Developing a regional and landscape ecology-based science PROGRAM to support management of aquatic resources:
thoughts from the Michigan Rivers Inventory mafia...

Paul Seelbach, USGS GLSC, formerly MI DNR Institute for Fisheries Research

Kevin Wehrly, MI DNR Institute for Fisheries Research

ELOHA

1. Reference flows

2. River types

3. Degree altered

4. Ecological responses

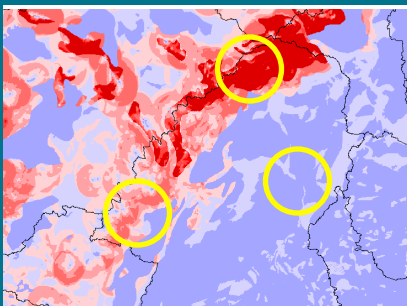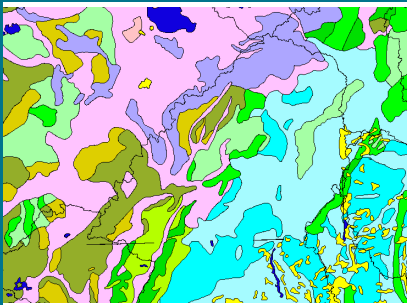5. Ecological targets

6. E-flow targets

7. Implement program

MRI

1. Landscape ecology approach

2. Regional databases

3. Relationships & predictive models

4. Choosing & delineating spatial units; experts

5. Component & system classifications; experts

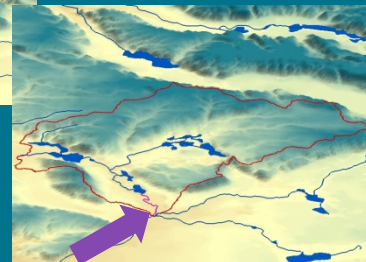6. Management applications

7. Key ingredient: collabortion

1. Landscape ecology approach

Object of study = regional "set" = **<u>all</u>** streams or lakes
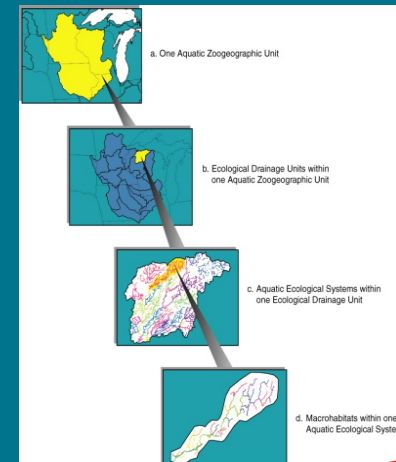Think systems, processes, hierarchy, landscape context
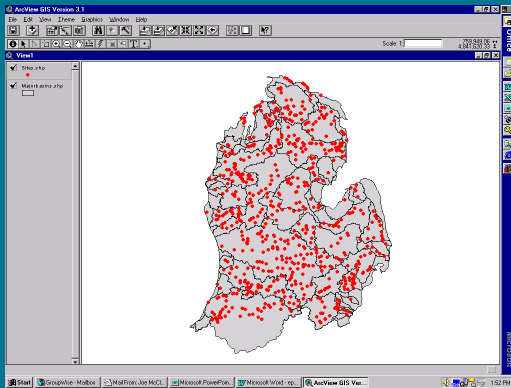
Historic View of "Habitat"

Catchment summaries

Riparian buffer
summaries

a. One Aquatic Zoogeographic Unit

b. Ecological Drainage Units within
one Aquatic Zoogeographic Unit

c. Aquatic Ecological Systems within
one Ecological Drainage Unit

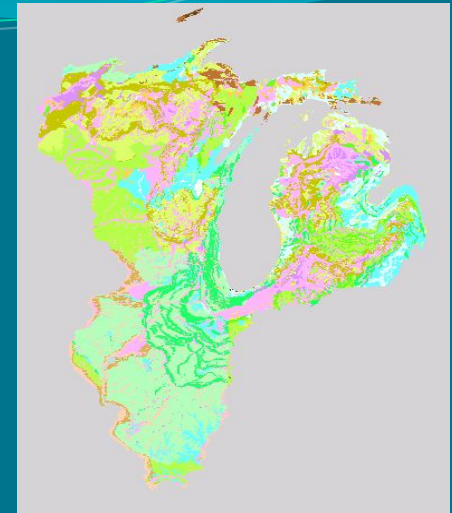d. Macrohabitats within one
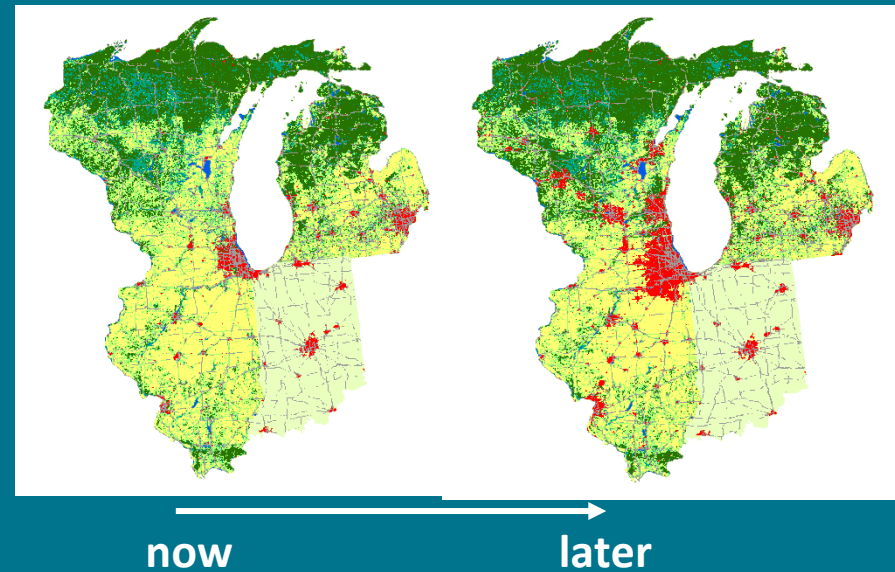Aquatic Ecological System

NHD+ Reach

2. Regional databases

Sampled sites; predicted units

Regional consistency, x-walking, & coverage
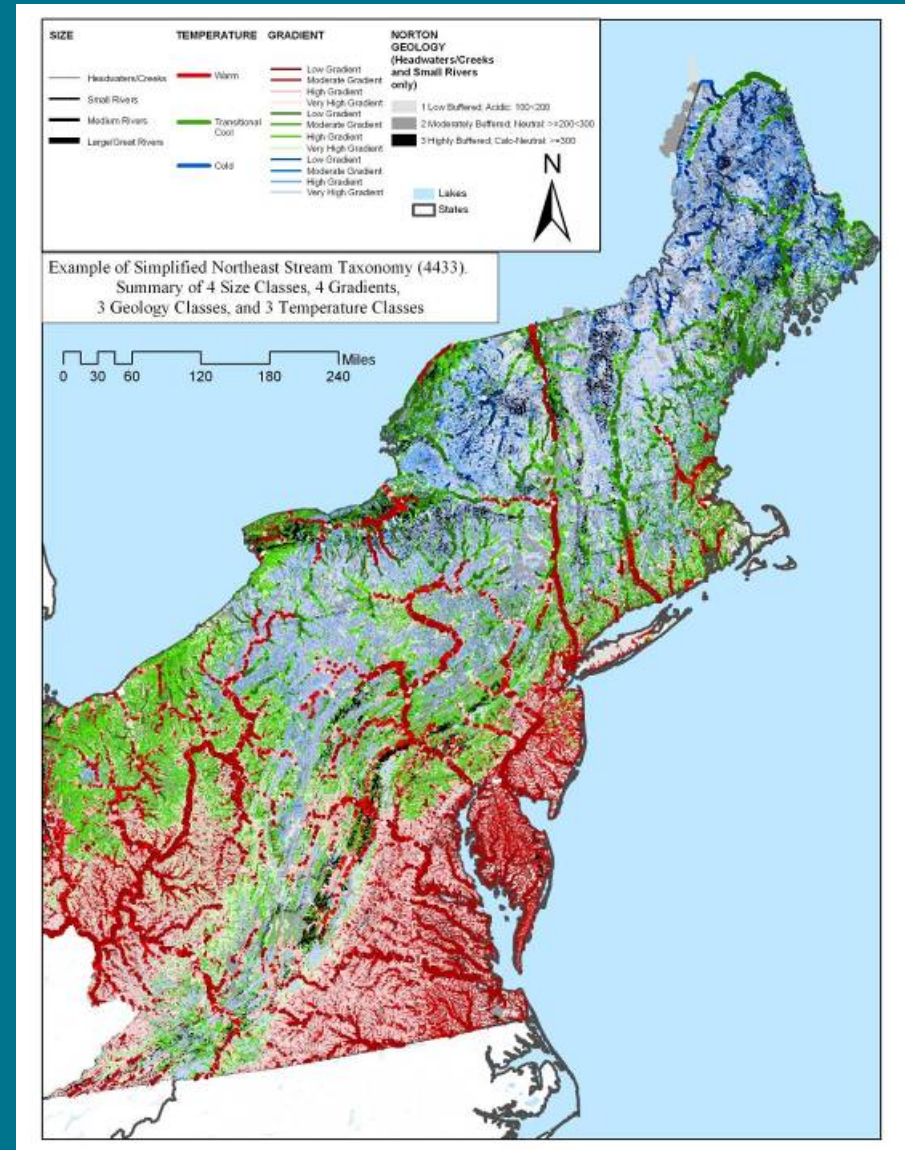

**Flow yields
Temperature
Fishes
IBIs
Nutrients
Stressors
Current land cover
Alternate scenarios**

now   later

2. Regional databases

Olivero reach database for NEast

Example of Simplified Northeast Stream Taxonomy (4433).
Summary of 4 Size Classes, 4 Gradients,
3 Geology Classes, and 3 Temperature Classes

3. Relationships and predictive models

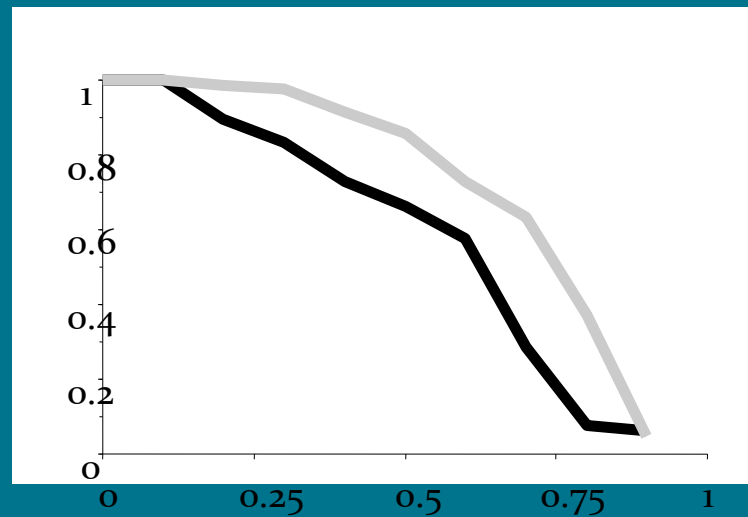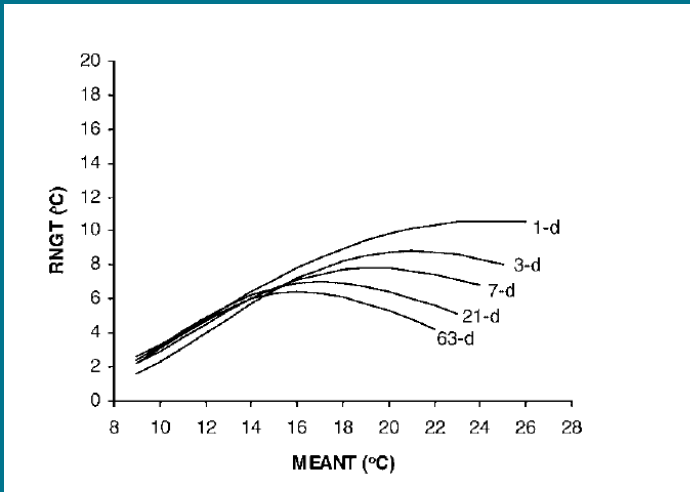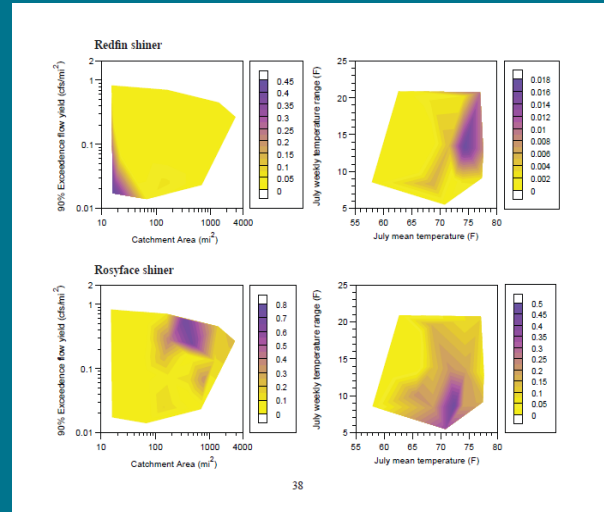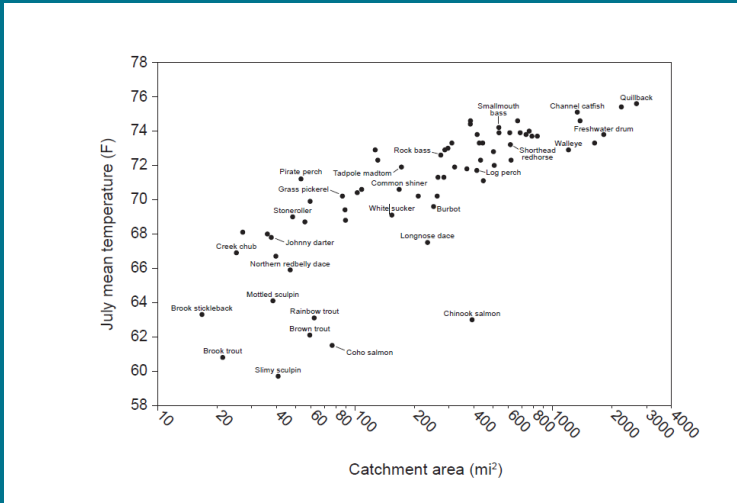Per reach unit. Apply to all reach units. Already second/third generations.
Estimate expectations or reference. Creates comprehensive NEW landscape mosaic. Philosophy of "multi models".

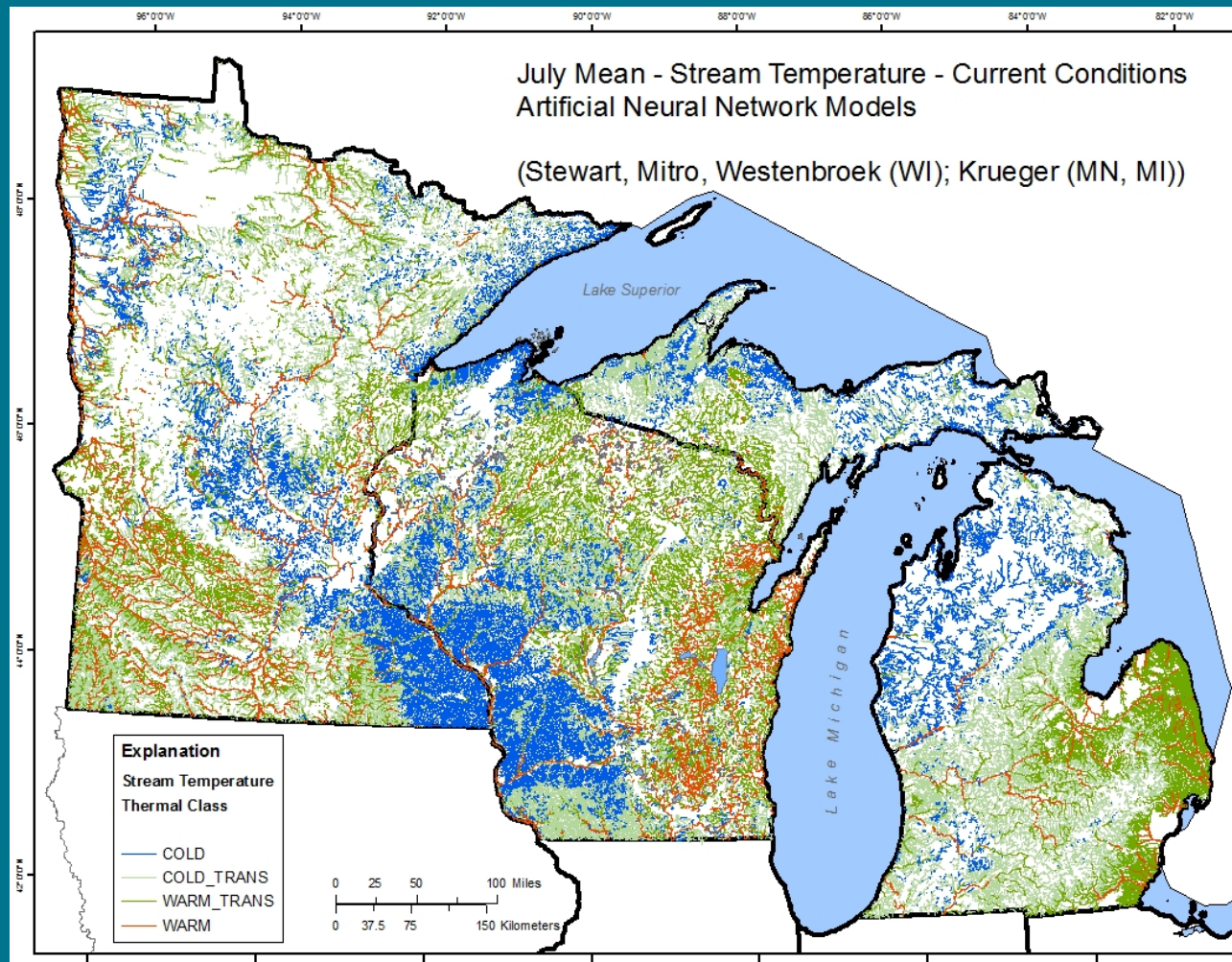Flows. State regressions. MA estimator. AFINCH for GL Basin.

Fish. State regressions. GL GAP regression trees and neural nets. NE = target fishes?

Temperature. State regressions, regression trees, GL GAP neural nets. Jana..

3. Relationships and predictive models

3. Relationships and predictive models

July Mean - Stream Temperature - Current Conditions
Artificial Neural Network Models
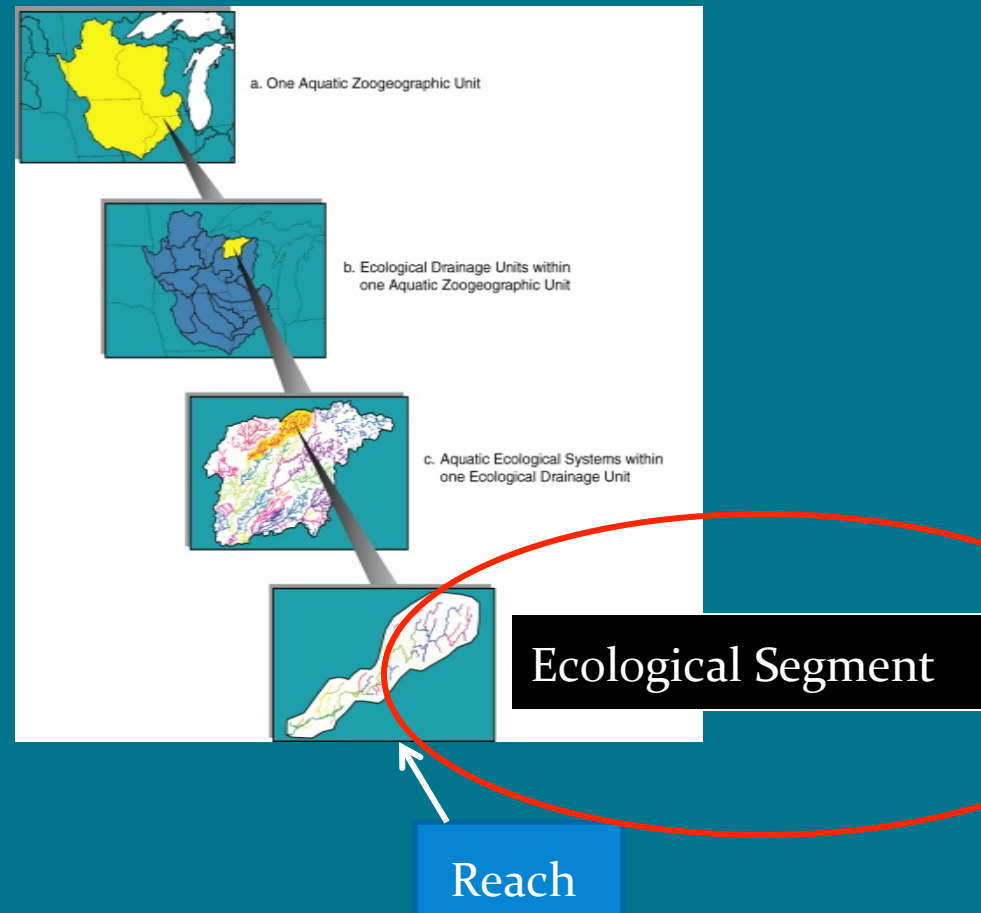
(Stewart, Mitro, Westenbroek (WI); Krueger (MN, MI))

4. Choosing and delineating spatial units; experts

Ecological segments are the key spatial unit. Rolled up from like neighbor reach attributes. 6,000 units from original 30,000.
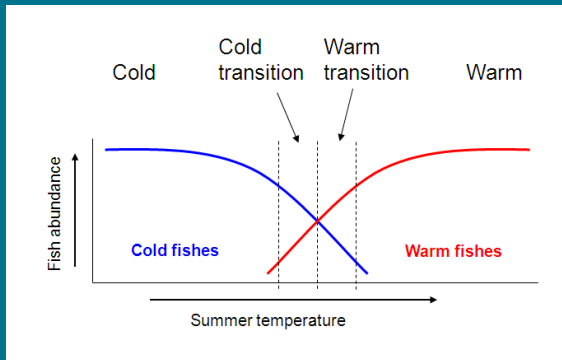
Relatively homogenous hydro-geomorph-thermal-fish units.
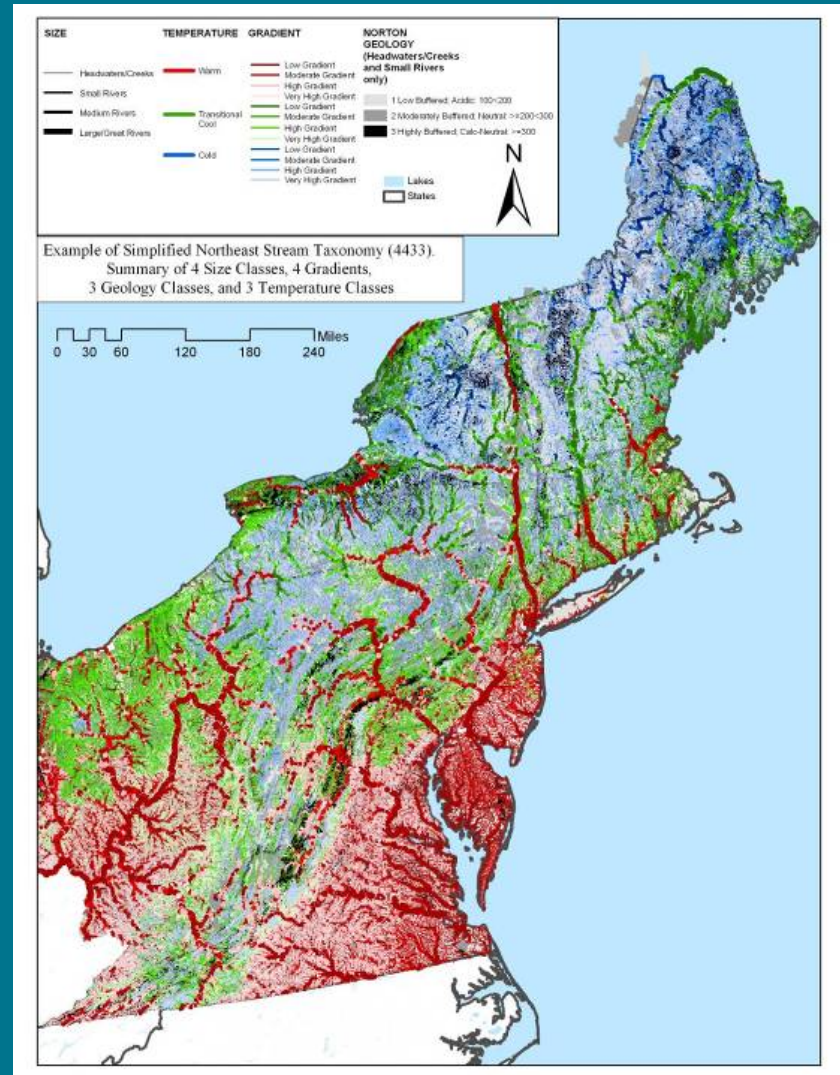
Seelbach et al. 2006. Brenden et al. 2010. Gets you 70% home; still need expert revision.

a. One Aquatic Zoogeographic Unit

b. Ecological Drainage Units within one Aquatic Zoogeographic Unit

c. Aquatic Ecological Systems within one Ecological Drainage Unit

Ecological Segment

Reach

5. Component and system classifications; experts

Example of Simplified Northeast Stream Taxonomy (4433). Summary of 4 Size Classes, 4 Gradients, 3 Geology Classes, and 3 Temperature Classes

MI experts altered 30% of segment class predictions

6. Management applications

Aquatic Ecosystem Toolkit services all aquatic management disciplines:

Water quantity
Water quality
Fisheries
Biodiversity Conservation
Vulnerability Assessment

MI Water Withdrawal Assessment Process and Screening Tool

6. Management applications

Toolkit services all aquatic management disciplines:
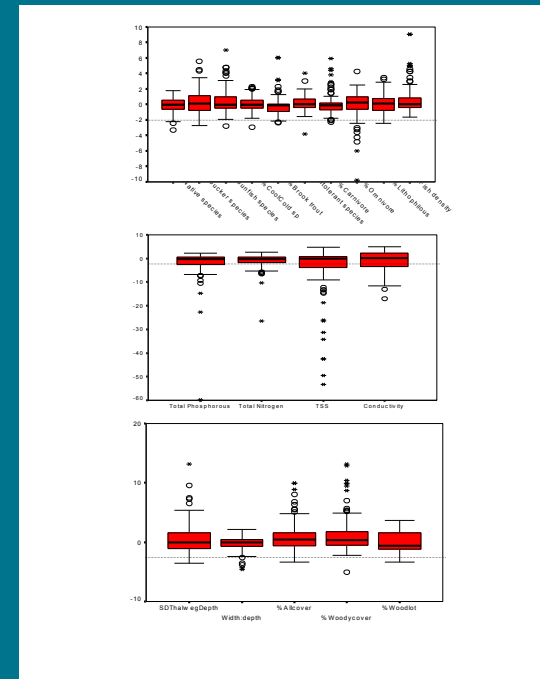### Water quantity
Water quality
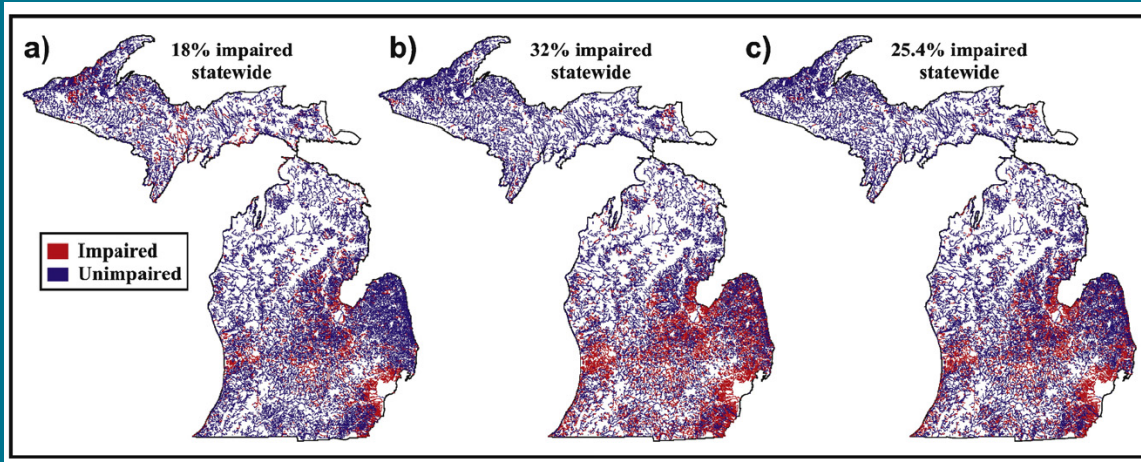### Fisheries
Biodiversity Conservation
Vulnerability Assessment

Northern Lakes and Forests

6. Management applications

Aquatic Ecosystem Toolkit services all aquatic management disciplines:
  Water quantity
  Water quality
  Fisheries
  Biodiversity Conservation
  Vulnerability Assessment

Stratification for DNR fish S&T Surveys for streams and lakes (also coordinated with DEQ biological surveys)
Potential for stocking, regulations, etc.

6. Management applications

Aquatic Ecosystem Toolkit services all aquatic management disciplines:
> Water quantity
> Water quality
> Fisheries
> **Biodiversity Conservation**
> Vulnerability Assessment

Basis for MI Wildlife Action Plan; second generation.
GL Aquatic GAP (McKenna)

6. Management applications

Toolkit services all aquatic management disciplines:
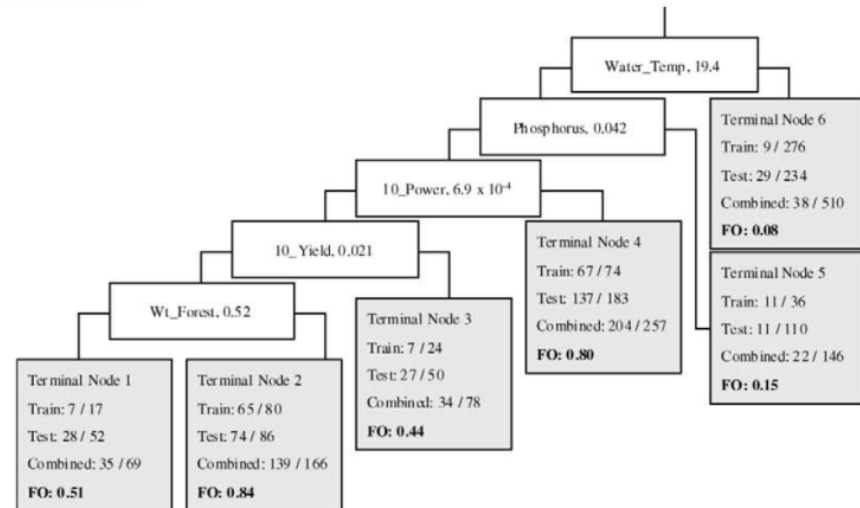- Water quantity
- Water quality
- Fisheries
- Biodiversity Conservation
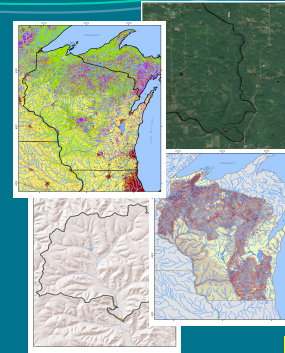- **Vulnerability Assessment**

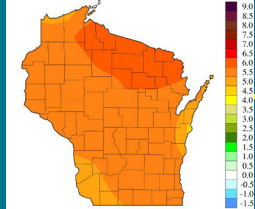a. Brook trout
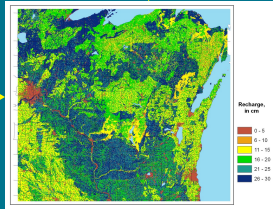
CLIMATE SCENARIOS – A1B Scenario (10 models)

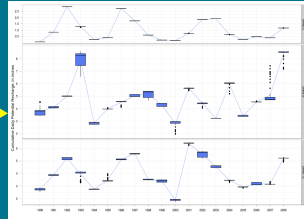**Run SWB**

SWB Clusters
(extract/aggregate values)

Static Landscape Characteristics

Run ANN

Downscaled GCM output
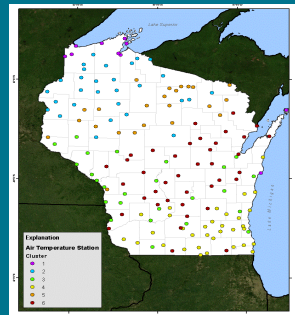
Accumulated Recharge
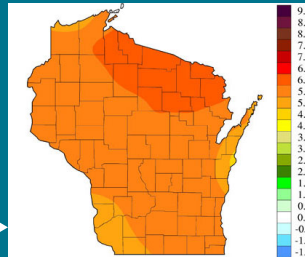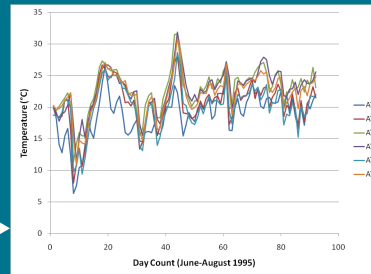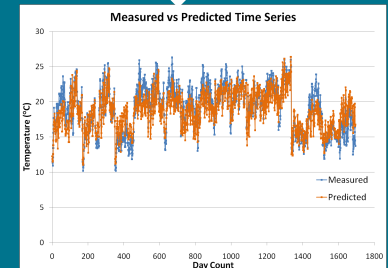
SWB Time Series

Air Temperature Clusters

Downscaled GCM Output

Down-scaled Air Temperature Time Series

Stream temperature climate scenario time series

7. Key ingredient is collaboration

Common agenda

Shared measurement systems

Mutually reinforcing activities

Continuous communication

Backbone support organization

"Collective Impact" (Stanford Social Innovation Review) – required conditions