

# Interactive discussion

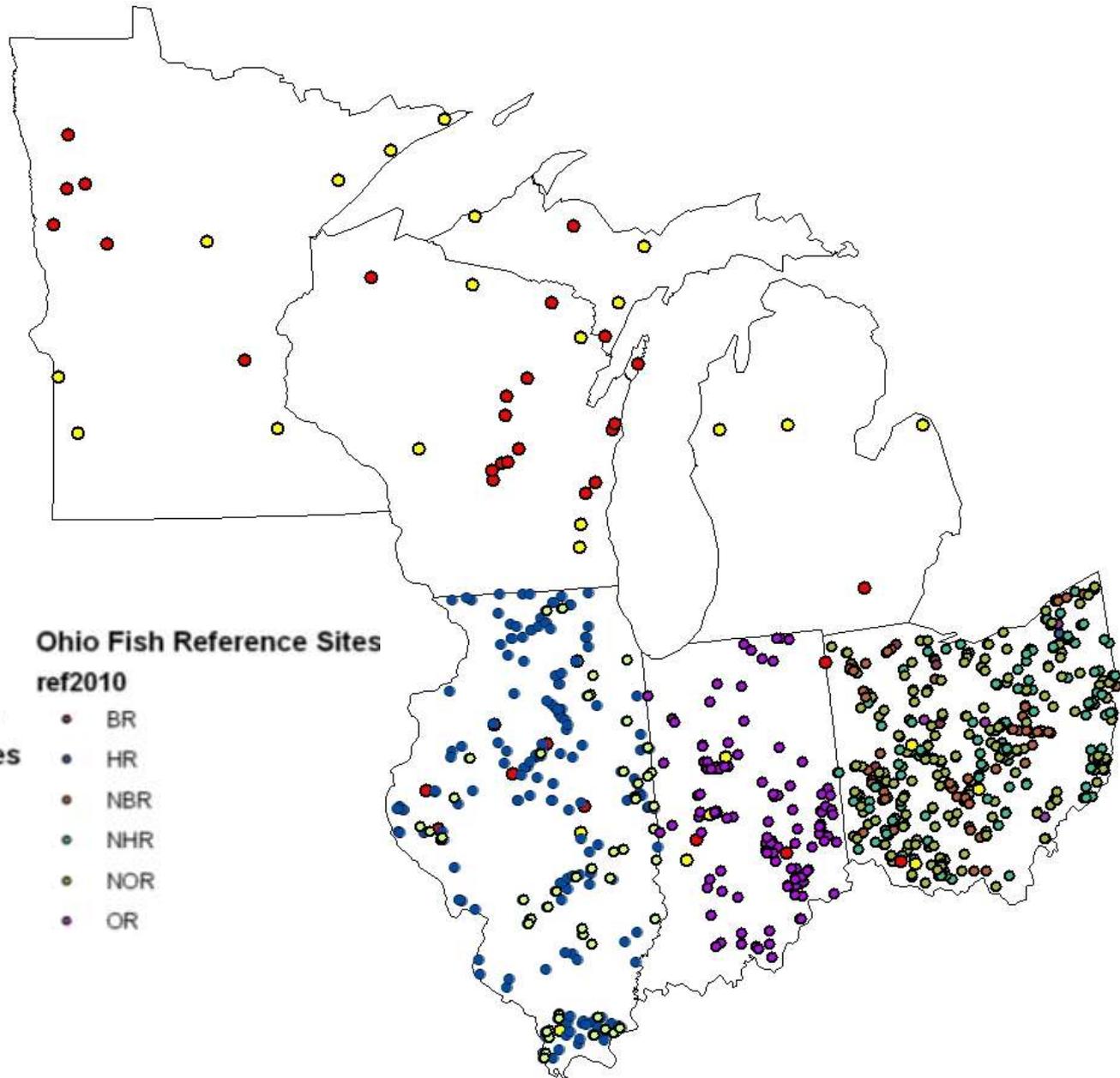
## Reference sites – selection criteria

Have you established reference sites in your state or on your tribal lands?

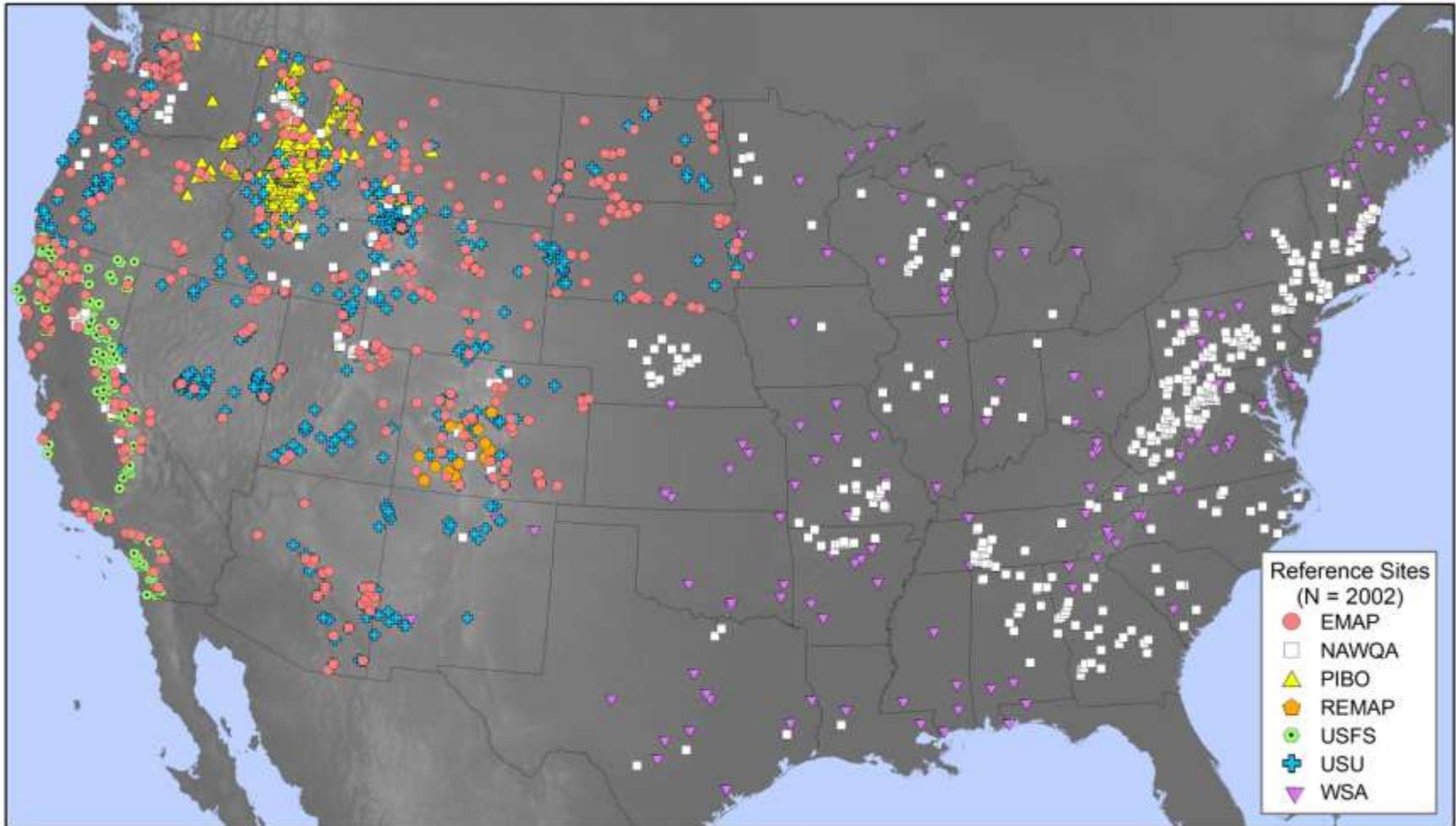
If so, what criteria do you use in your selection process?

- Biological condition (i.e., fish IBI, BCG)
- Environmental factors (i.e., habitat (QHEI), land use, human disturbance)
- Best professional judgment
- Combination of the above?

# Spatial distributions of reference sites in the Midwest (draft)



# Map of national survey reference sites – NAWQA and WSA sites in the Midwest



Map produced by the Western Center for Monitoring and Assessment of Freshwater Ecosystems



# Historic vs. contemporary reference

- Do you differentiate between historic (i.e. BCG level 1, pristine wilderness) vs. contemporary reference conditions (i.e. reasonably attainable for a given region)
- How do you define contemporary reference conditions?
  - “least disturbed condition” (LDC)
  - “minimally disturbed condition” (MDC)

Reference: Stoddard, J., D. Larsen, C. Hawkins, R. Johnson, and R. Norris. 2006. Setting expectations for the ecological condition of streams: the concept of reference condition. *Ecological Applications* 16:1267–1276).

## Least disturbed condition (LDC)

- best available physical, chemical, and biological habitat conditions given today's state of the landscape (Stoddard et al. 2006).
  - Criteria will vary from region to region.
  - Criteria developed iteratively to establish the least amount of ambient human disturbance (e.g., ,1% agricultural land use, ,3% agriculture, ,20% agriculture, etc.) in the region under study.

## Minimally disturbed condition (MDC)

- the biological state showing only slight signs of human disturbances. (Stoddard et al. 2006).
  - Contrasts LDC which shows lowest signs of human disturbance in an area with extensive human disturbance.

# Historic reference condition – BCG Level 1 (based on biology)?

## Levels of Biological Condition

Natural structural, functional, and taxonomic integrity is preserved.

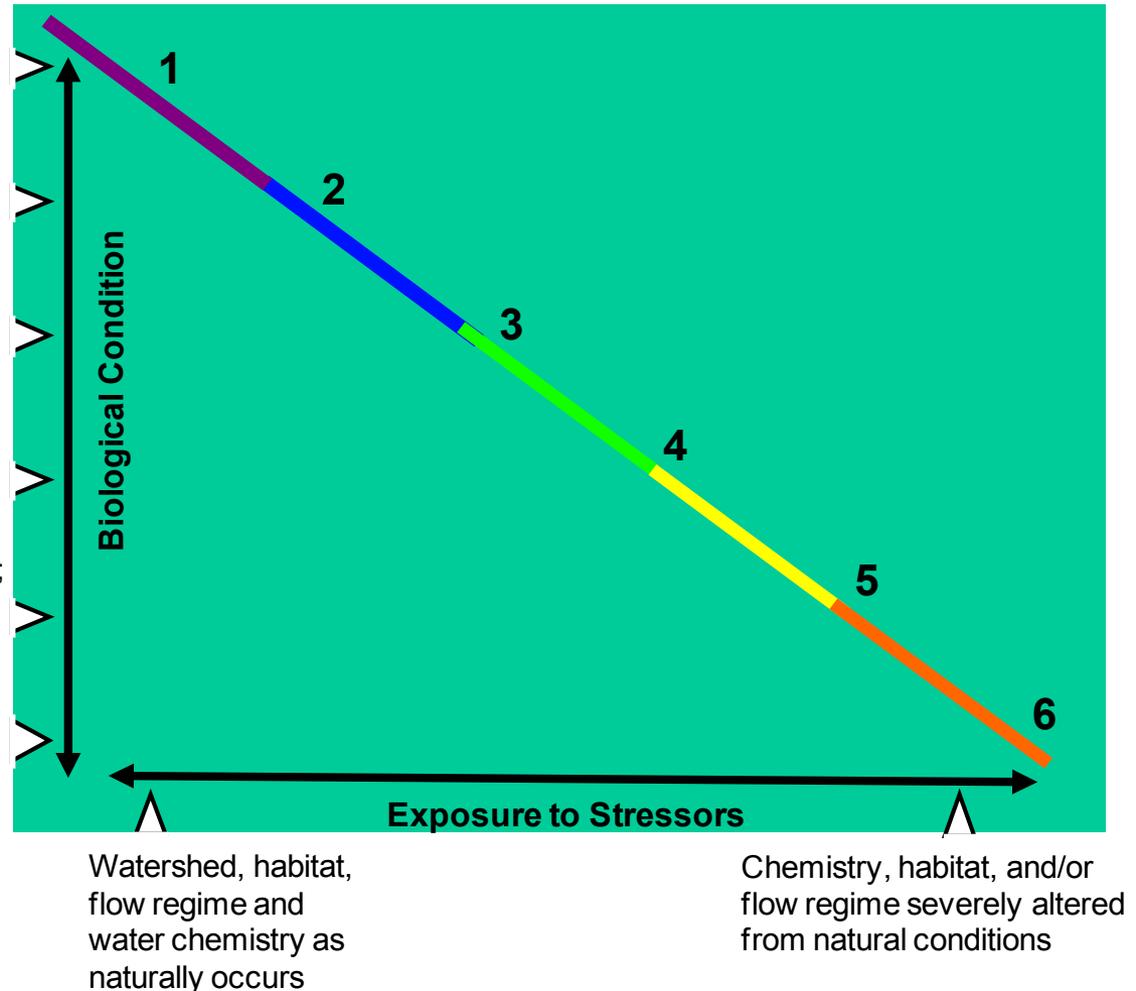
Structure & function similar to natural community with some additional taxa & biomass; ecosystem level functions are fully maintained.

Evident changes in structure due to loss of some highly sensitive taxa; shifts in relative abundance; ecosystem level functions fully maintained.

Moderate changes in structure due to replacement of some sensitive ubiquitous taxa by more tolerant taxa; ecosystem functions largely maintained.

Sensitive taxa markedly diminished; conspicuously unbalanced distribution of major taxonomic groups; ecosystem function shows reduced complexity & redundancy.

Extreme changes in structure and ecosystem function; wholesale changes in taxonomic composition; extreme alterations from normal densities.



Schematic of biological condition gradient, showing six levels of condition.



# Interactive discussion

## Long – term monitoring sites

- Do you have fixed long-term monitoring sites?
- Would you consider these to be reference sites?
- What terminology do you use to describe these sites (i.e., long-term, trend monitoring, sentinel)?
- How often do you monitor these sites?
- Why did you establish these sites?
- Do you also monitor probabilistic sites? If so, how many per year?

# Fixed long-term monitoring sites

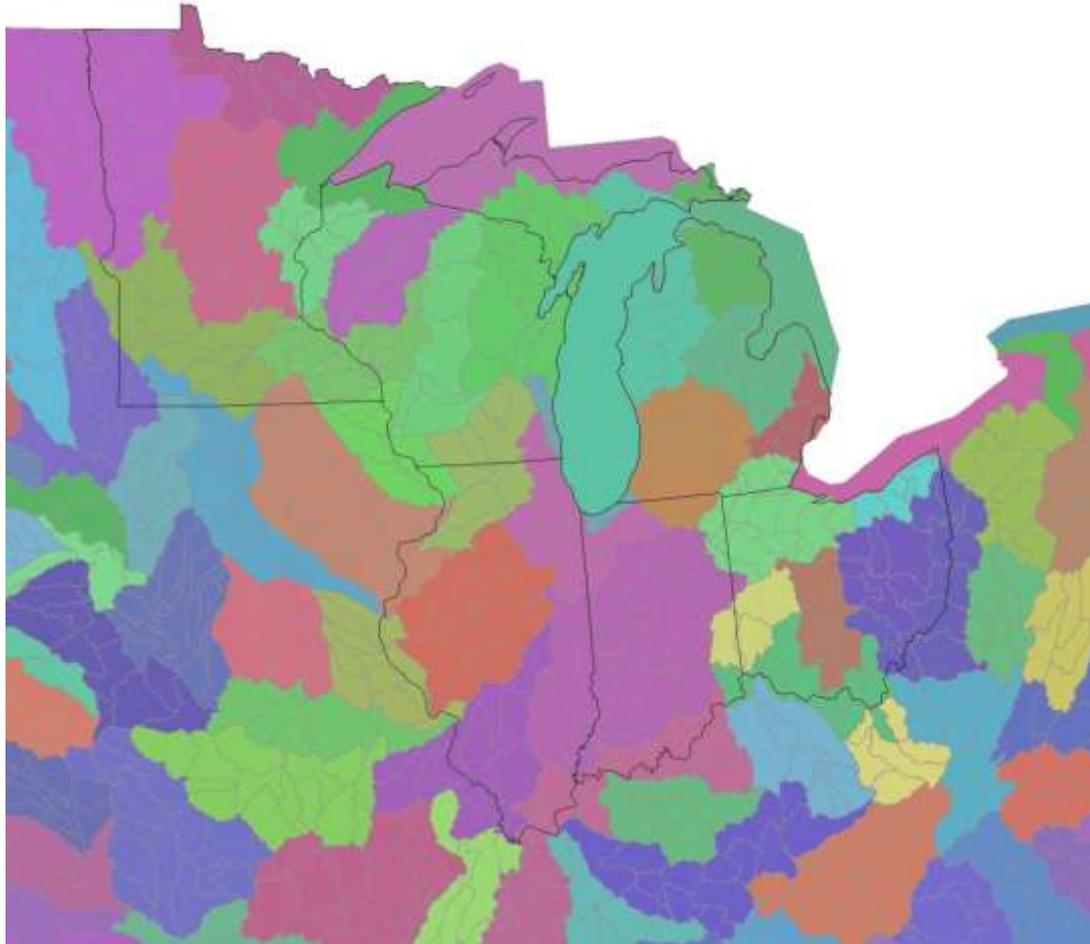
- Provide information about **natural variability**, which is something we need to learn more about (calibration data sets for models like the RIVPACS should ideally capture full range of natural variability)
- Monitor **reference site ‘drift’** (look at streams with minimal land use disturbance to isolate effects of climate change)

## Interactive discussion

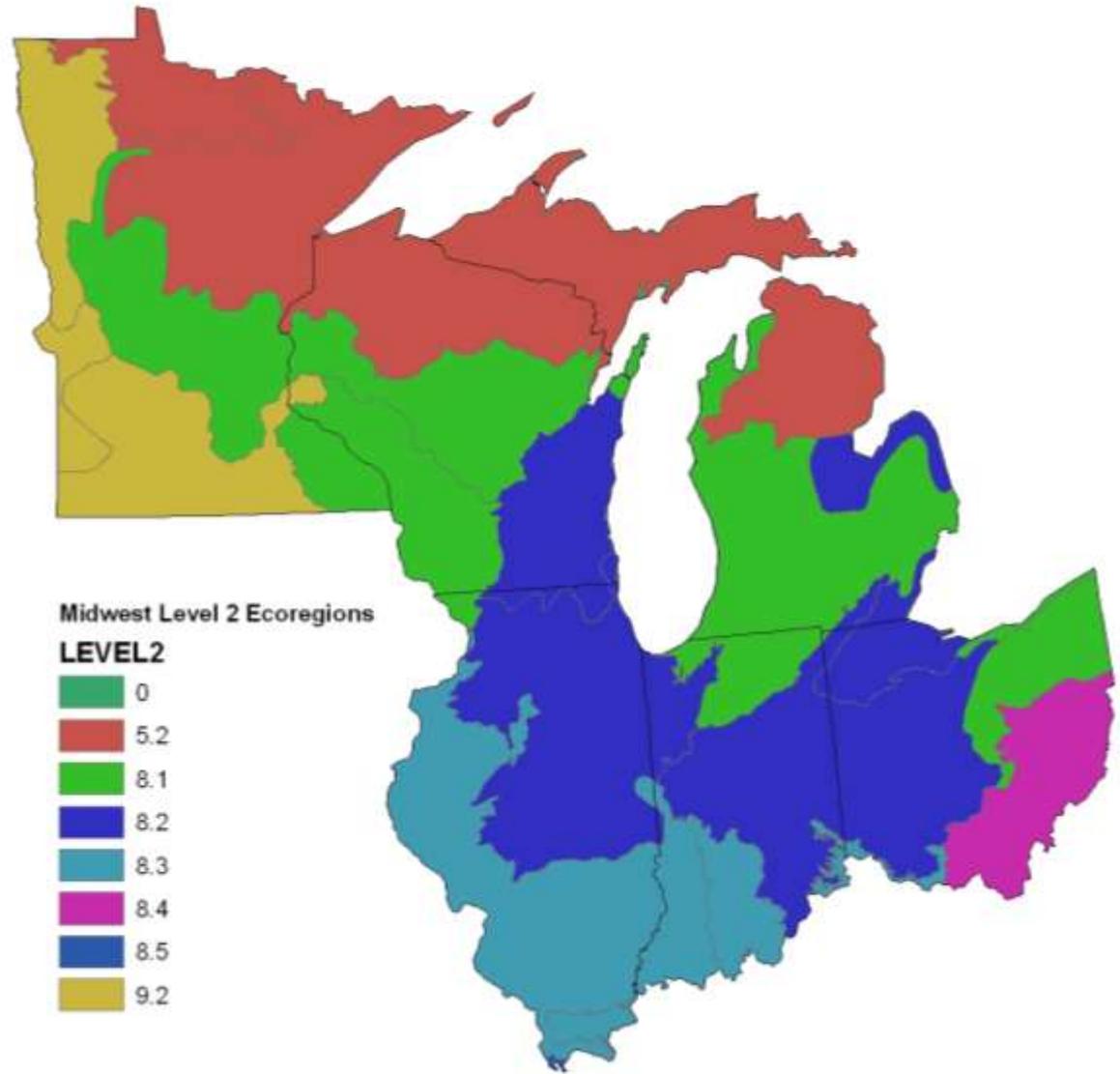
If a regional monitoring network were to be established, what would be an appropriate classification template/level of stratification for the Midwest?

- Stream size (drainage area, width?)
- Ecoregion (level 2 or 3?)
- Watershed/basin
- Habitat
  - pool-glide vs. riffle-run
  - temperature (cold-cool-warm water)

# Watershed basins/HUCs



# Ecoregions – Level 2



# Ecoregions – Level 3



## Midwest\_ecoregions

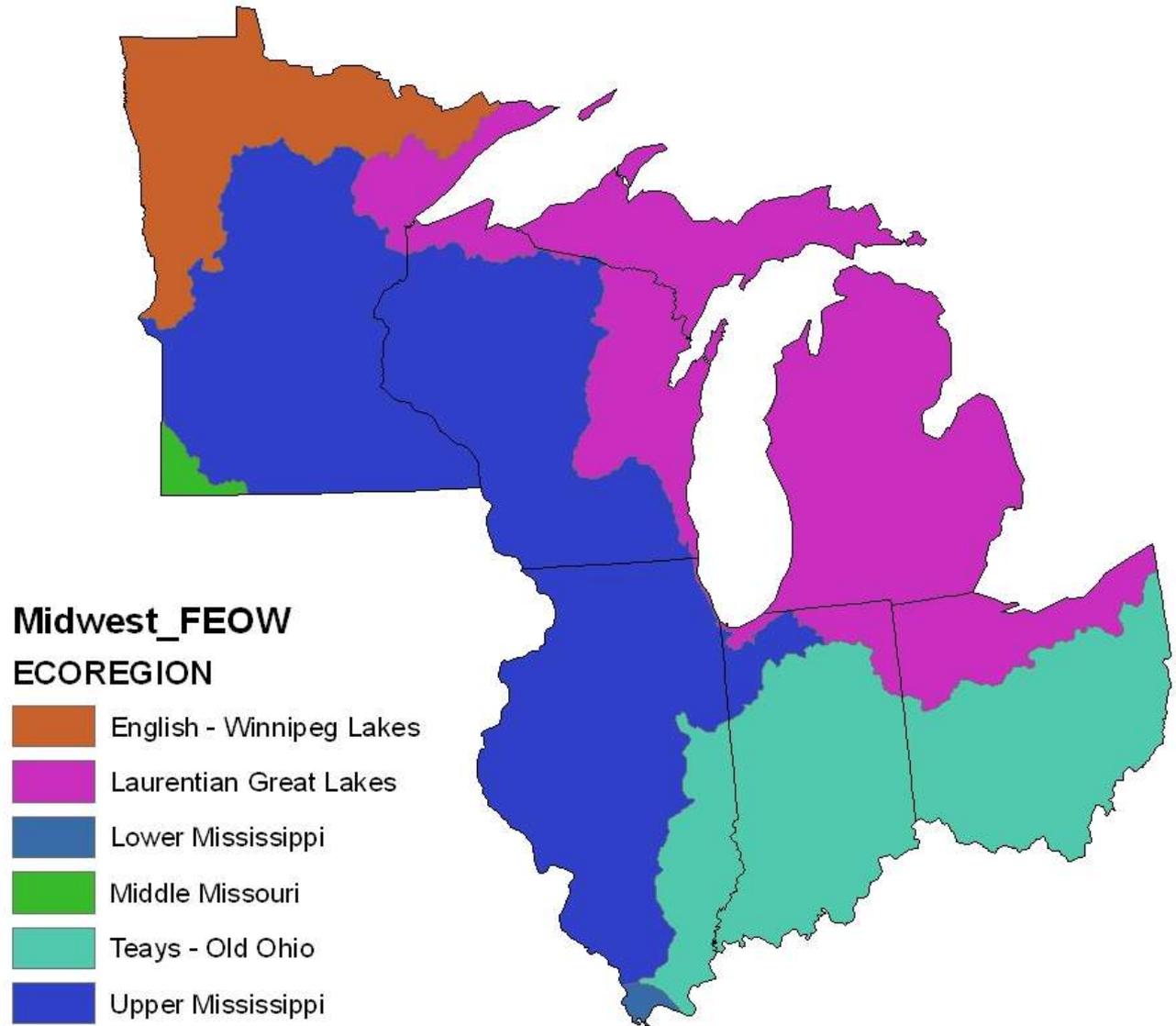
### LEVEL3\_NAM

- |  |   |
|--|---|
|  Central Corn Belt Plains                  |  Lake Agassiz Plain                                |
|  Central Irregular Plains                  |  Mississippi Alluvial Plain                        |
|  Driftless Area                            |  North Central Hardwoods                           |
|  Eastern Corn Belt Plains                 |  Northern Glaciated Plains                         |
|  Eastern Great Lakes and Hudson Lowlands |  Northern Lakes and Forests                        |
|  Erie Drift Plain                        |  Northern Minnesota Wetlands                      |
|  Huron/Erie Lake Plains                  |  Ozark Highlands                                 |
|  Interior Plateau                        |  Southeastern Wisconsin Till Plains              |
|  Interior River Valleys and Hills        |  Southern Michigan/Northern Indiana Drift Plains |
|  |  Western Allegheny Plateau                       |
|  |  Western Corn Belt Plains                        |

# Freshwater Ecoregions of the World (FEOW)

- Delineations driven by freshwater species (primarily fish) and freshwater processes

- Match closely with watershed basins (HUCs) in the Midwest



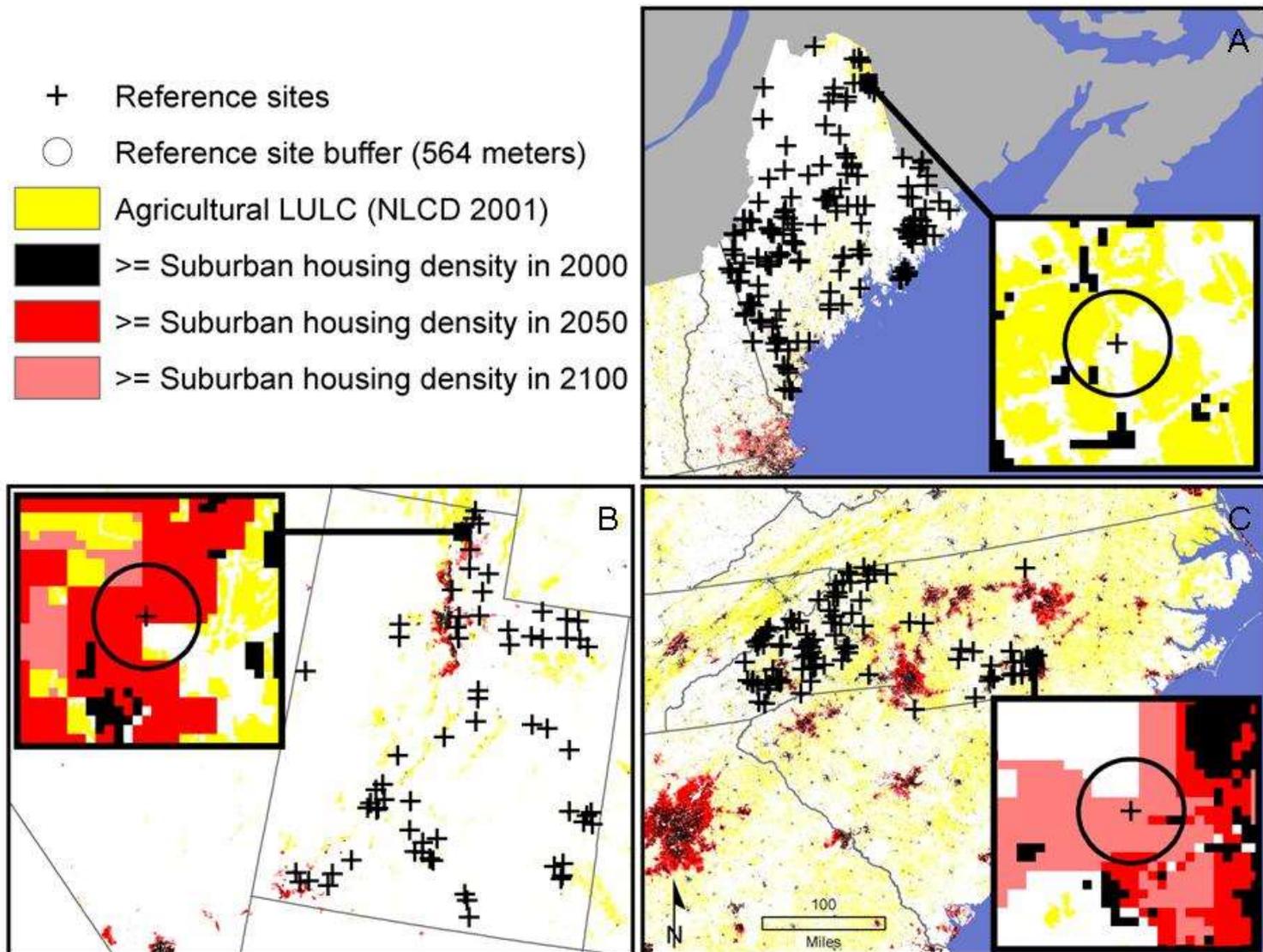


## Interactive discussion

### Protection of reference sites

- Do you have mechanisms for protecting reference sites in your state or on your tribal lands for the long-term? If so, what are they?
- What can we do to make sites more resilient?
  - Examples of BMP success stories

# Vulnerability of reference sites to development in Maine, North Carolina and Utah



# Vulnerability of reference sites to development

	Future Scenario (A2)			
	State	2000	2050	2100
<b>Mean of reference sites <math>\geq 10\%</math></b>	Maine	23% (26)	24% (26)	30% (32)
	North Carolina	20% (9)	27% (9)	40% (10)
	<b>Utah</b>	<b>0% (0)</b>	<b>87% (2)</b>	<b>64% (3)</b>
<b>Mean of all reference sites</b>	Maine	6% (139)	6% (139)	8% (139)
	North Carolina	4% (82)	5% (82)	7% (82)
	<b>Utah</b>	<b>0% (27)</b>	<b>6% (27)</b>	<b>7% (27)</b>



## Interactive discussion

**Will climate change affect reference sites disproportionately?**

# Assessment finding: Reference station status degrades if cold water taxa drop out

