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 x $10^{15}$ Gallons Groundwater
Geologic Setting
(the template for WI streams)
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
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:

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)
Pilot Probabilistic Study
REMAP 2003
Target Population:
3,560 Wadeable streams
8,840 stream miles

Sample Population:
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)

Scores > 1
Significant Risk to Biota
Probabilistic Studies:
WI-REMAP and NWSA

Fish IBI Ratings
- excellent
- good
- fair
- poor

Fish IBI Scores

REMAP NWSA

[Box plot showing distribution of Fish IBI Scores]
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?