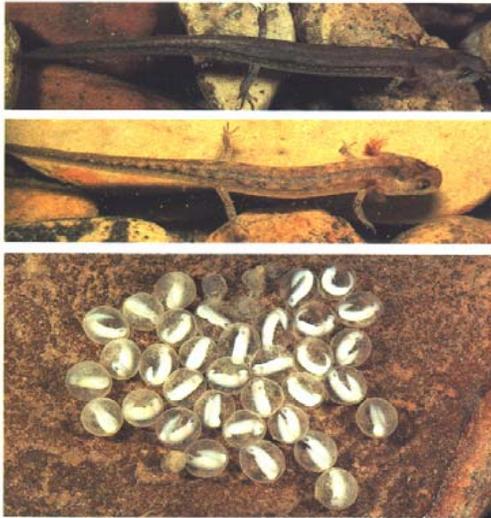




OhioEPA
Division of Surface Water

Headwater Stream Initiative



- Robert D. Davic
- Steve Tuckerman
- Paul Anderson
- Mike Bolton



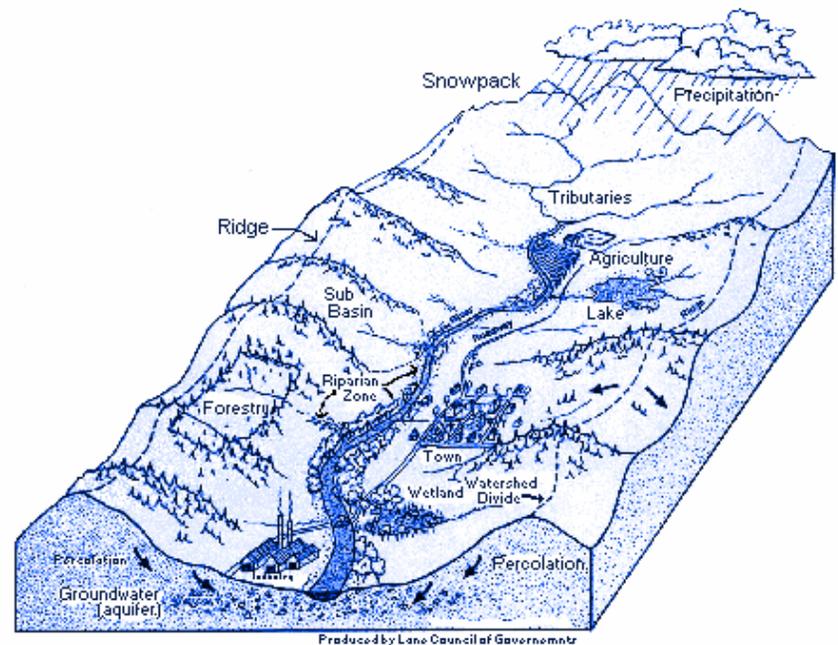
Why are headwater streams important?

- The most prevalent form of stream in the state, with over 115,000 miles estimated to exist (vs. 21,000 miles of named streams).
- Provide habitat for native fauna well adapted to headwater stream conditions.
- Important in the assimilation of pollutants and storage of runoff and flood waters.
- The “capillaries” of the state’s stream network.



Federal Clean Water Act

- The Clean Water Act provides authority for states to issue water quality standards and “designated uses” to all waters of the United States upstream to the highest reaches of the tributary streams.
- Source: Memorandum dated January 19, 2001, General Counsels of USEPA and US Army corps of Engineers



Ohio EPA

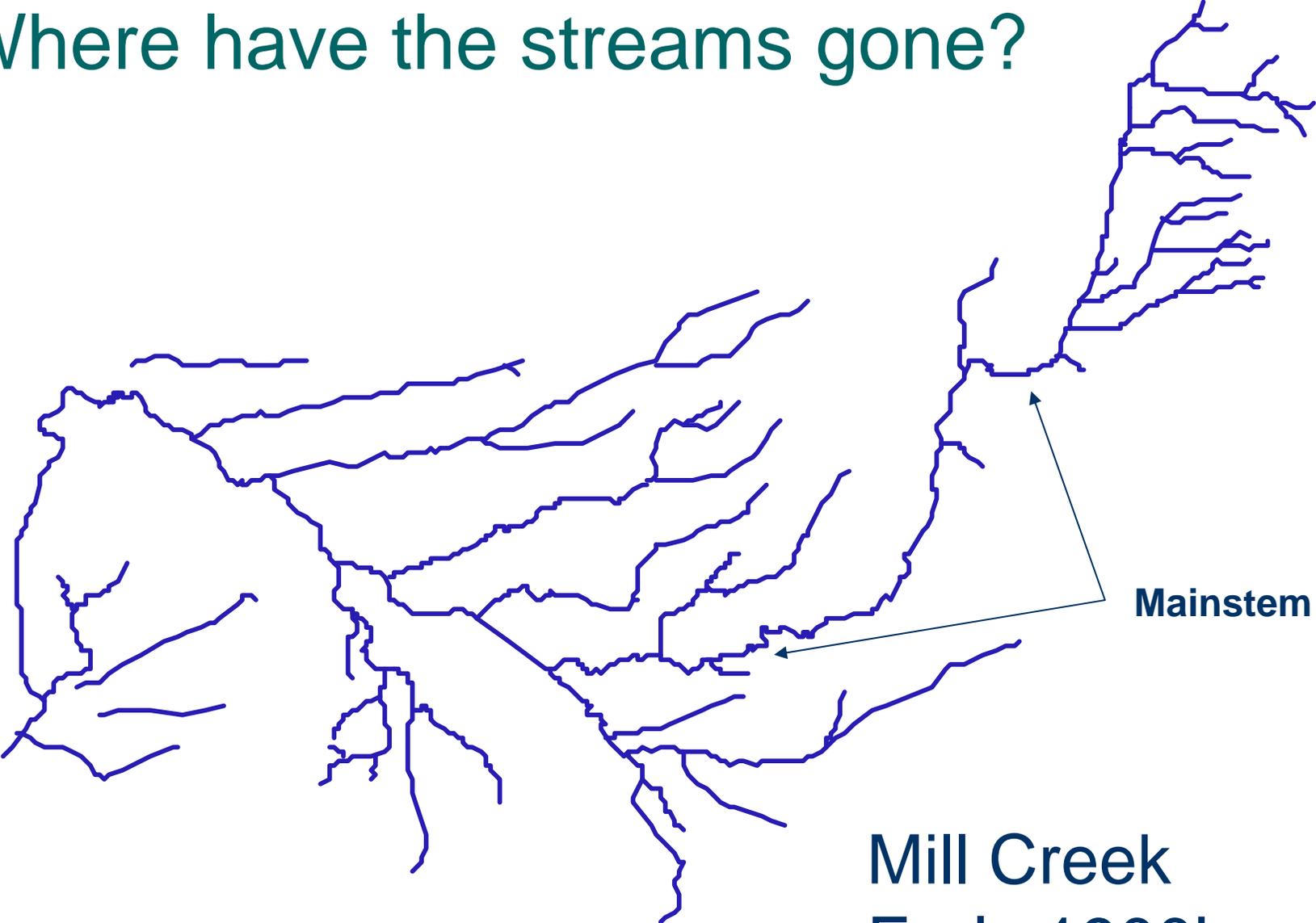
Headwater Stream Initiative

- **Ohio rules require all water bodies to have designated uses.**
[OAC 3745-1-01, OAC 3745-1-07 (A)(1)]
- **Current stream use designations are inadequate to classify small headwater streams.**
- **Since 1999 research has been conducted to determine appropriate methods for classifying headwater streams.**
- **Data will be used to propose new aquatic life use designations for “primary headwater habitat” streams in Ohio.**

Primary Headwater Habitat Streams

- **Generally < 1 mi² watershed area and pools less than 40 cm in depth.**
- **“Primary headwater habitat” term is used to distinguish from “headwater” fish streams in current use designations (<20 mi²).**
- **Primary headwater habitat (PHWH) streams are incapable of supporting well balanced communities of fish because of their small size and lack of deep pools.**

Where have the streams gone?



Mainstem

Mill Creek
Early 1900's

Where have the streams gone?



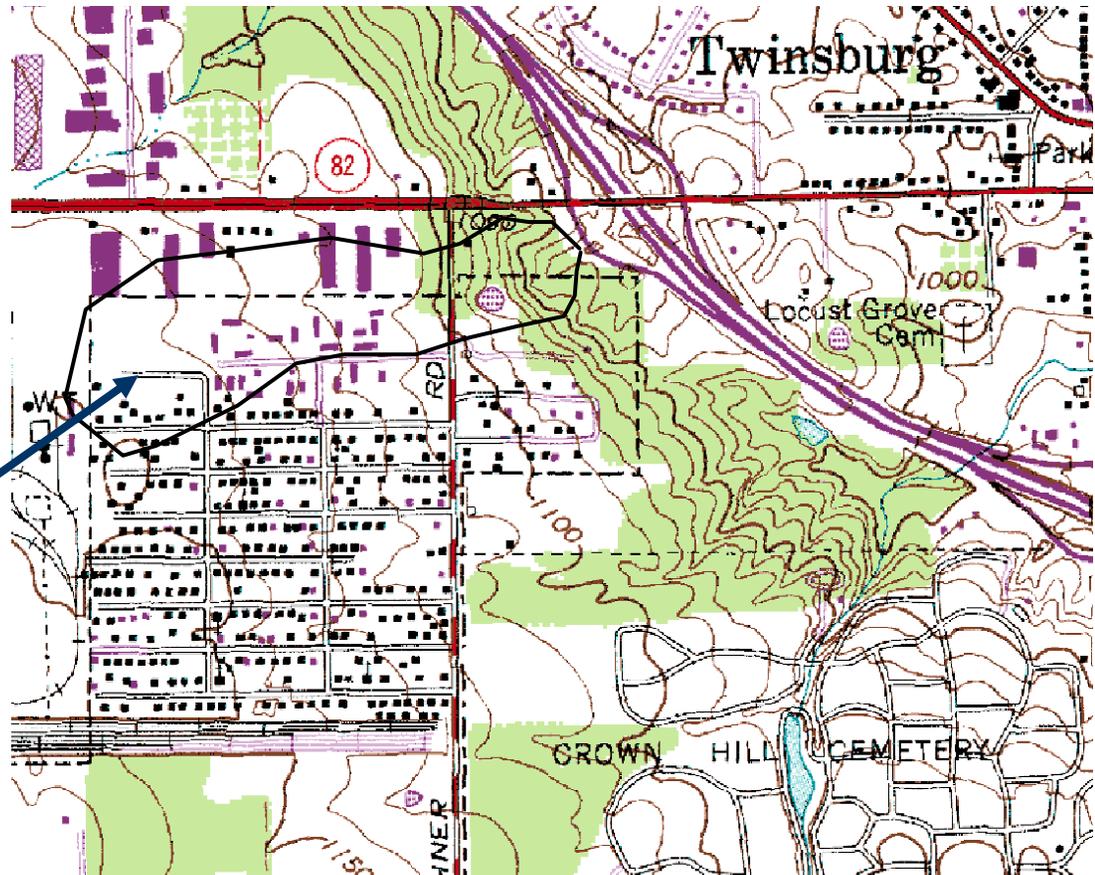
Source: Cuyahoga SWCD

Mill Creek
Present Day

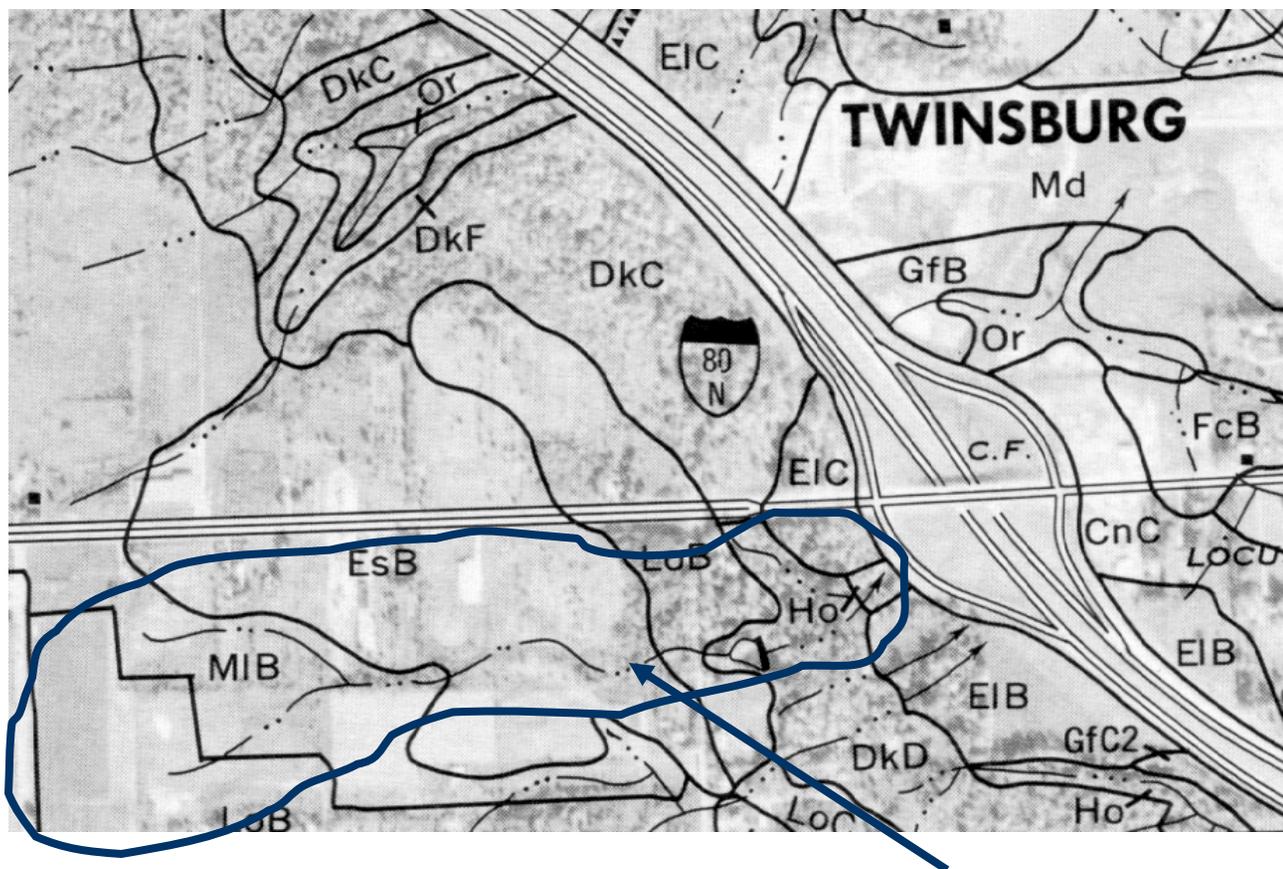
Desktop Headwater Stream Identification

- USGS
1: 24,000
Topographic
Mapping
Scale

0.68 sq. mi.



Desktop Headwater Stream Identification



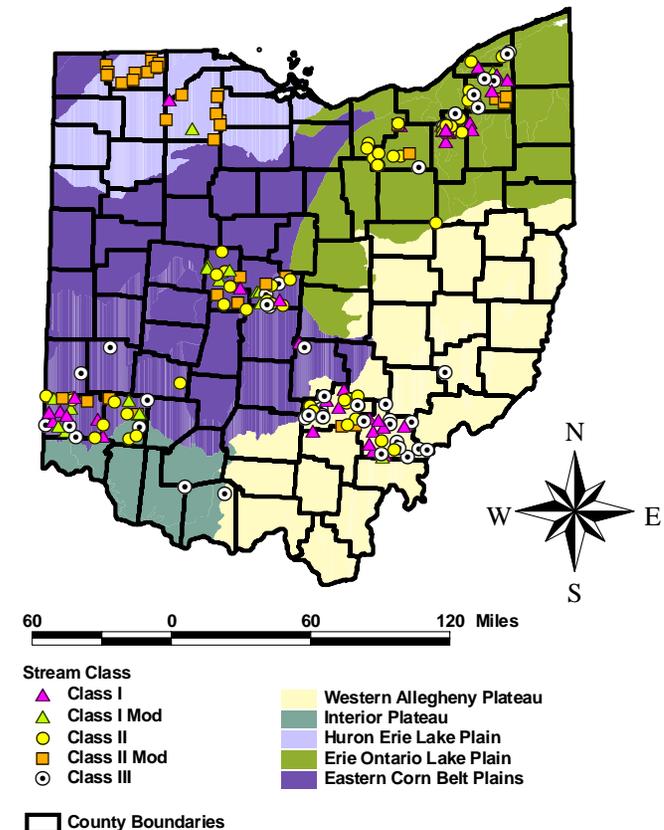
- **NRCS Soil Map including hydro-layer**

Scale Range =
1:15,000 to
1:20,000

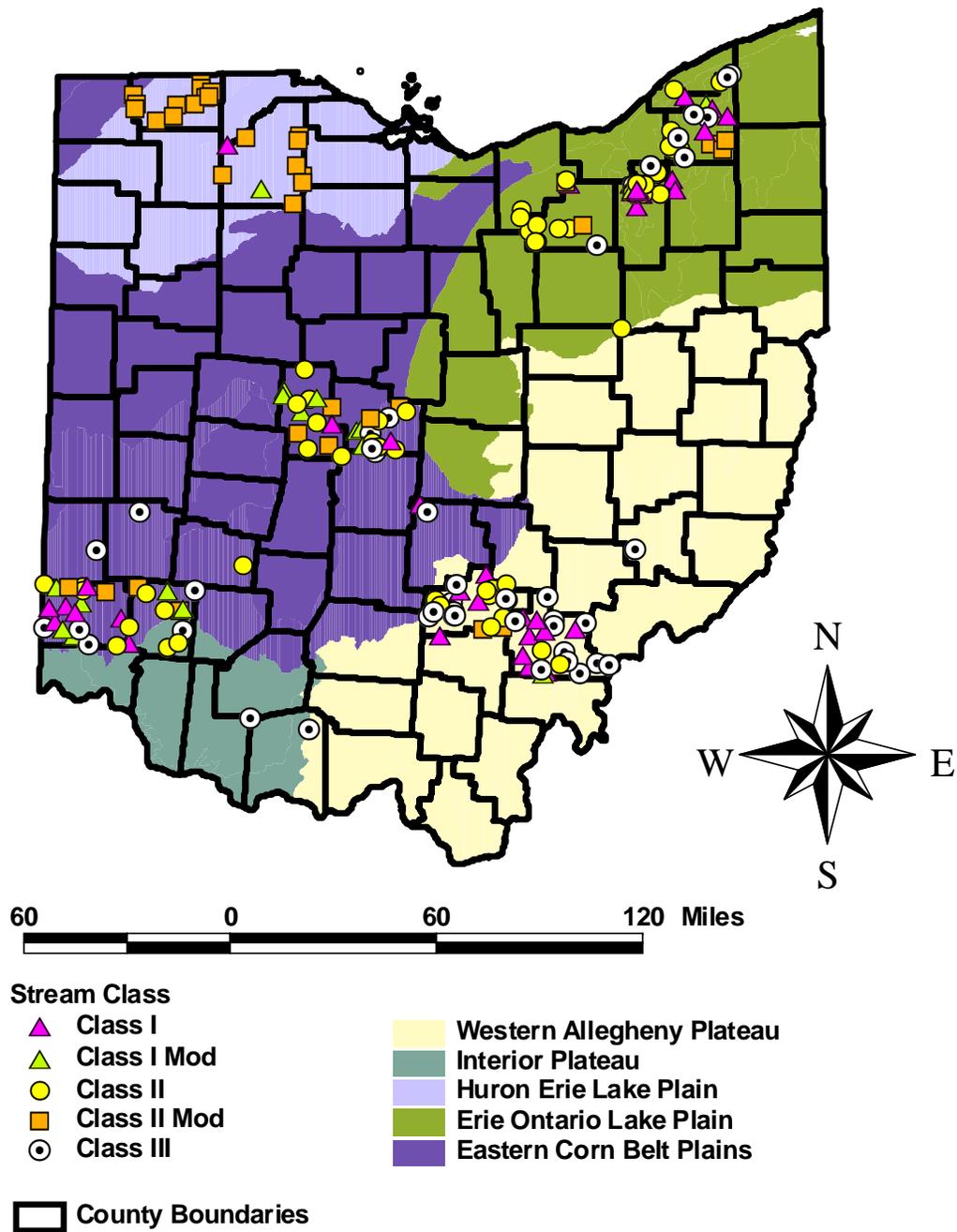
Watershed from previous USGS slide

Primary Headwater Stream (PHWH) Evaluation Methodologies

- An evaluation protocol for PHWH streams was developed in 1999.
- A total of 305 sites were sampled by the Ohio EPA in 1999-2000. Quarterly biological monitoring of reference sites was also conducted.
- Randomized sampling of five geographic areas was conducted in 2000 to estimate the distribution of different types of headwater streams in the state.



PHWH Survey Sites 1999-2000



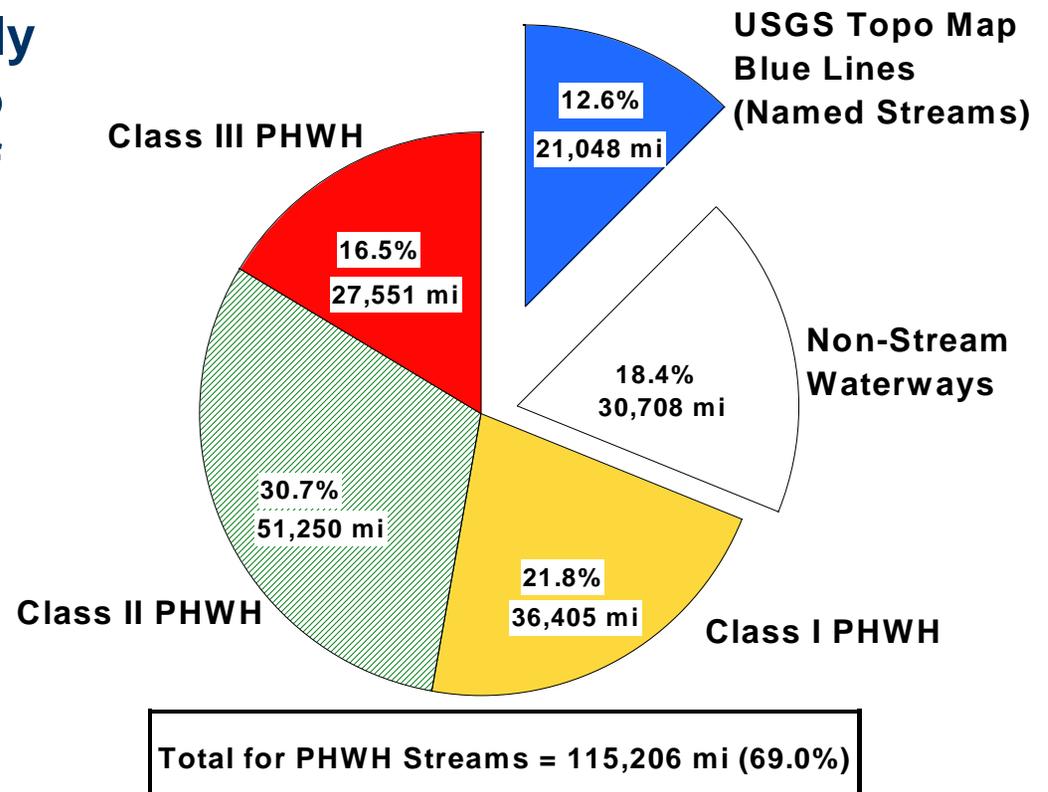
Study Design: Field Evaluation

- **Biology:**
 - Fish
 - Macroinvertebrates
 - Amphibians
- **Water Quality:**
 - Field measures
(DO,pH,Temp.,Conductivity)
- **Physical and Habitat Features:**
 - 200 foot zone



PHWH Stream Assessment Results

- Sampling of randomly chosen sites used to estimate the miles of various stream categories.
- Ratio of PHWH streams to streams delineated on USGS topo maps = 5.5:1



Class I PHWH Streams

- **Ephemeral Flow.** Dry channel present annually.
- **Aquatic life absent or present seasonally - low diversity.**



Natural channel, Geauga Co.



Modified channel, Delaware Co.

Class II PHWH Streams

- Warmwater adapted community.
- Flow may be intermittent.
- Permanent pools present annually.



Modified channel, Delaware Co.



Natural channel, Geauga Co.

Class III PHWH Streams

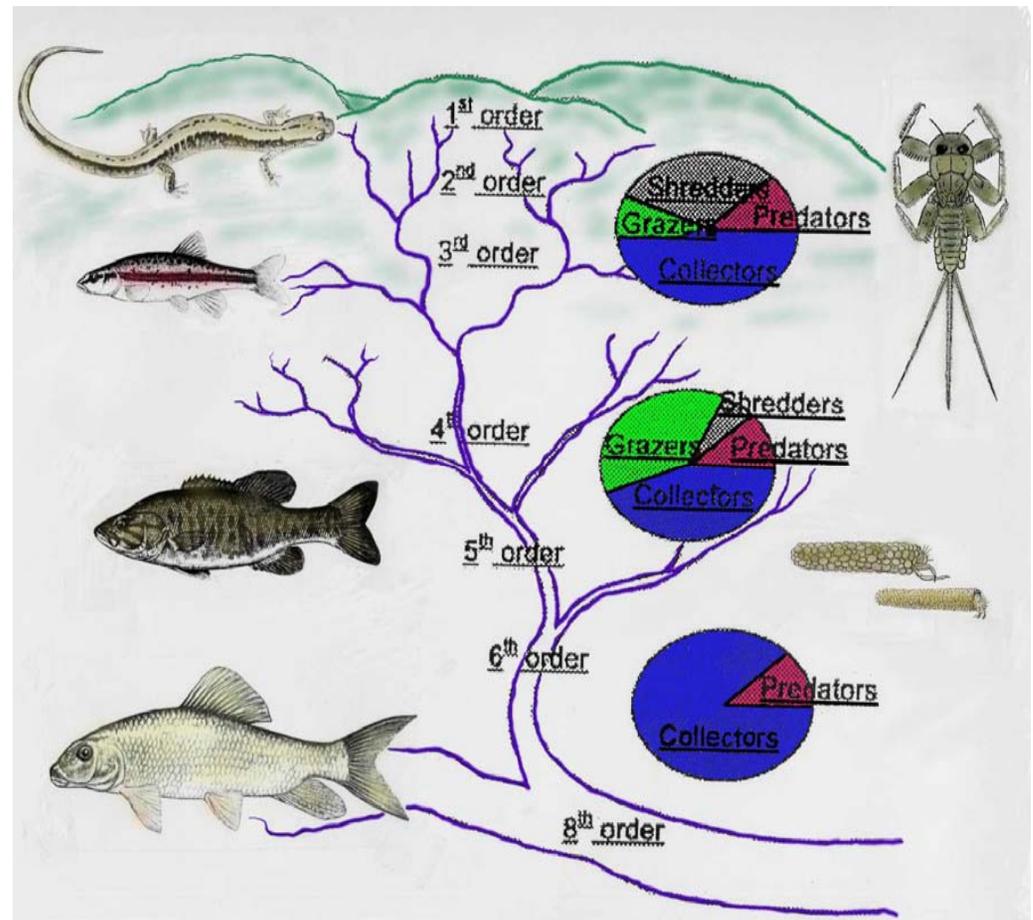
- **Perennial flow.**
- **Presence of one or more of the following at all times:**
 - **Obligate aquatic salamanders**
 - **Cold water or pioneering fish species**
 - **Cool water adapted benthic macro-invertebrates.**



Delaware Co.

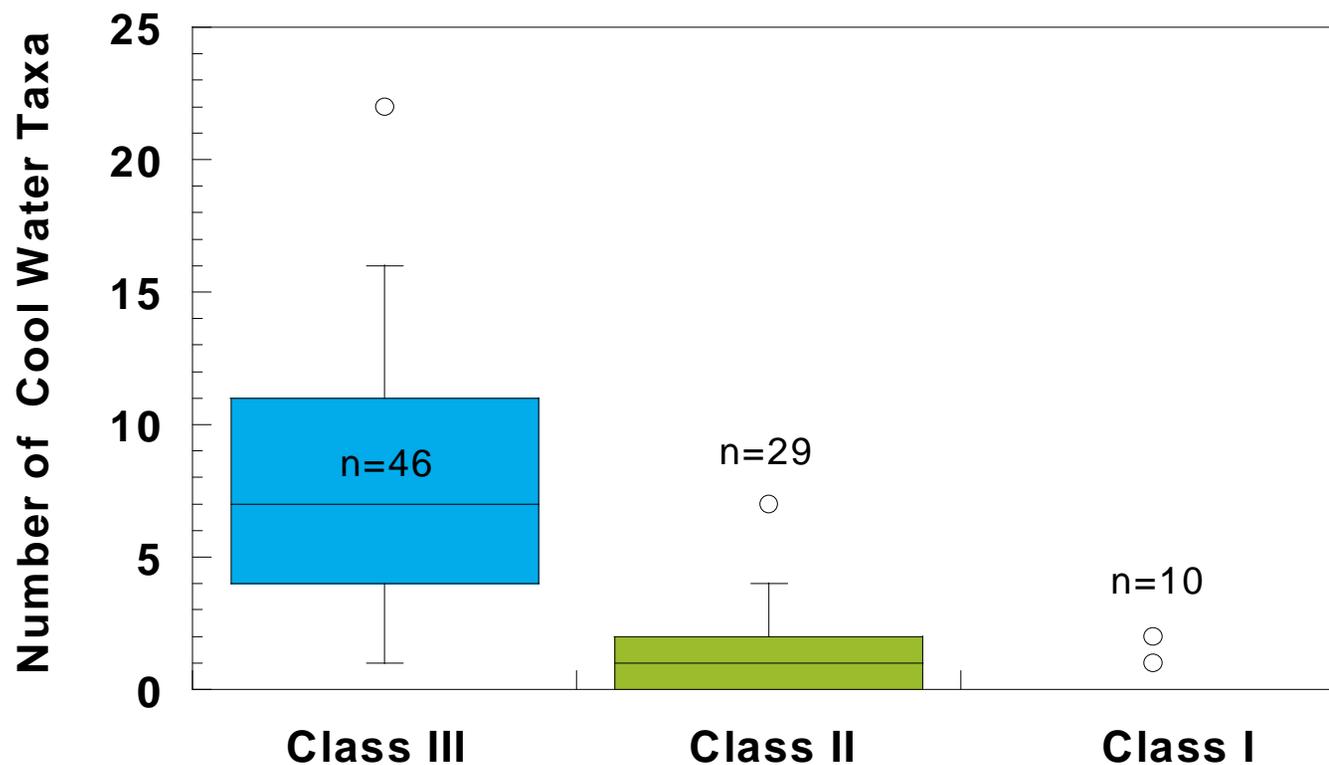
River Continuum Concept

- Salamanders replace fish as the top vertebrate predator in primary headwater streams.
- Shredder functional group of benthic invertebrates is most common in primary headwater streams.



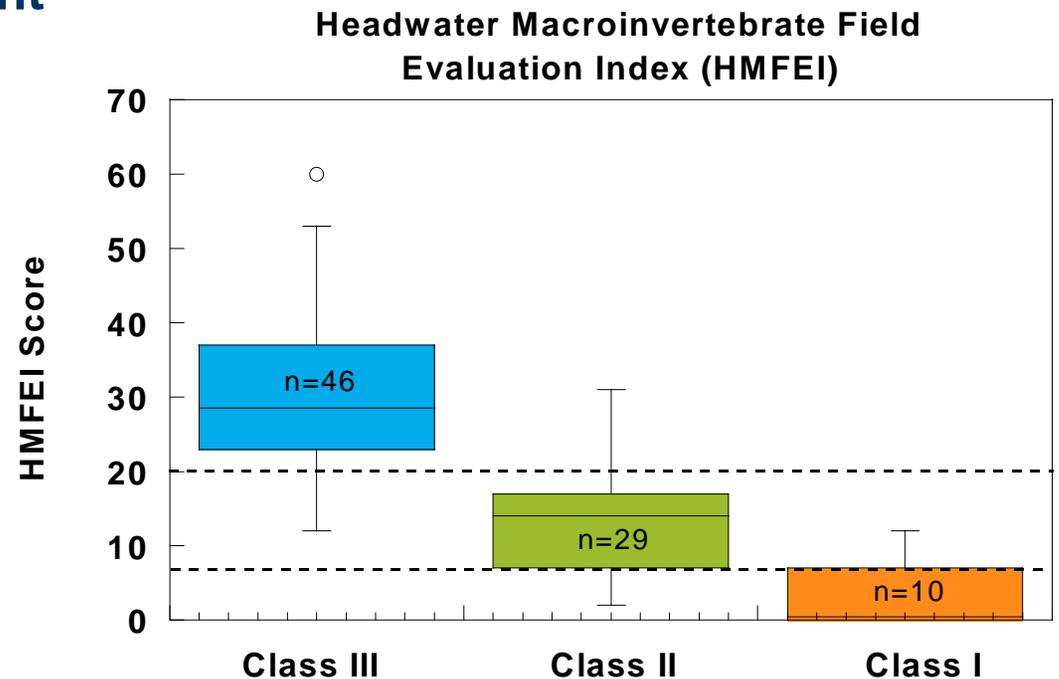
Results: Benthic Macroinvertebrates

Two distinct macroinvertebrate communities:



Results: Headwater Macroinvertebrate Field Evaluation Index (HMFEI)

- Rapid field assessment methodology based upon Family or Order level of taxonomy.
- Scoring based upon correlation to cool water habitats and number of EPT taxa present.
- HMFEI is a surrogate. Final use class based upon identification to species level.



Index developed by Mike Bolton, Ohio EPA Biologist

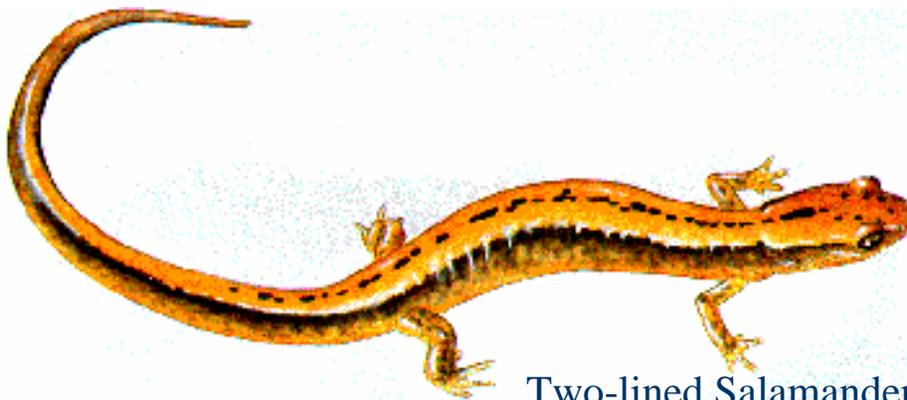
Class III-PHWH Streams: Presence of Obligate Salamanders and/or Cold Water Fish



Copyright: Metro Toronto Zoo

Reside Dace

- Cold water adapted species of fish and/or salamanders are found in Class III headwater streams



Two-lined Salamander

Salamanders Found in Headwater Streams in Ohio

Class III Streams (Gilled larvae present on annual basis)

- Plethodontidae (Lungless)
- Subfamily Plethodontinae:
 - *Gyrinophilus* (2 species)
 - *Pseudotriton* (2 species)
 - *Eurycea* (4 species)

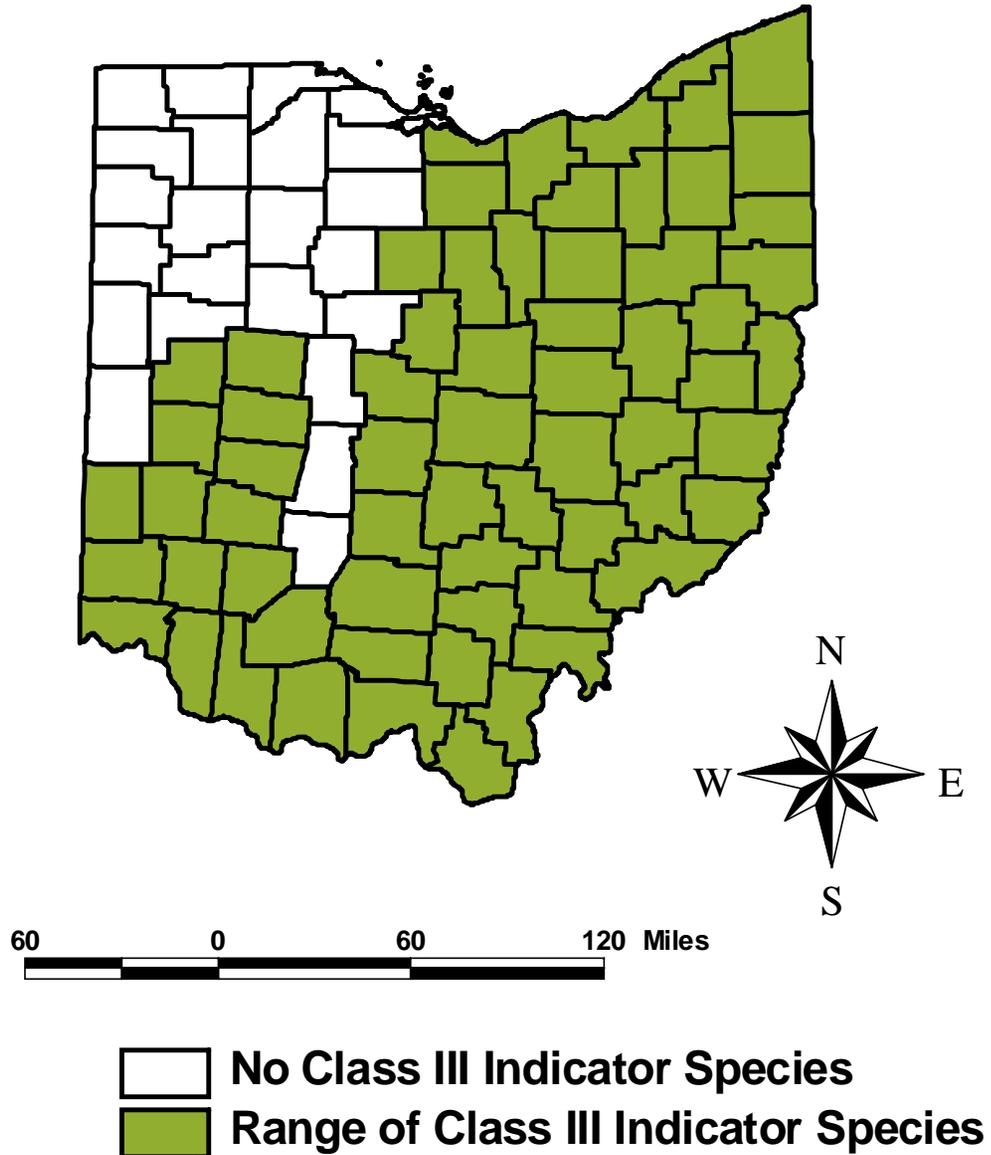


Class II Streams (Gilled larvae present seasonally)

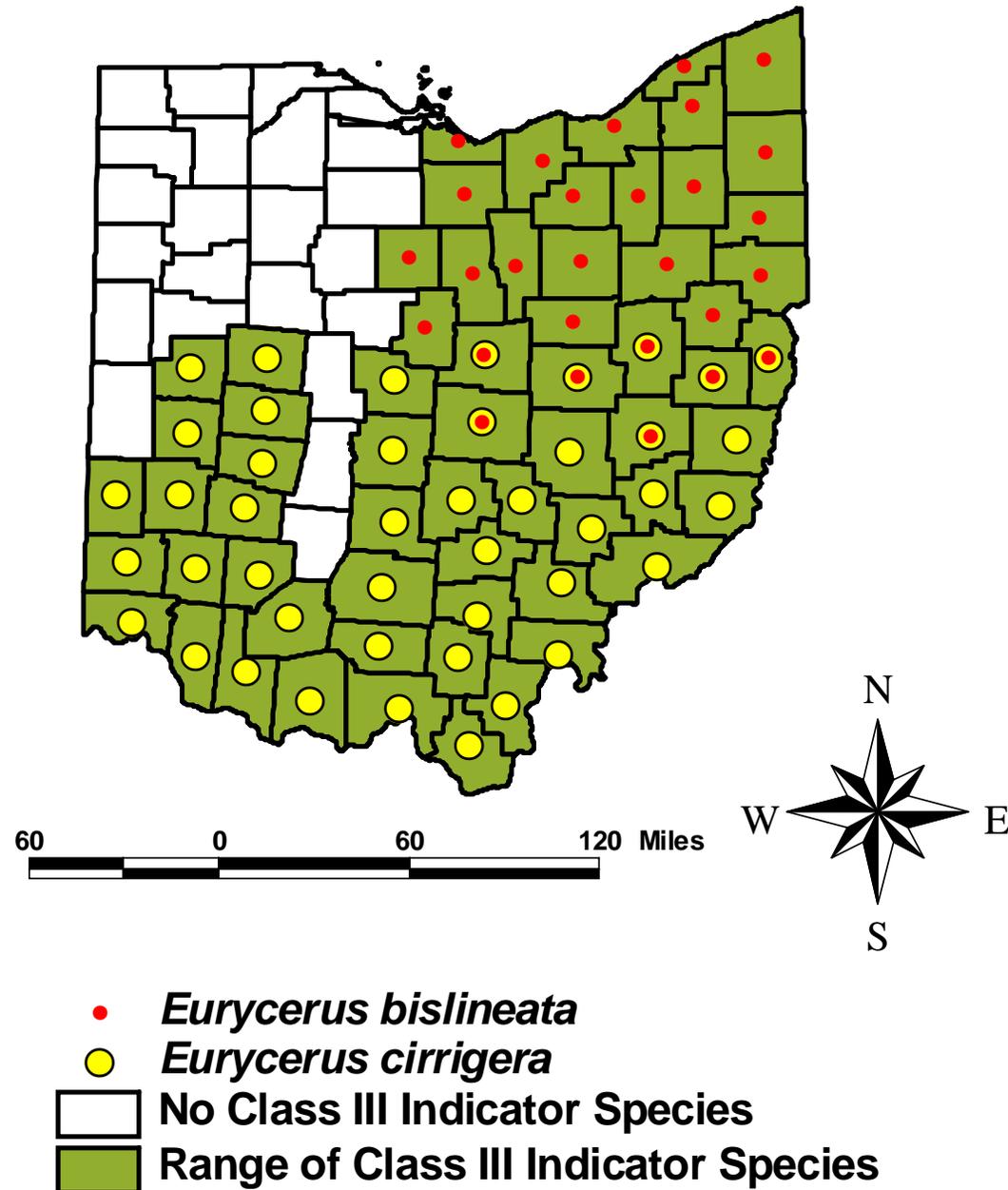
- Ambystomatidae (Mole)
 - *Ambystoma* spp.
- Plethodontidae (Lungless)
- Subfamily Desmognathinae:
 - *Desmognathus* (2 species)



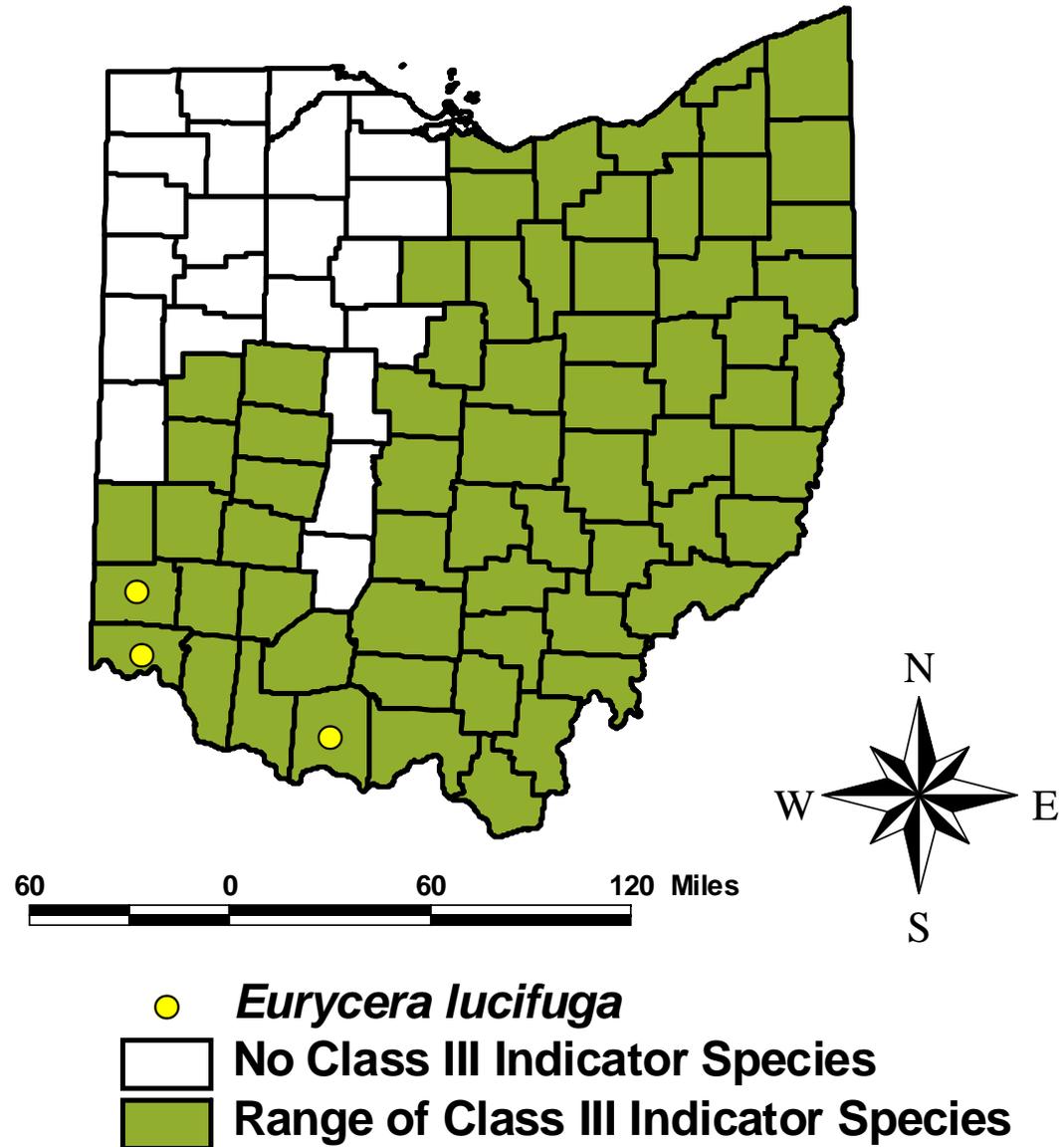
Distribution of Class III PHWH Indicator Salamander Species



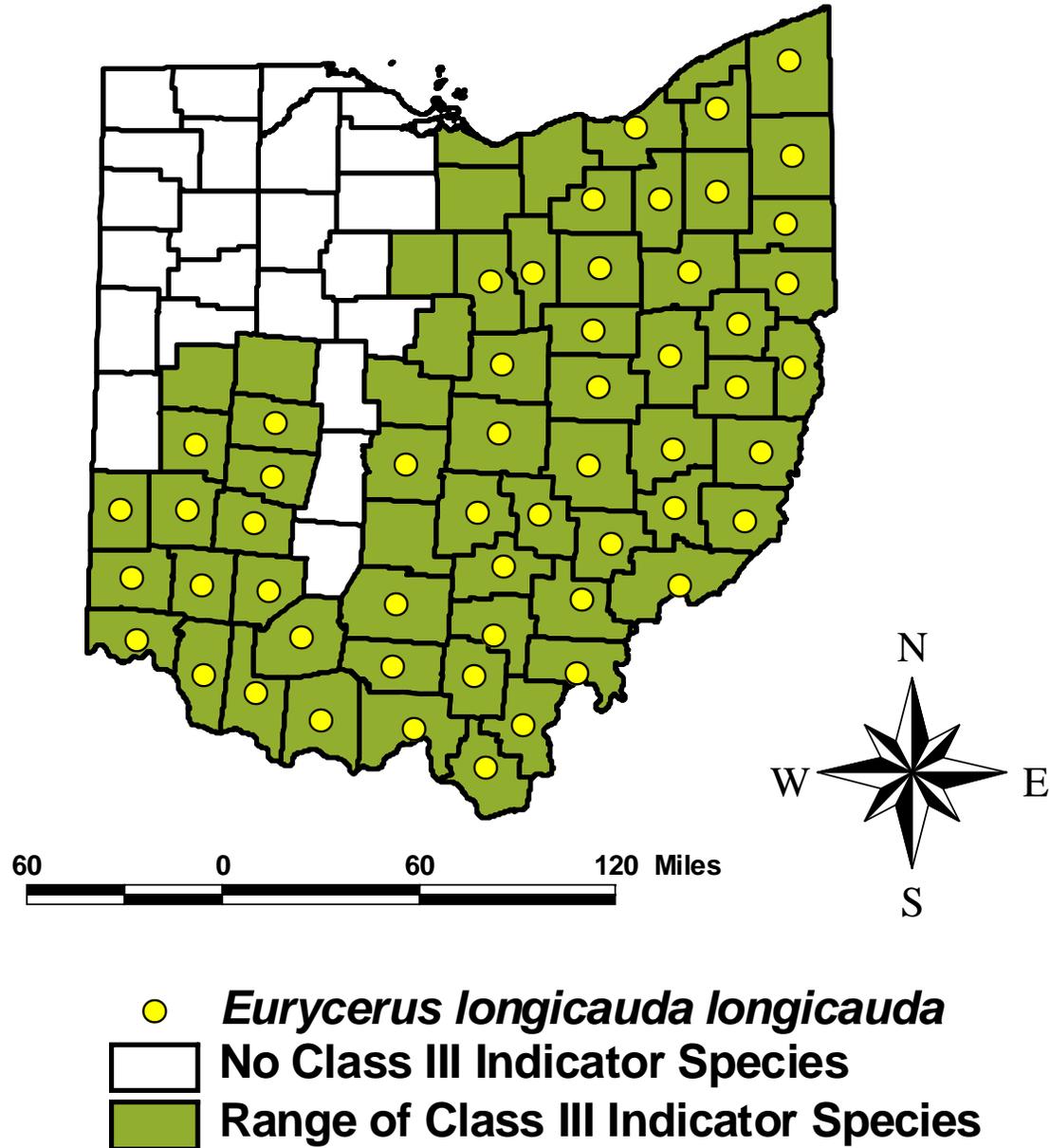
Two-Lined Salamanders



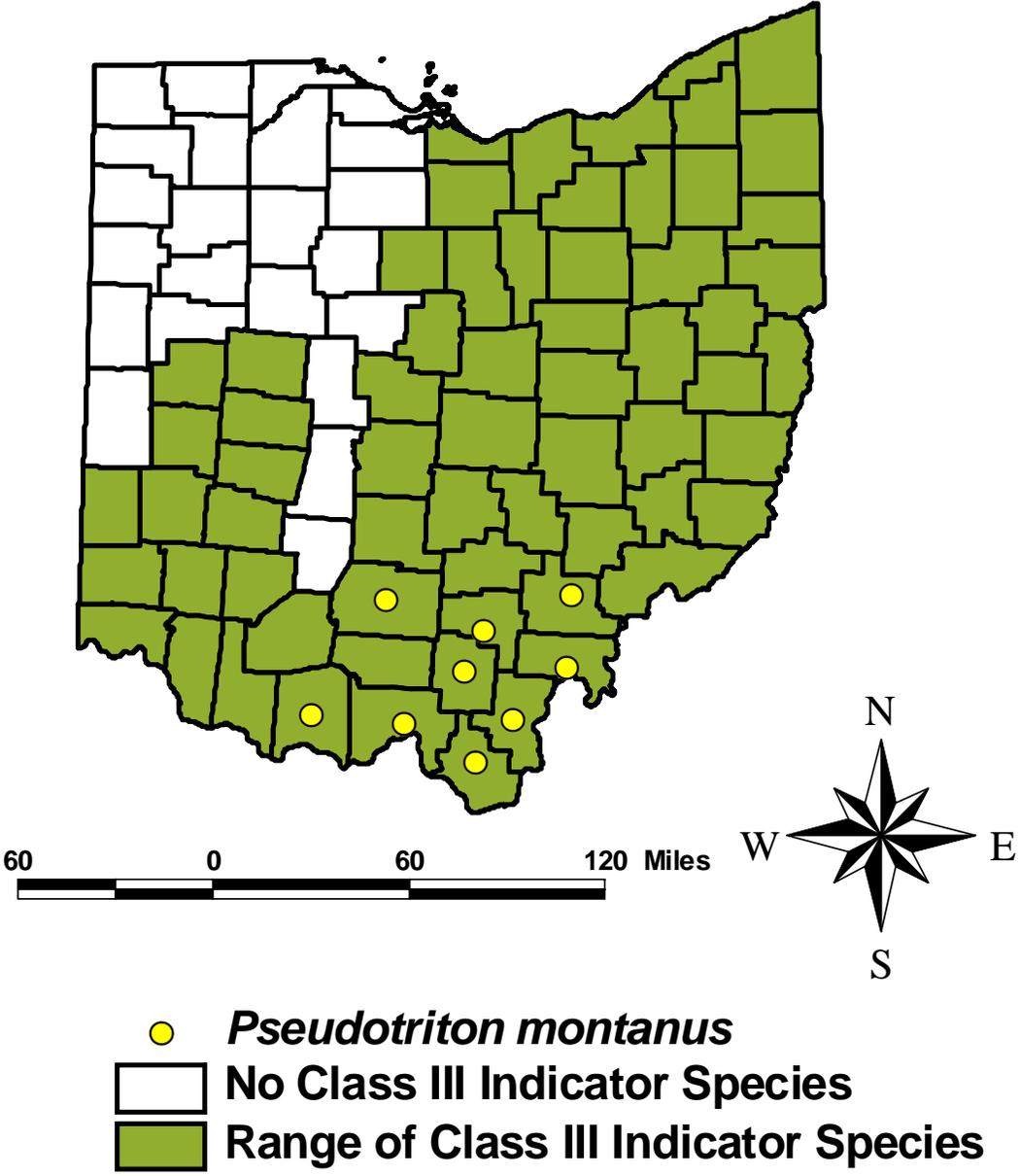
Cave Salamander



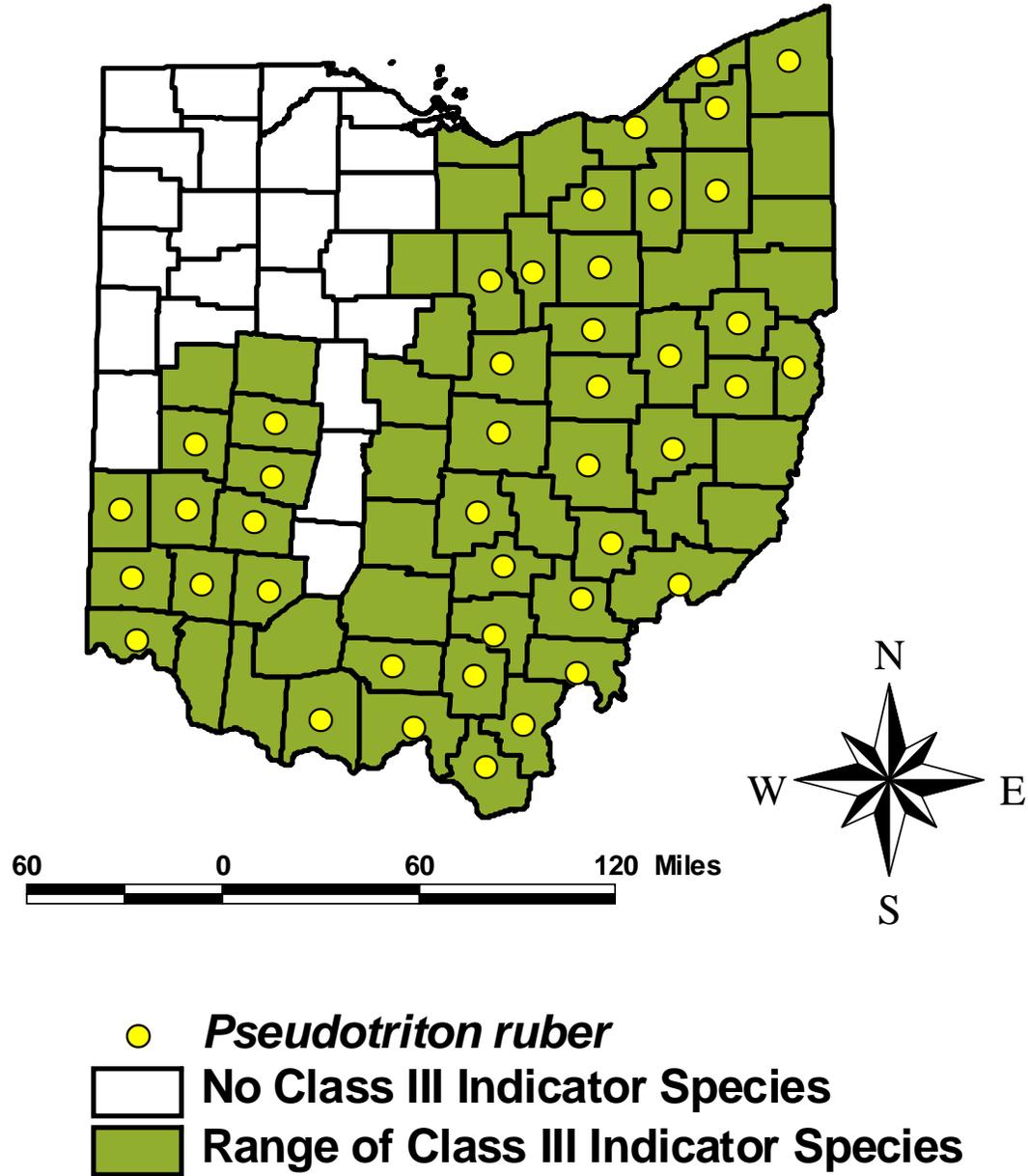
Longtail Salamander



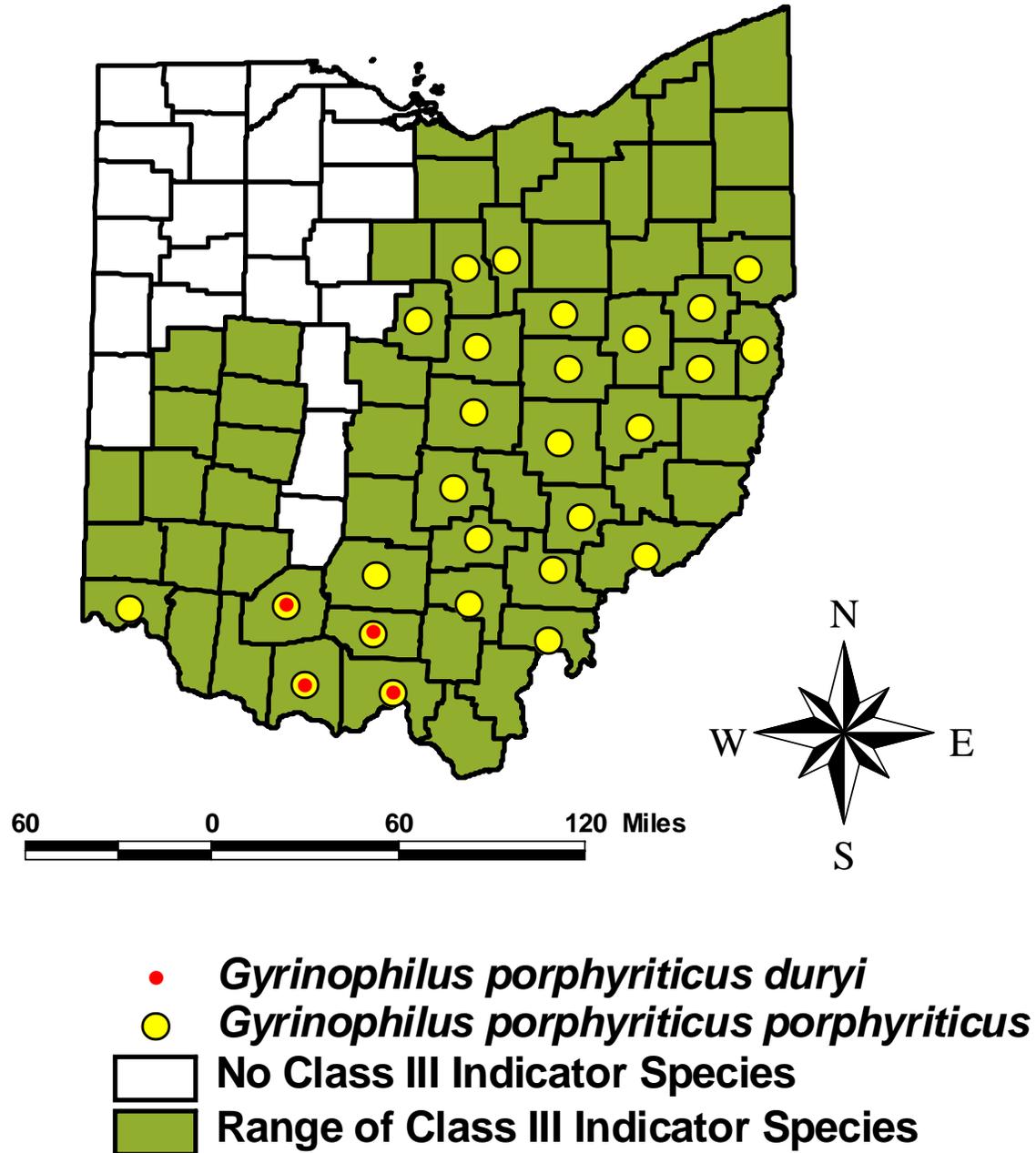
Mud Salamander



Red Salamander



Spring Salamanders

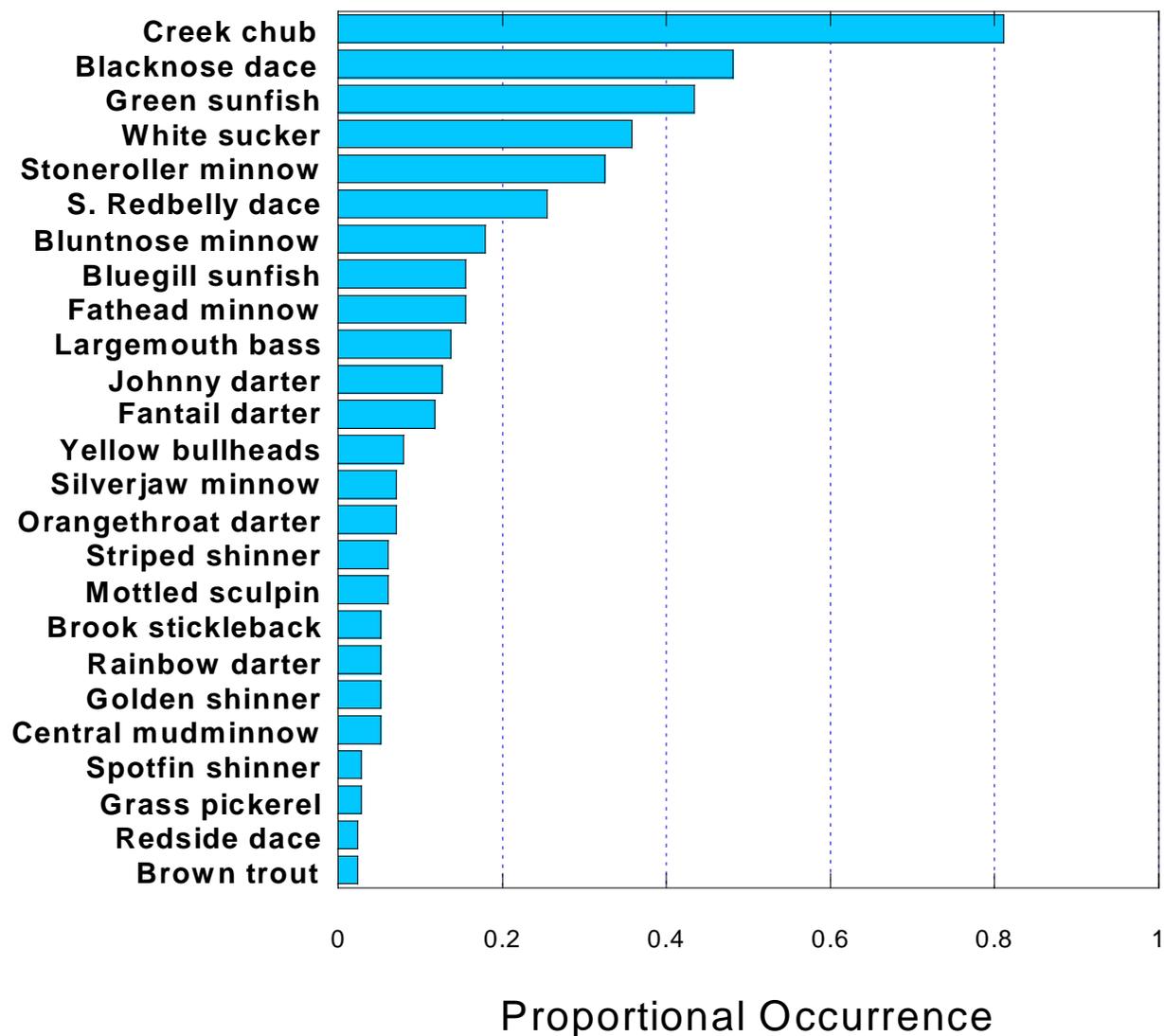


HWH Fish Evaluation Summary

Species	Relative No. (%)	Pioneering Species	IBI-Headwater Species
Creek Chub	22 (32.8)	Yes	No
Bluntnose Minnow	13 (19.4)	Yes	No
Blacknose Dace	7 (10.4)	No	Yes
Rainbow Darter	5 (7.5)	No	No
Bluegill Sunfish	3 (4.5)	No	No
Johnny Darter	3 (4.5)	Yes	No
Stoneroller Minnow	3 (4.5)	No	No
Largemouth Bass	2 (2.9)	No	No
Fantail Darter	2 (2.9)	No	Yes
Greenside Darter	2 (2.9)	No	No
White Sucker	2 (2.9)	No	No
Green Sunfish	2 (2.9)	Yes	No
<i>Redside Dace</i>	<i>1 (1.5)</i>	<i>No</i>	<i>Yes</i>
<i>Mottled Sculpin</i>	<i>1 (1.5)</i>	<i>No</i>	<i>Yes</i>
<i>Native Brook Trout</i>	<i>1 (1.5)</i>	<i>No</i>	<i>No</i>
Rainbow Trout**	1 (1.5)	No	No
Goldfish**	1 (1.5)	No	No
Mudminnow	1 (1.5)	No	No
Orangethroat Darter	1 (1.5)	Yes	No

 Fish species in **bold** represent primary HWH stream indicator native species based on habitat preference

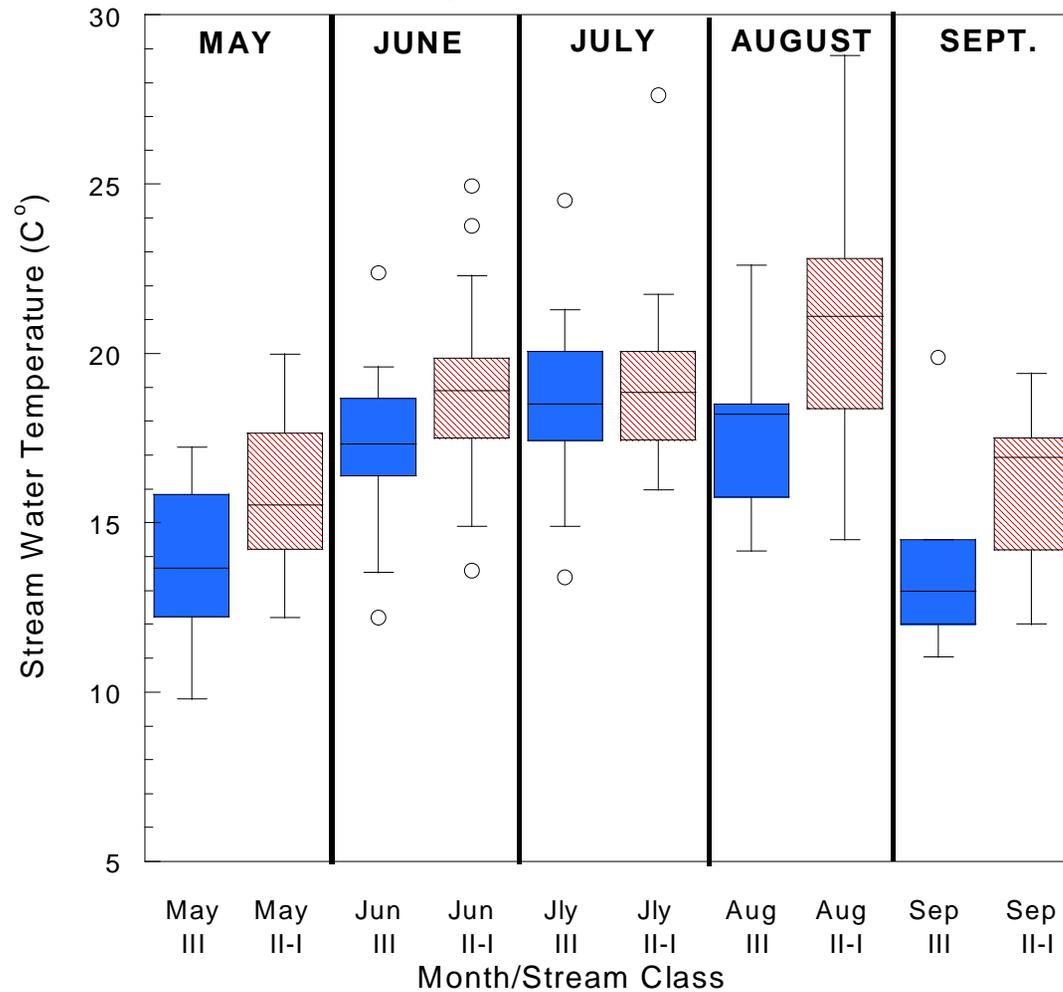
**25 Most Common Fish Species in
Primary Headwater Streams (< 1 sq. mi)
from Ohio EPA Electrofishing Surveys
(N=212 Sample Events from 144 Streams)**



Stream Water Temperature

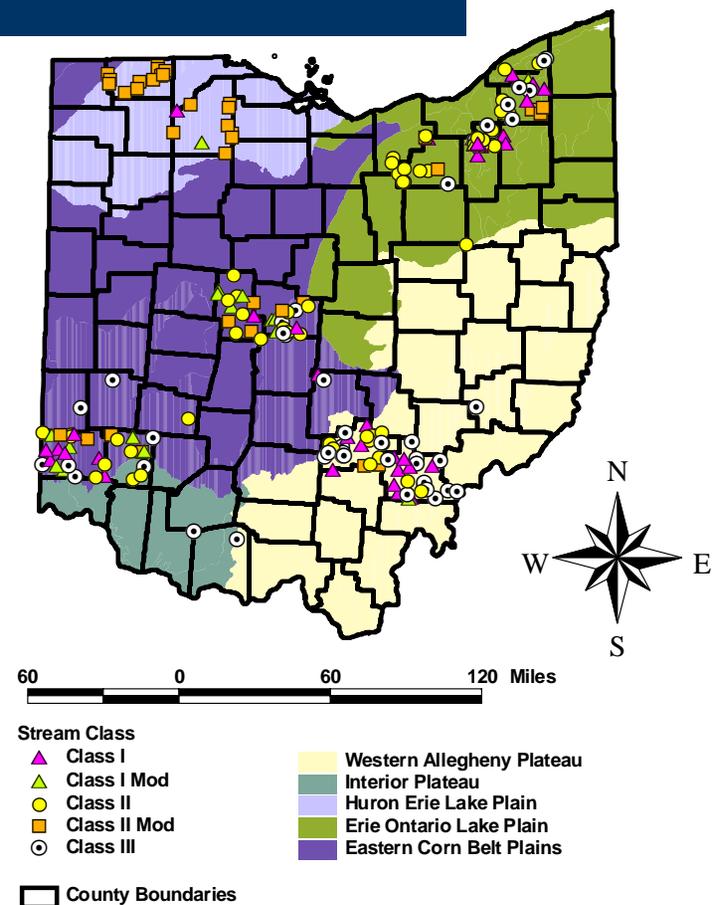
Seasonal Differences in Water Temperature Between Class III and Class II-I Primary Headwater Streams in Ohio

(Excluding Northwest Ohio Modified Streams)

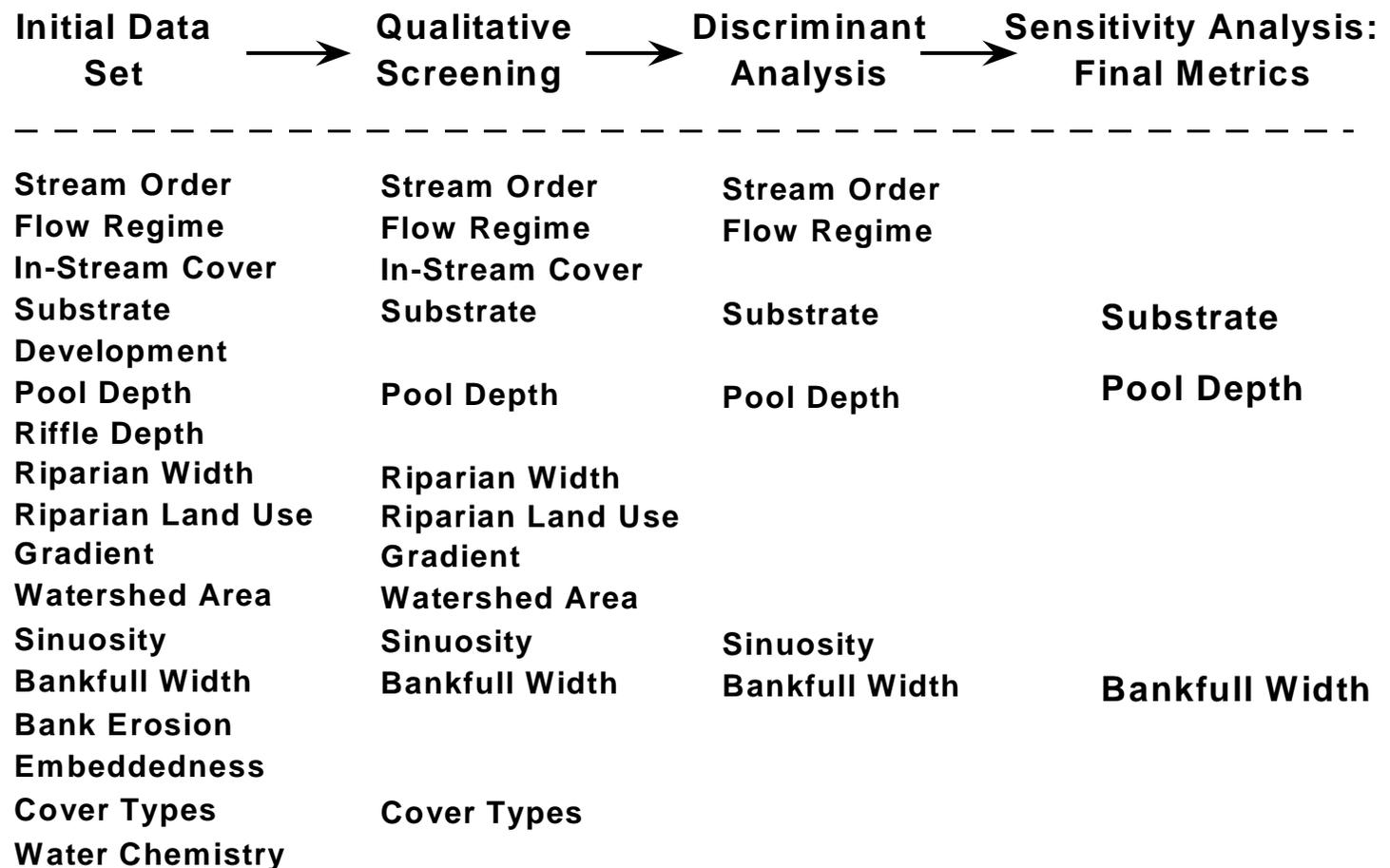


Development of a Headwater Habitat Evaluation Index (HHEI) to Predict PHWH-Stream Classes

- A Headwater Habitat Evaluation Index (HHEI) was developed to provide a rapid assessment tool to predict PHWH stream classes.
- Data from 213 sites state-wide was used to develop the index.
- The approach was similar to that used to develop the QHEI, an index of fish habitat quality in use in Ohio for over 20 years.



The Headwater Habitat Evaluation Index (HHEI): Metrics



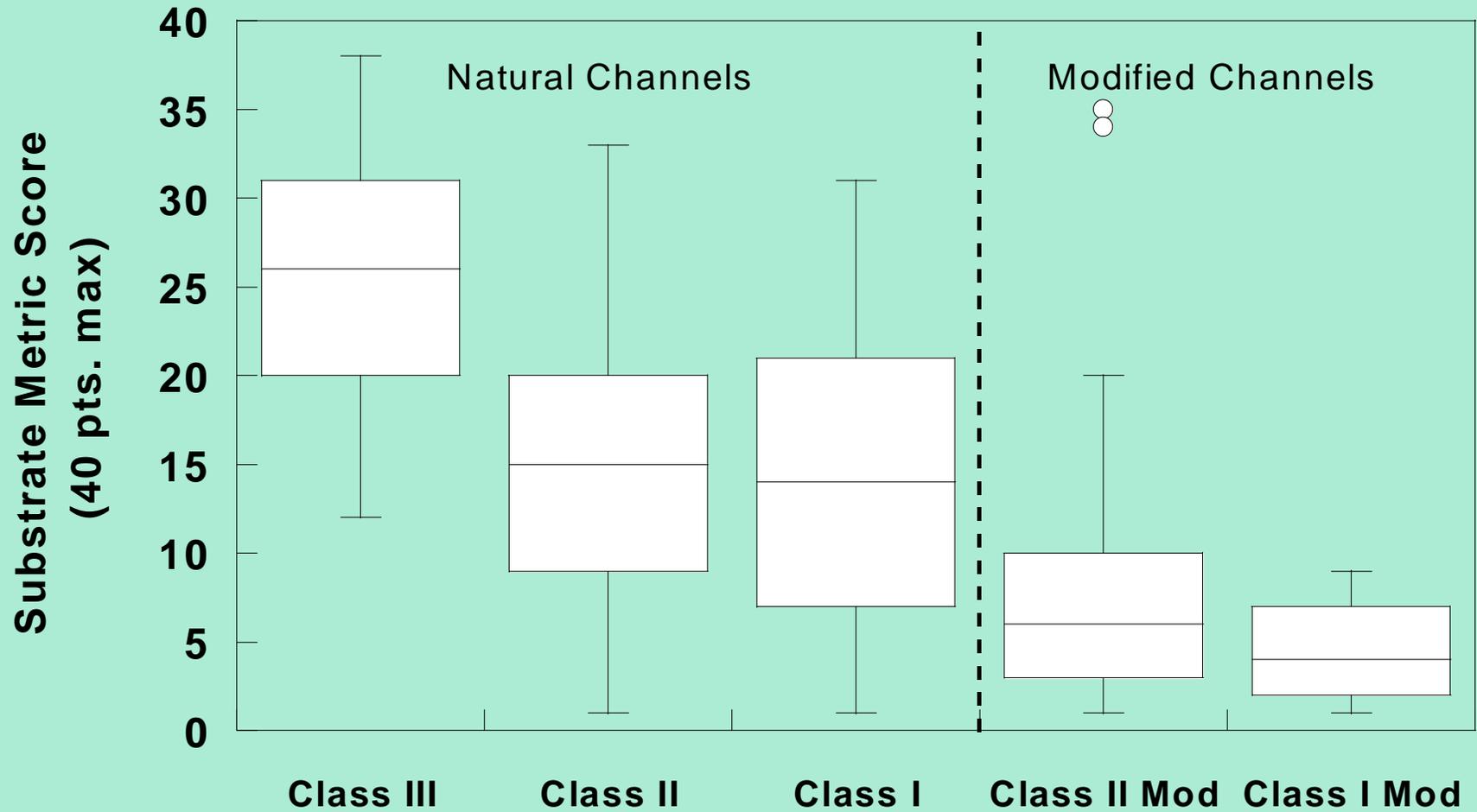
The Headwater Habitat Evaluation Index (HHEI): Metrics

Final HHEI based on three metrics:

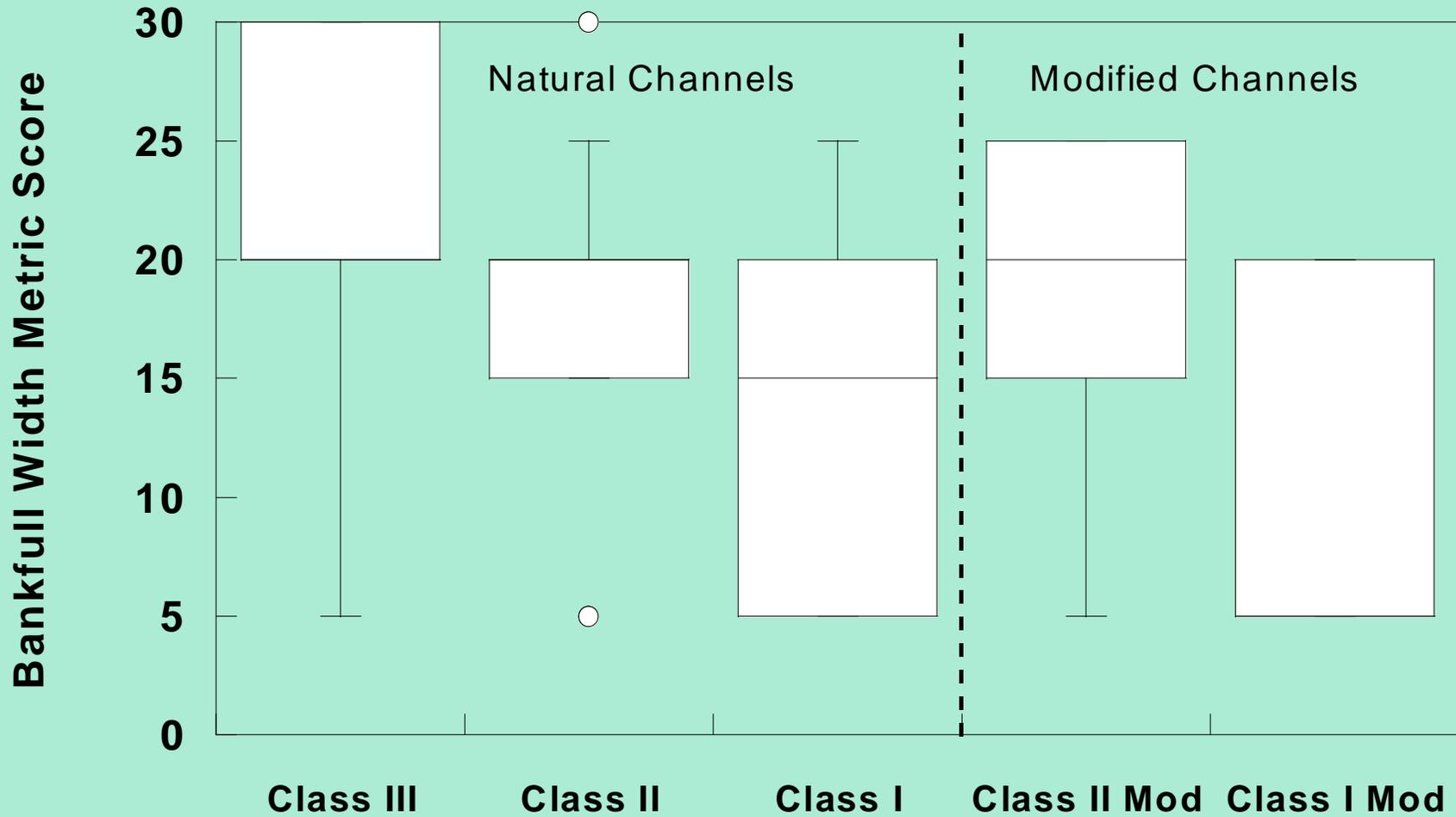
- **Substrate Metric (40 points)**
 - Based upon predominant channel substrate types and the number of substrate types present.
- **Bankfull Width (30 points)**
 - Based upon average bankfull width.
- **Maximum Pool Depth (30 points)**
 - Based upon a single measure of maximum pool depth.

Total HHEI Score ranges from 0 to 100

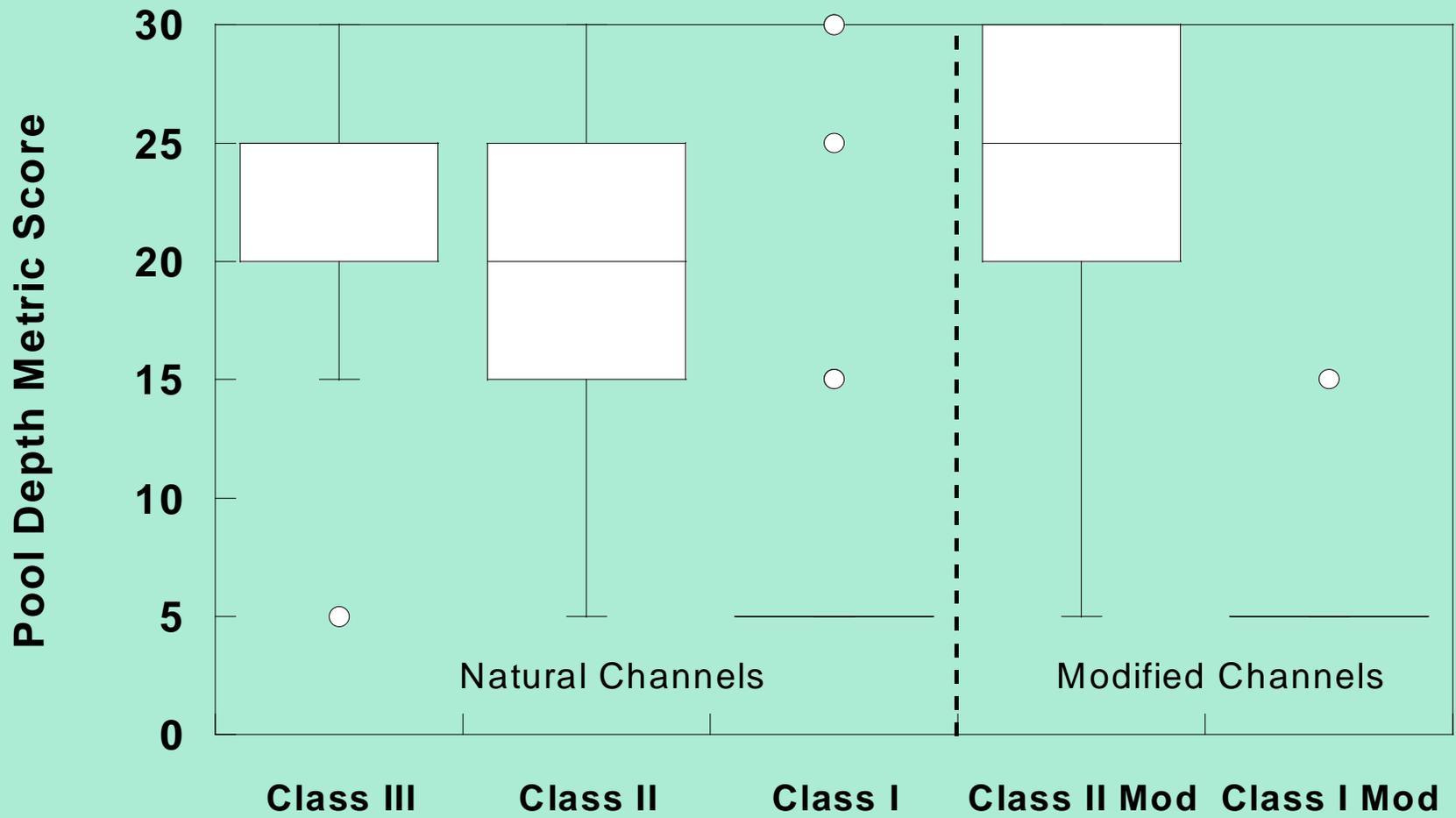
Substrate Metric Scores



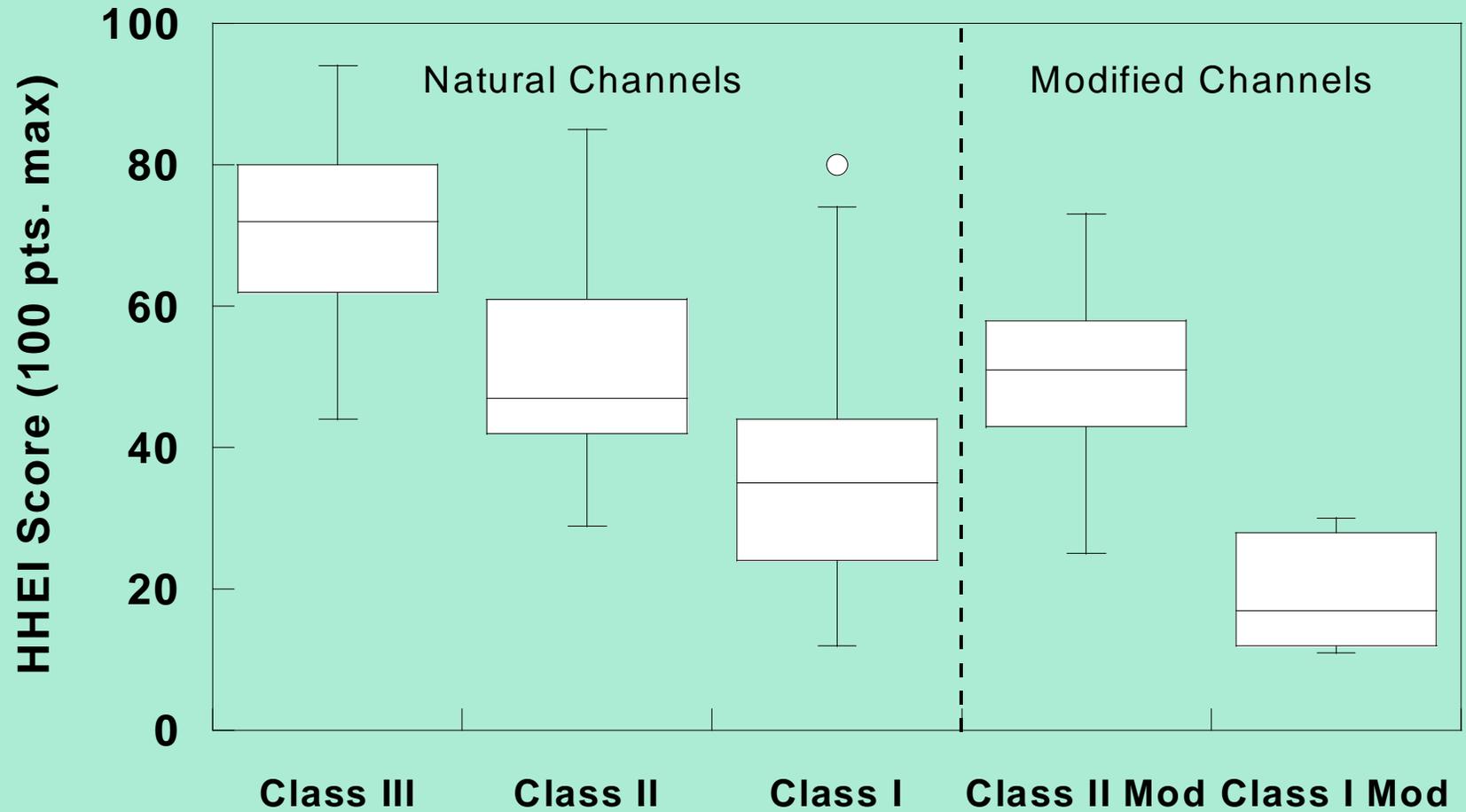
Bankfull Width Metric Scores



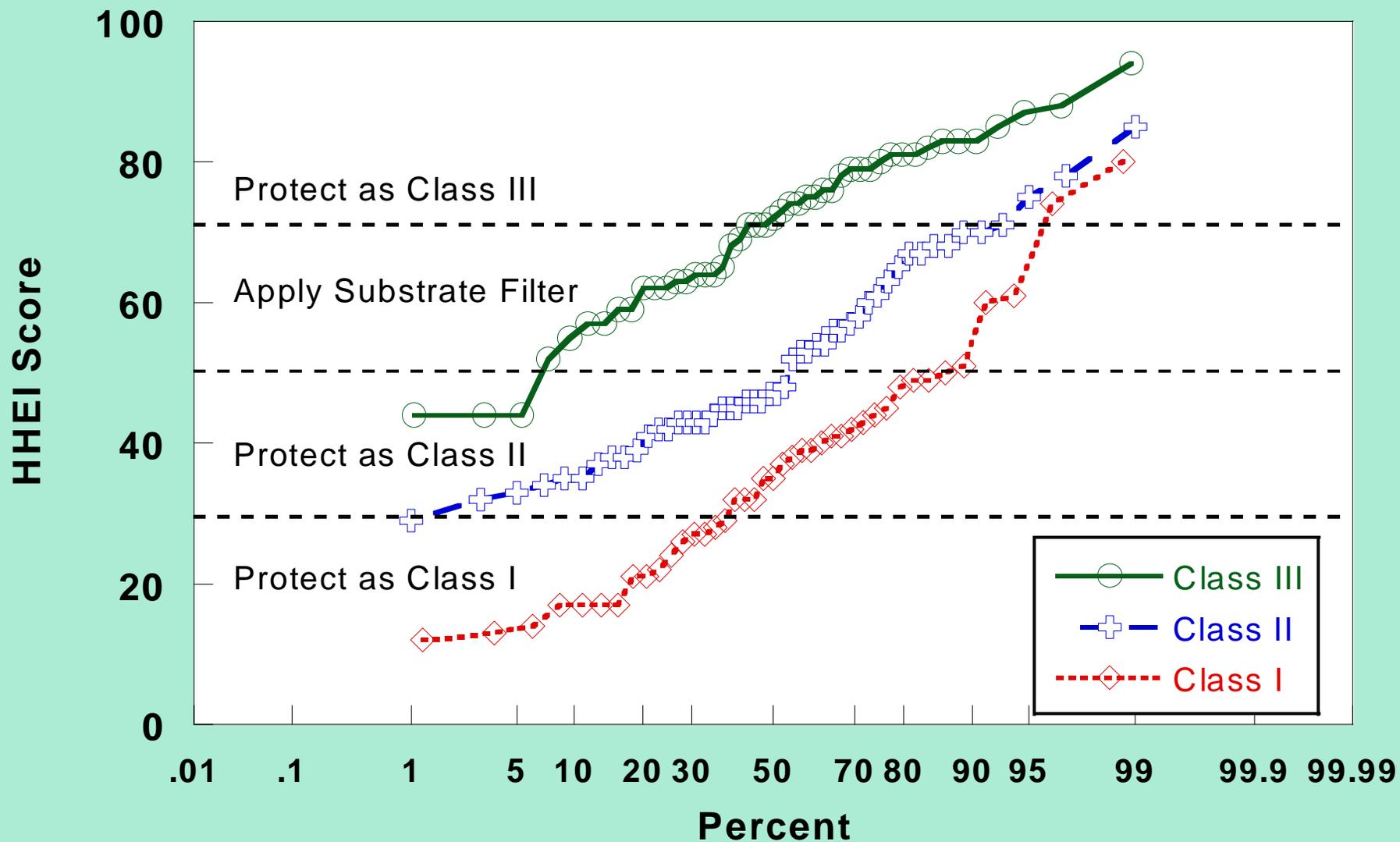
Pool Depth Metric Scores



Total HHEI Scores



Use of the HHEI to Predict Headwater Stream Classification



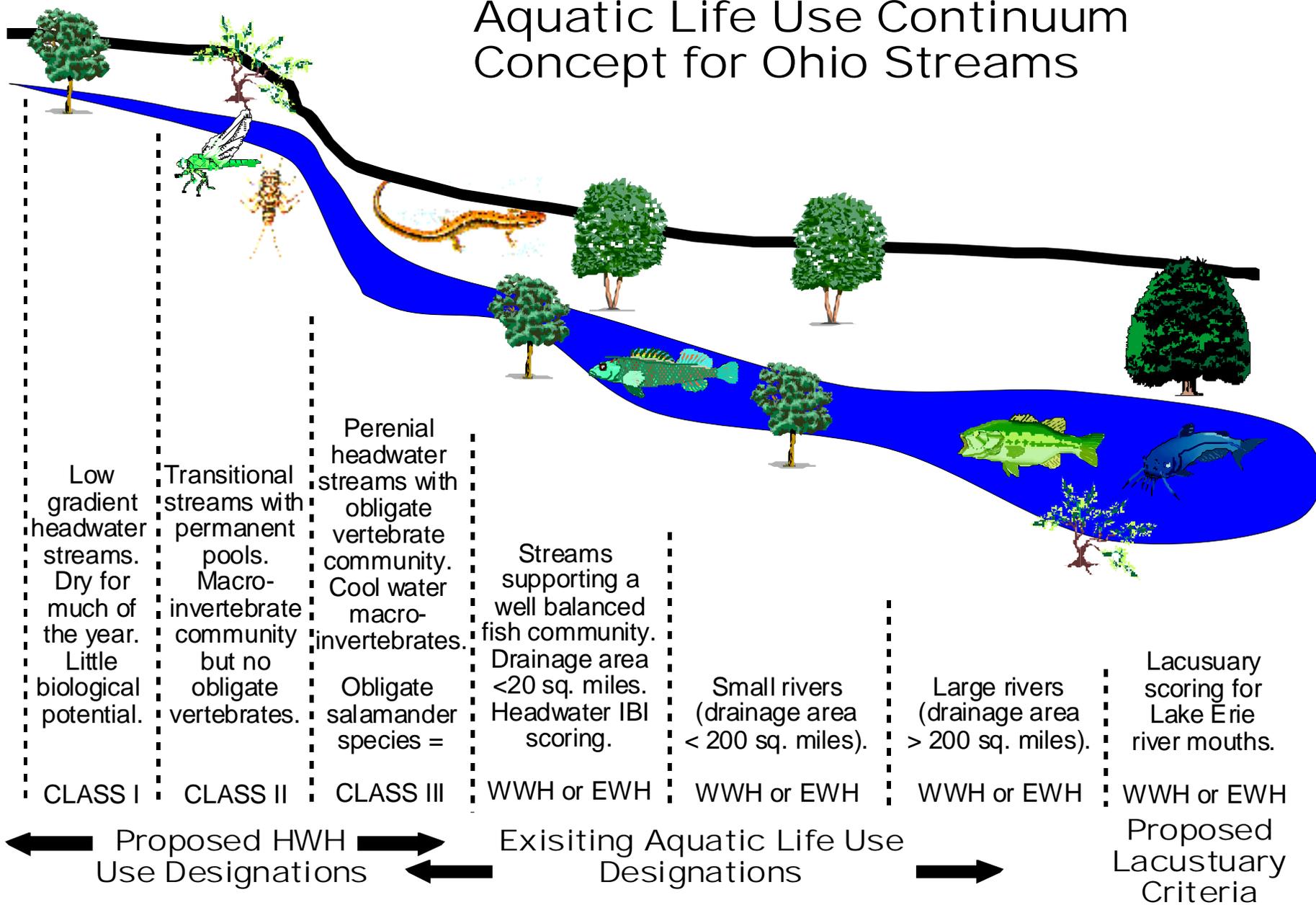
Advantages to HHEI Approach

- Provides rapid assessment which can be conducted in 15-20 minutes.
- Provides immediate insight into stream classification.
- Can be learned with minimal training.
- Does not require rigorous biological evaluation.
- Can be conducted at any time of the year.
- Independent of factors which are not within OEPA's regulatory authority.

Three-Tiered Evaluation Approach

- 1st Tier: HHEI scoring and flow chart (required for all sites)
- 2nd Tier: Rapid bio-assessment using HMFEI (common)
- 3rd Tier: 10 meter salamander survey, fish survey, macroinvertebrates identified to species (very rarely needed)

Aquatic Life Use Continuum Concept for Ohio Streams



What we are losing



1999

Unnamed Class III tributary
to Tinkers Creek HHEI Score = 55

2001

