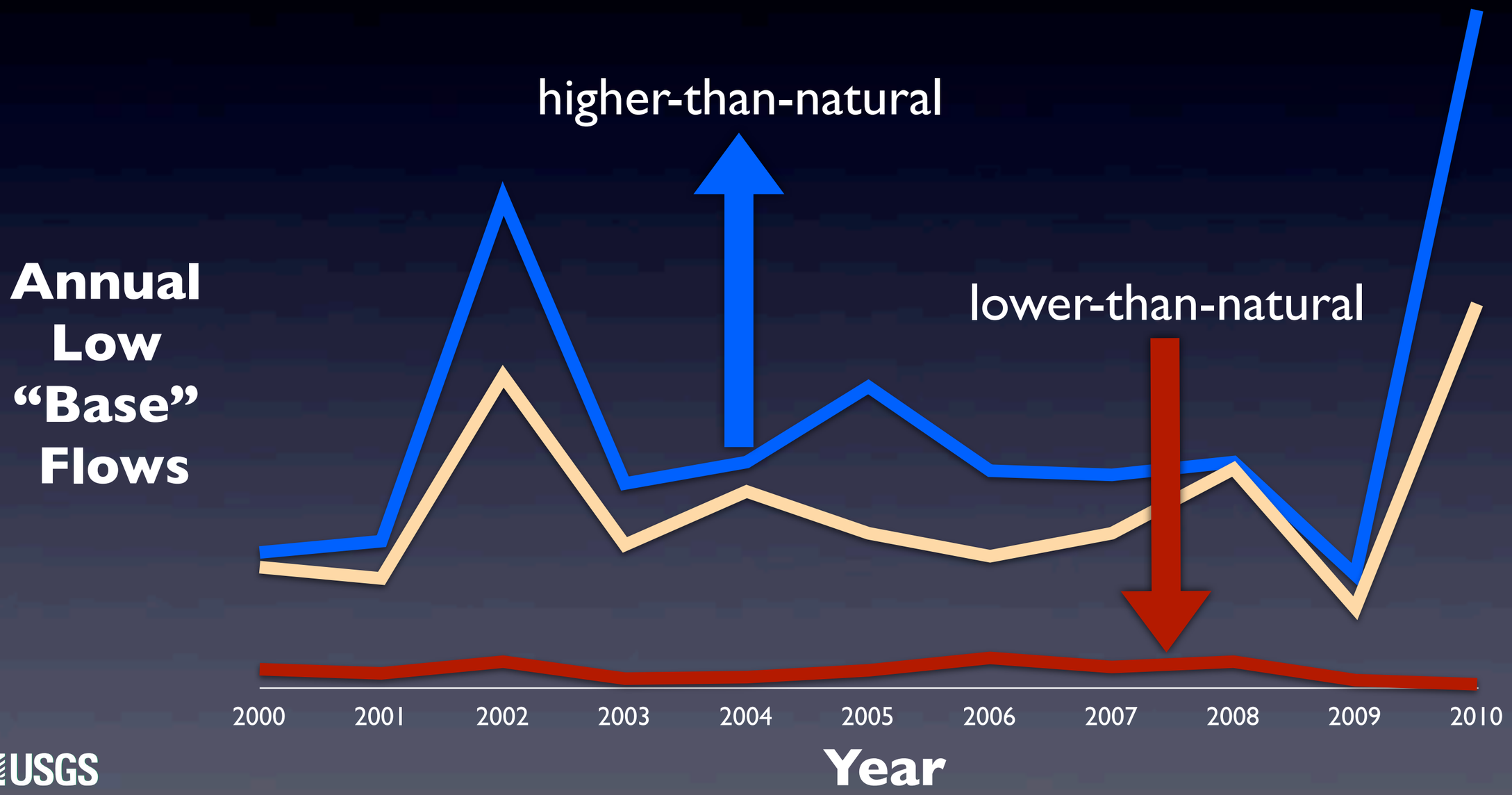
USGS

Streamflow Modification



USGS

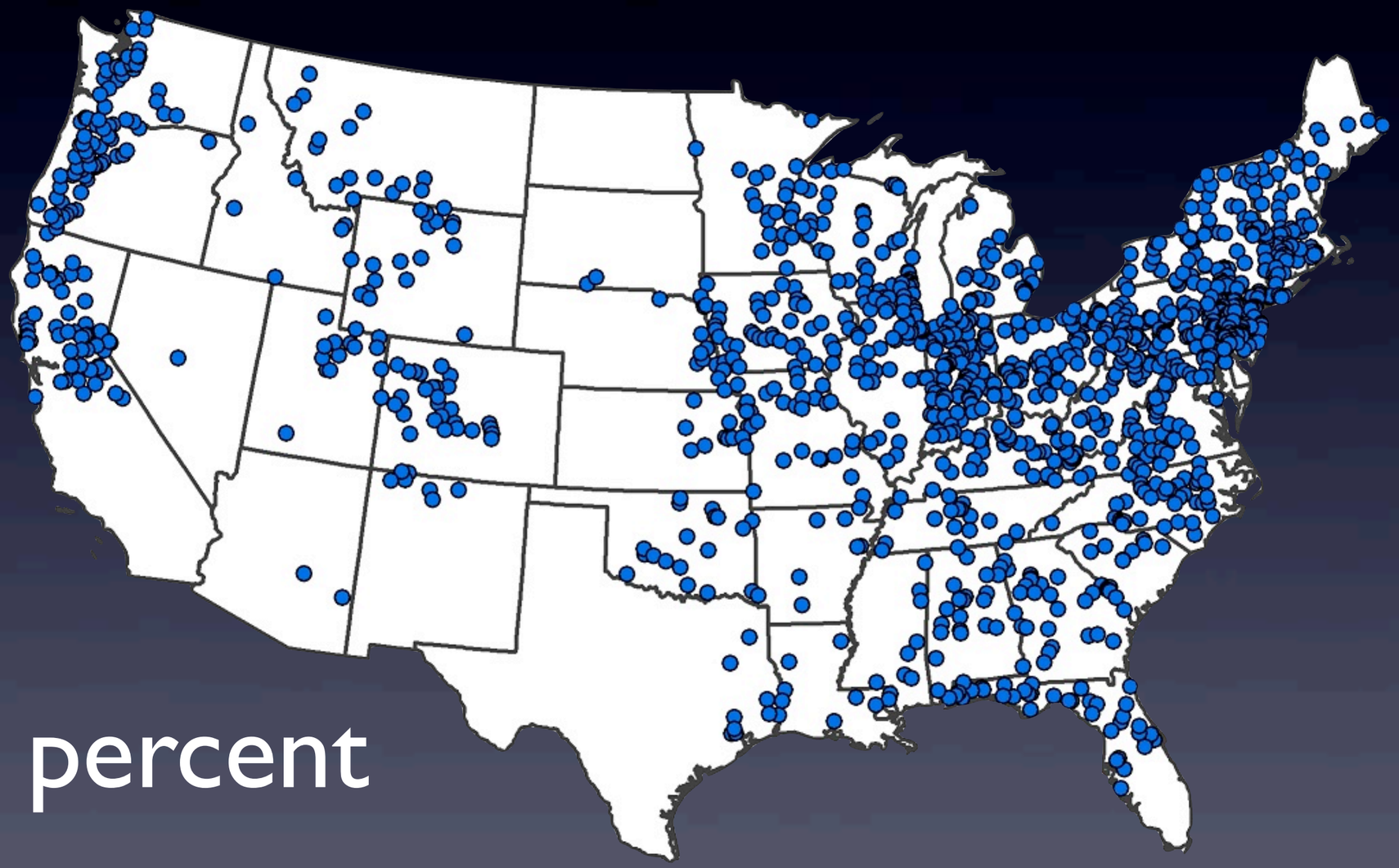
Streamflow Modification



USGS

Base Flow

- Higher

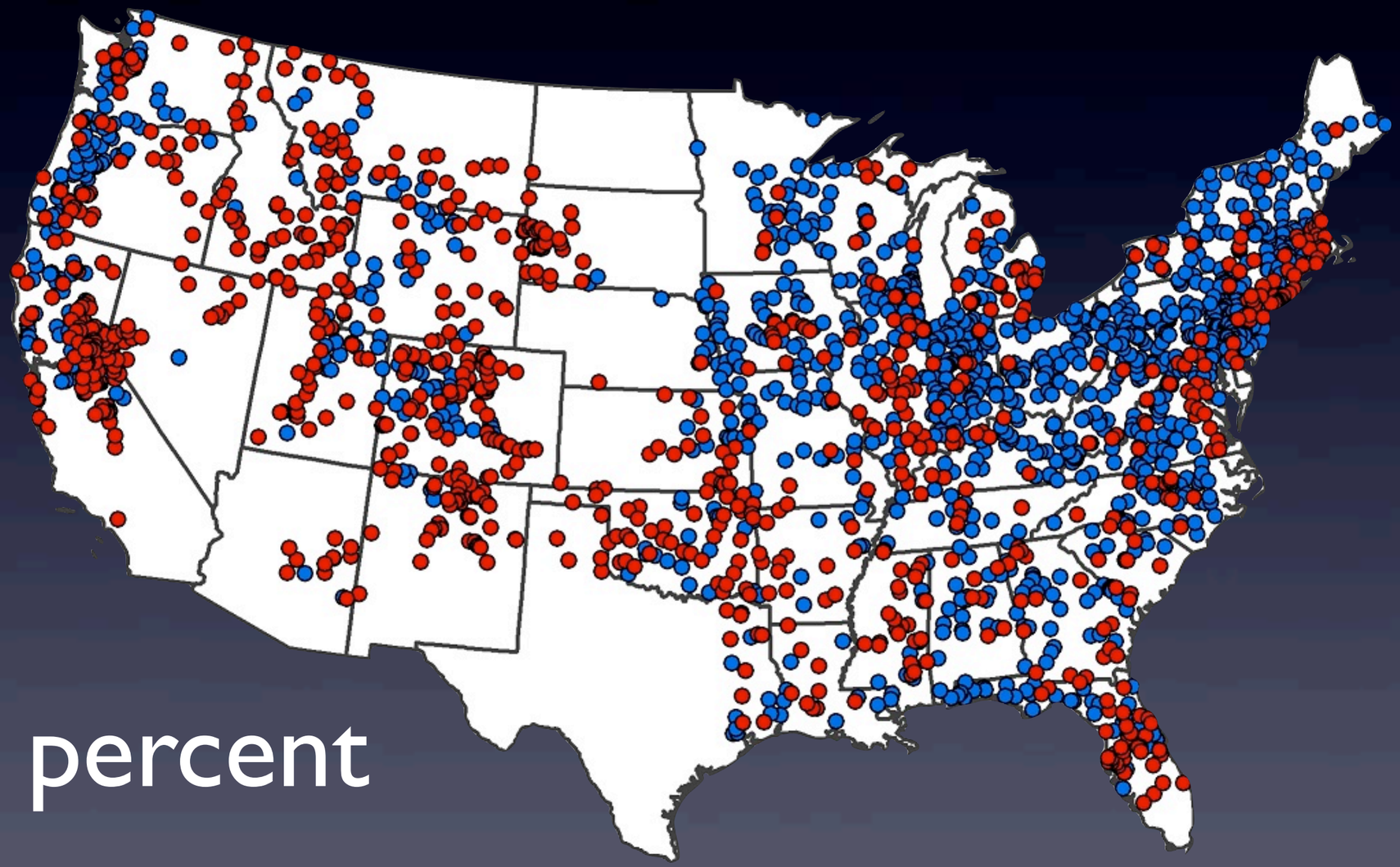


44 percent

USGS

Base Flow

Higher Lower

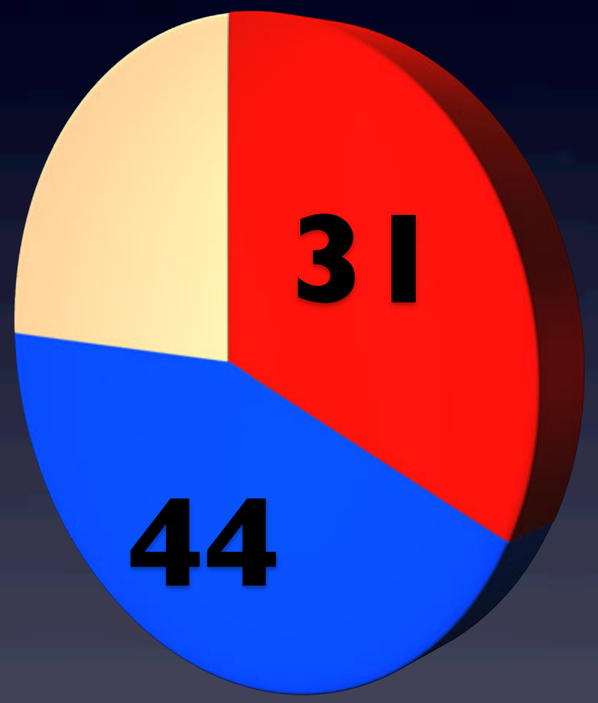


31 percent

USGS

Flow Modification

Higher Lower Not Modified

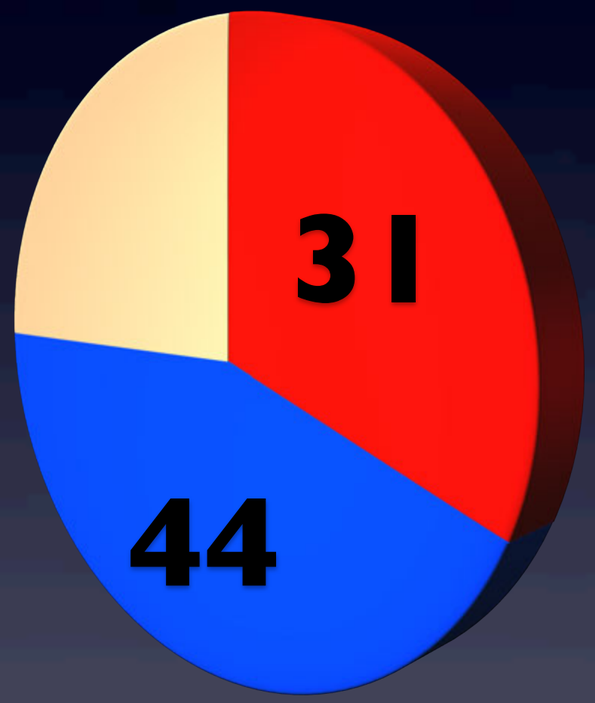


Base Flow

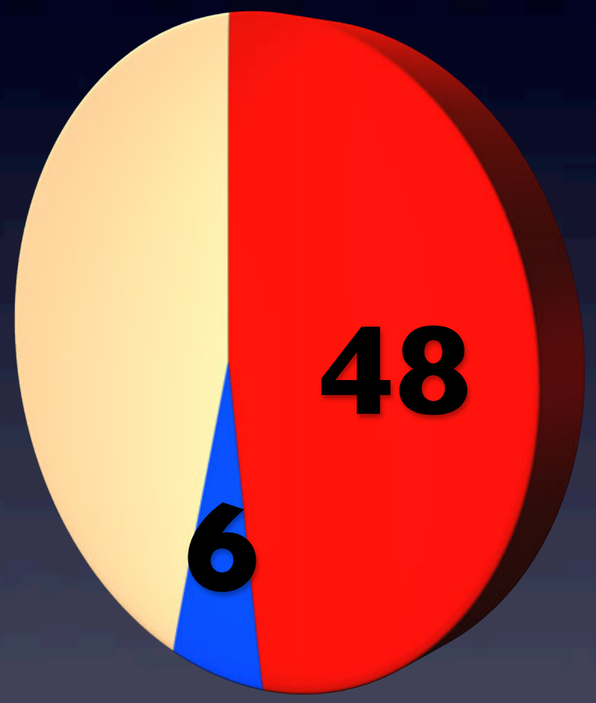
USGS

Flow Modification

Higher Lower Not Modified



Base Flow

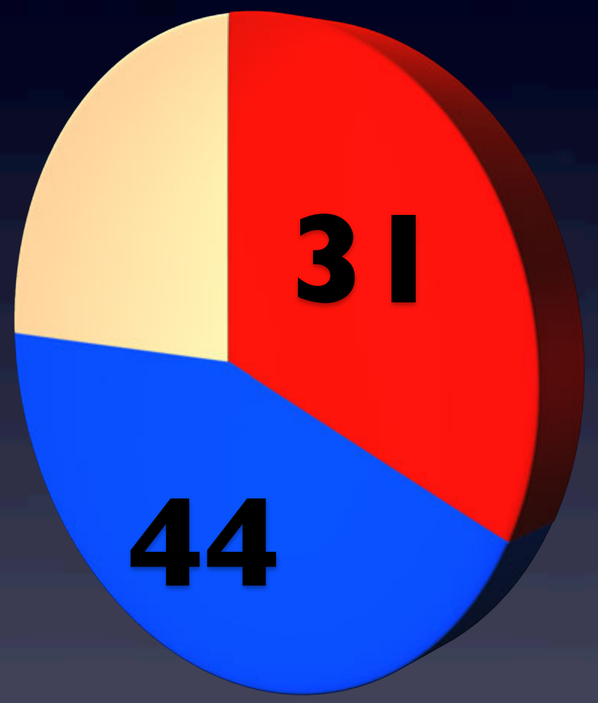


High Flow

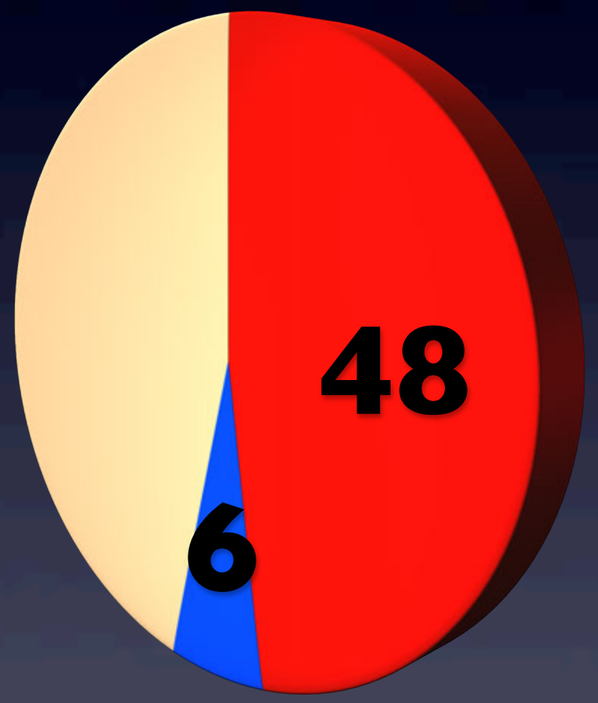
USGS

Flow Modification

Higher Lower Not Modified



Base Flow



High Flow

Flow Variability

USGS

Natural Flows

Depleted Flows

- cool-cold temperature
- build nests in gravel

- warm temperature
- scatters eggs

- many native species
- cool-cold temperature
- high oxygen

- few native species
- warm temperature
- low oxygen

- many native species

- variable outcomes

USGS

Excess Nutrients

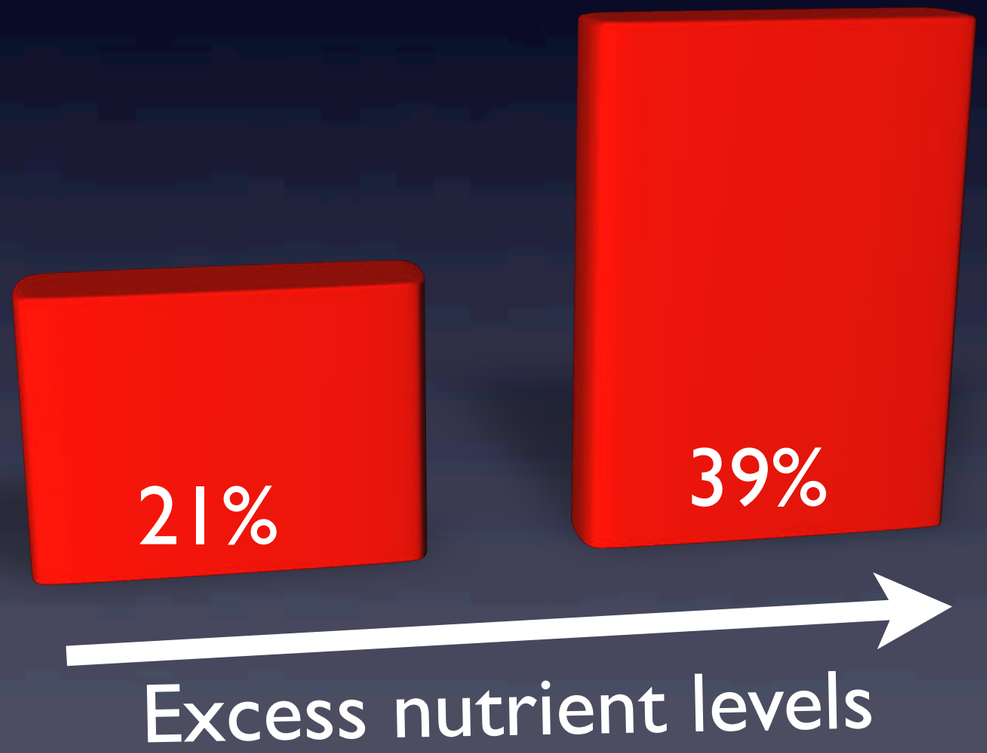
USGS

Excess Nutrients

USGS

Excess Nutrients

Communities in poor condition



USGS

Pesticides

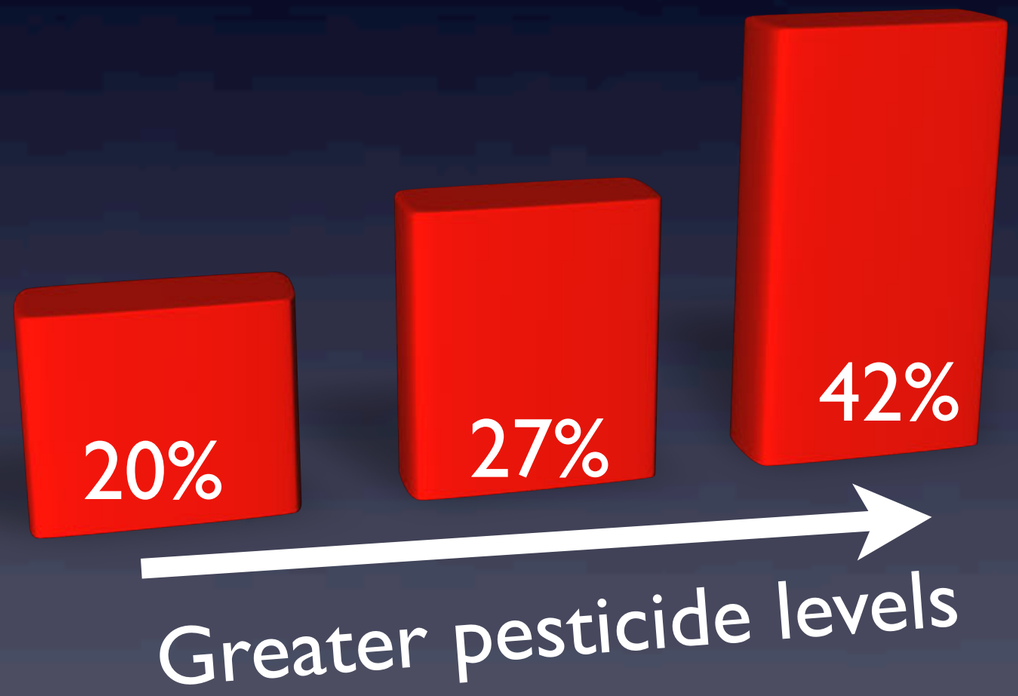
USGS

Pesticides

USGS

Pesticides

Communities in poor condition



USGS

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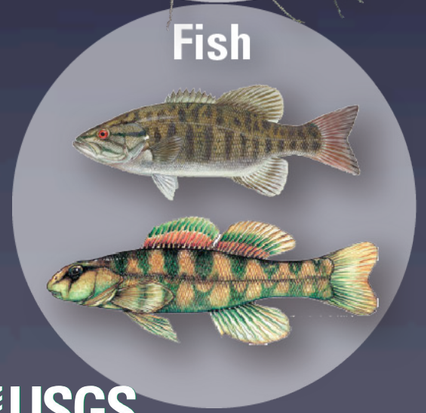

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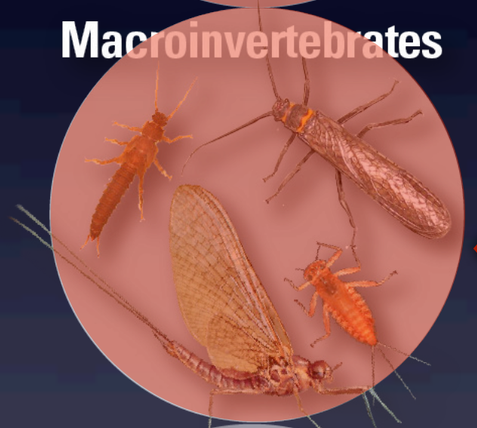
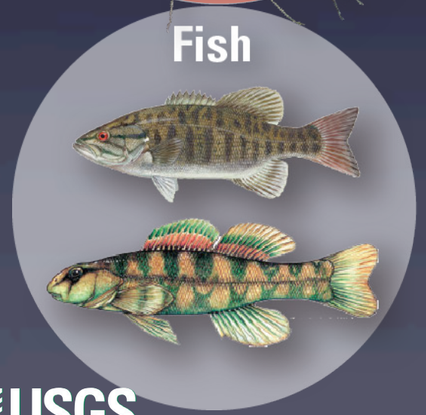
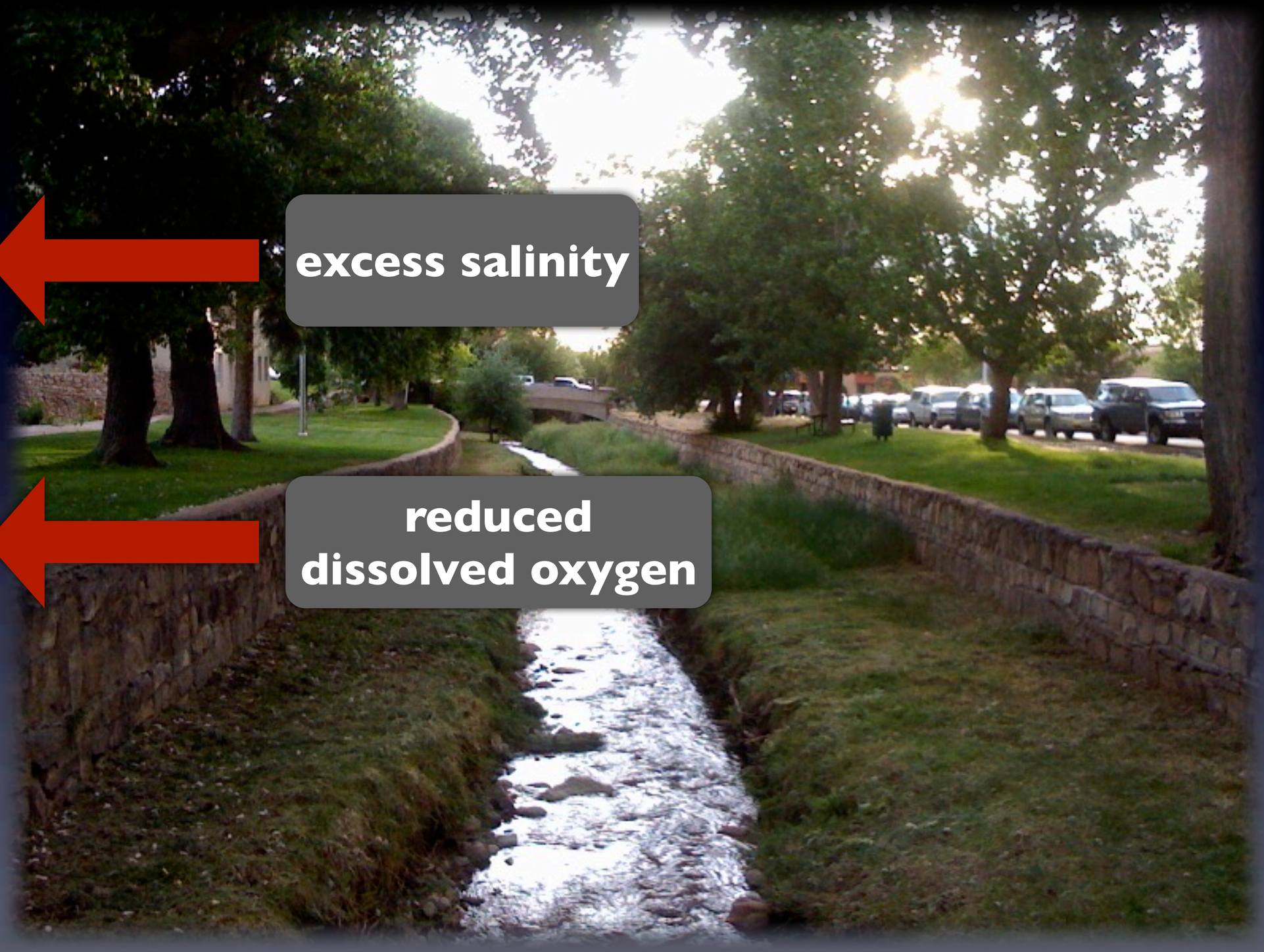
Algae
Macroinvertebrates
Fish
excess salinity
USGS



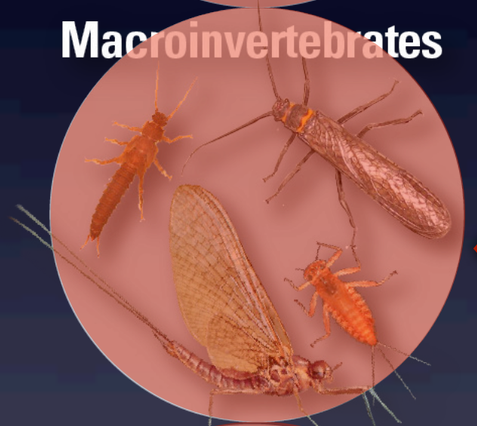


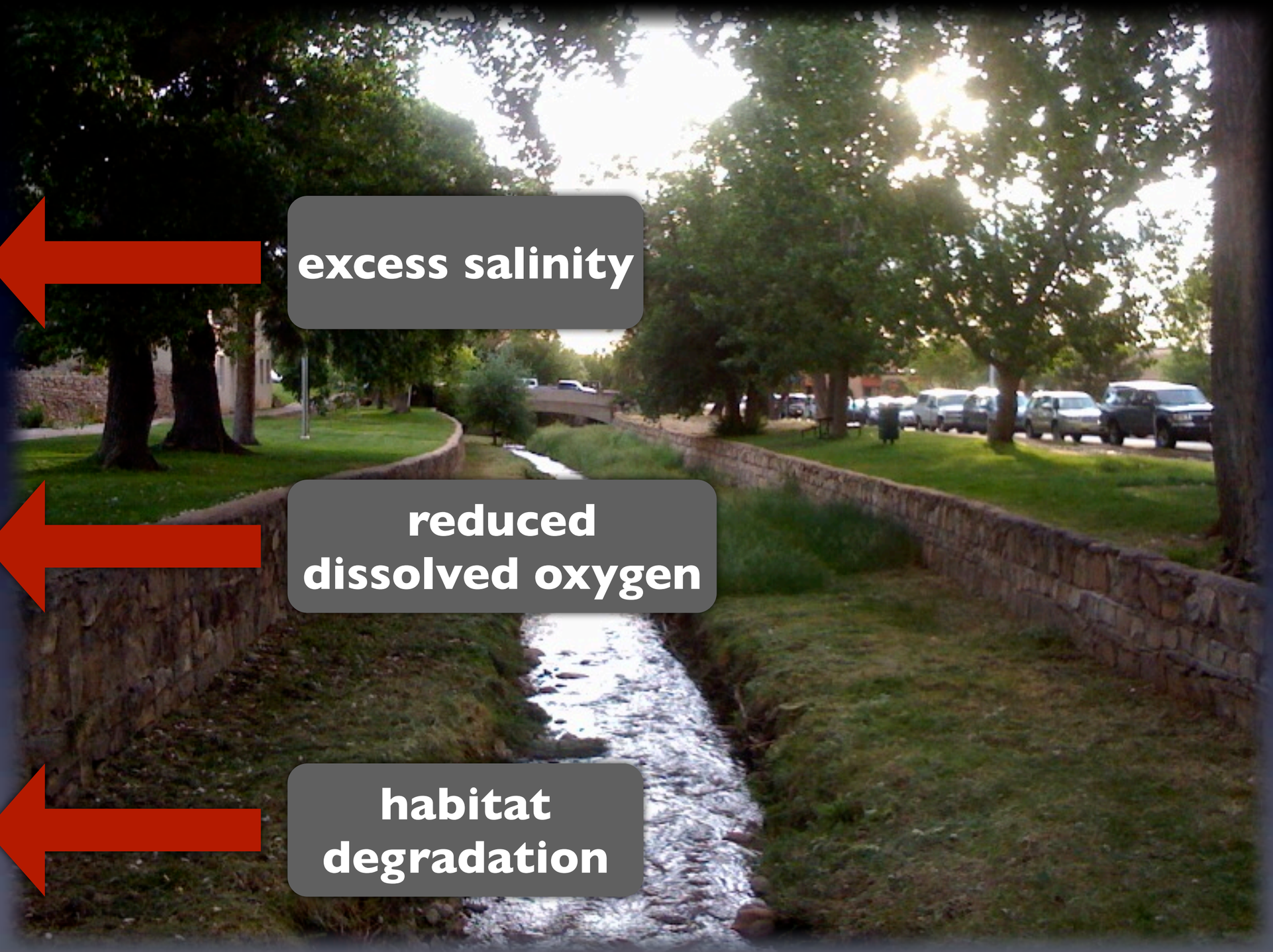


excess salinity

reduced dissolved oxygen

USGS





excess salinity

reduced dissolved oxygen

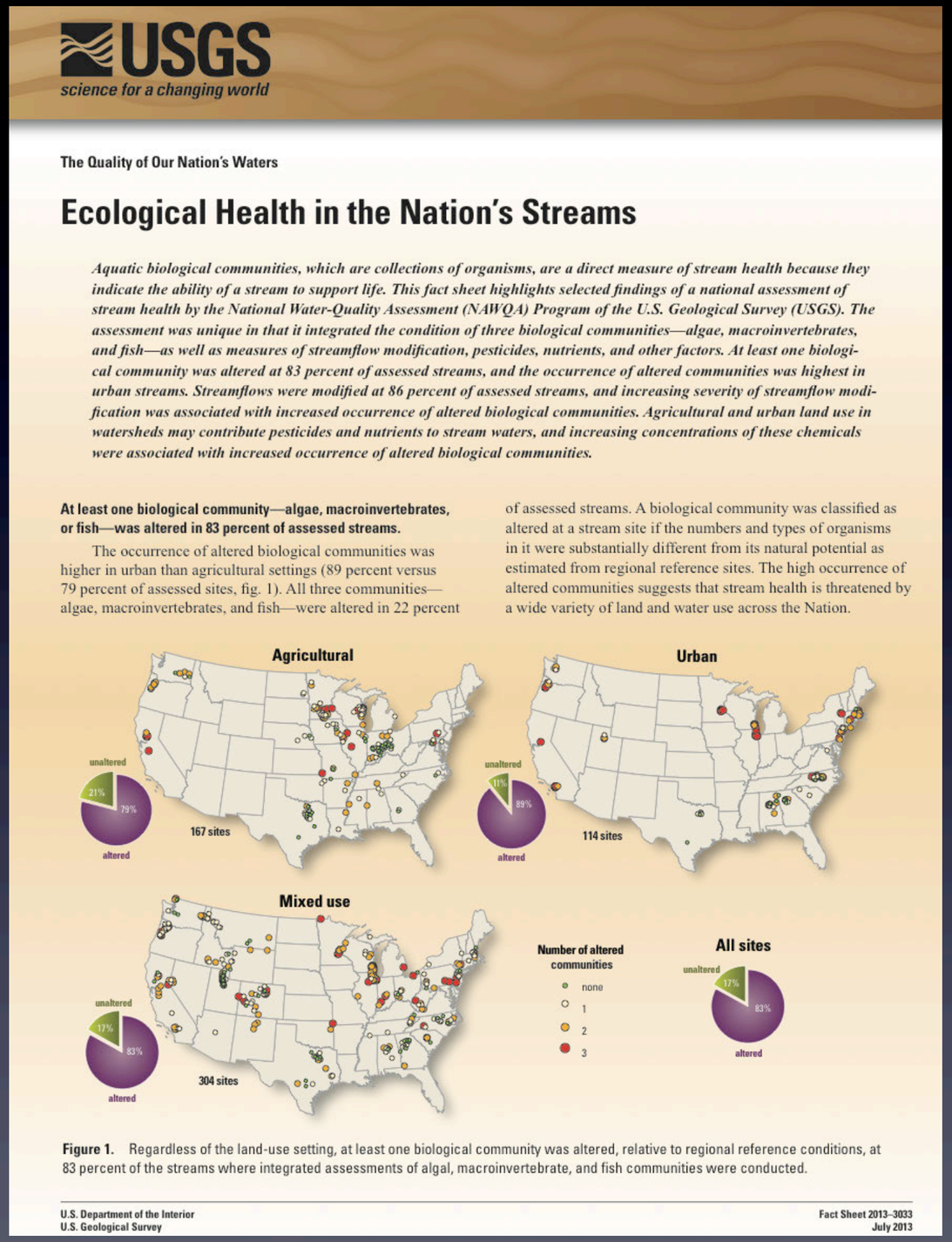
habitat degradation

USGS

Summary

- The value of multi-community assessments
- Streamflow: widely modified and critical to ecological health
- Reduced stream health often caused by several factors

USGS



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The Quality of Our Nation's Waters

Ecological Health in the Nation's Streams

Aquatic biological communities, which are collections of organisms, are a direct measure of stream health because they indicate the ability of a stream to support life. This fact sheet highlights selected findings of a national assessment of stream health by the National Water-Quality Assessment (NAWQA) Program of the U.S. Geological Survey (USGS). The assessment was unique in that it integrated the condition of three biological communities—algae, macroinvertebrates, and fish—as well as measures of streamflow modification, pesticides, nutrients, and other factors. At least one biological community was altered at 83 percent of assessed streams, and the occurrence of altered communities was highest in urban streams. Streamflows were modified at 86 percent of assessed streams, and increasing severity of streamflow modification was associated with increased occurrence of altered biological communities. Agricultural and urban land use in watersheds may contribute pesticides and nutrients to stream waters, and increasing concentrations of these chemicals were associated with increased occurrence of altered biological communities.

At least one biological community—algae, macroinvertebrates, or fish—was altered in 83 percent of assessed streams.

The occurrence of altered biological communities was higher in urban than agricultural settings (89 percent versus 79 percent of assessed sites, fig. 1). All three communities—algae, macroinvertebrates, and fish—were altered in 22 percent of assessed streams. A biological community was classified as altered at a stream site if the numbers and types of organisms in it were substantially different from its natural potential as estimated from regional reference sites. The high occurrence of altered communities suggests that stream health is threatened by a wide variety of land and water use across the Nation.

Figure 1. Regardless of the land-use setting, at least one biological community was altered, relative to regional reference conditions, at 83 percent of the streams where integrated assessments of algal, macroinvertebrate, and fish communities were conducted.

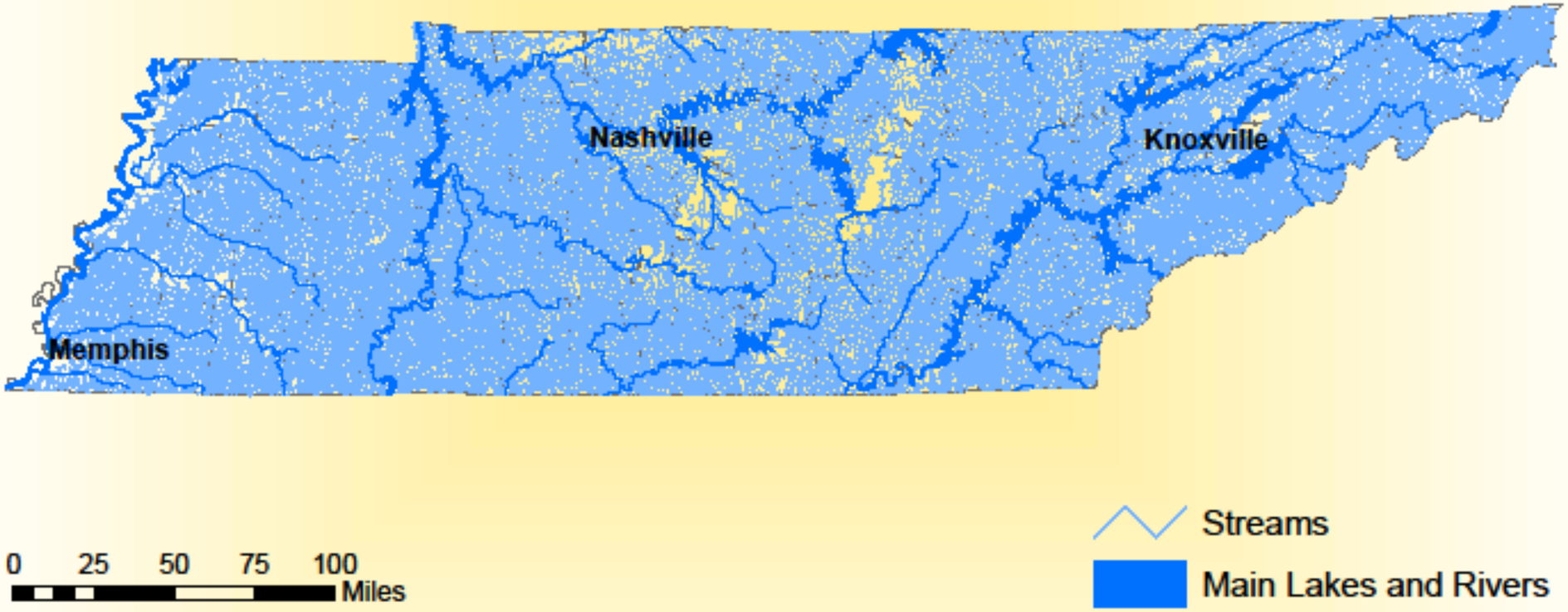
U.S. Department of the Interior
U.S. Geological Survey

Fact Sheet 2013–3033
July 2013

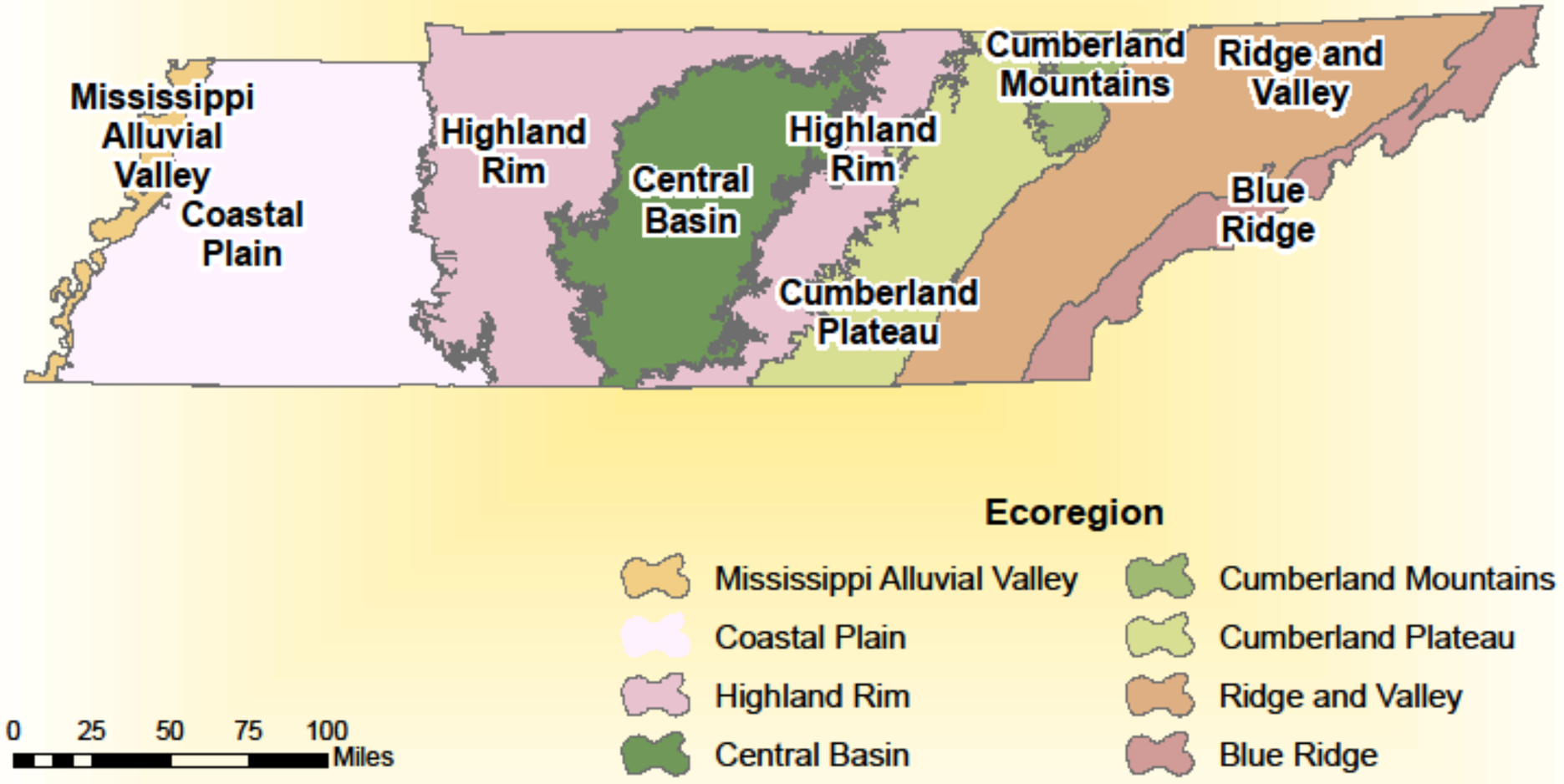
water.usgs.gov/nawqa

David McKinney,
Tennessee Wildlife Resources

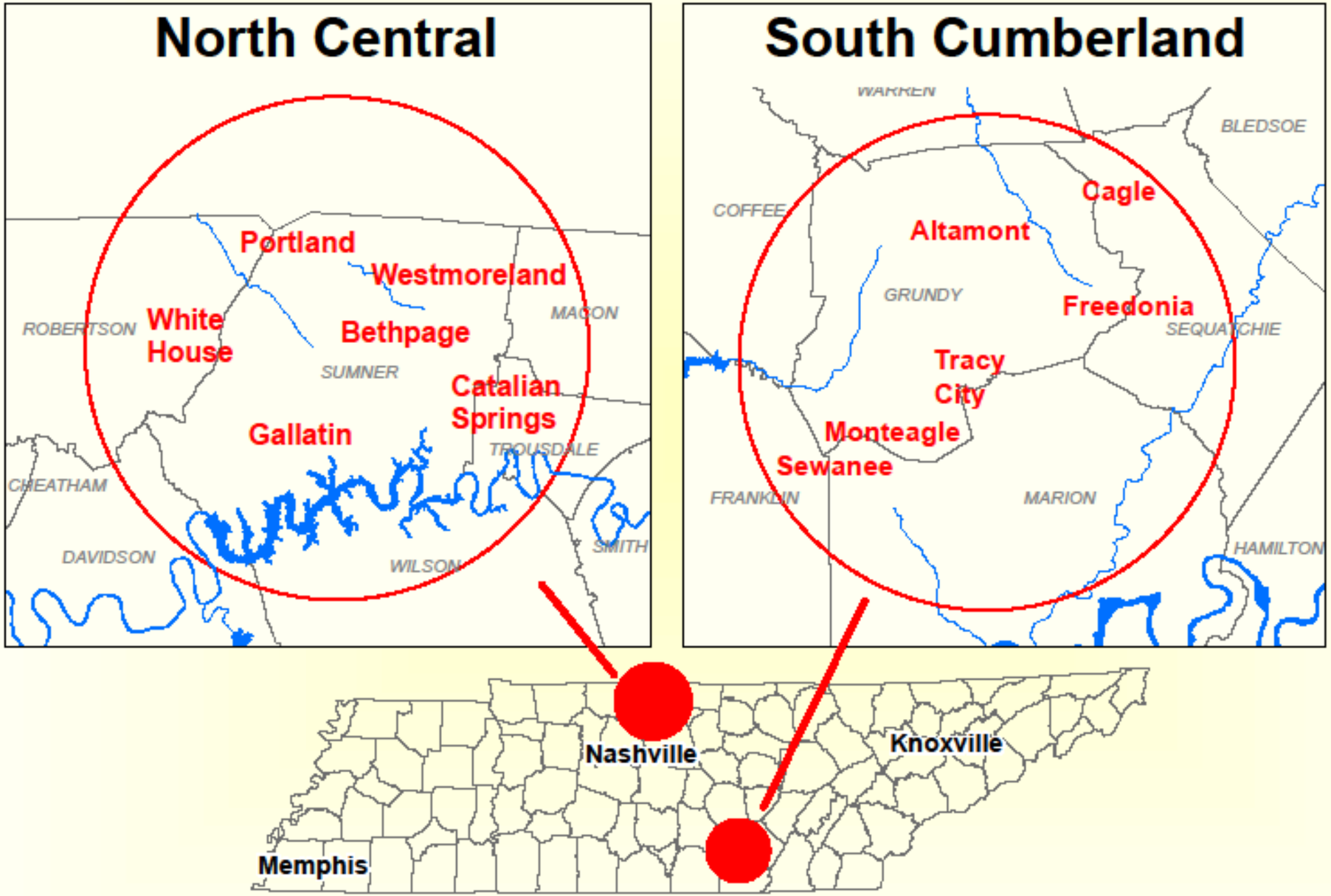
Waters of Tennessee
60,000 miles of Rivers and Streams



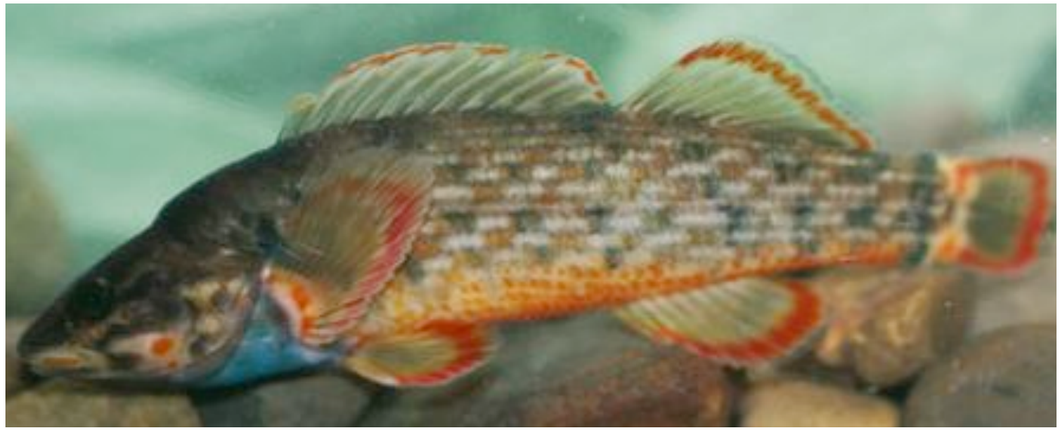
Tennessee Ecoregions



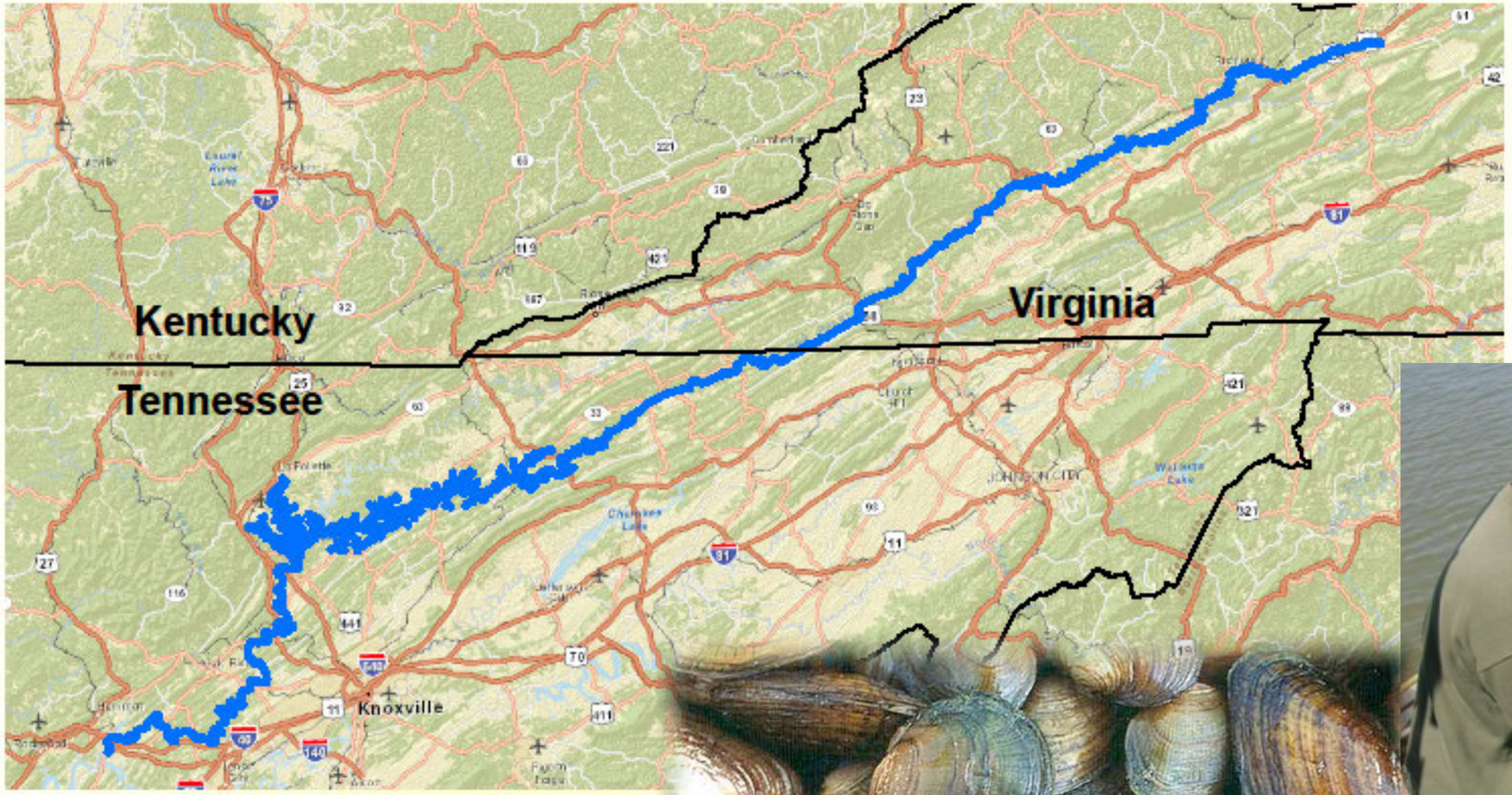
Tennessee Water Resources Regional Planning

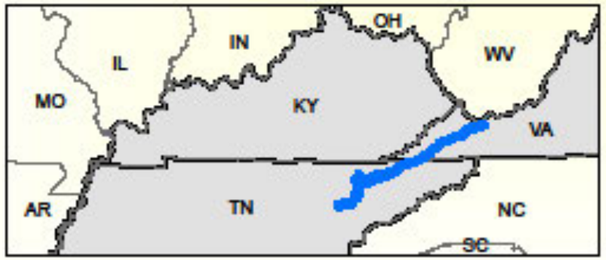


Aquatic Biological Diversity



Clinch River





CALIFORNIA DEPARTMENT OF
FISH and WILDLIFE

Peter Ode

USGS Programs Strengthen California's Aquatic Resource Management

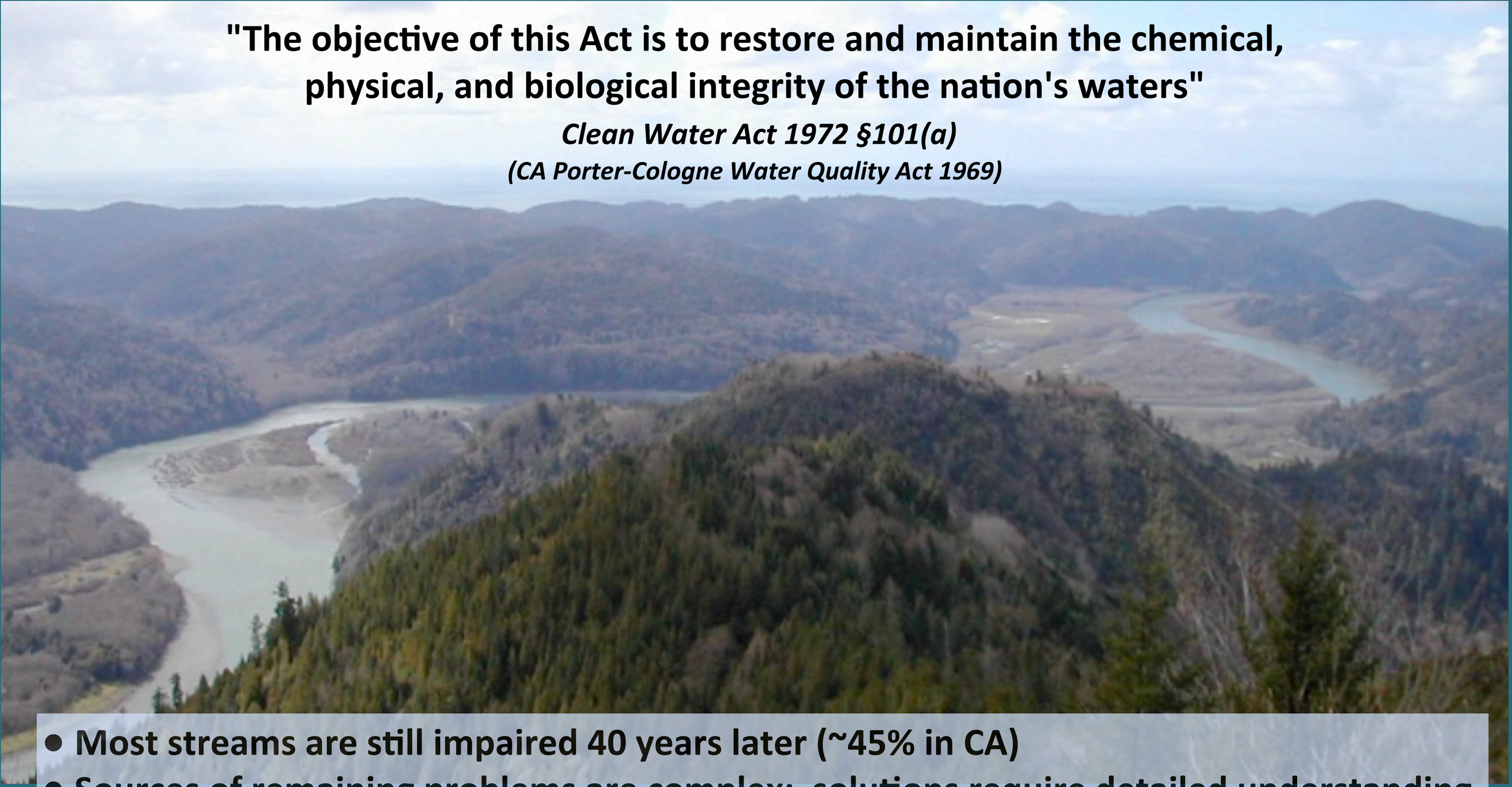
Peter Ode, Director
Water Pollution Control Laboratory/
Aquatic Bioassessment Laboratory
Office of Spill Prevention and Response
California Department of Fish and Wildlife

CALIFORNIA
Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

SWAMP
Surface Water Ambient Monitoring Program

Aquatic Bioassessment Laboratory

CALIFORNIA DEPARTMENT OF FISH & WILDLIFE



"The objective of this Act is to restore and maintain the chemical, physical, and biological integrity of the nation's waters"

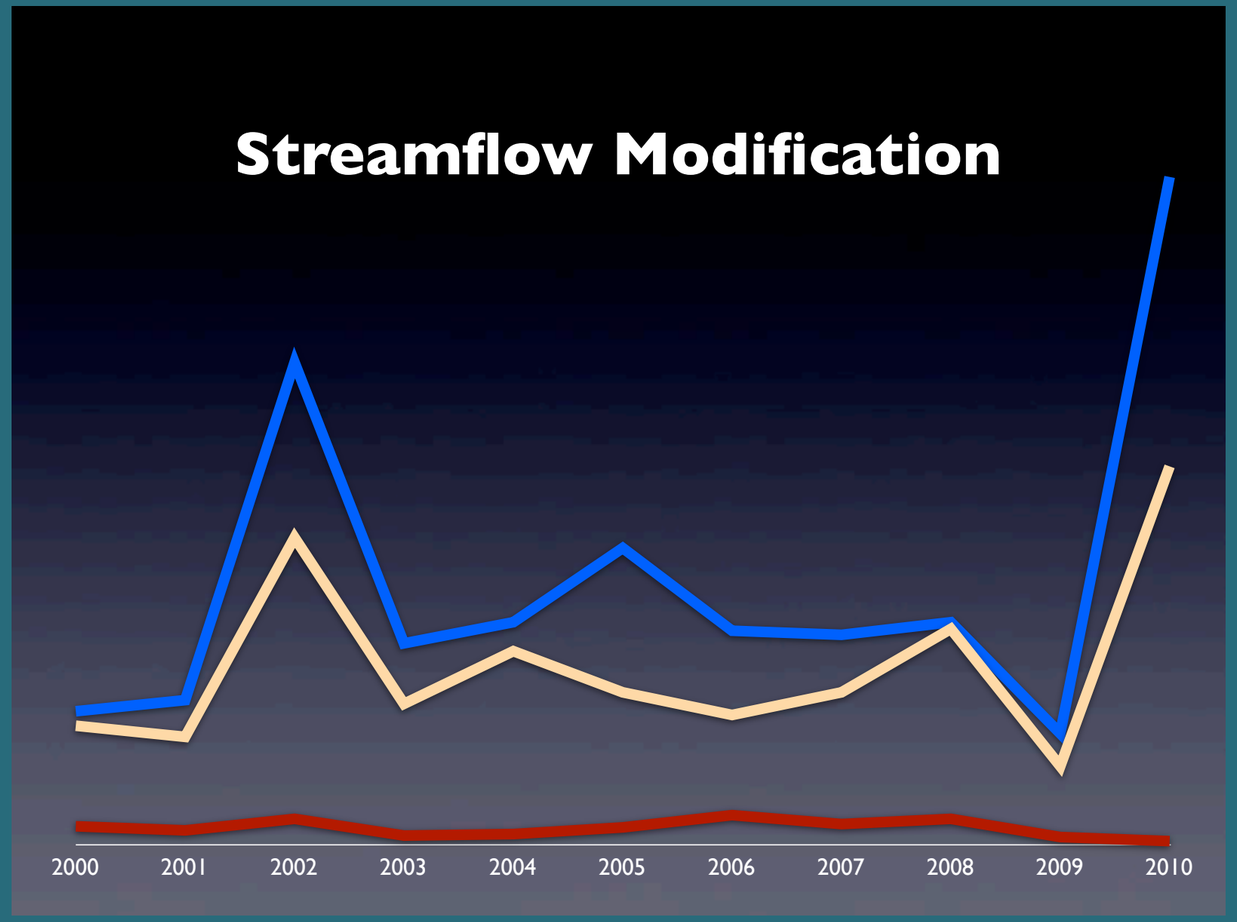
Clean Water Act 1972 §101(a)

(CA Porter-Cologne Water Quality Act 1969)

- **Most streams are still impaired 40 years later (~45% in CA)**
- **Sources of remaining problems are complex; solutions require detailed understanding**

Federal programs help states in two key ways:

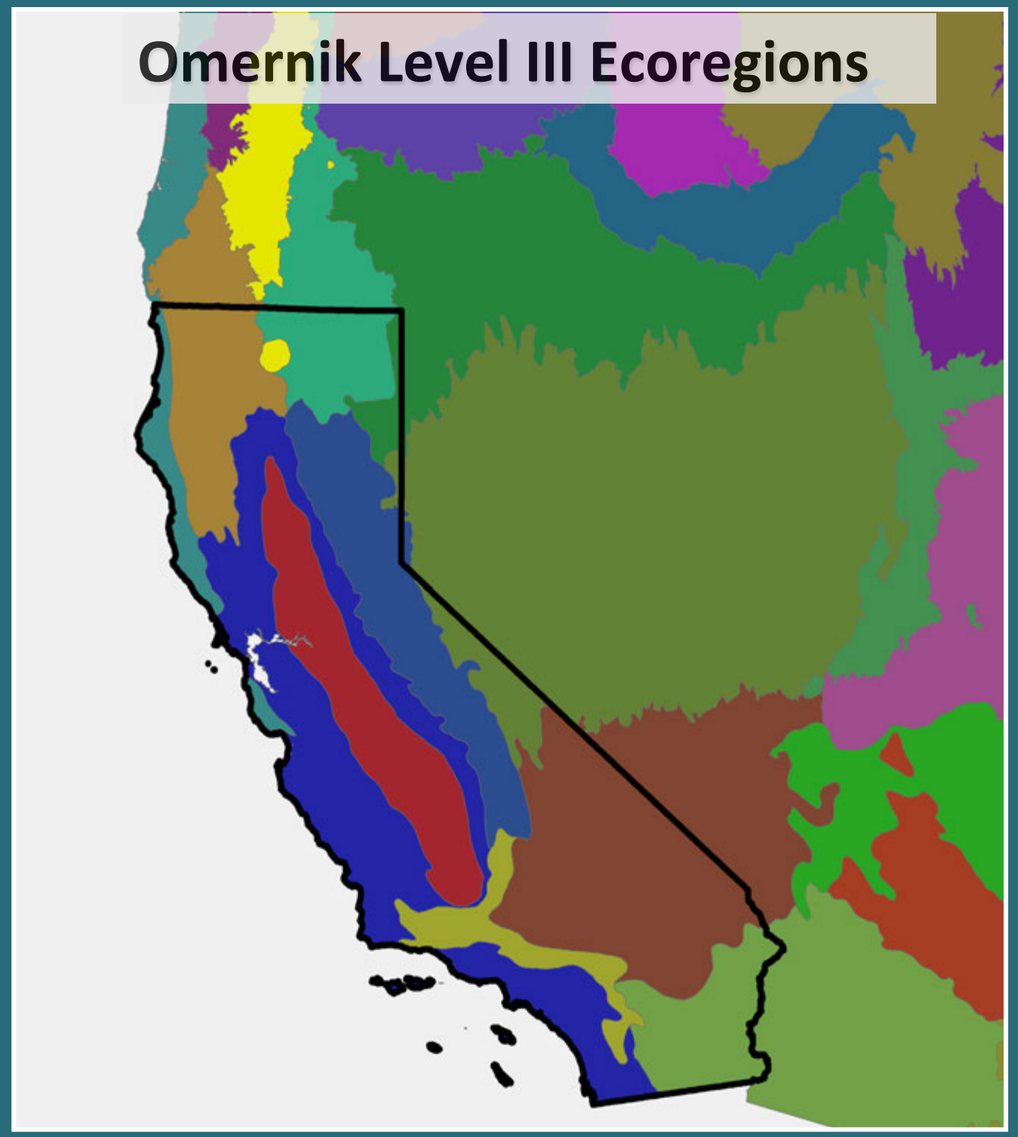
1) States can rarely afford to fund complex environmental investigations on their own



Federal programs help states in two key ways:

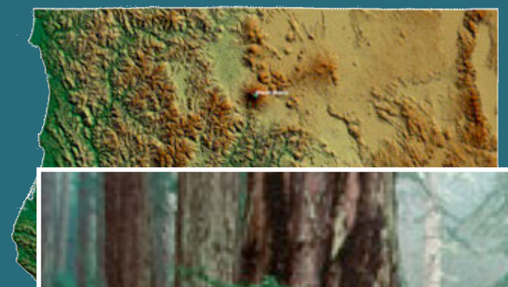
1) States can rarely afford to fund complex environmental investigations on their own

2) Investigating problems at larger scales gives states perspective they can't get with state data alone

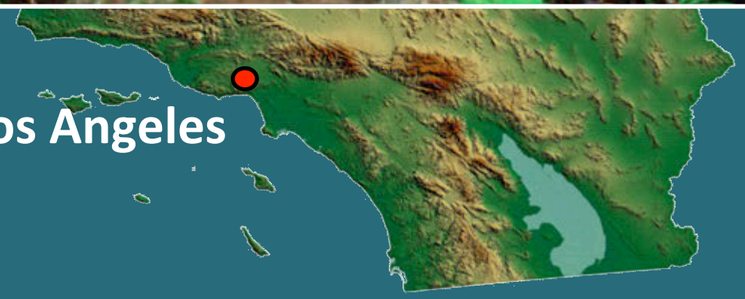


California has complex natural diversity

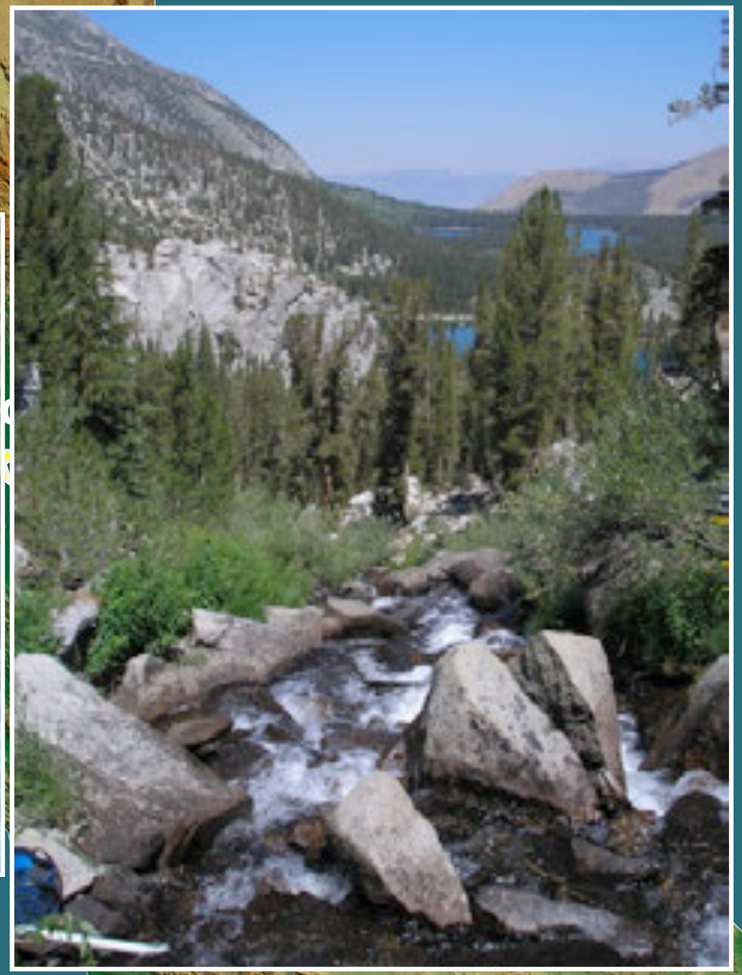
California has complex natural diversity



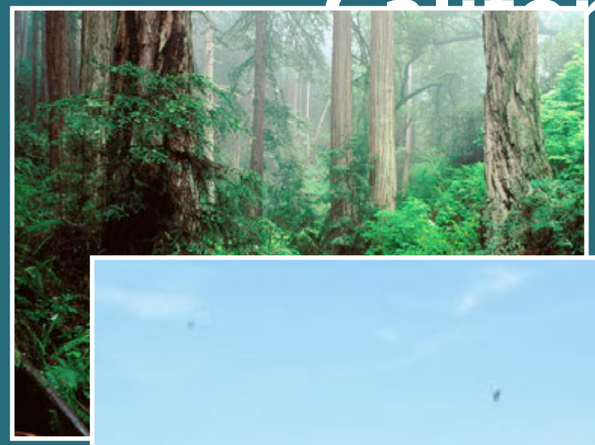
San Fra

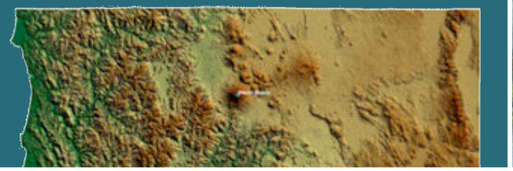


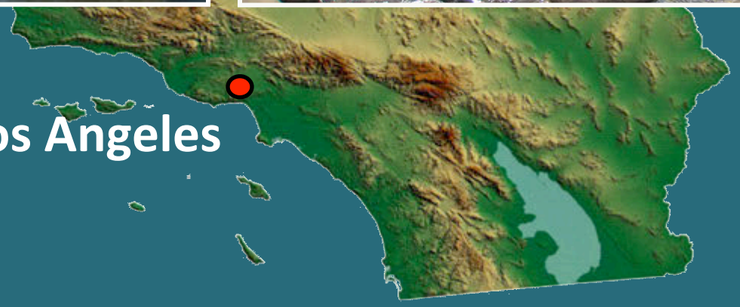
California has complex natural diversity



California has complex natural diversity







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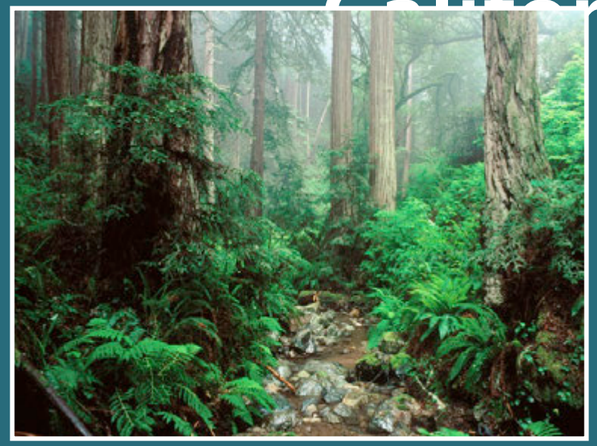
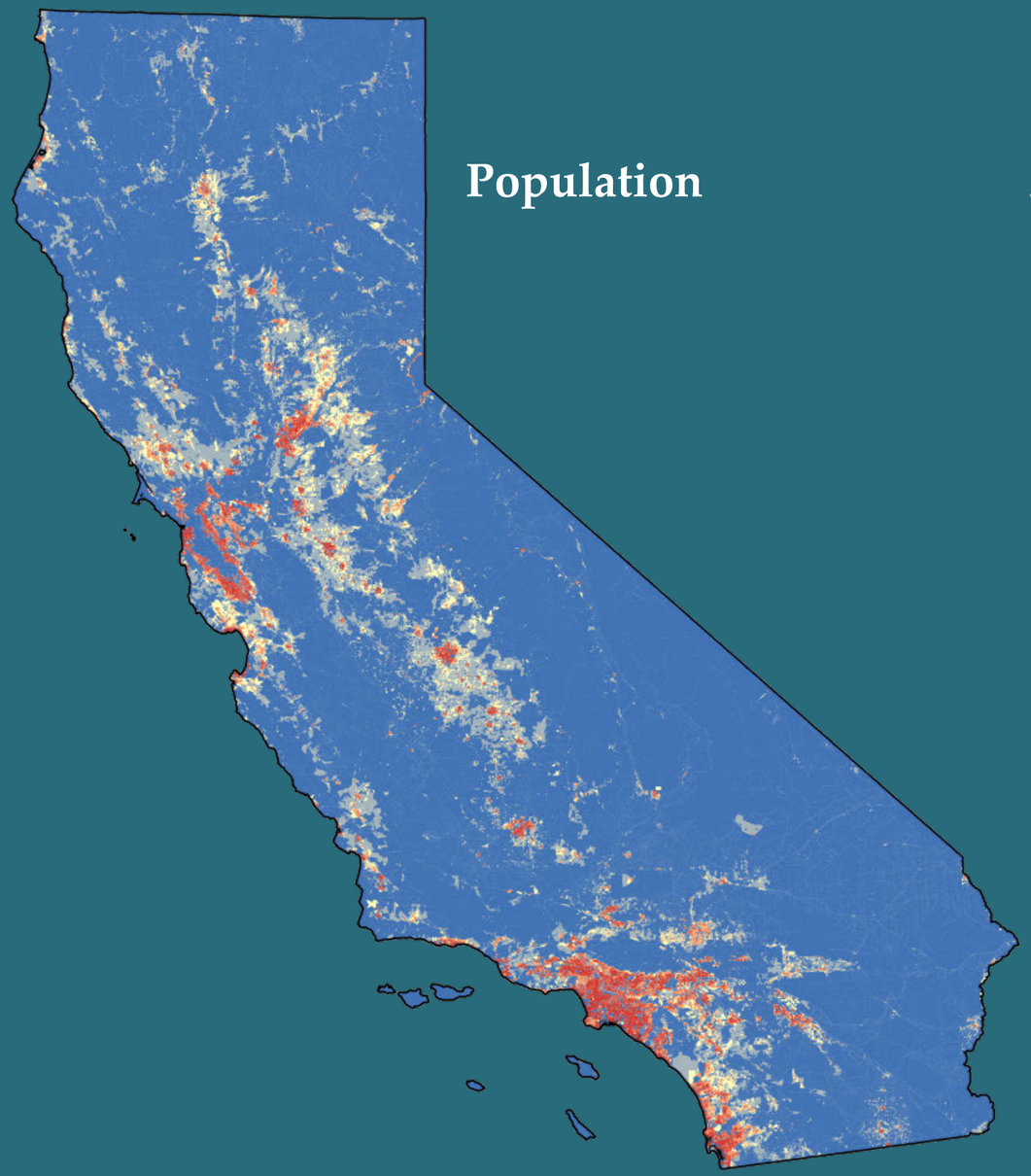


California has complex patterns of land use



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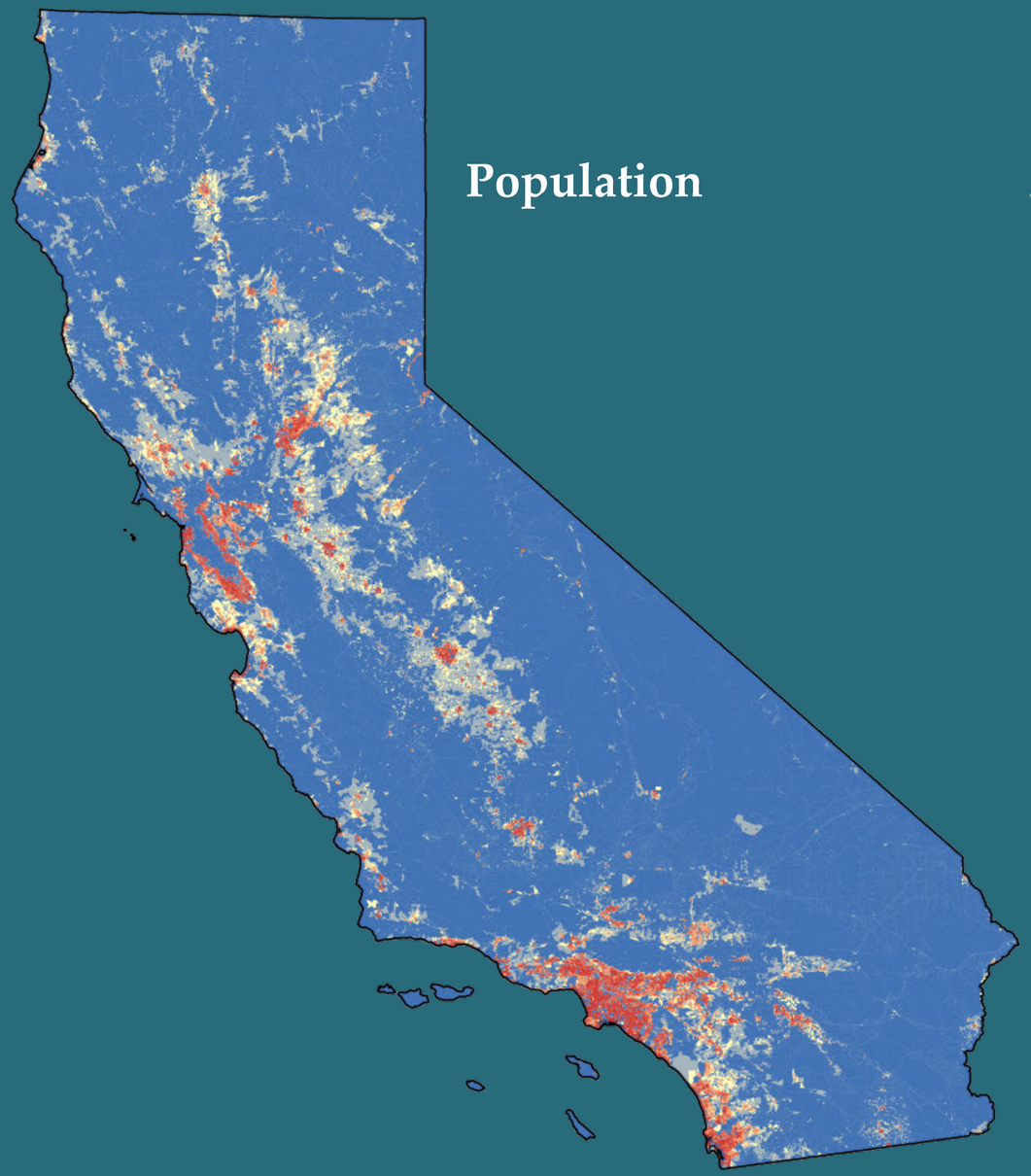

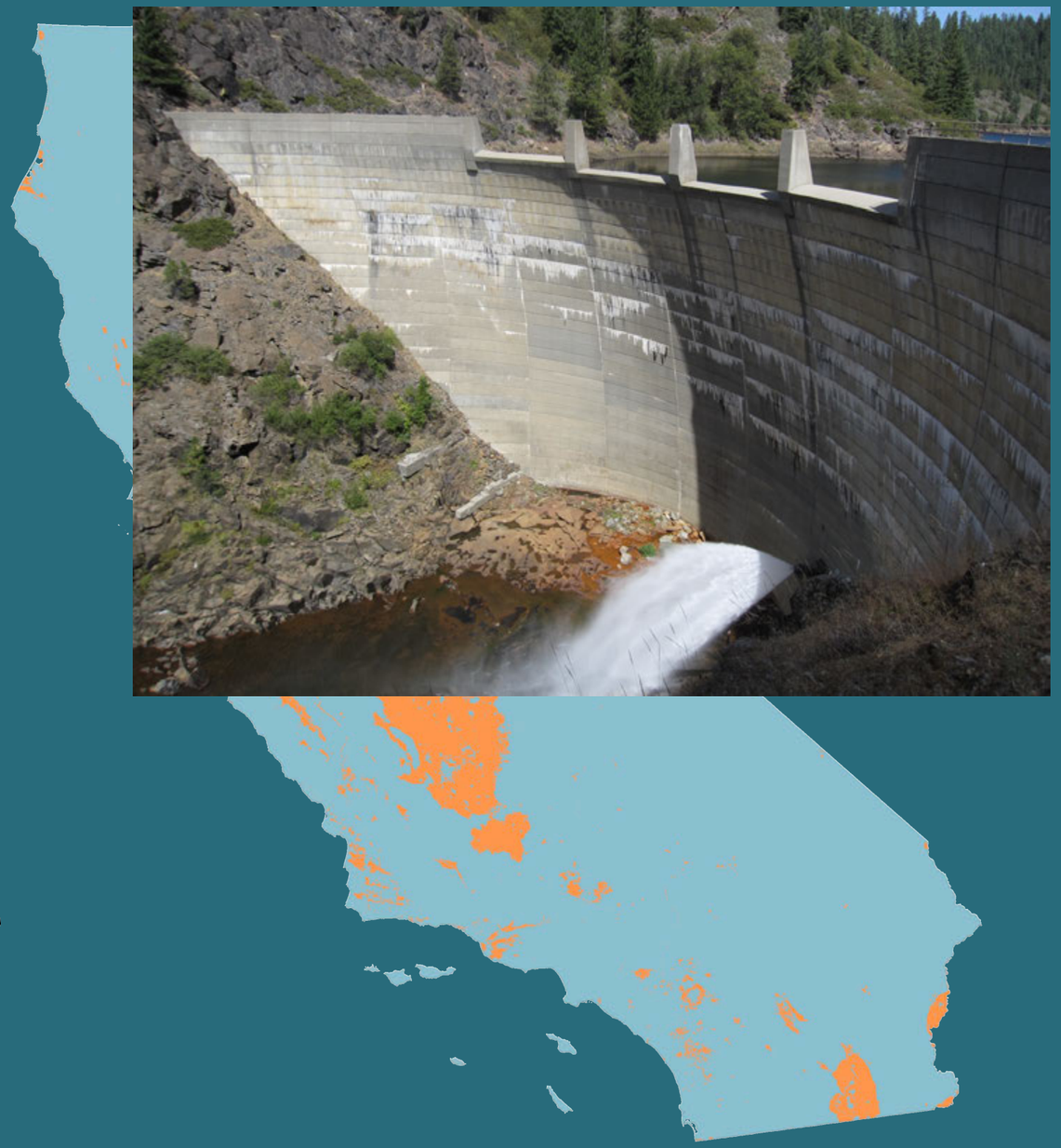

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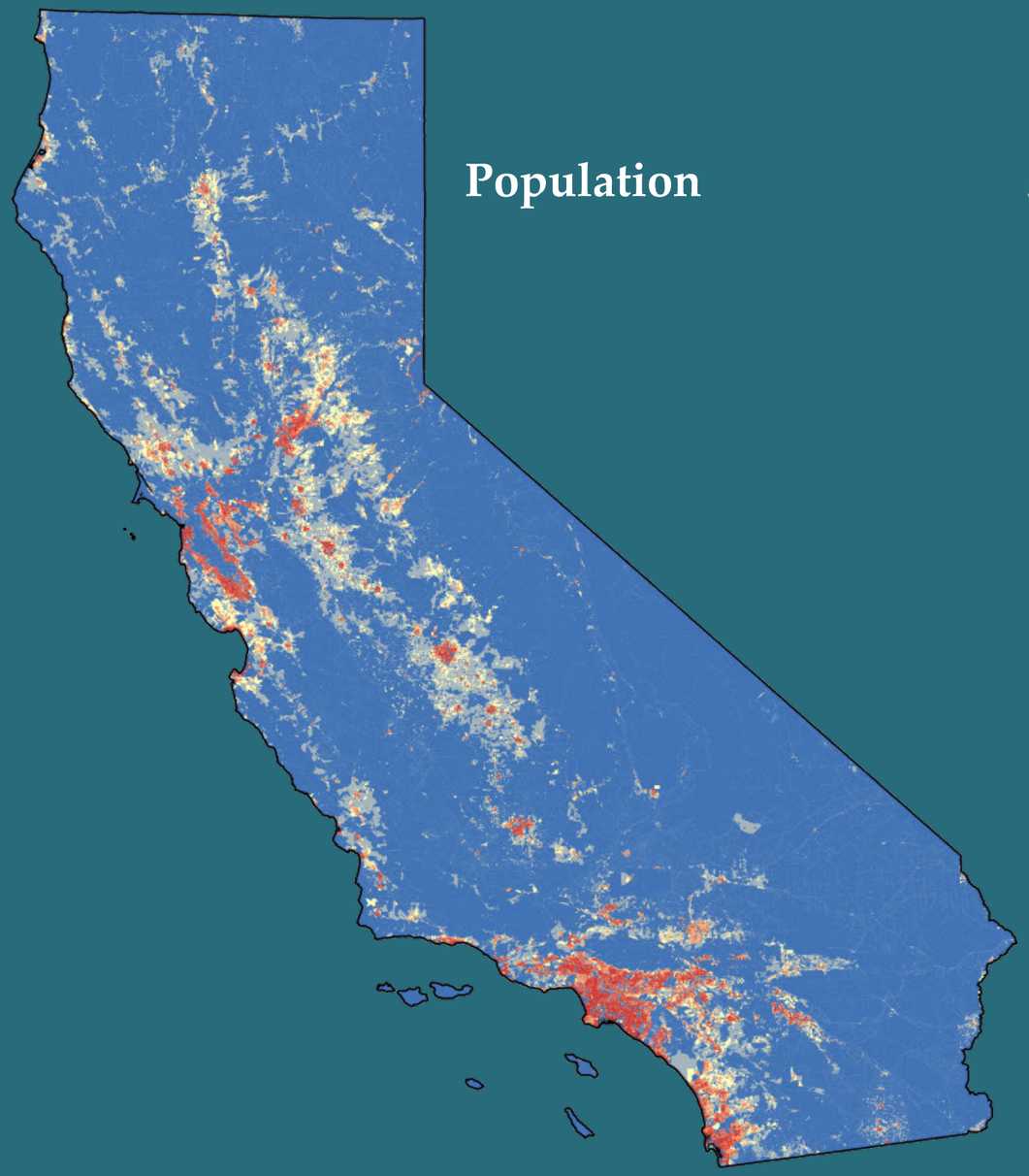

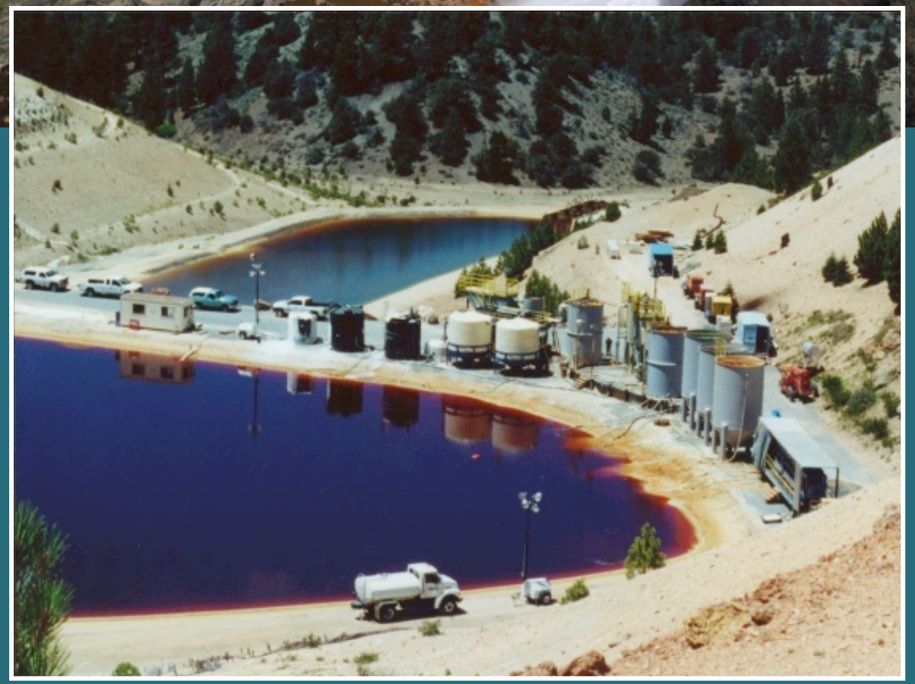

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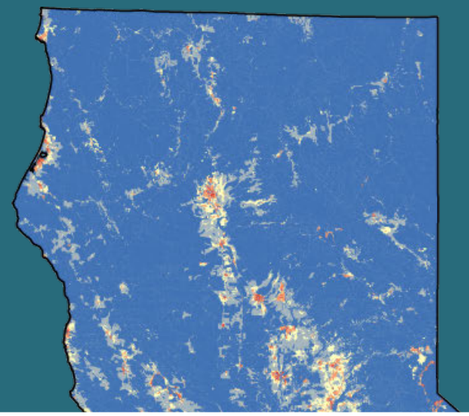
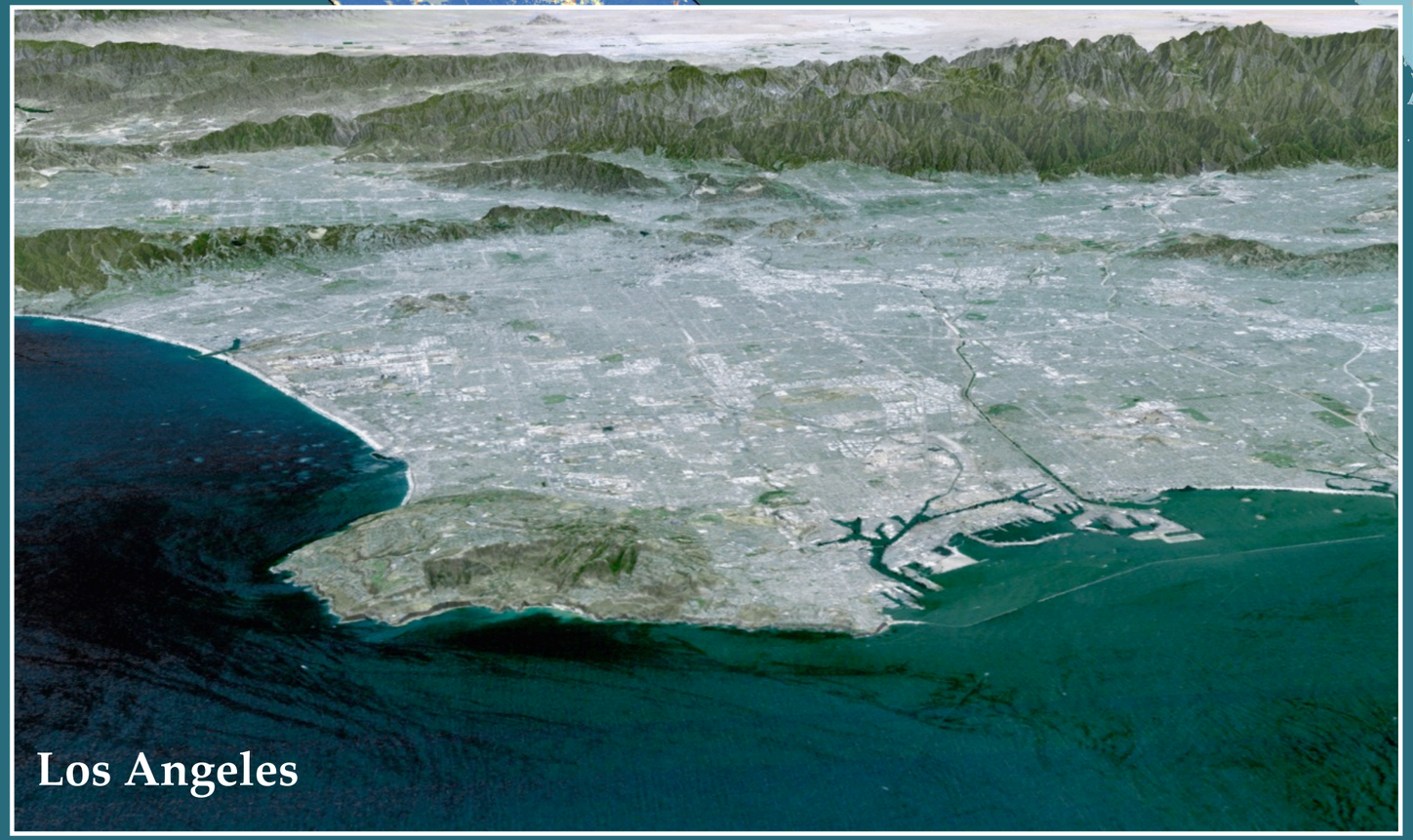
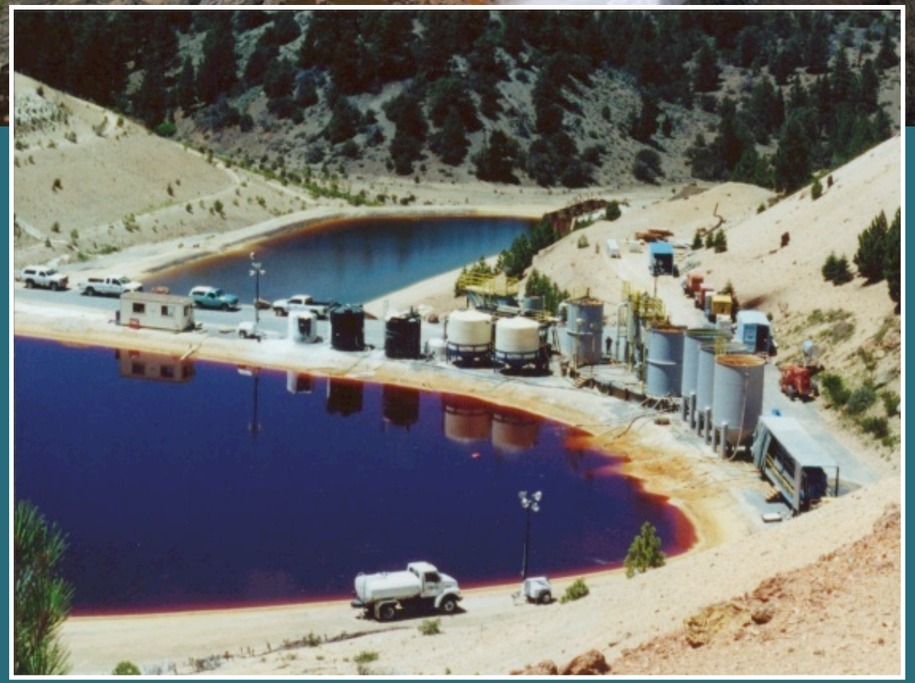


Population



Los Angeles



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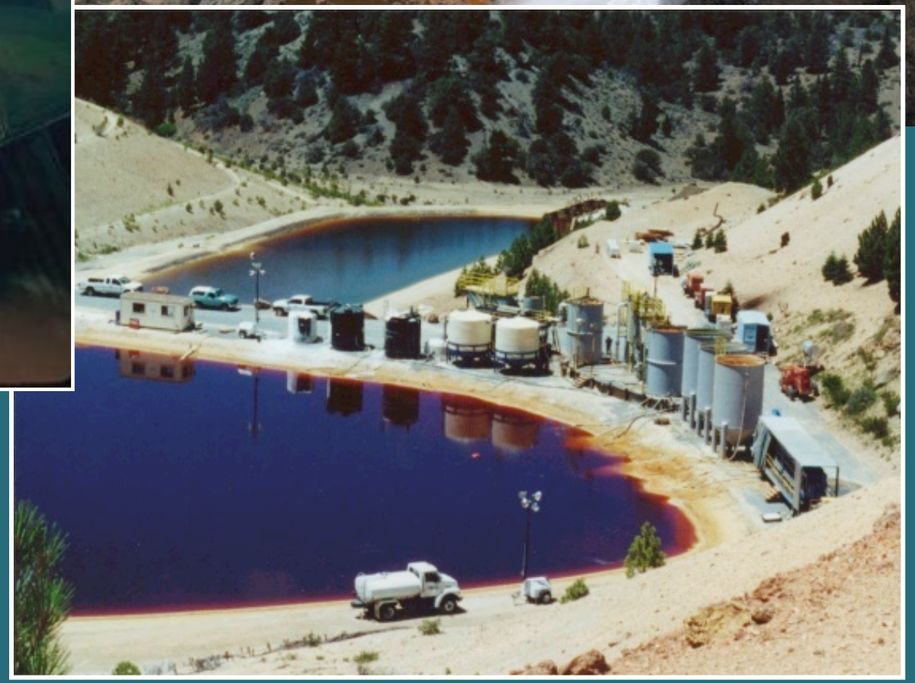


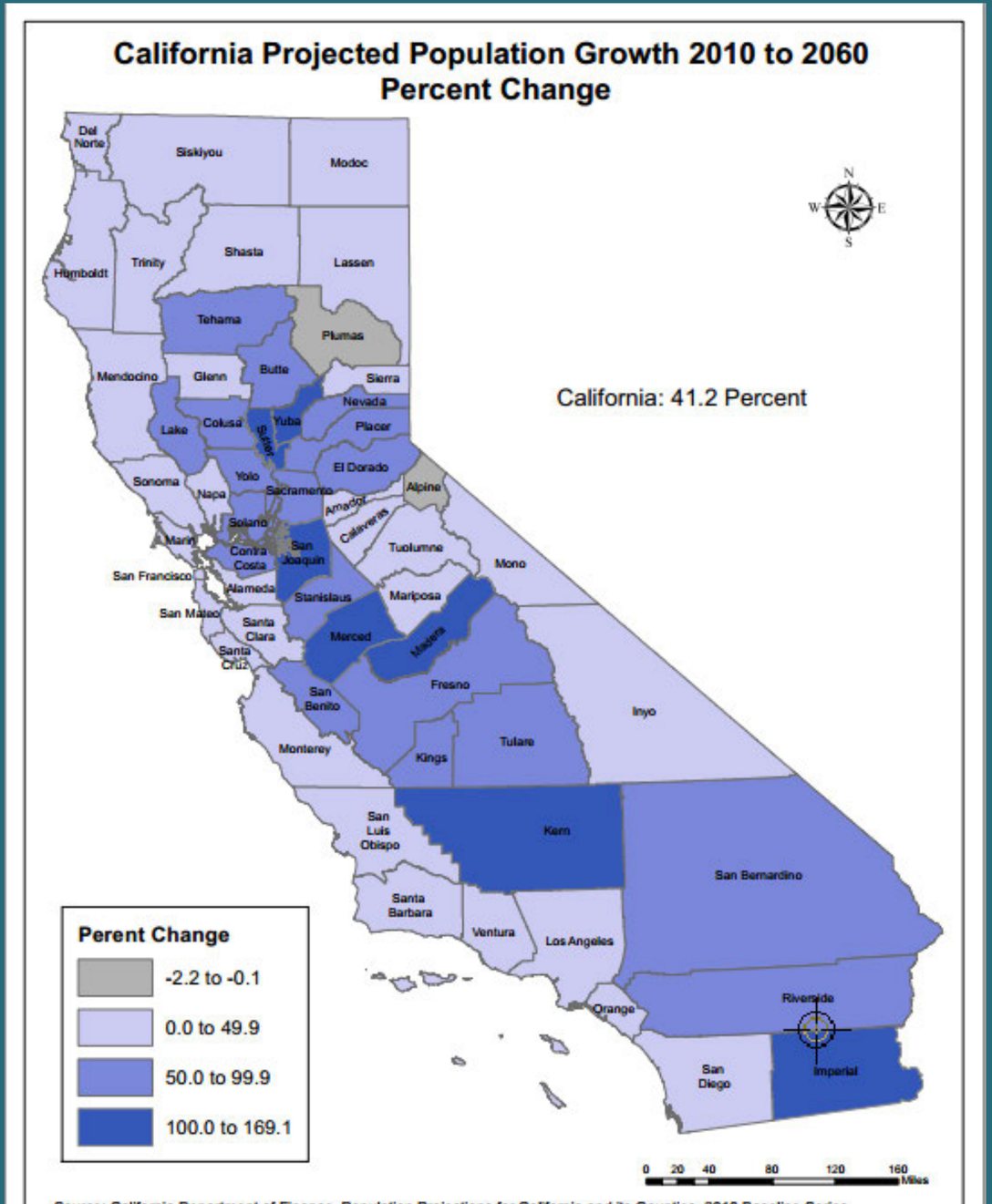
California's rivers face increasing pressure

Population currently 38 million (1 in every 8 Americans)

- 20% increase by 2030
- 40–50% in dry areas by 2030

Intense competition for water

- domestic/agriculture needs
- environmental flows



California’s snowpack

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Supplies water for:

- 25 million people
- 1 million acres of Agriculture

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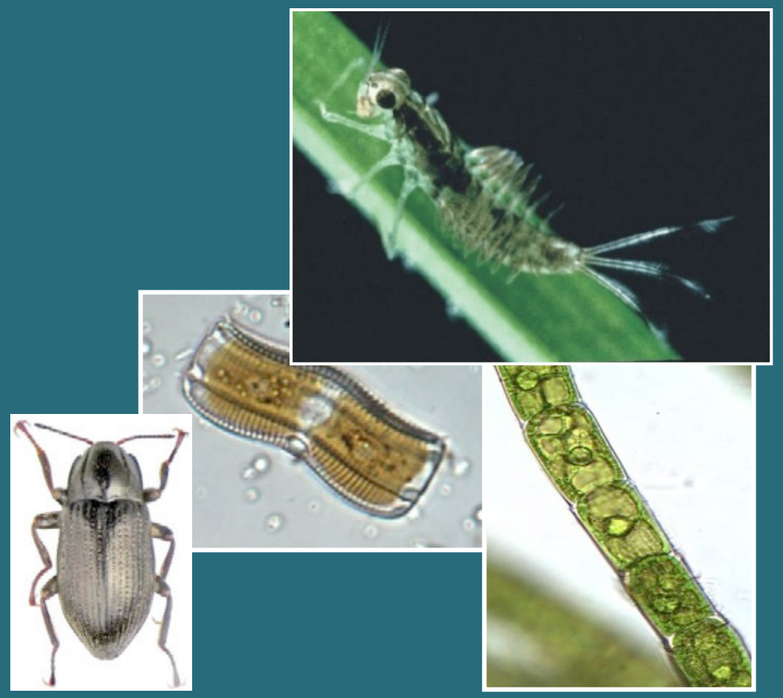
Climate change

- 2013 may be the "new normal"
- models predict 50% less snowpack by 2070

California's resource agencies need tools to prioritize protection/remediation

Build capacity to directly monitor ecological condition

- benthic macroinvertebrates
- benthic algae
- riparian condition indicators



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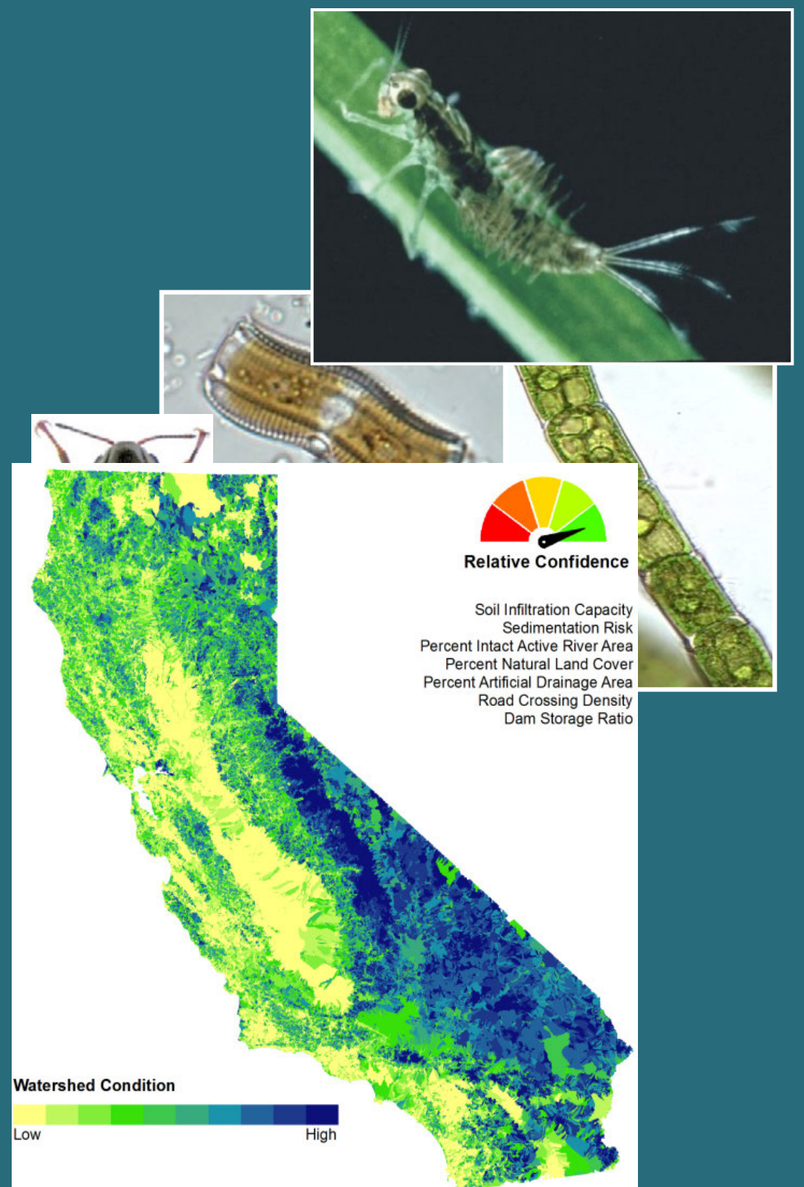
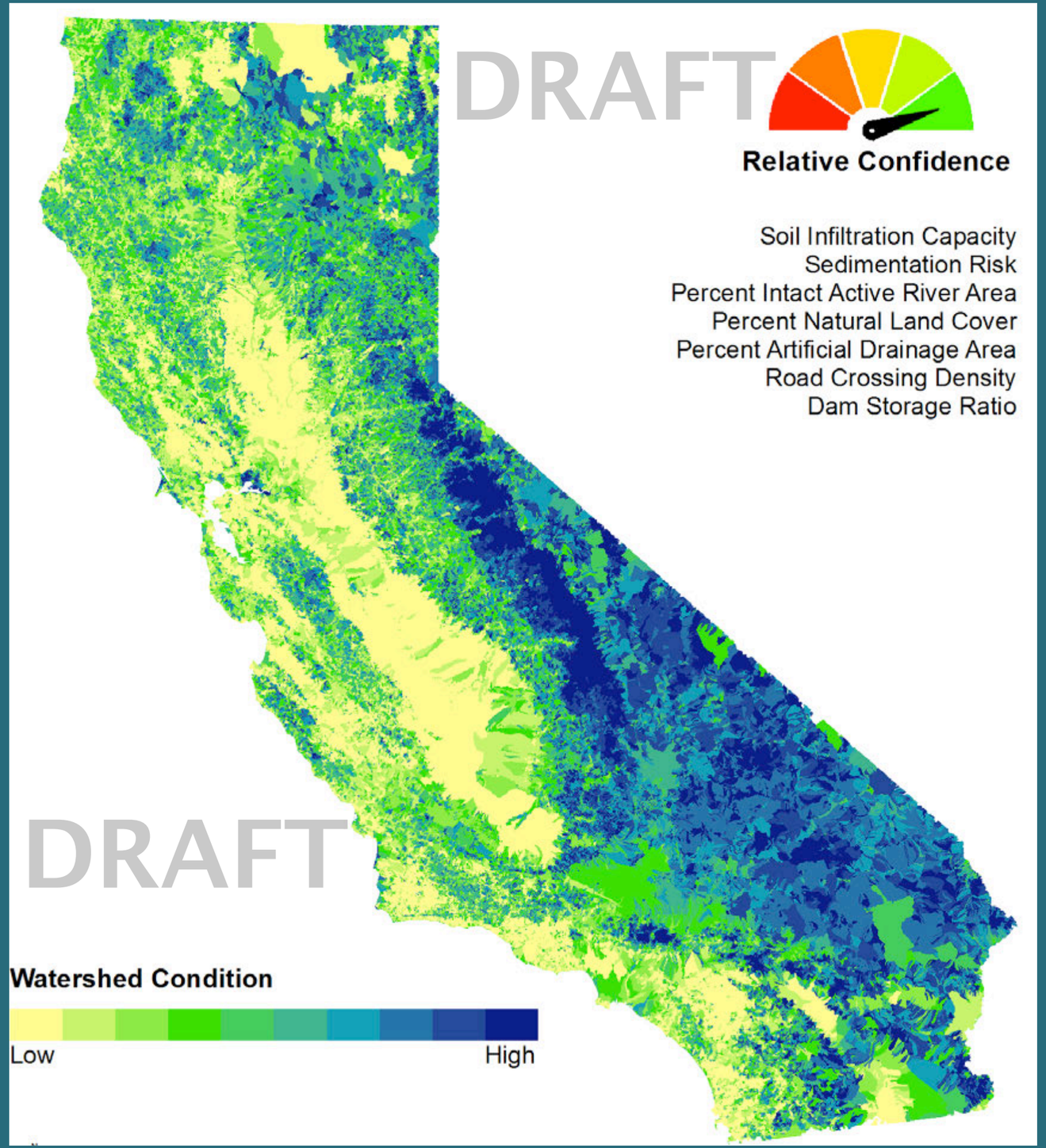
Build a framework to combine different types of information about watershed health

- collaboration with EPA's Healthy Watersheds Initiative

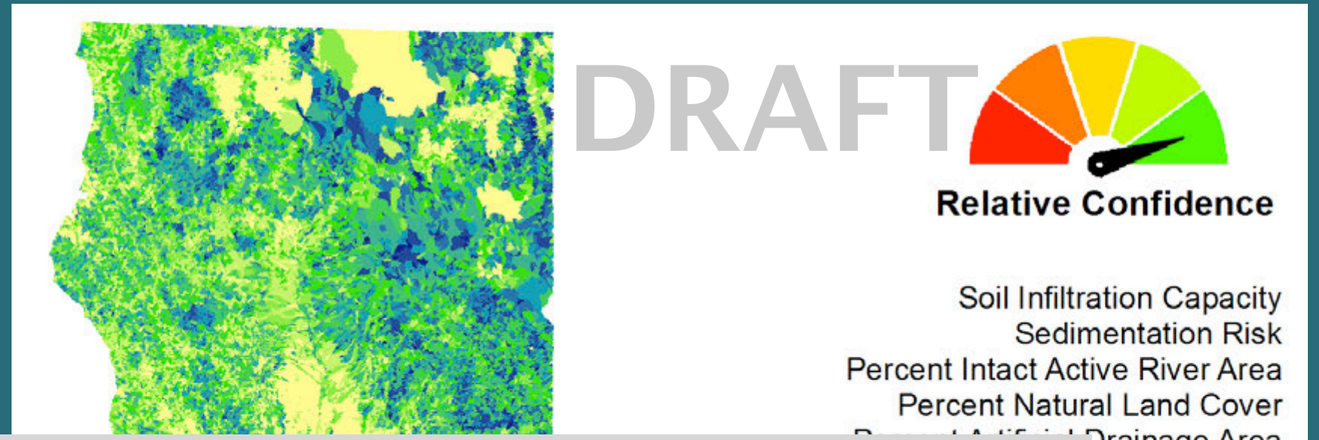


California Healthy Watersheds Initiative Integrated Assessment



Healthy Watersheds Initiative

California Healthy Watersheds Initiative Integrated Assessment

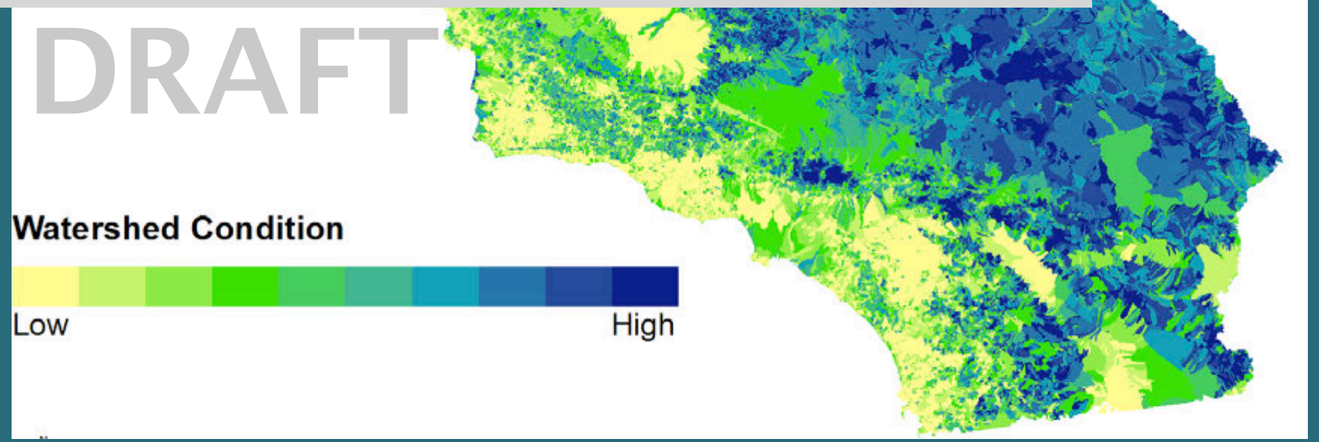


Objective Framework for Asking Management Questions:

“Where are our best streams?”

“Where are our most vulnerable streams?”

“Where are our best opportunities for restoration?”



Healthy Watersheds

Healthy Watersheds Initiative

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Example: Predicting flow in hydrologically complex regions

Long-term USGS studies have given us a sound understanding of how to assess altered flow conditions

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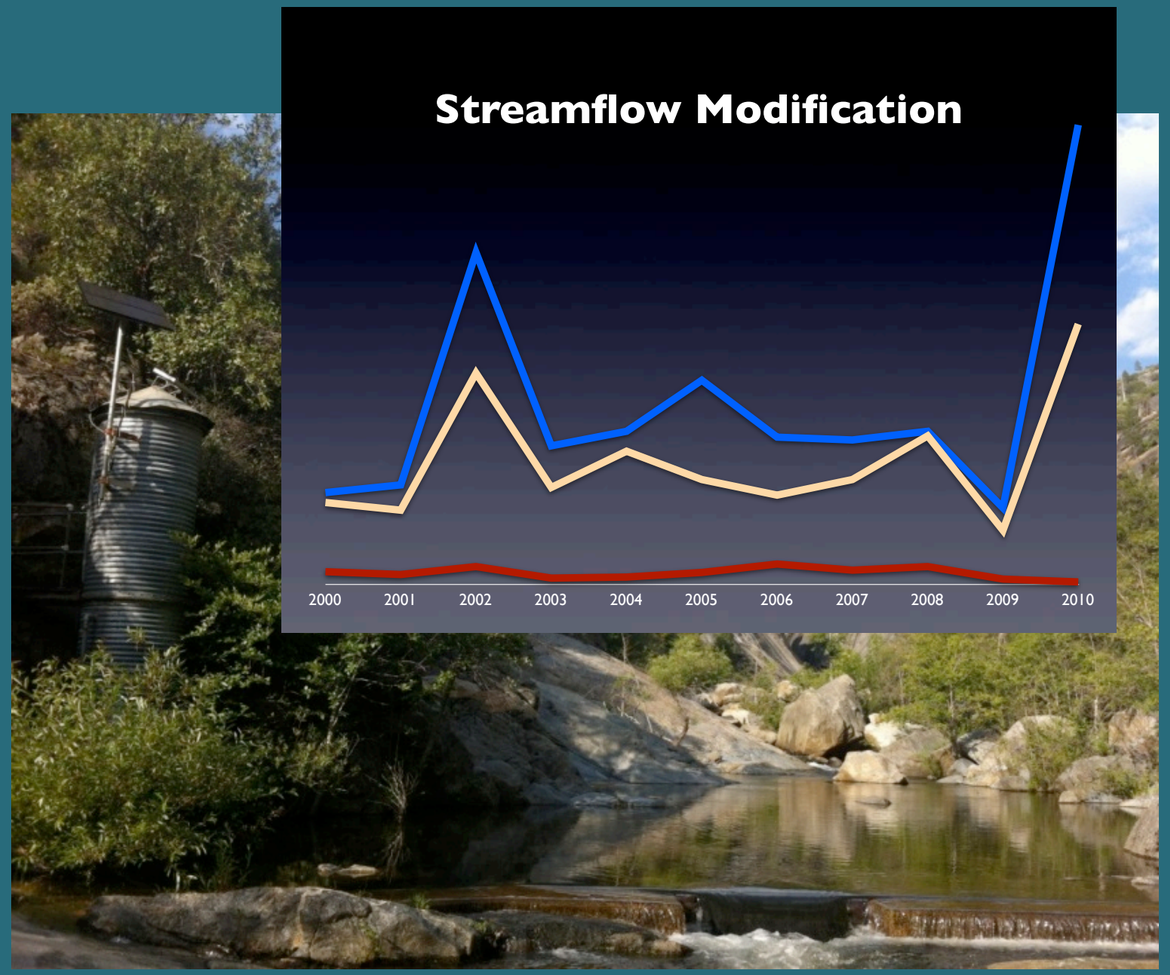

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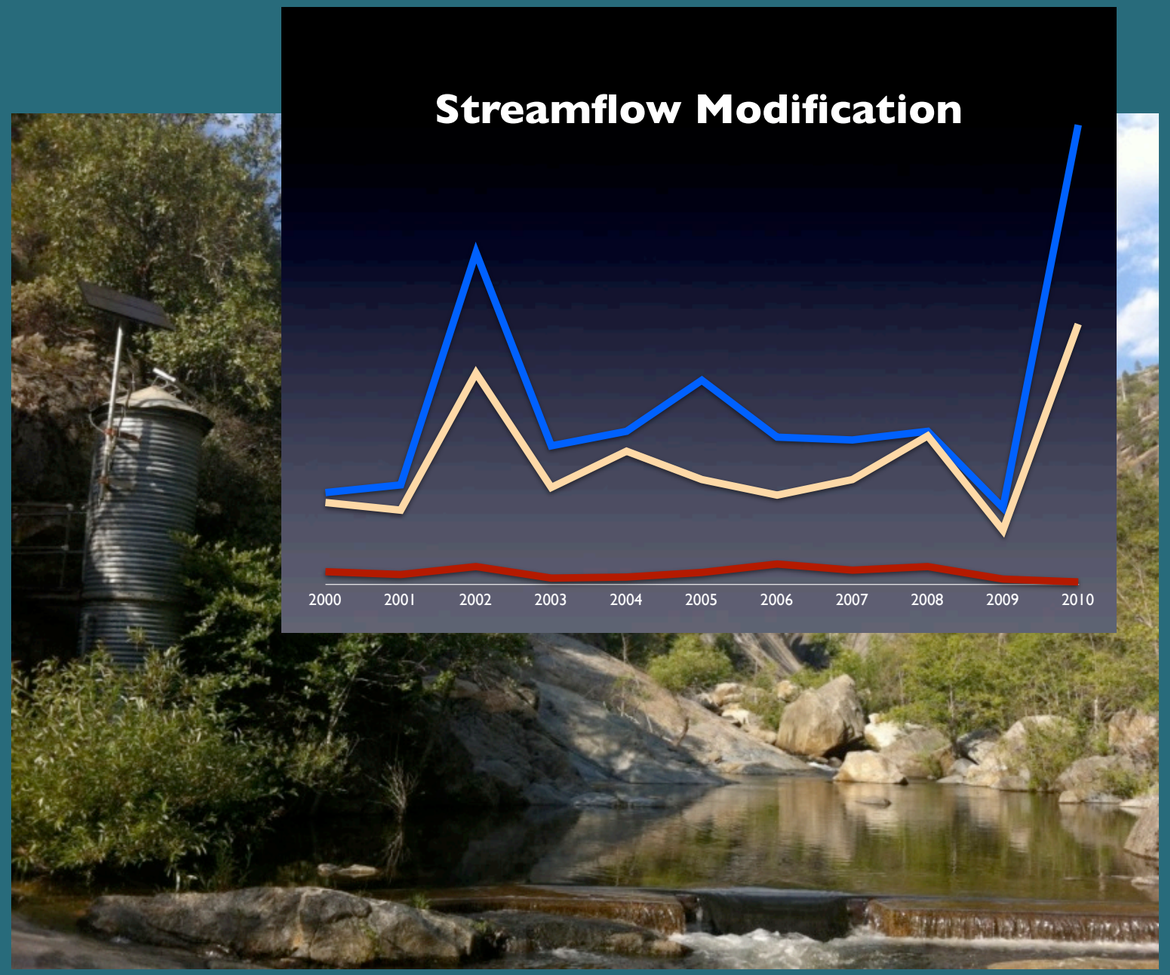

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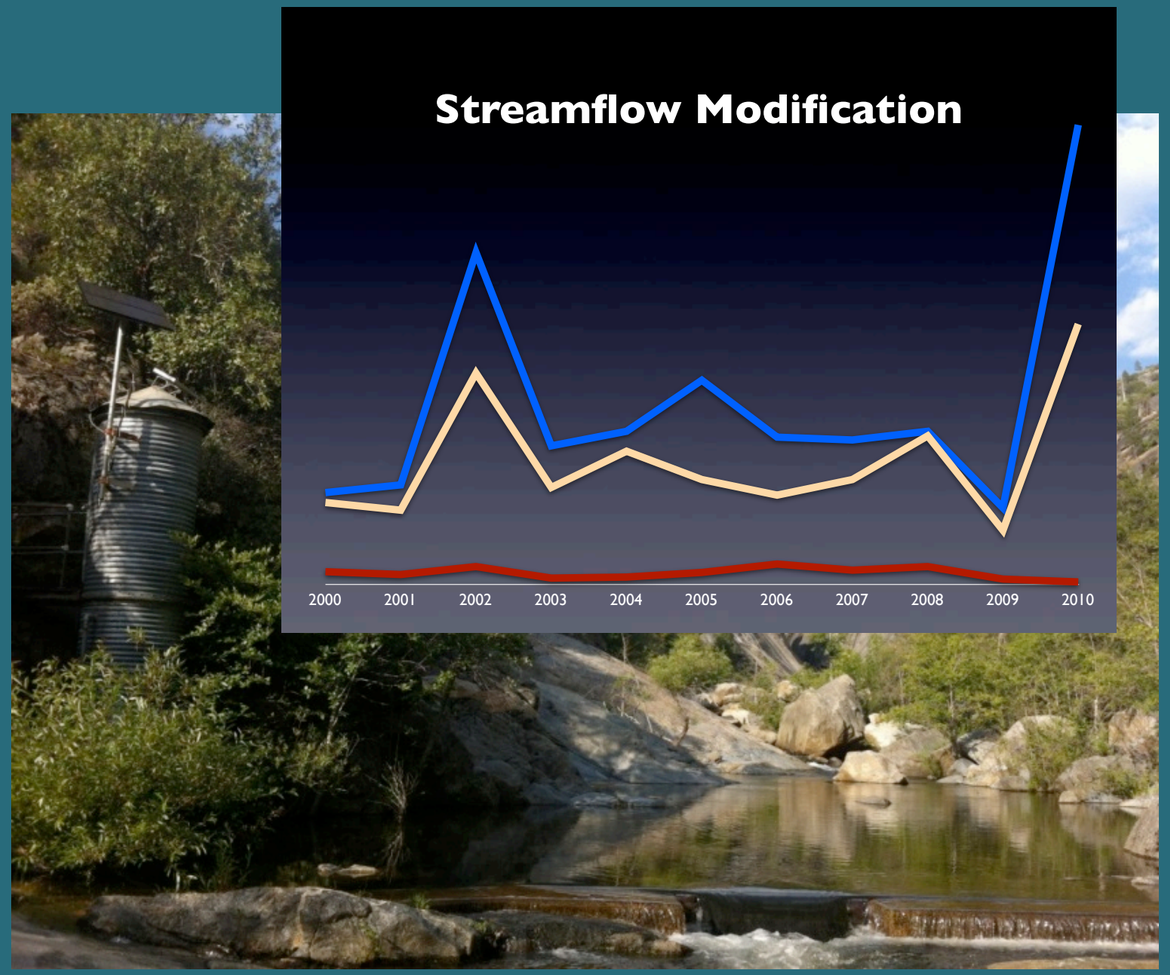

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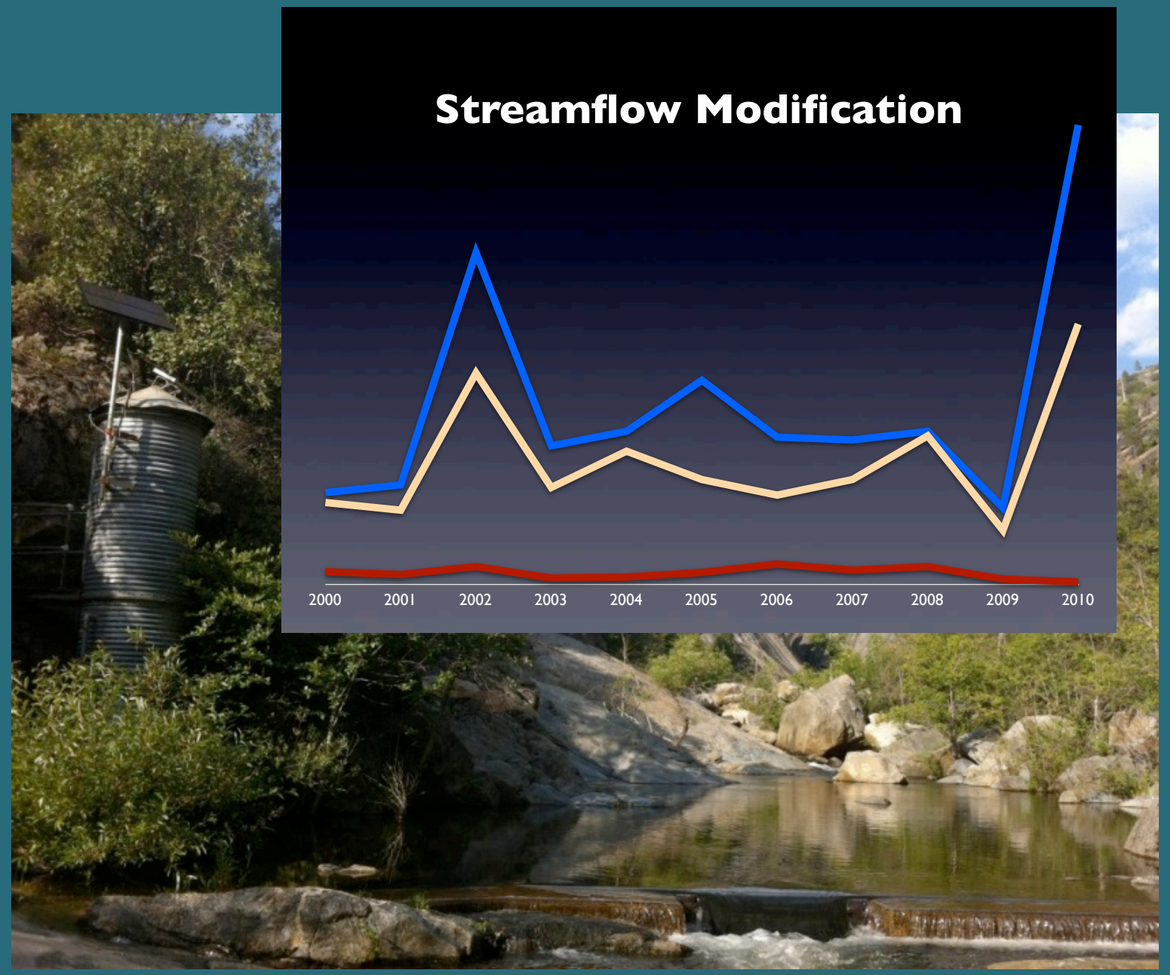
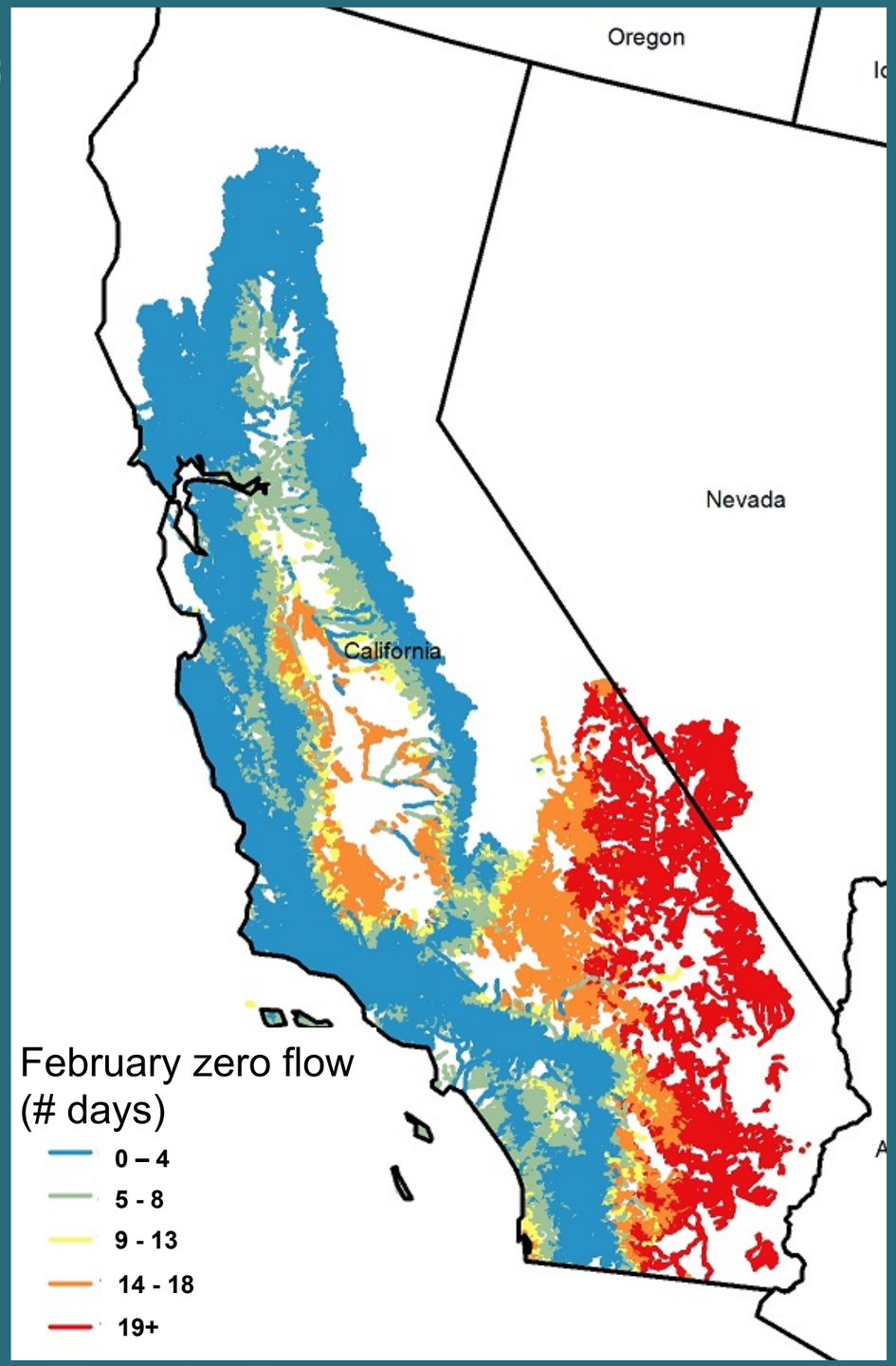
- How much alteration can be tolerated by biological communities?
- What are best indicators of environmental flow requirements?



Ability to predict flow/flow alteration are key to managing resources in arid regions



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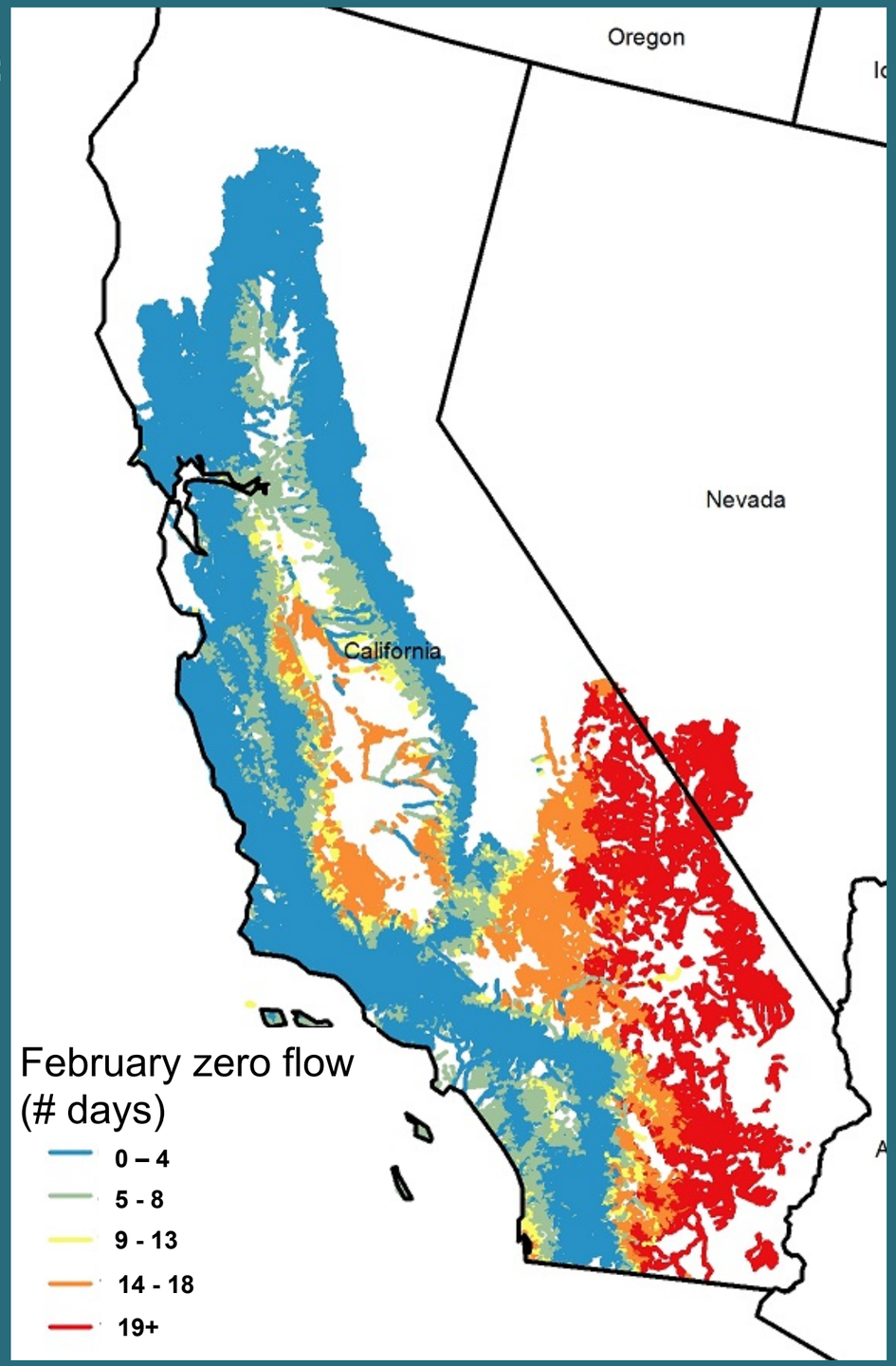

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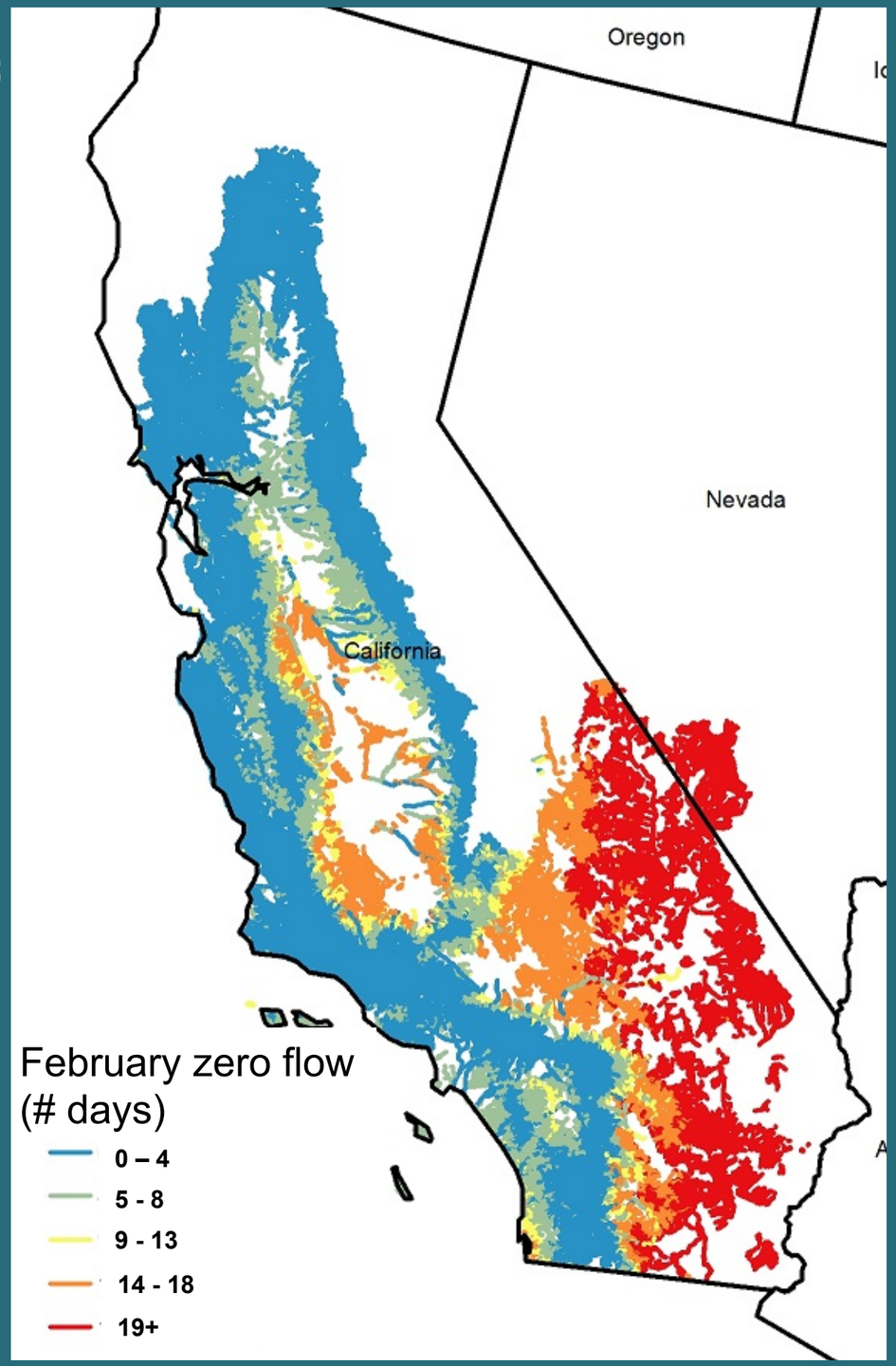

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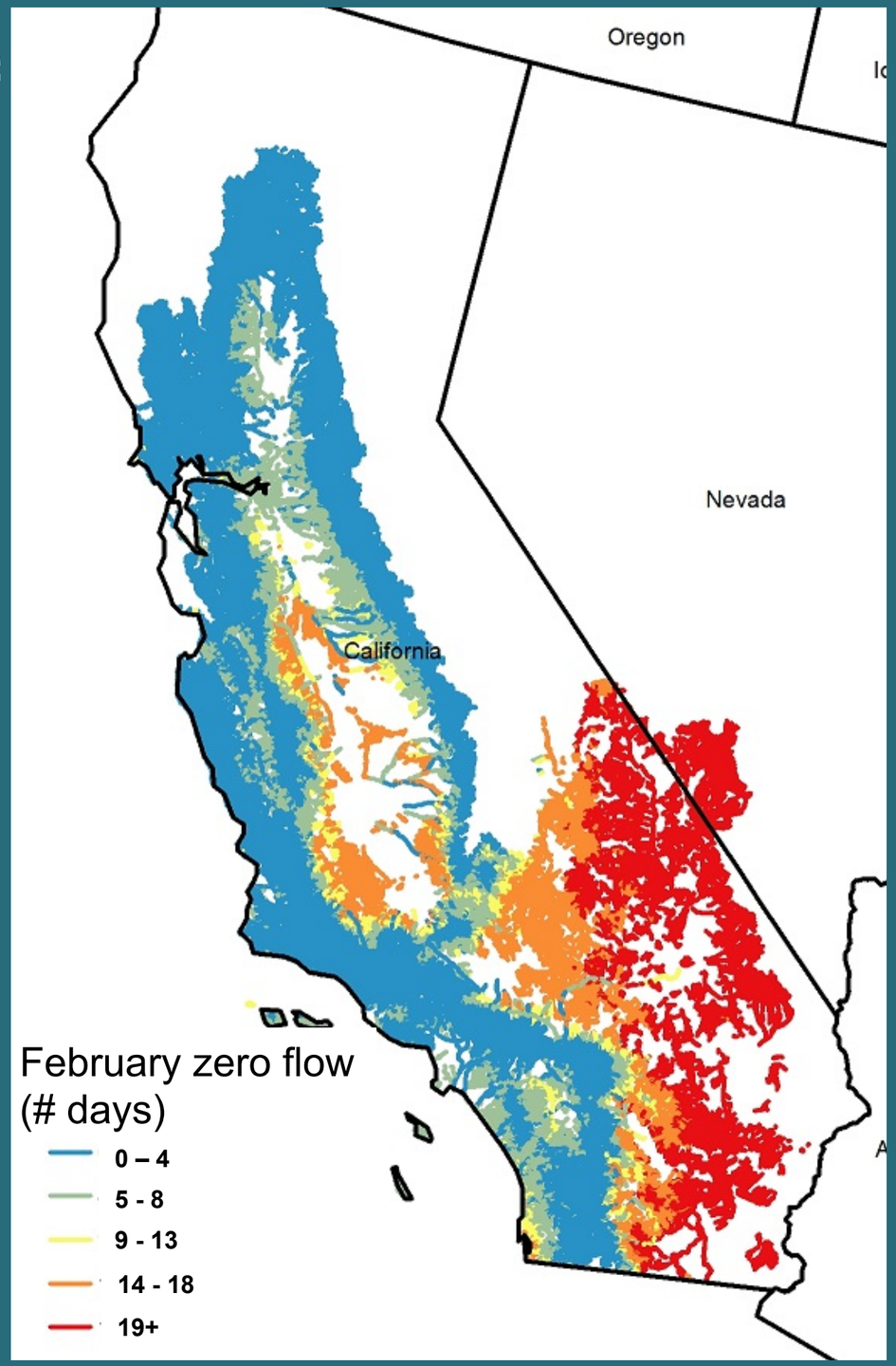
- Better information for resource prioritization (e.g., Healthy Watersheds)
- Better ability to predict impacts of climate change
- Federal contributions of expertise and ability to integrate broad national and regional perspectives are keys to success



Thank you