Assessment of Stream Resources in Wisconsin Using Probabilistic Sampling Designs

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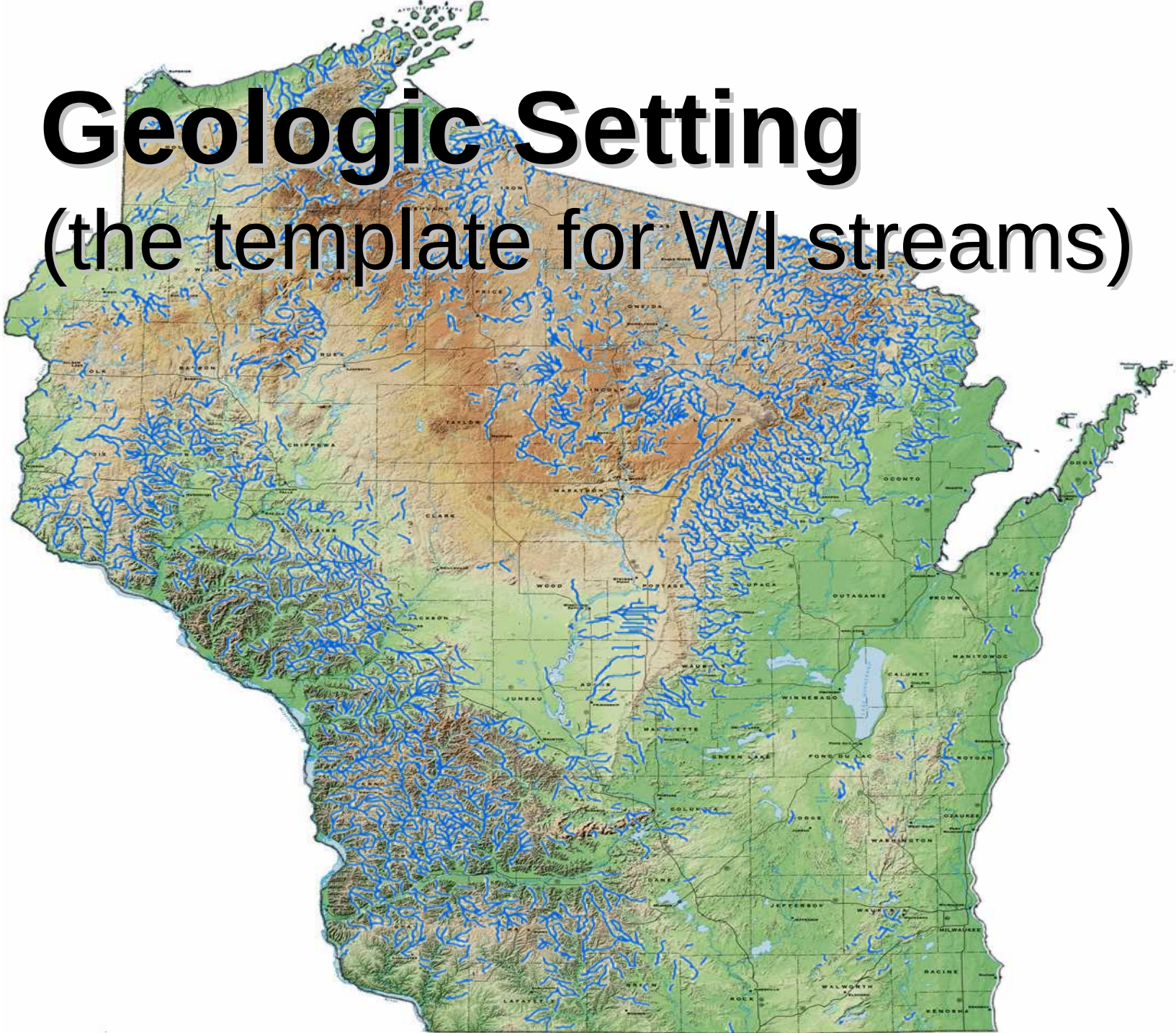
Presentation Overview:

- Environmental Setting (Past / Present)
- Program Data Needs
- Sampling Design (3 – Tiered Approach)

Water Defines Wisconsin

15,000 Lakes
22,000 Perennial Streams
5.3 Million Acres Wetlands
1,017 Miles Grt. Lakes Shoreline
2,300 Miles Miss. River Shoreline
1.2×10^{15} Gallons Groundwater

Geologic Setting
(the template for WI streams)



Legacy Land Use Impacts

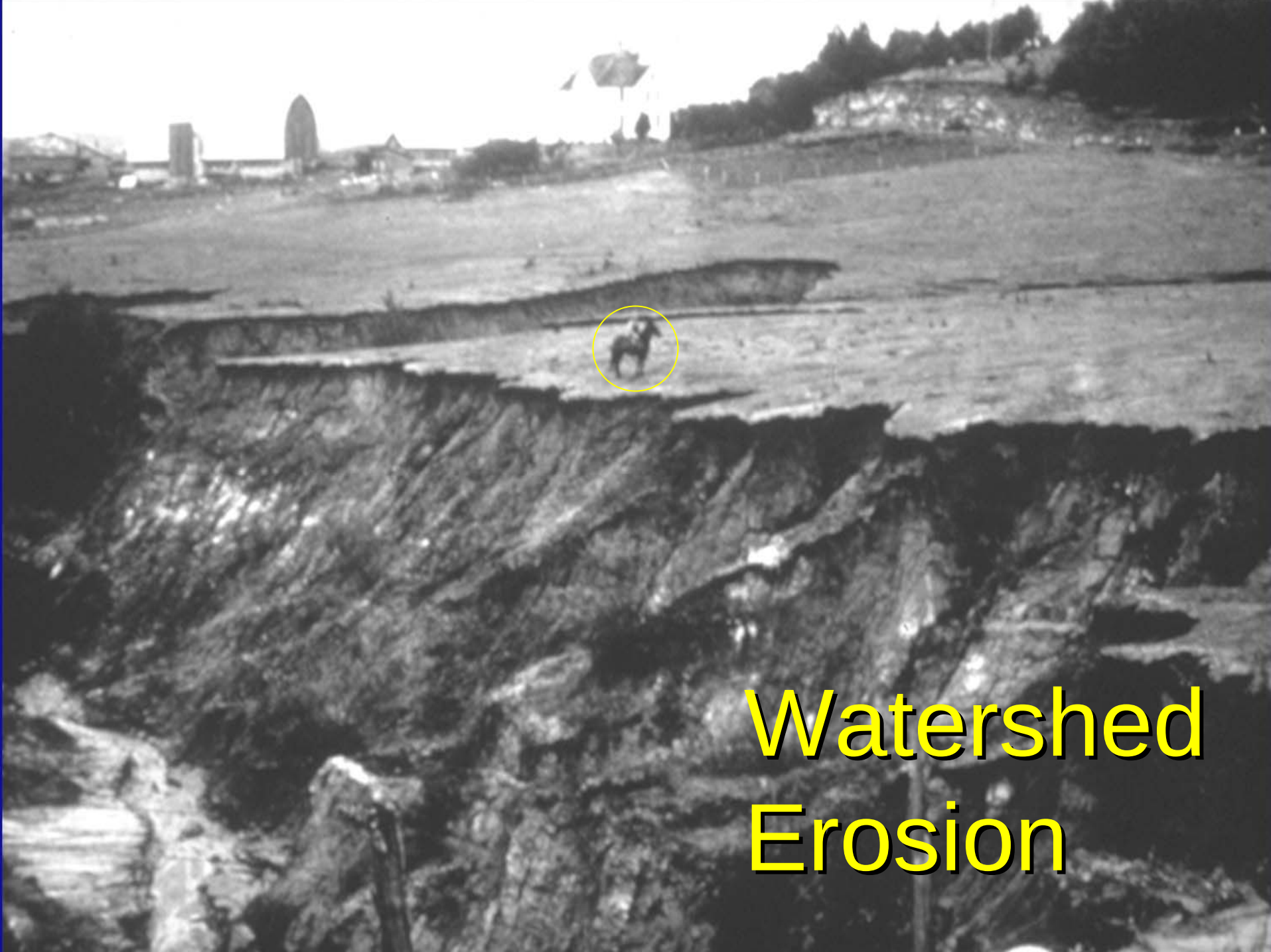
Legacy Land Use Impacts

The streams of the Midwest have undoubtedly changed much in character since the country has become so thickly settled. I have been informed that many streams, formerly deep and narrow, and abounding in pickerel, bass, and catfishes, have grown wide and shallow, while the water in them varies greatly in different seasons, and they are inhabited by bullheads, suckers, and a few minnows."

Seth Meek, 1892

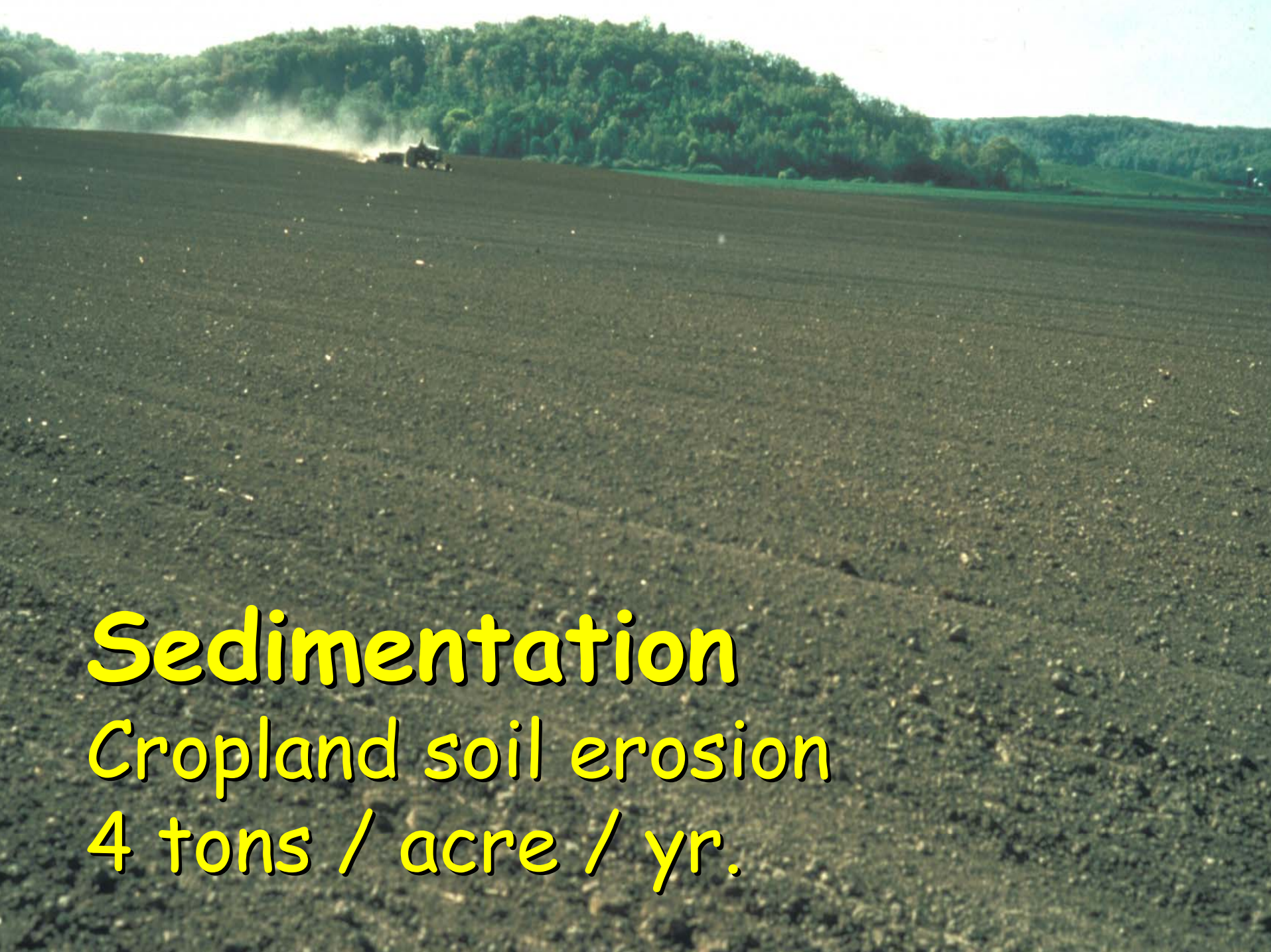
Statewide Deforestation 1870 - 1910

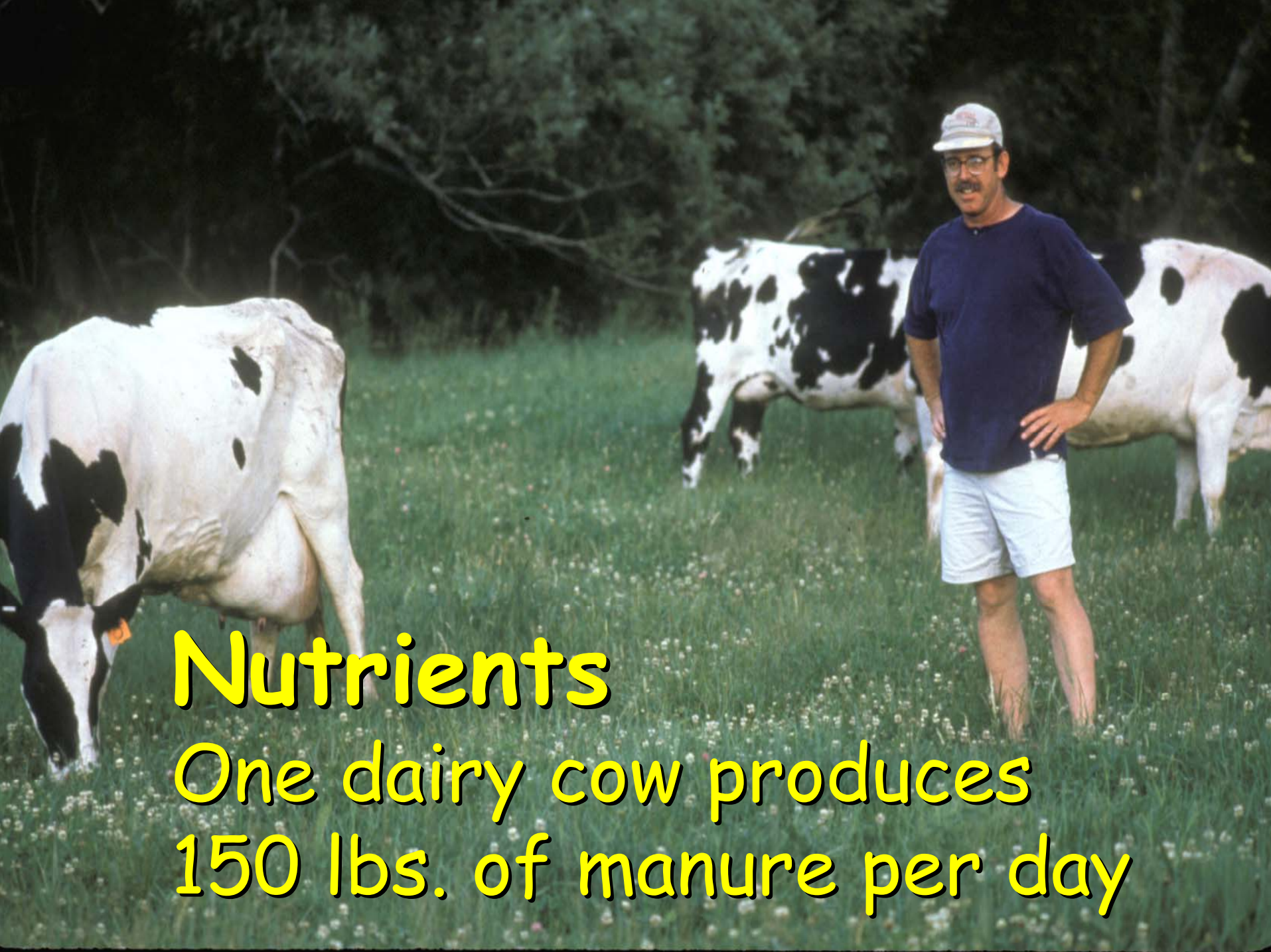
Wisconsin Clear-cut by 1910s


Watershed
Erosion

Legacy
impacts
100 + yrs.
later

Current Land Use Impacts


Sedimentation
Cropland soil erosion
4 tons / acre / yr.

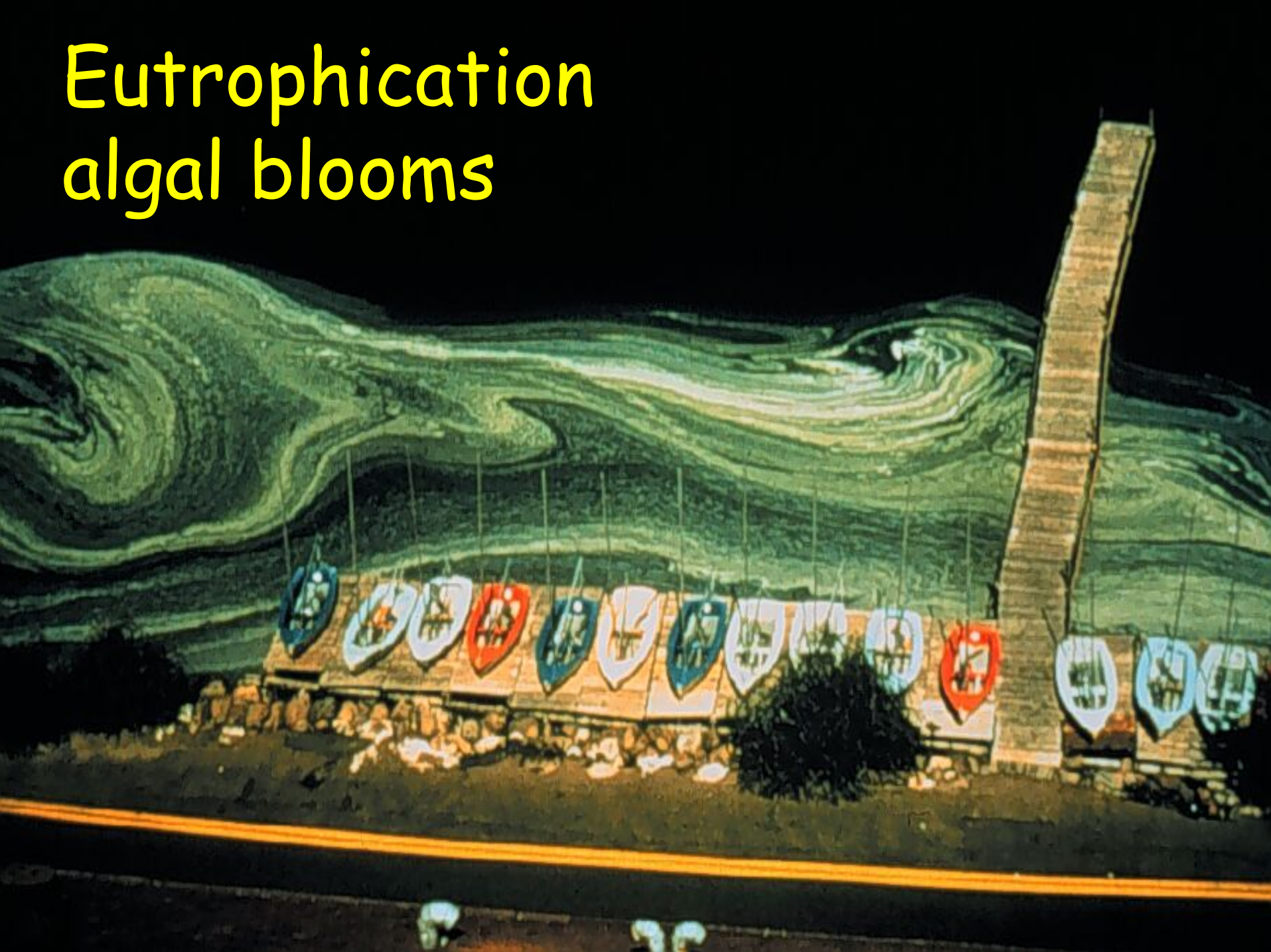


Nutrients

One dairy cow produces 150 lbs. of manure per day

Wisconsin's 1.2 million dairy cows produce 65 billion lbs. manure / yr.

Eutrophication algal blooms



Urbanization
hydrologic alterations

Program Data Needs:

- Environmental Quality
- Natural Resources Mgmt.

  (3 Broad Categories)

1. Environmental Quality (Clean Water Act)

2. WI Public Trust Doctrine

"All navigable waters are common highways and forever free."

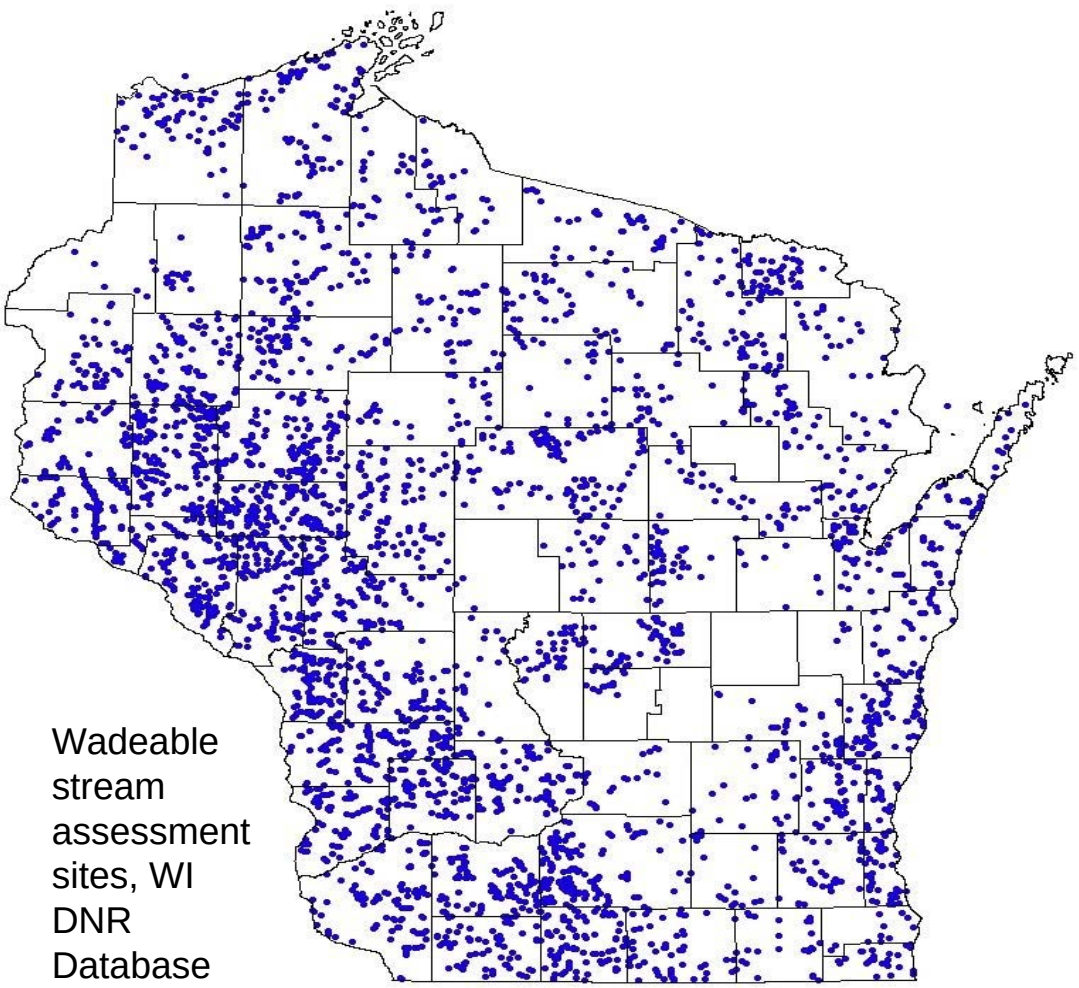
Art. IX, Sec. I Wisconsin State Constitution

3. Natural Resource (Fisheries) Management

Direct and evaluate management:

- Fish stocking
- Habitat restoration / enhancement
- Harvest regulations

Targeted - Sampling Biases:



Wadeable stream assessment sites, WI DNR Database

Geographic:

Data clusters and sampling gaps

Stratigraphic:

High-quality game fish, and low-quality

NPS streams sampled, few 1st order streams

With 22,000 perennial streams & finite ($), how can WI adequately characterize the condition of these resources?

How about using a sample survey?

"You don't need to eat the whole oxen to know that it's tough."

- Arab Proverb

For this to hold true, a sufficient number of cuts selected in an unbiased manner need to be eaten.

Unfortunately, WI Fisheries biologists target Tenderloin (i.e. trout streams), whereas Water Quality biologists often target Chuck Roast (impaired waters)

EPA - EMAP a beacon in the darkness!

Tony Olsen
(Zen Master)

M. Miller
(lowly weed-hopper)

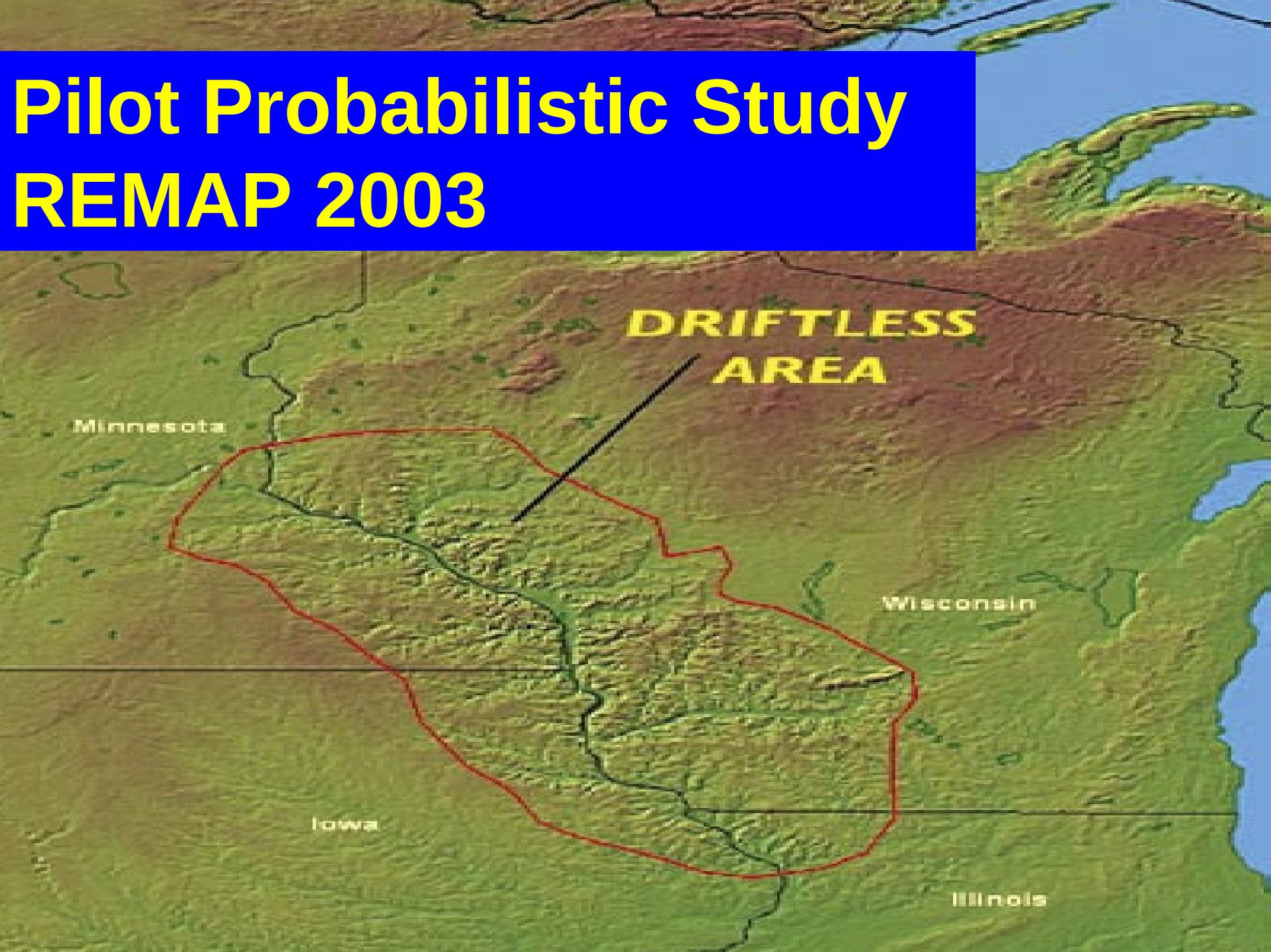
Susan Holdworth Karen Blocksom

Bob Hughes Florence Fulk

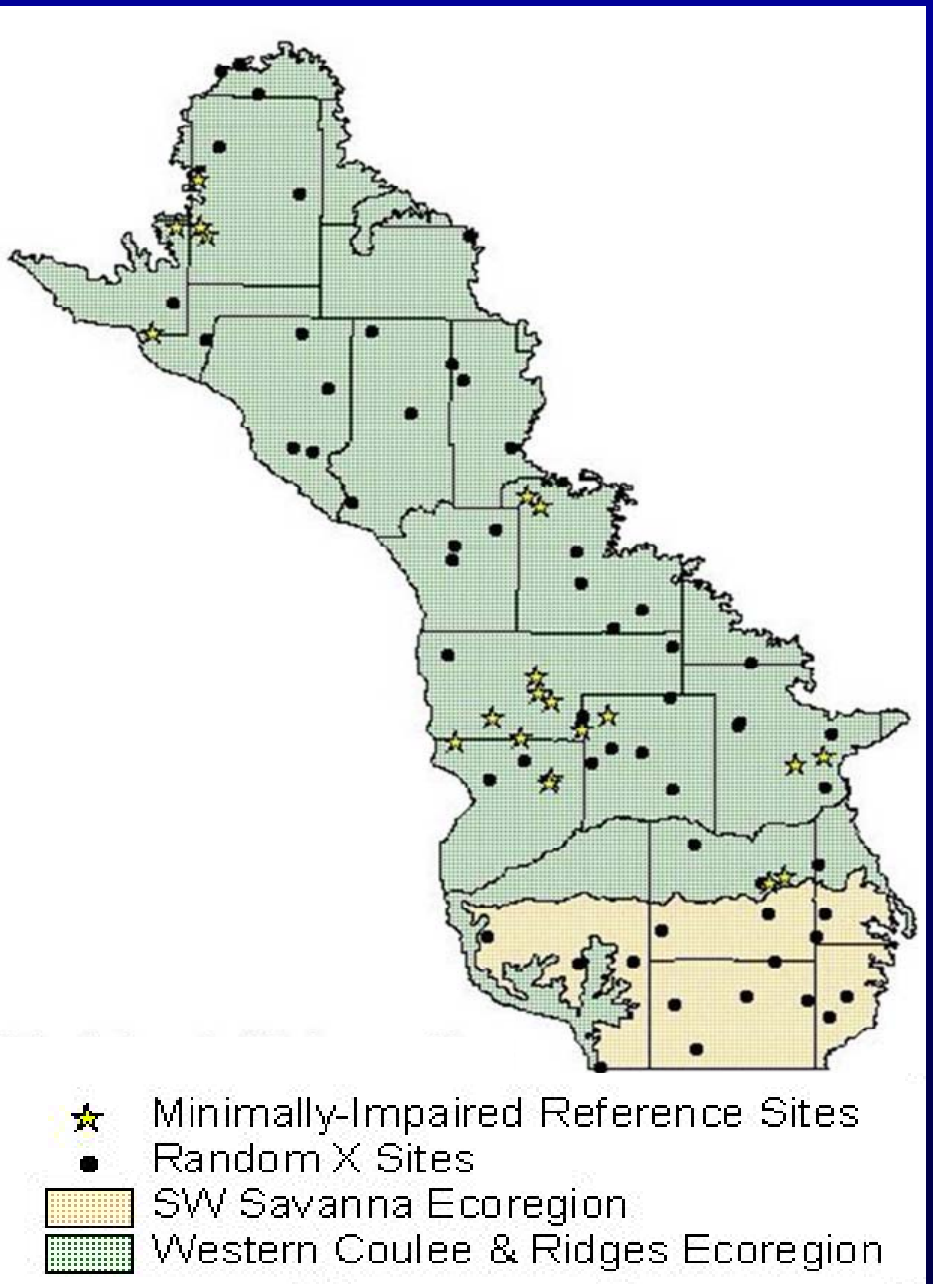
Ed Hammer Sarah Lehmann

Steve Paulsen Ellen Tarquinio

Pilot Probabilistic Study REMAP 2003



2003 REMAP Study Sites

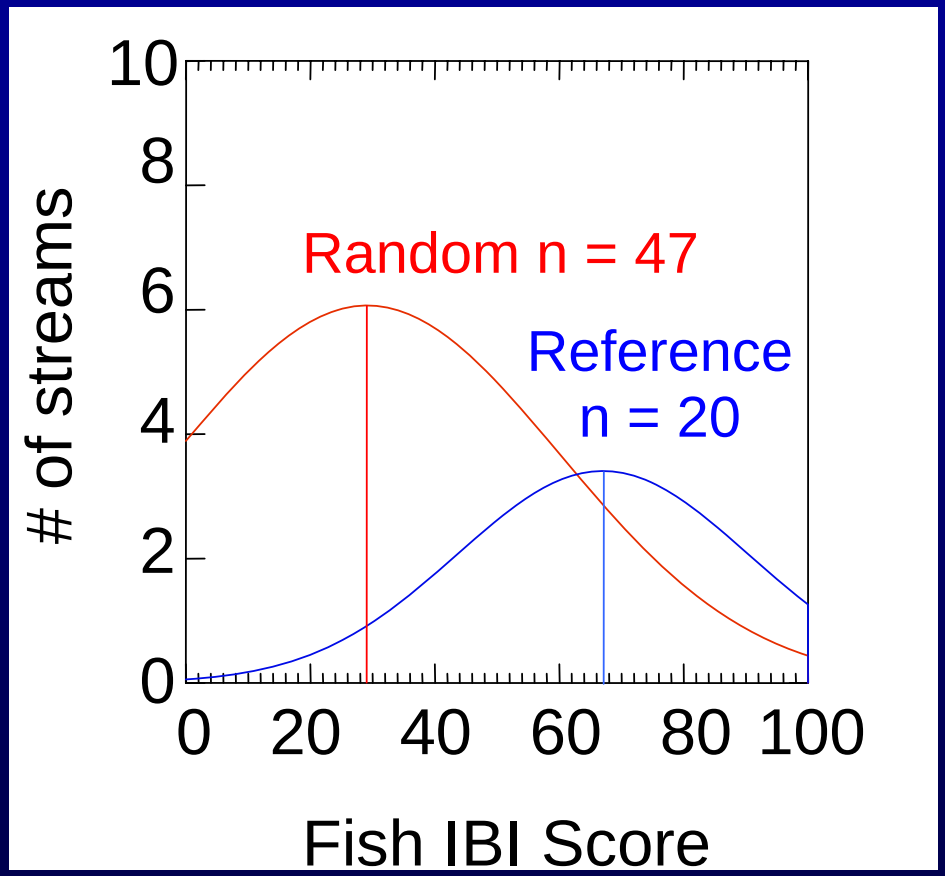


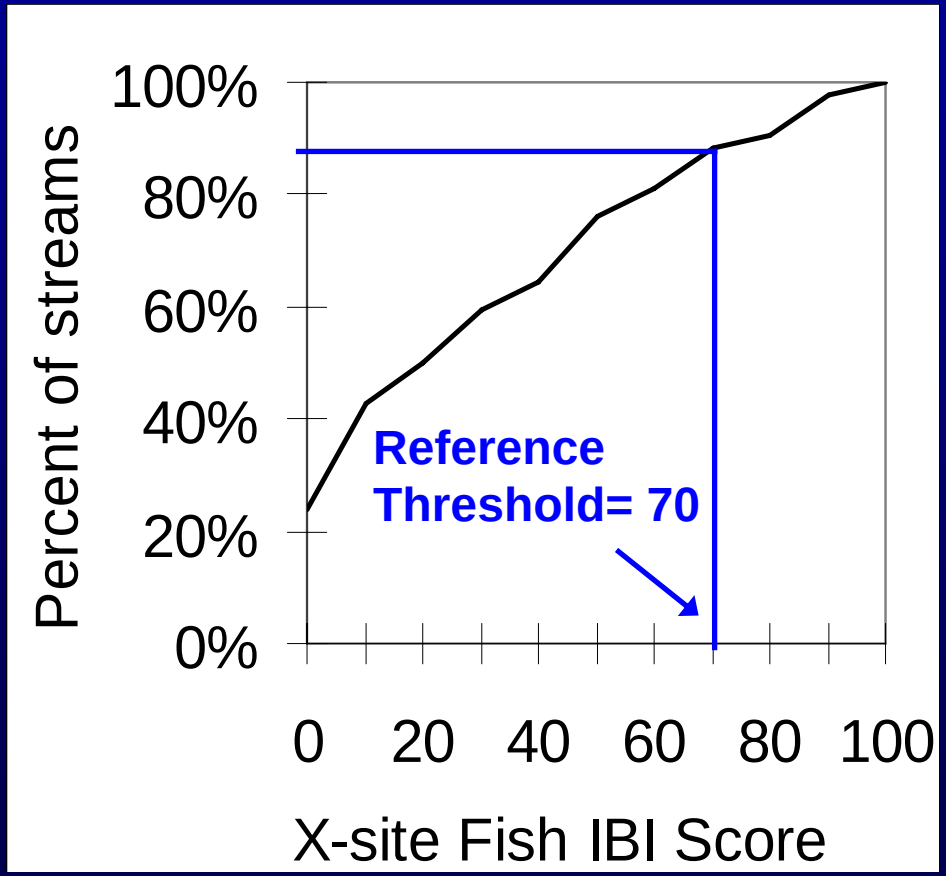
<u>Target Population:</u>
3,560 Wadeable streams
8,840 stream miles

<u>Sample Population</u>:
Random sites (n = 60)
Reference sites (n = 22)

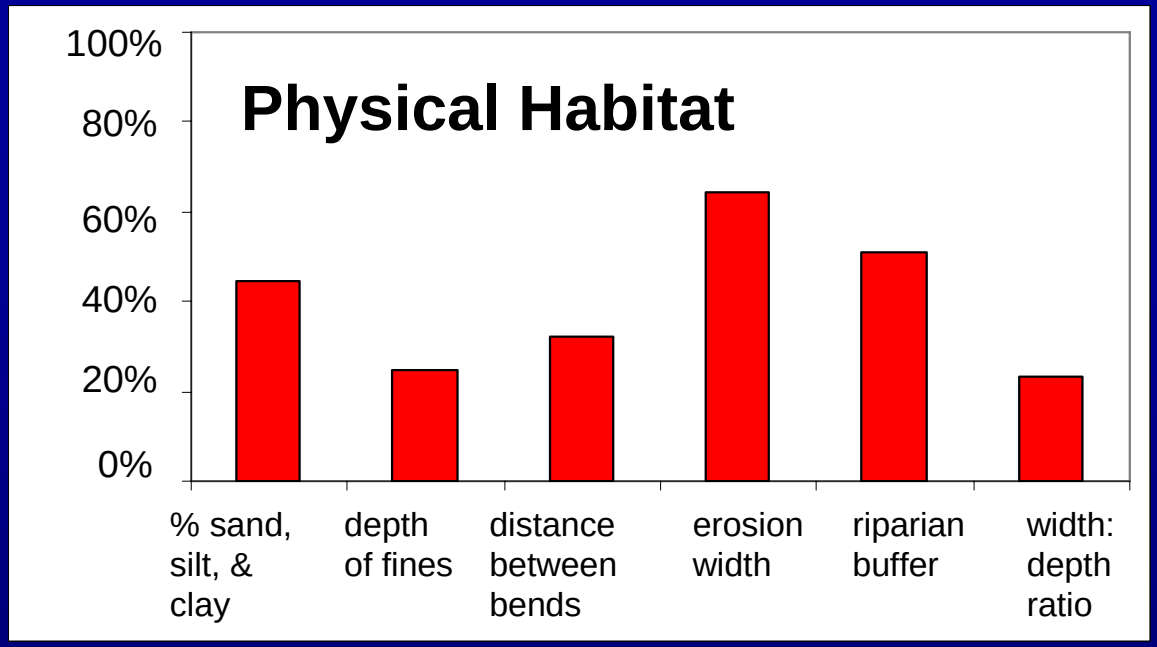
Physical, chemical, and biological data gathered

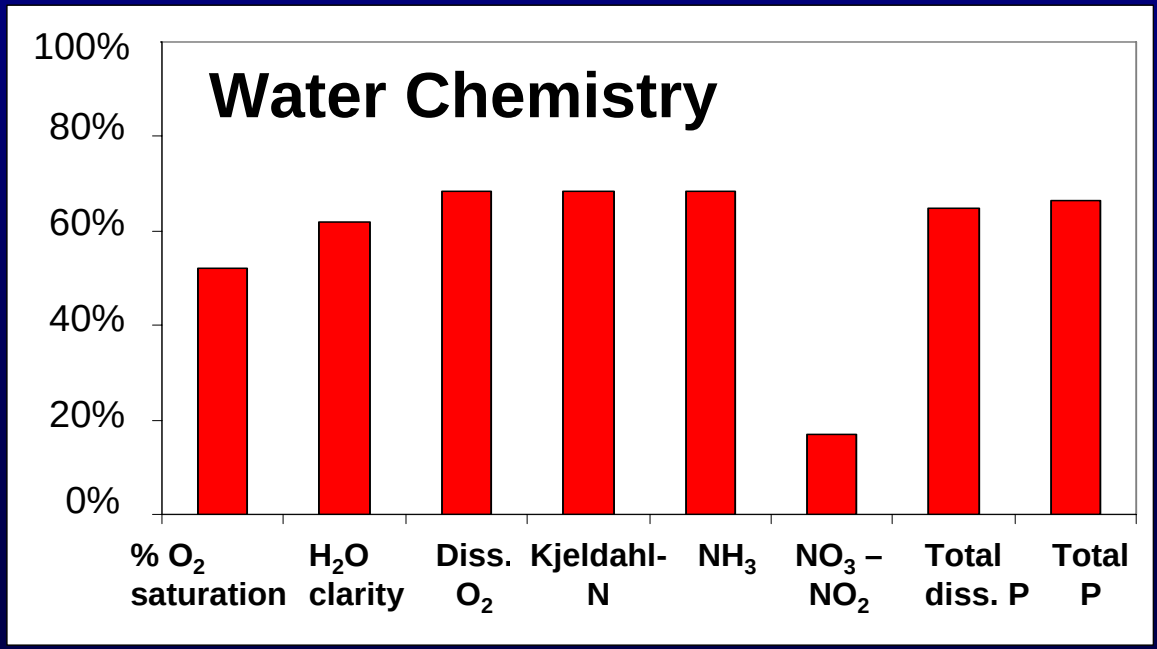
REMAP Assessment: setting expectations and estimating target population conditions (e.g. fish Index of Biotic Integrity data)



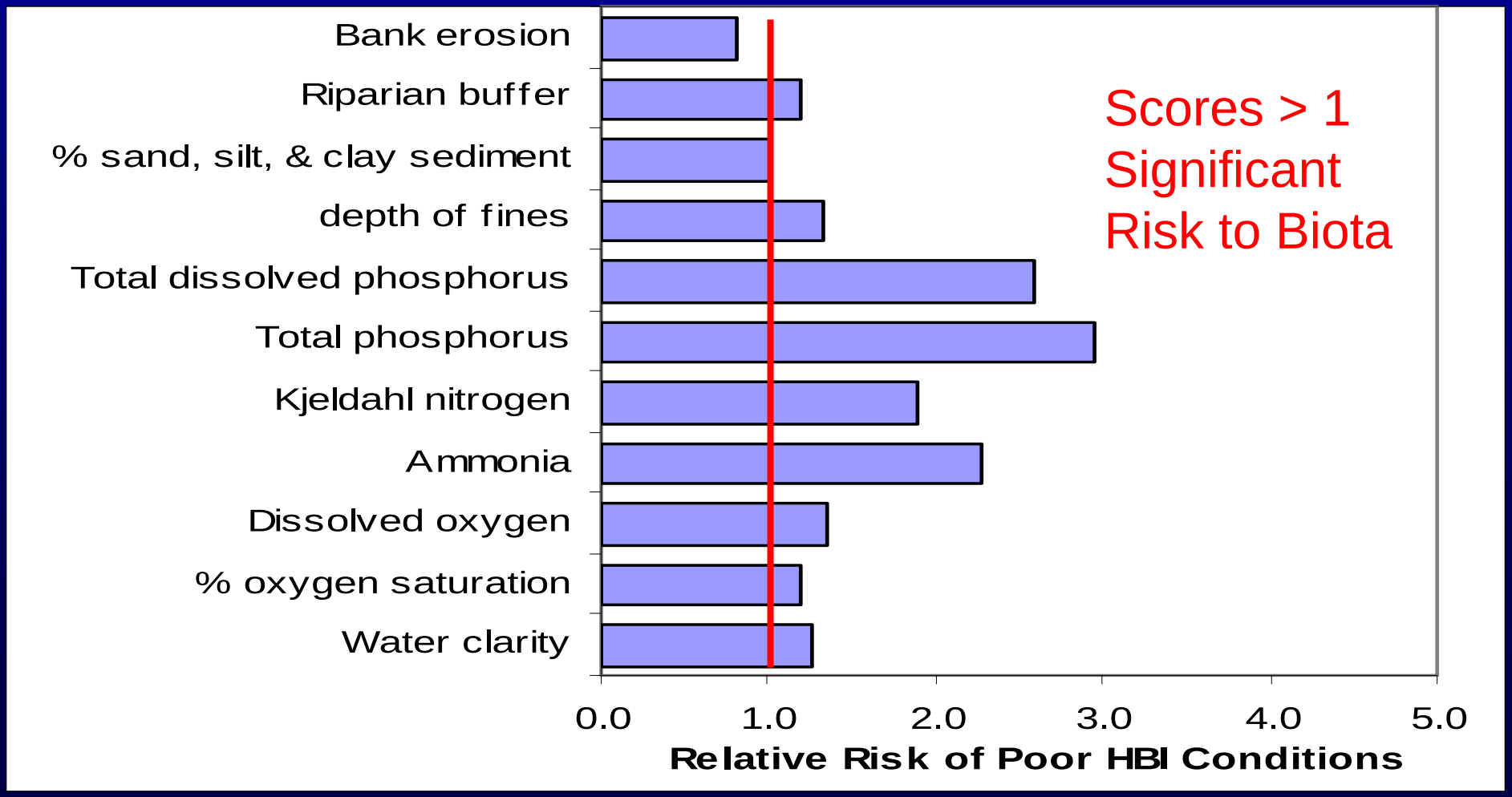


Percent stream miles **NOT** meeting reference condition physical, or chemical thresholds:



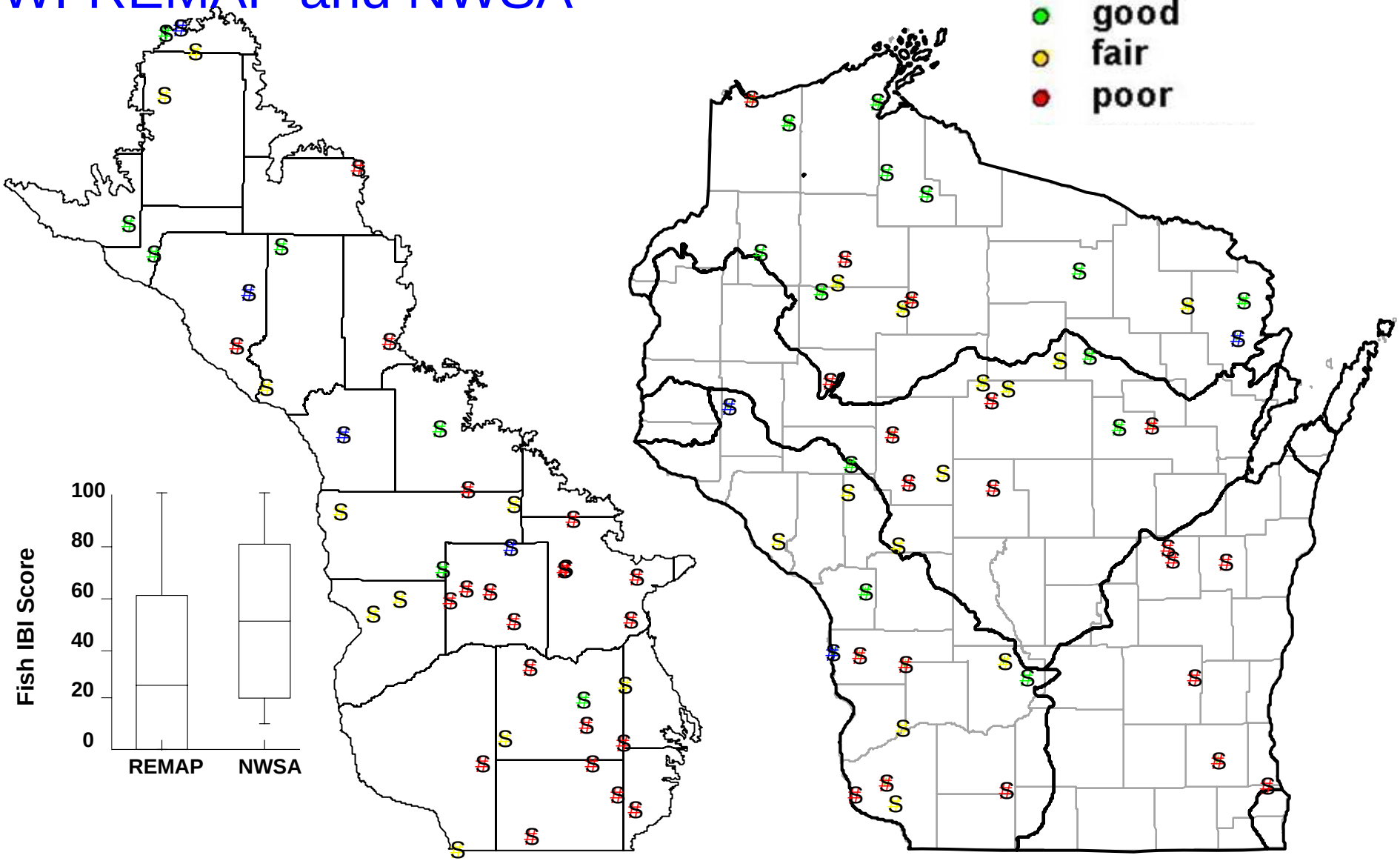


Quantifying the Relative Risk that Various Physical or Chemical Stressors Pose to Biota (e.g. inverts)

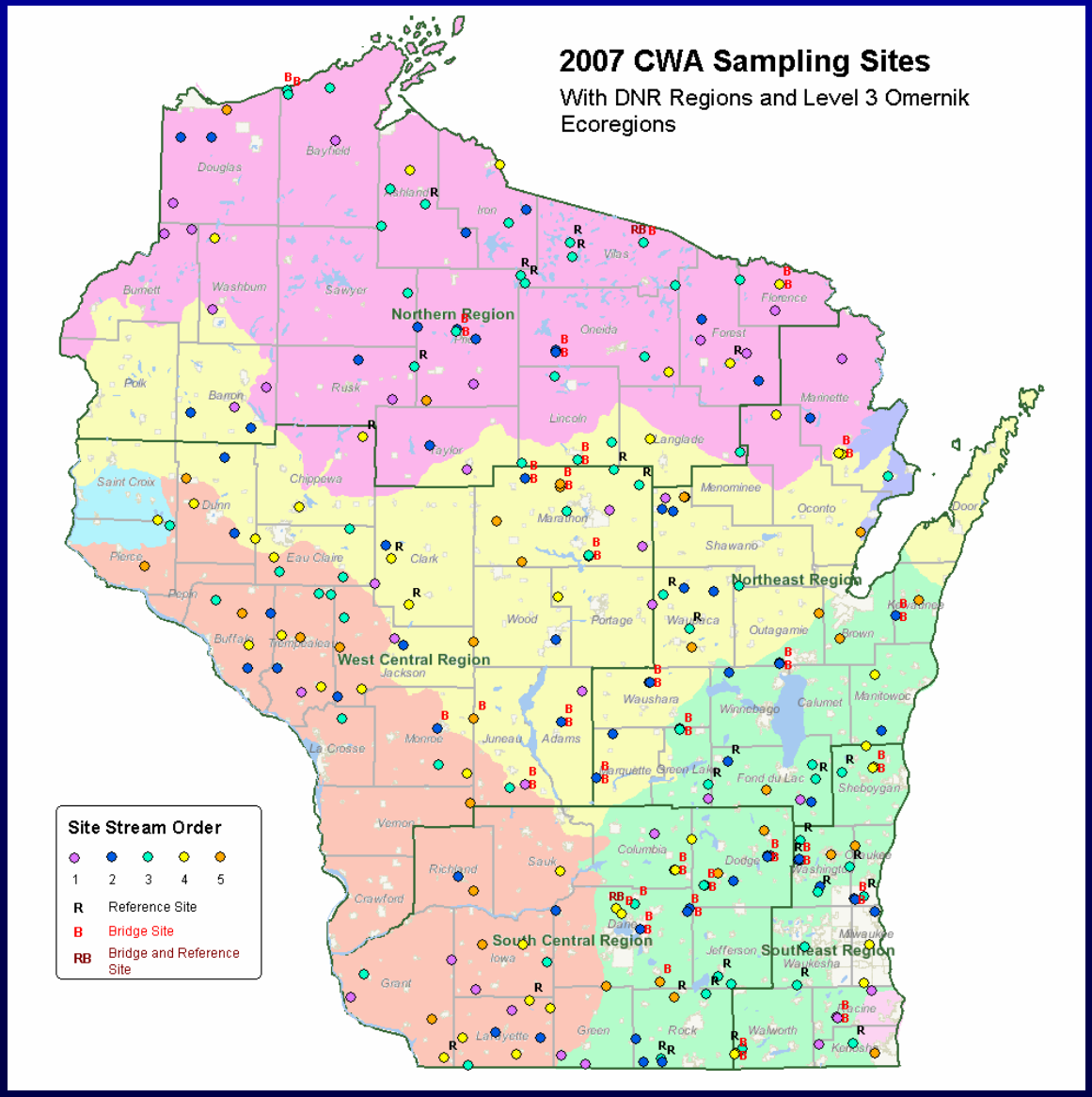


Probabilistic Studies:

WI-REMAP and NWSA



2007 Wadeable Stream Sampling



Stratification:

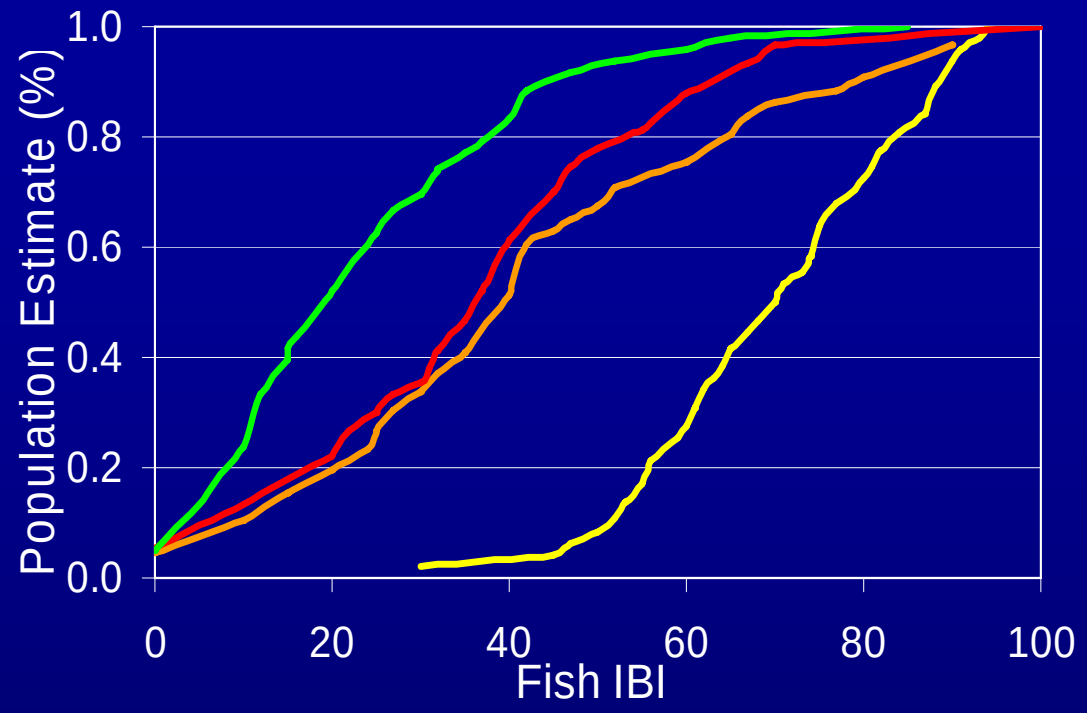
- ecoregion
- stream order

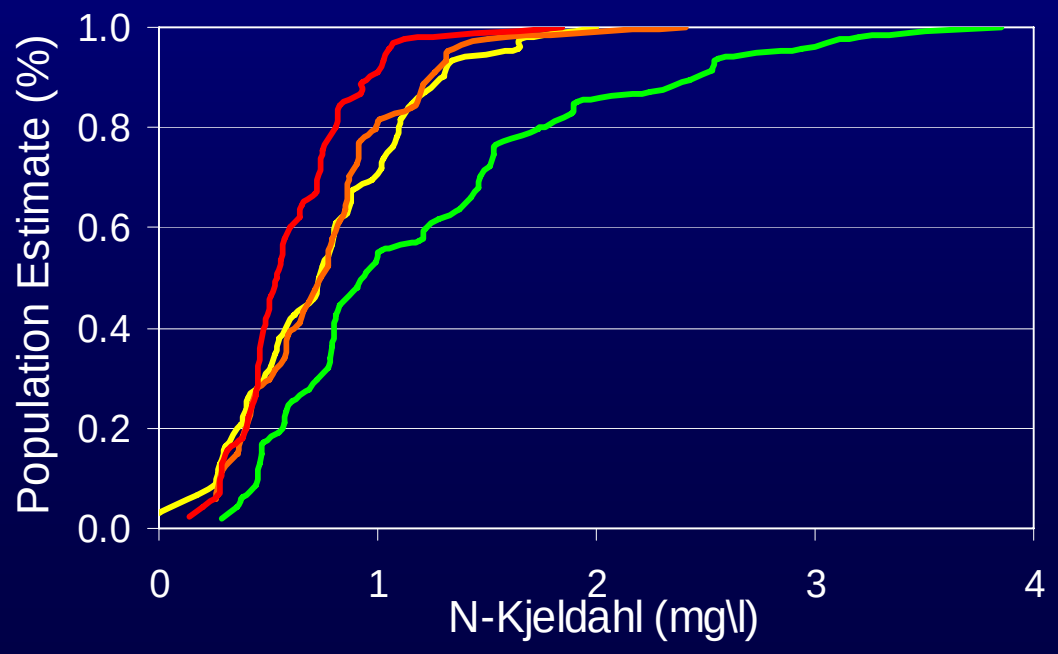
- 50 random sites per ecoregion

- 50 reference sites statewide

- Phys., chem., bio. data at all sites

Preliminary 2007 WI Probabilistic Sampling Results





Omernik Level III

Northern Lakes and Forests

North Central Hardwood Forests

Driftless Area

SE WI Till Plains

Refined WI Sampling Strategy Incorporates Prob. Monitoring

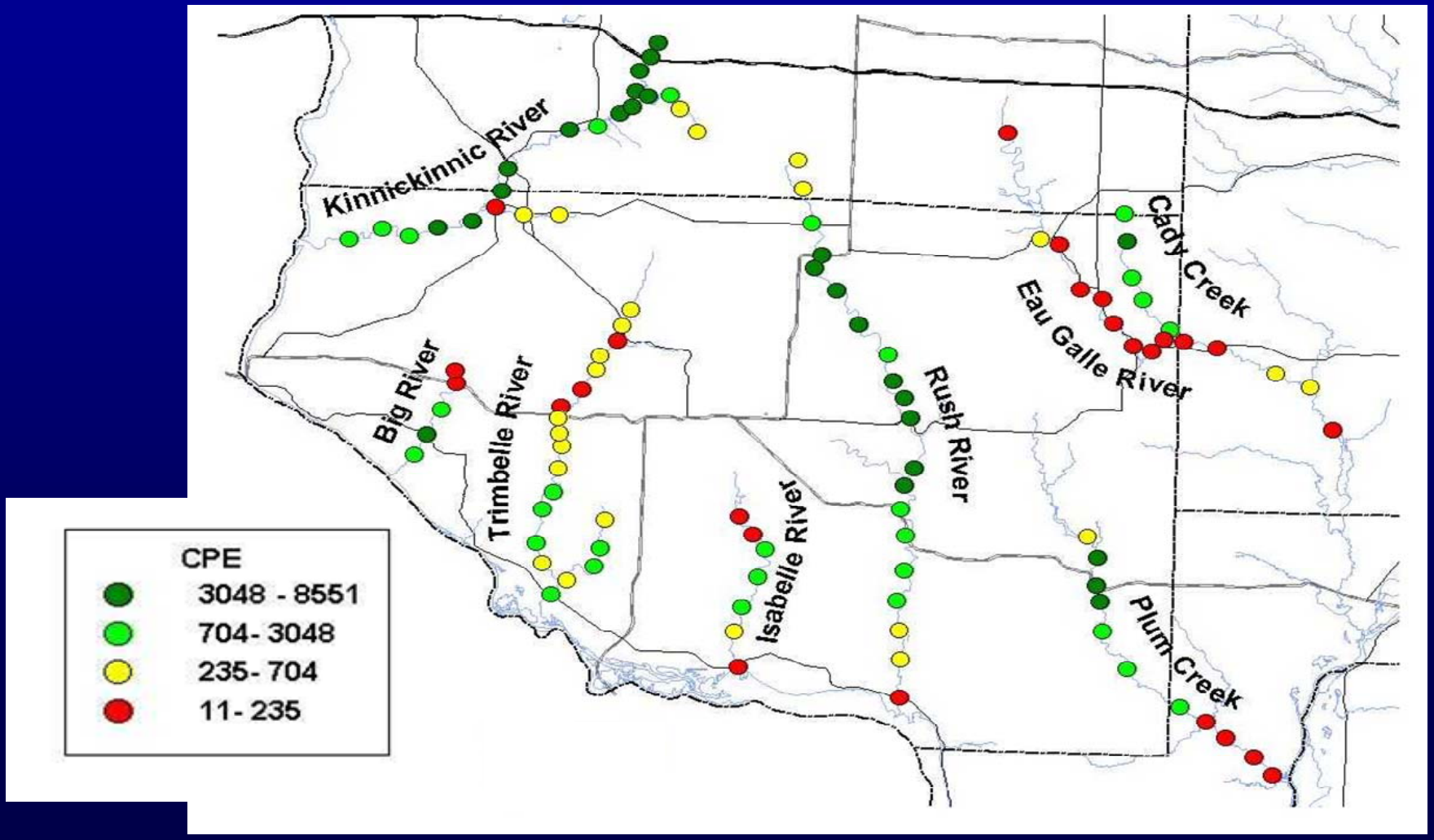
- **Tier 1:** Probabilistic broad-scale status & trends
- **Tier 2:** Targeted stream-specific assessment / problem identification
- **Tier 3:** Targeted program or management evaluation (e.g. before-after studies)

Tiers 2 & 3 Sampling:

- Targeted
- Watershed or stream-specific
- Increased sampling intensity:
  - Spatial
  - Temporal
  - More parameters / site

Tier 2 Example:

County – wide trout catch per effort (CPE) census (?) survey



Tier 3 Example: Management Evaluation

Elk Creek, Vernon Co., WI (Before)

Elk Creek (during channel reconstruction)

Summary:

- Given vast aquatic and finite ($) resources, data needs must be clearly defined and prioritized.
- Probabilistic sampling has recently been incorporated in WI, and will improve the accuracy of the characterization of the State's aquatic resources.
- A multi-tiered sampling approach can provide data for both local and broad-scale assessments, to address a range of resource management issues.

Questions?