

Lakeshore Habitat Condition of Wisconsin Lakes Across Gradients in Land Use and Lake Area: Building on the National Lakes Assessment

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When you look at a lake,
what do you see?



Limnology focused on the pelagic zone and so did state wide monitoring efforts

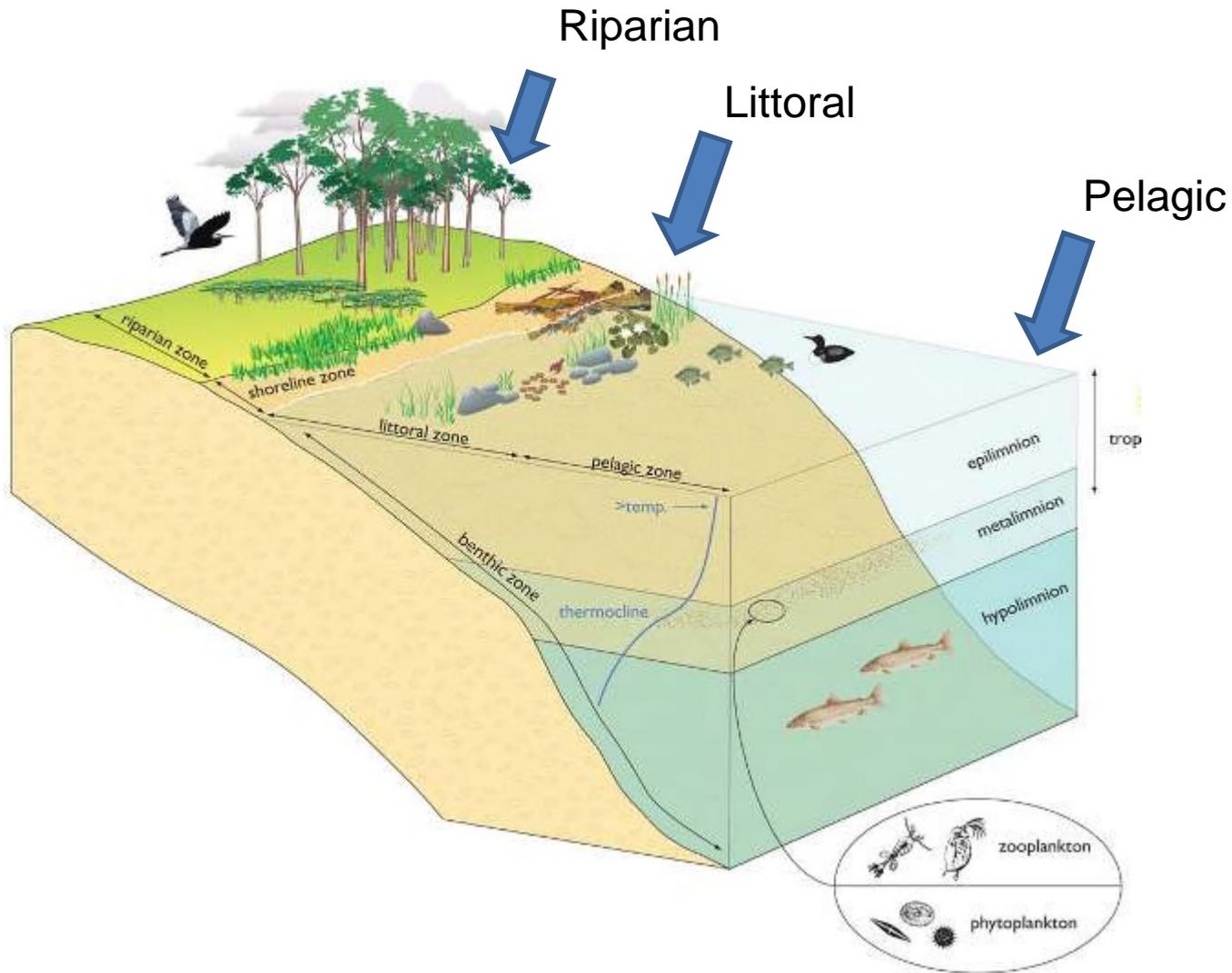
- Secchi depth
- Phosphorus
- Chlorophyll-a
- Temperature
- Dissolved oxygen







Littoral zone often more productive and diverse than pelagic!

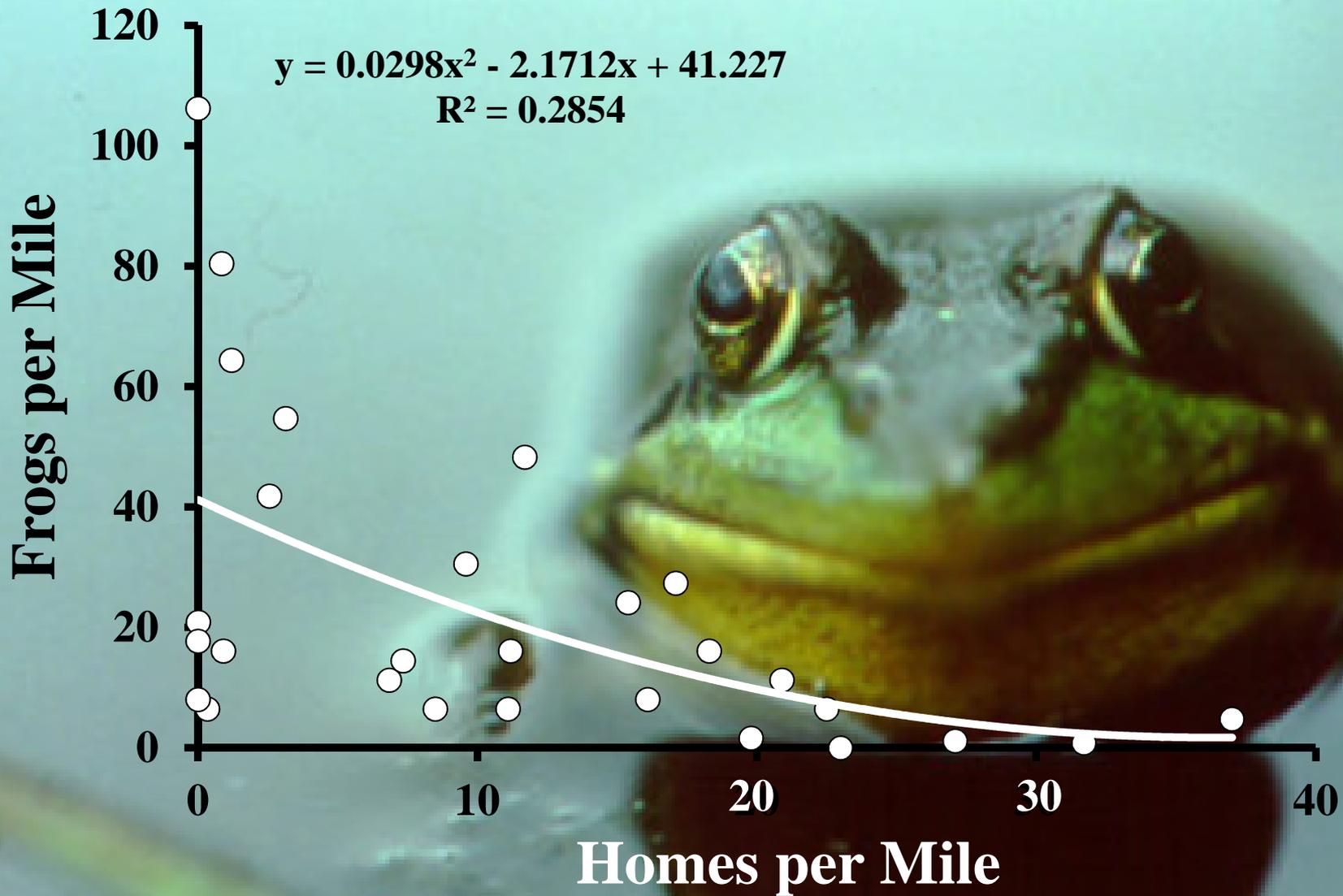


Littoral Habitat Destruction

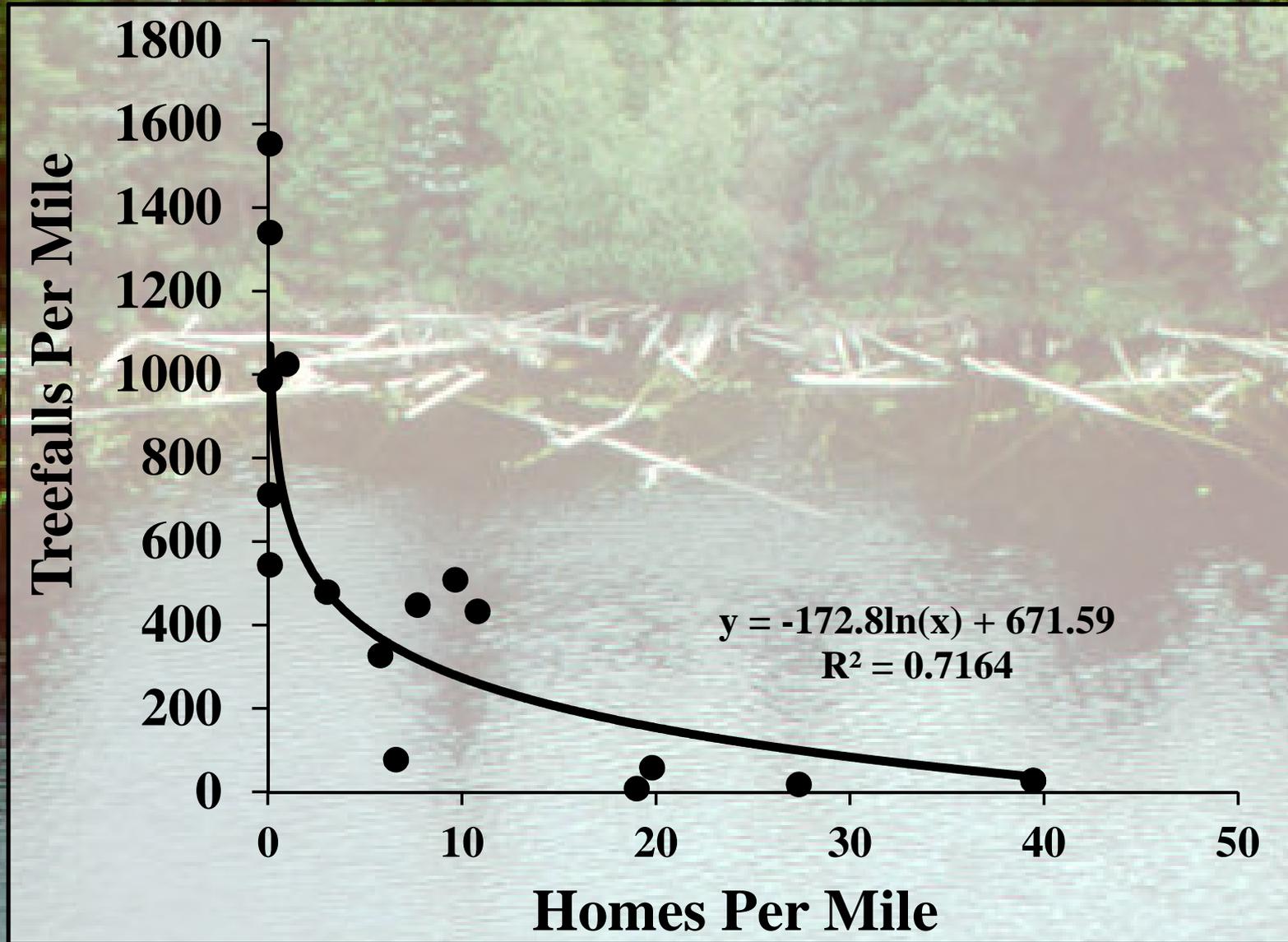
- ↑ Sedimentation
- ↓ Native plants
- ↓ Physical habitat structure
- ↓ Fish
- ↓ Aquatic invertebrates
- ↓ Birds



Green Frogs



Treefalls



Initiating Lakeshore Habitat Monitoring in Wisconsin

Goals

- Statewide inventory of lakeshore health
- Identify problem areas for restoration
- Evaluate shoreland habitat restorations



Evaluate Success of Habitat Restorations

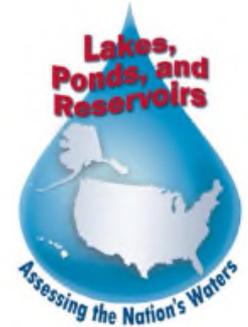
Bony Lake
The Johnsons



What percentage of lakes are in good, fair, or poor condition?

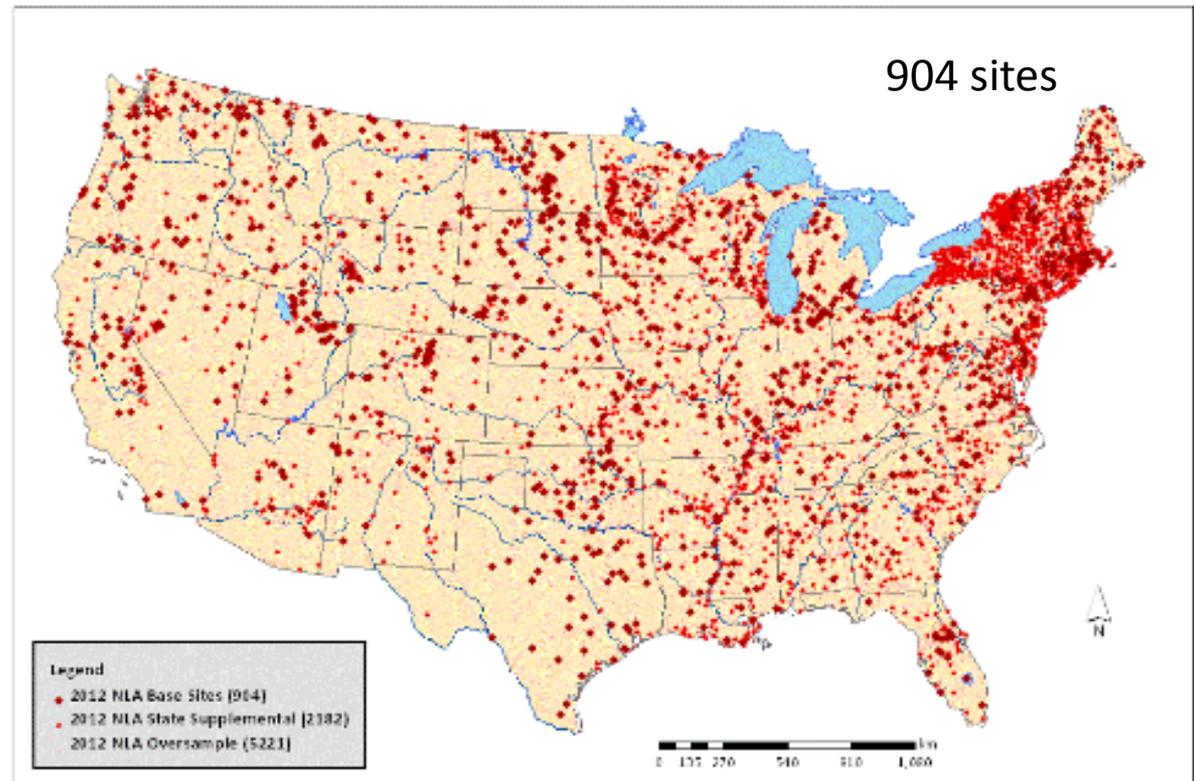


EPA National Lakes Assessment

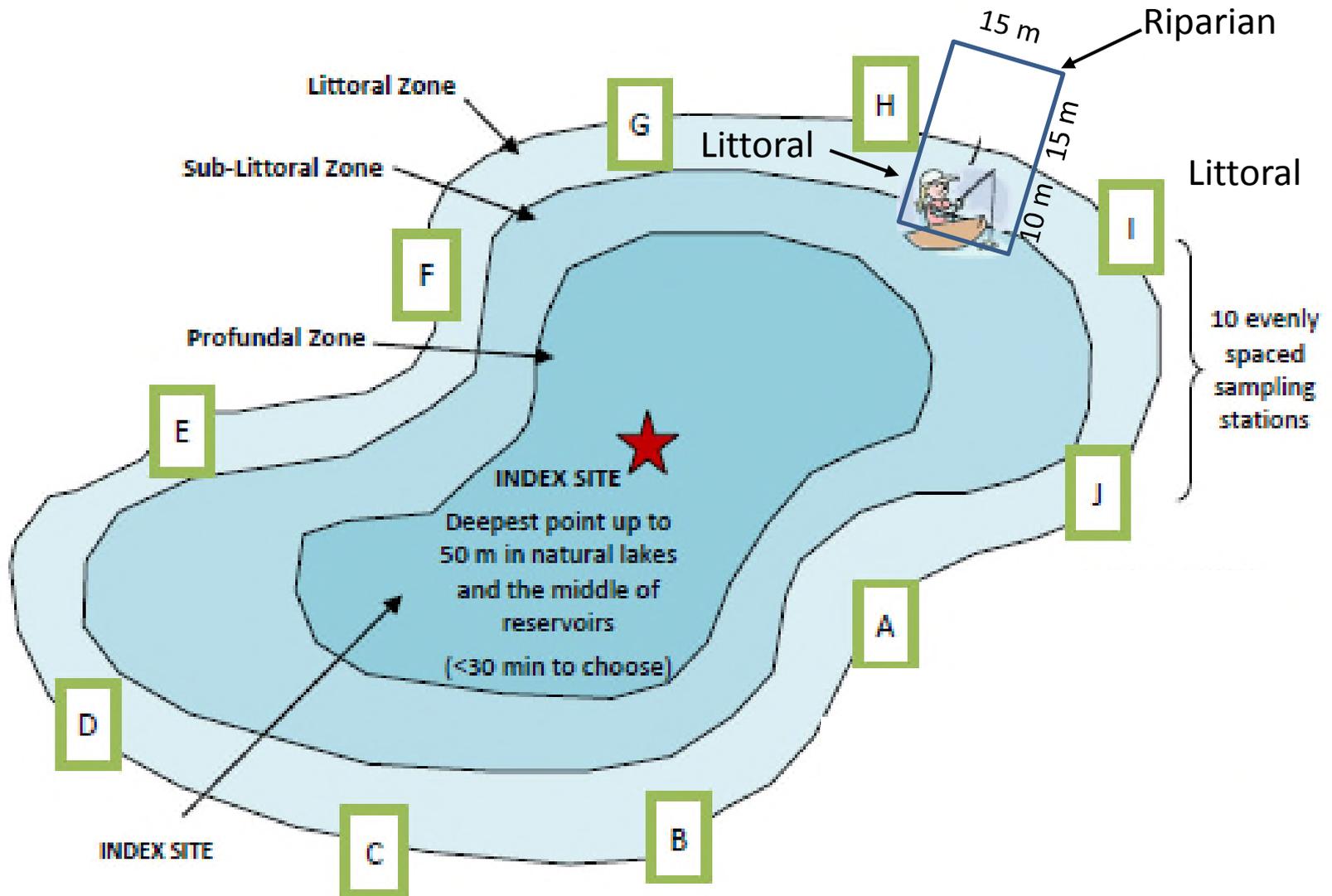


- 5 year cycle
- Benthic Macroinvertebrates
- Algal Toxins
- Chlorophyll A
- Nutrients
- Phytoplankton
- Sediment Dating
- Sediment Diatoms
- Sediment Mercury
- Water Chemistry
- Zooplankton
- Shoreline Habitat

Design Sites for the 2012 National Lakes Assessment



Lake Sampling Design



Shoreline Habitat Variables

5 Categories: Absent Sparse Moderate Heavy Very Heavy
 0% <10% 10-40% 40-75% >75%

Littoral Zone

- Bottom substrate
 - silt, sand, gravel, cobble, boulders, bedrock, wood, detritus
- Macrophytes
 - submergent, emergent, floating, total cover
- Fish Cover
 - herbaceous veg., big wood, small wood, inundated live trees, overhanging veg, ledges, boulders, docks

Riparian Zone

- Canopy > 5m high
 - big trees, small trees
- Understory
 - woody shrubs, herbaceous plants
- Ground Cover 0.5 – 5m
 - woody shrubs, herbaceous plants, inundated veg, barren
- Shoreline Substrate
 - silt, sand, gravel, cobble, boulders, bedrock, wood, detritus
- Human Influence
 - buildings, commercial, park facilities, docks/boats, walls, trash, roads/railroad, power lines, row crops, pasture, orchard, lawn



3 = Heavy (40-75%) 4 = Very Heavy (>75%)

BOTTOM SUBSTRATE						Flag
Bedrock (>4000mm; larger than a car)	0	1	2	3	4	
Boulders (250-4000mm; basketball-car)	0	1	2	3	4	
Cobble (64-250mm; tennis ball-basketball)	0	1	2	3	4	
Gravel (2-64mm; ladybug to tennis ball size)	0	1	2	3	4	
Sand (0.06 - 2mm; gritty between fingers)	0	1	2	3	4	
Silt, Clay, or Muck (<0.06mm; not gritty)	0	1	2	3	4	
Woody Debris	0	1	2	3	4	
Organic (Leaf Pack, Detritus)	0	1	2	3	4	
Color	<input type="radio"/> Black <input type="radio"/> Gray <input type="radio"/> Brown <input type="radio"/> Red <input type="radio"/> Other					
Odor	<input type="radio"/> None <input type="radio"/> H ₂ S <input type="radio"/> Anoxic <input type="radio"/> Oil <input type="radio"/> Chemical <input type="radio"/> Other					

AQUATIC MACROPHYTES						Flag
Submergent	0	1	2	3	4	
Emergent	0	1	2	3	4	
Floating	0	1	2	3	4	
Total Aquatic Macrophyte Cover	0	1	2	3	4	
Do macrophytes extend lakeward? <input type="radio"/> Yes <input type="radio"/> No						

FISH COVER						Flag
Aquatic and Innundated Herbaceous Veg.	0	1	2	3	4	
Woody Debris/Snags > 0.3 m Dia.	0	1	2	3	4	
Woody Brush/Woody Debris <0.3 m dia. (alive or dead)	0	1	2	3	4	
Inundated Live Trees >0.3 m dia	0	1	2	3	4	
Overhanging Veg. within 1 m of Surface	0	1	2	3	4	
Ledges or Sharp Dropoffs	0	1	2	3	4	

<input type="radio"/> Deciduous <input type="radio"/> Broadleaf Evergreen <input type="radio"/> Coniferous						
<input type="radio"/> Mixed <input type="radio"/> None						
Big Trees (Trunk >0.3 m dBH)	0	1	2	3	4	
Small Trees (Trunk <0.3 m dBH)	0	1	2	3	4	

UNDERSTORY (0.5 TO 5m high)						Flag
<input type="radio"/> Deciduous <input type="radio"/> Broadleaf Evergreen <input type="radio"/> Coniferous						
<input type="radio"/> Mixed <input type="radio"/> None						
Woody Shrubs & Saplings	0	1	2	3	4	
Tall Herbs, Grasses, & Forbs	0	1	2	3	4	

GROUND COVER (<0.5 high)						Flag
Woody Shrubs & Saplings	0	1	2	3	4	
Herbs, Grasses and Forbs	0	1	2	3	4	
Standing Water or Inundated Vegetation	0	1	2	3	4	
Barren, Bare Dirt or Buildings	0	1	2	3	4	

SHORELINE SUBSTRATE ZONE						Flag
Bedrock (>4000mm; larger than a car)	0	1	2	3	4	
Boulders (250-4000mm; basketball-car size)	0	1	2	3	4	
Cobble (64-250mm; tennis ball-basketball size)	0	1	2	3	4	
Gravel (2-64 mm; ladybug-tennis ball size)	0	1	2	3	4	
Sand (0.06 - 2mm; gritty between fingers)	0	1	2	3	4	
Silt, Clay, or Muck (<0.06mm; not gritty)	0	1	2	3	4	
Woody Debris	0	1	2	3	4	
Organic (Leaf Pack, Detritus)	0	1	2	3	4	
Vegetation or Other	0	1	2	3	4	

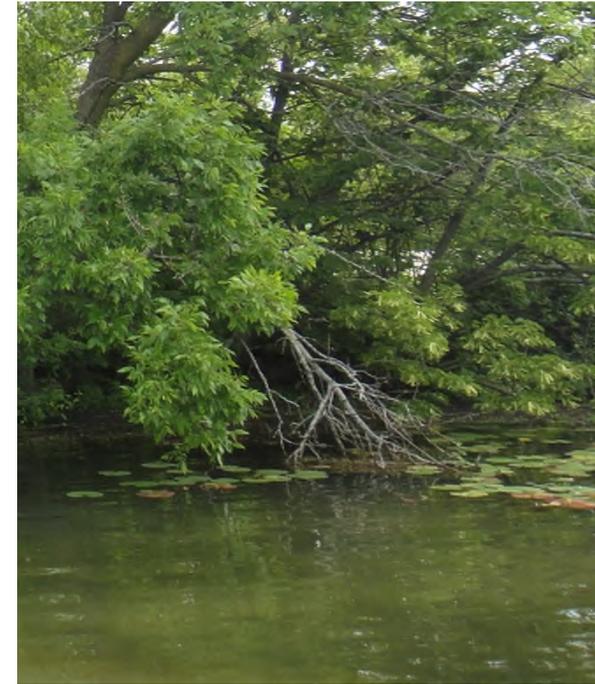
HUMAN INFLUENCE						Flag
0 = Not Present P = Present outside plot C =Present within plot						
Buildings	0	P	C			

3 Metrics to Assess Health

Human Influence

Riparian Habitat

Littoral Habitat

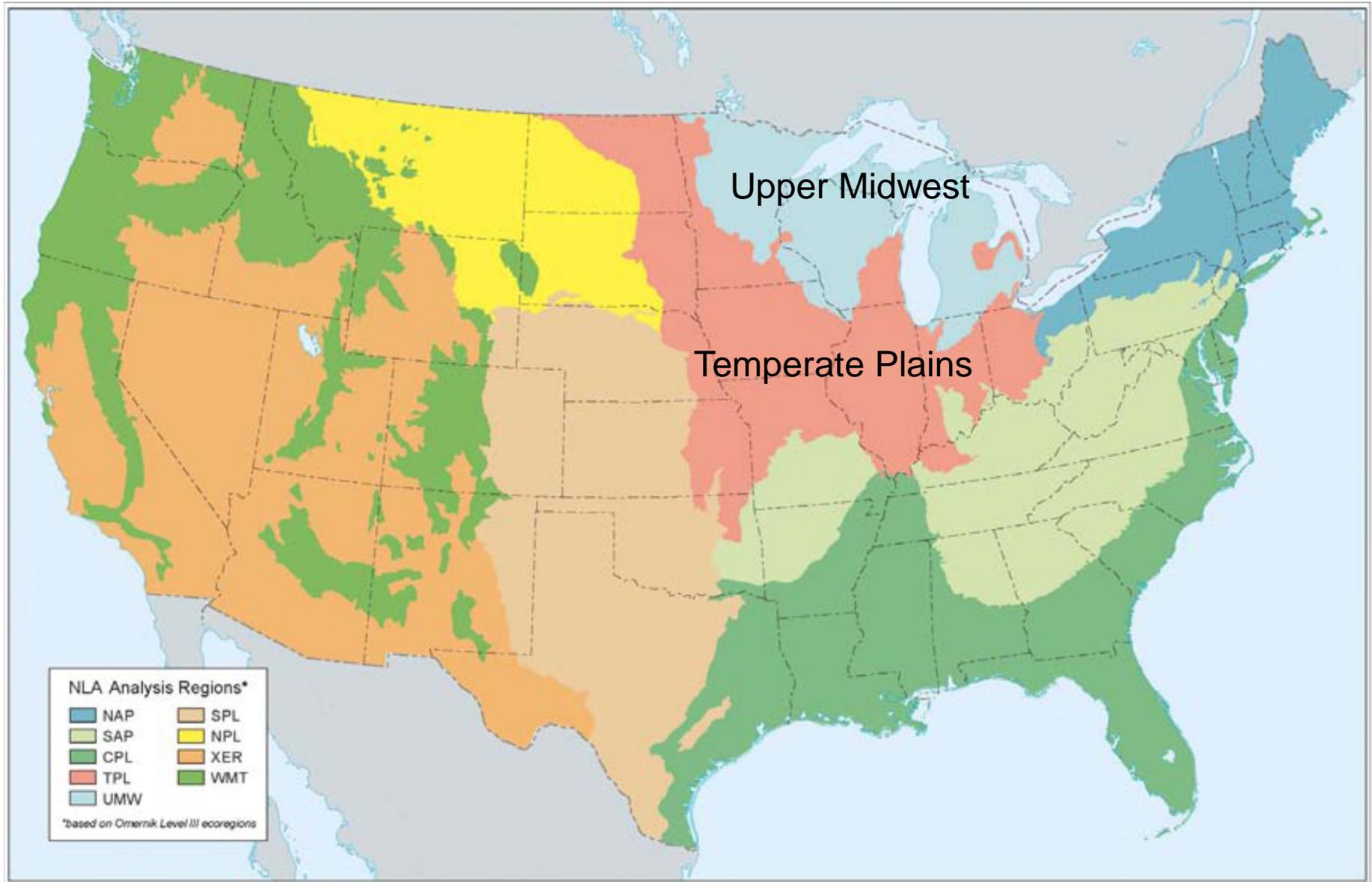


Average Count
of Human Influences

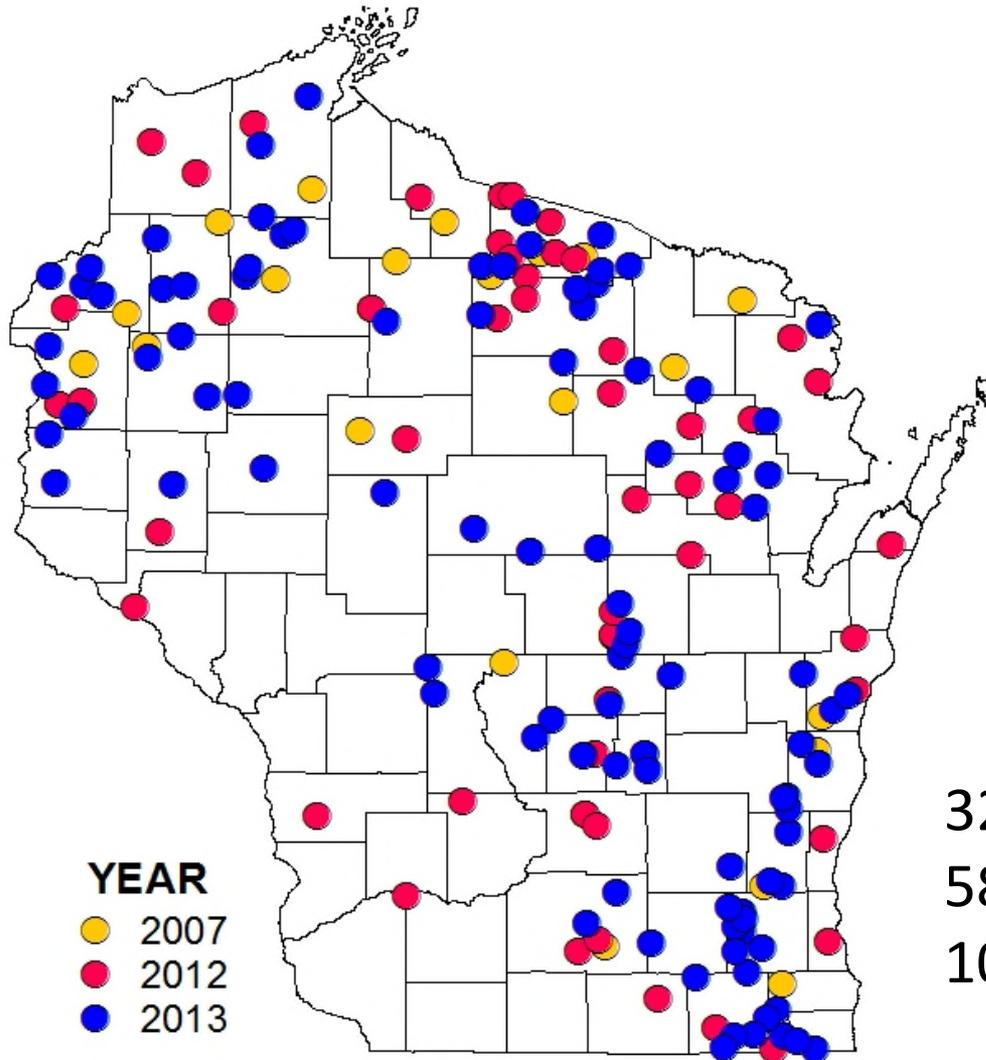
Average % Cover
Woody Vegetation
& Inundated Vegetation

Average % Cover
Emergent & Floating
Macrophytes &
Most Fish Cover

Metrics are Specific to Combined Ecoregions

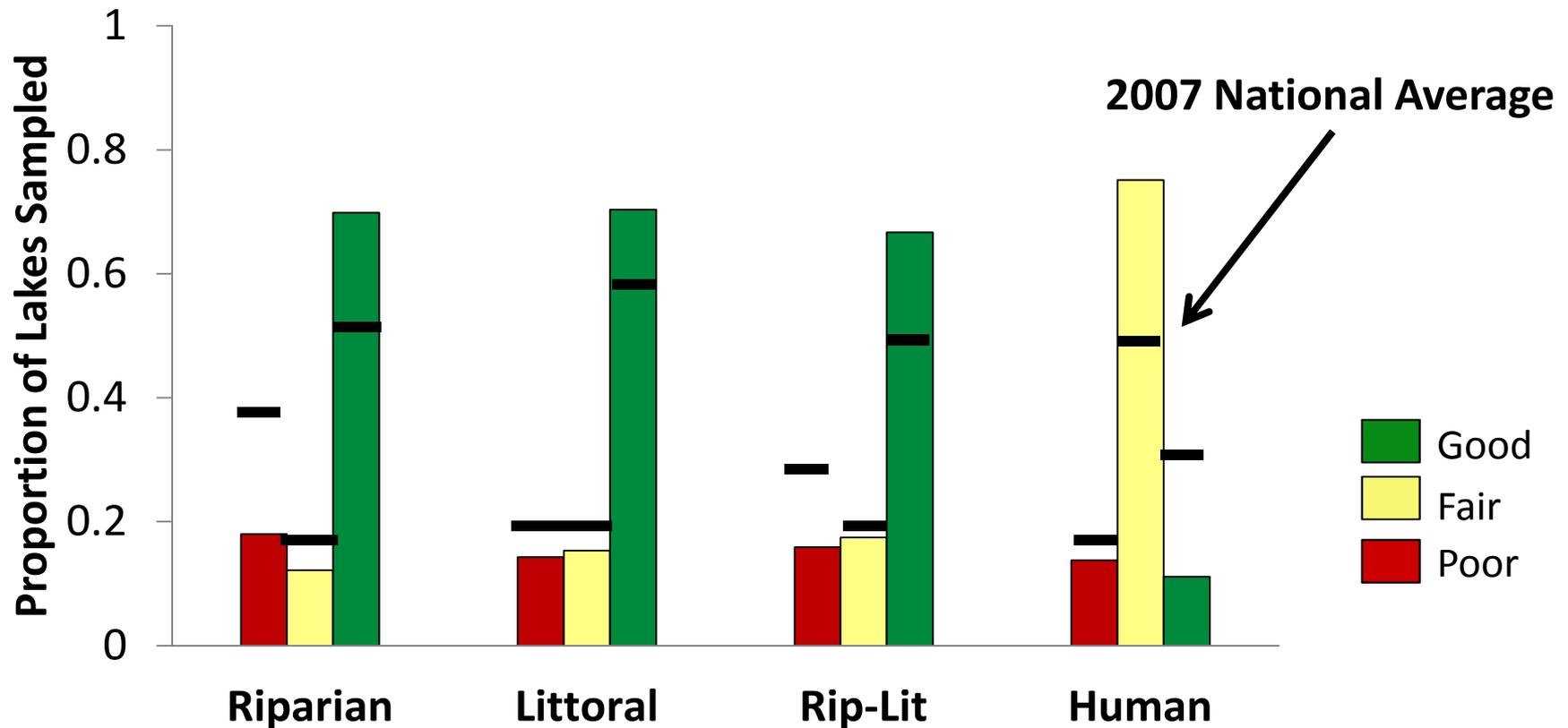


Lake Shoreline Habitat Sampling



32 lakes in 2007
58 lakes in 2012
100 lakes in 2013

Lakeshore Habitat Condition

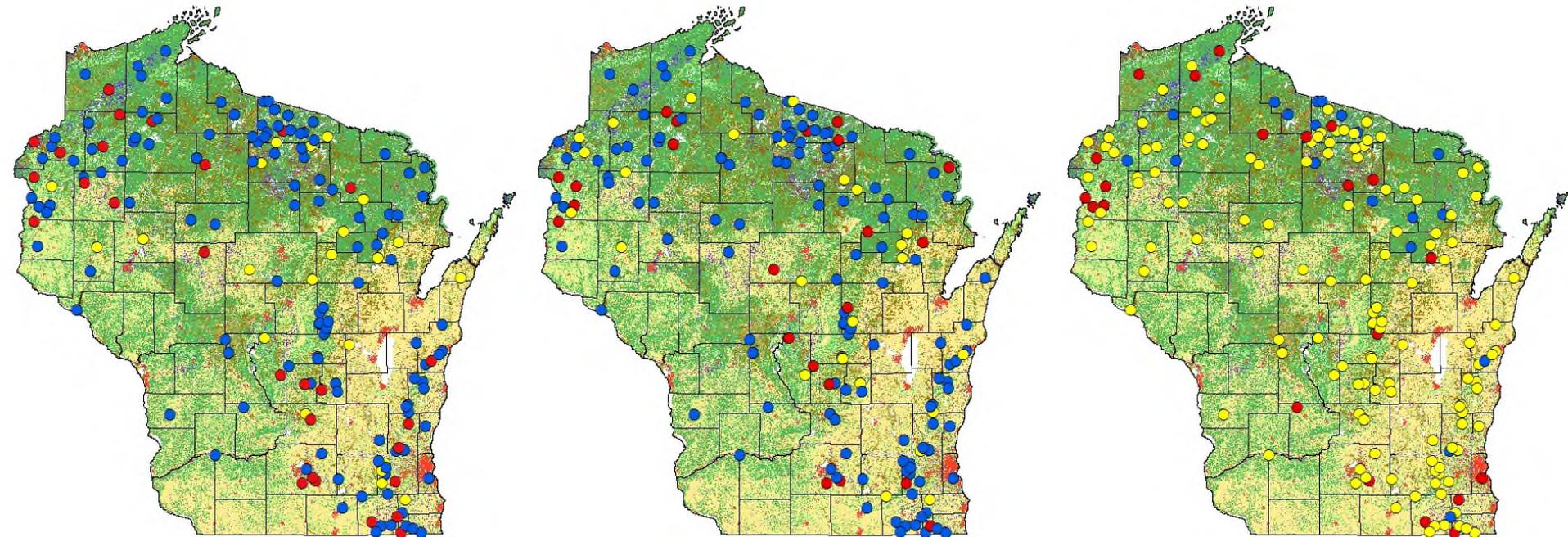


Lakeshore Habitat Health

Riparian

Littoral

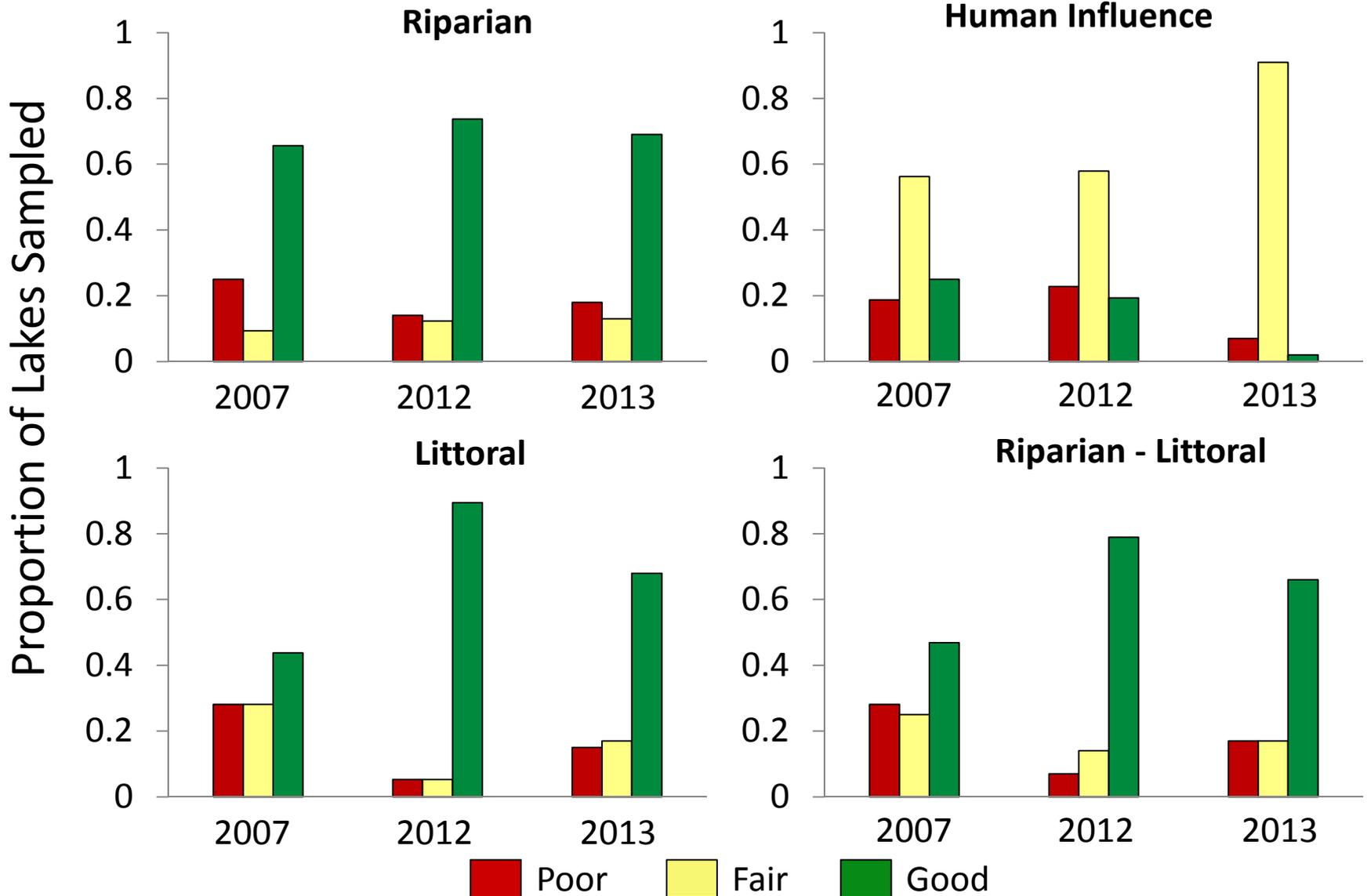
Human Influence



- Good
- Fair
- Poor

- Forest
- Agriculture

Lakeshore Habitat Health Over Time



Metric “Validation”

ALL METRICS = GOOD



100-m Riparian Buffer

84% Wetland

16% Forest

ALL METRICS = POOR



100-m Riparian Buffer

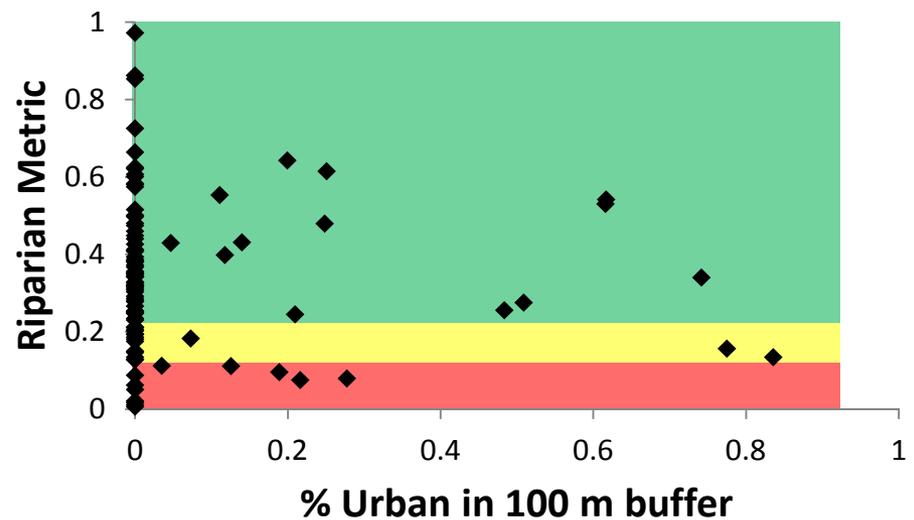
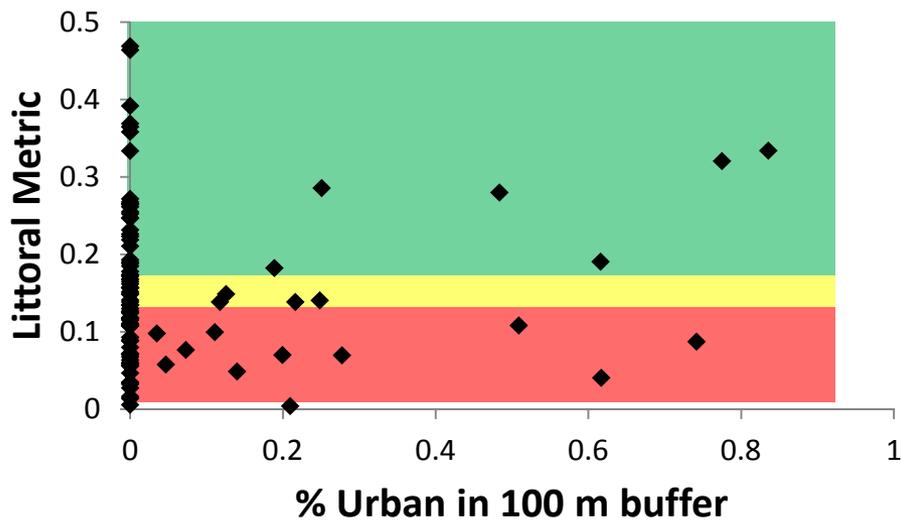
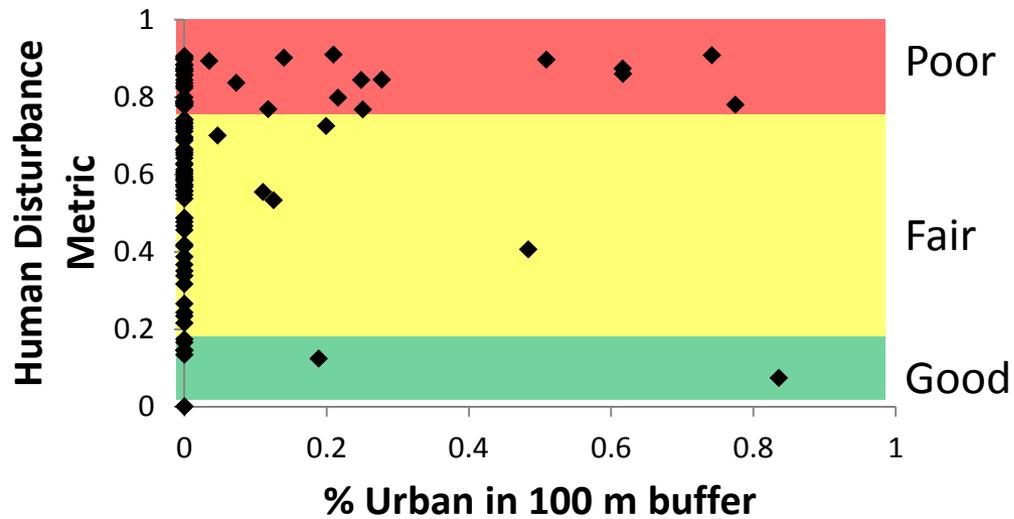
28% Urban

62% Grassland

3% Wetland

7% Forest

How do metrics relate to land use?



Conclusions

- Most lakes in Wisconsin are in “good” health in terms of riparian and littoral habitat despite most lakes being “fair” in terms of human development
- “On the ground” measurements needed!



Next Steps

- Analyze relationships of habitat indicators to lake size, riparian land use, and other variables
- Develop Wisconsin-specific habitat metrics
- Test precision of metrics



Fish grow ~3X faster in lakes with lots of woody habitat

