



**Using Indices of
Biological Integrity to
Assess River, Wetland
and Habitat Health**

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Threats to Rivers

- Nutrient enrichment
- Sediment delivery
- Contaminants
- Habitat Deterioration
- Altered Flow Regimes
- Non-indigenous species

Consequences include elimination of native species, altered biological communities, and loss of ‘fishable’ and ‘swimmable’ qualities

What is Biological Integrity?

- Biological integrity is highest when the biological community includes a full complement of native species, and ecosystem processes are maintained
- A suite of protocols now allows us to assign numerical scores to sampled sites
- Originally developed for fishes, it is increasingly an umbrella term for healthy ecosystems, measured using various biota including fishes, invertebrates, algae, and intolerant species; by processes such as photosynthesis and respiration; and by quantification of habitat

Biological Assessment

- Index of Biotic Integrity (IBI) for fishes is a composite of ~ 10 individual metrics, including no. of species, trophic composition, sensitive species and anomalies
- Quantitative scores translate into “excellent”, “good”, “fair”, “poor”
- Scores are scaled to reference (unaltered) or best available sites
- Change in any environmental variable (note 5 categories) can result in decline in an IBI

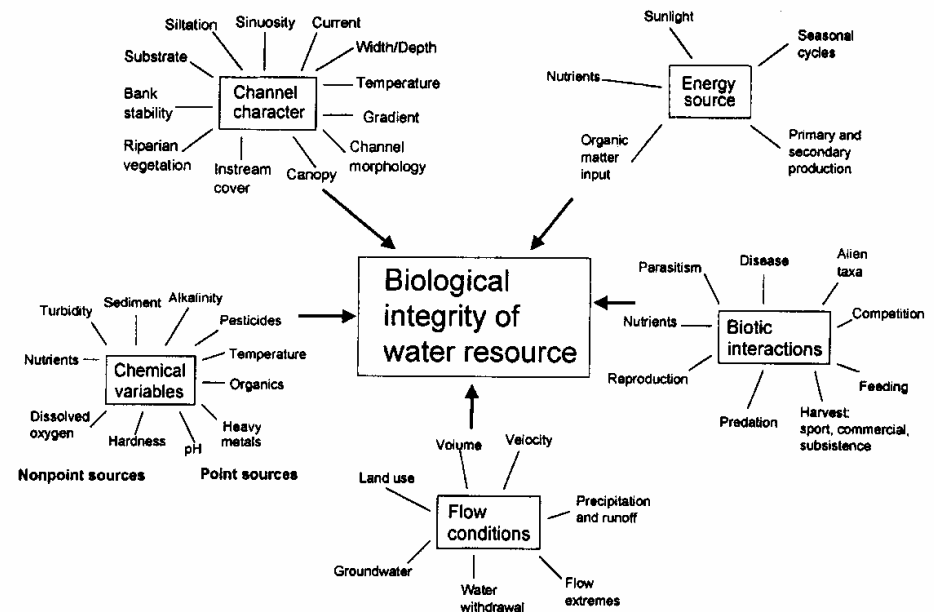


Figure 1. The five principal factors with some of their important chemical, physical, and biological components that are commonly altered by human actions (modified from Karr et al., 1986).

Karr and Chu 2000.
Hydrobiologia 422/423:1-14

Invertebrate Metrics

Taxa Richness Metrics

- Total taxa
- Ephemeroptera taxa
- Plecoptera taxa
- Trichoptera taxa
- EPT taxa
- Long-lived taxa

Taxa Composition Metrics

- % Ephemeroptera taxa
- % Trichoptera taxa
- % Diptera and Non-Insect taxa

Tolerants and Intolerants

- Intolerant taxa richness
- % Tolerant taxa

Feeding and Other Habits

- % Predators
- Clinger Taxa

Population Attributes

- Dominance (3 taxa)



Habitat

- Channel Shape
 - Bankfull area, avg. depth, channel incision
- Substrate
 - Proportion of cobble, avg. particle size, fines
- Reach Measures
 - Measure of riffles, woody debris, slope
- Visual Metrics
 - benthic habitat, fast and slow water, flow stability, etc.



Visual Habitat Assessment



Channel alteration



Bank stability

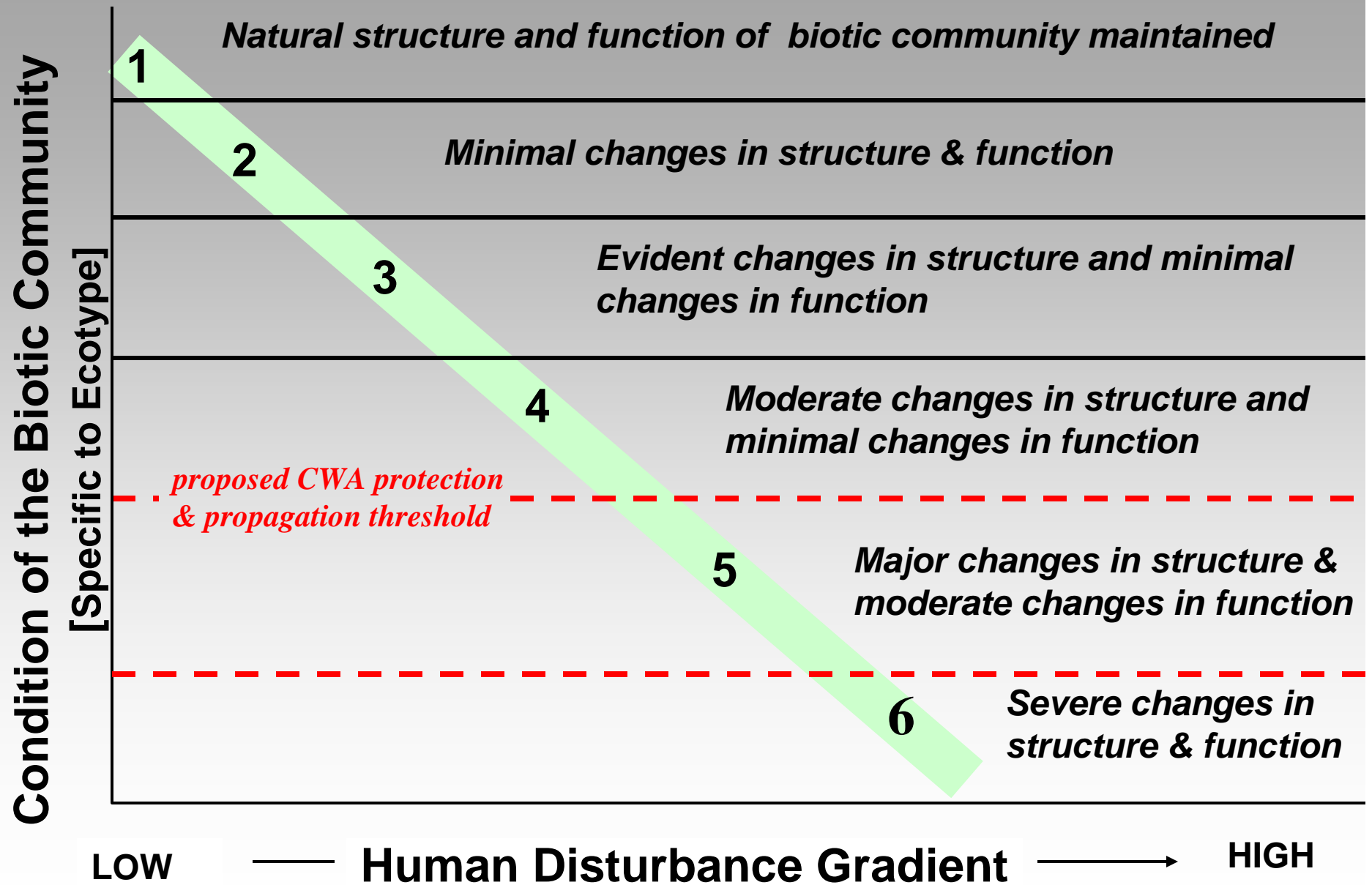
Poor



Good

Tiered Aquatic Life Use Conceptual Model: Draft Biological Tiers -1

(10/22 draft, Susan Jackson, EPA)



A Habitat Index for (Non-Wadeable) Rivers

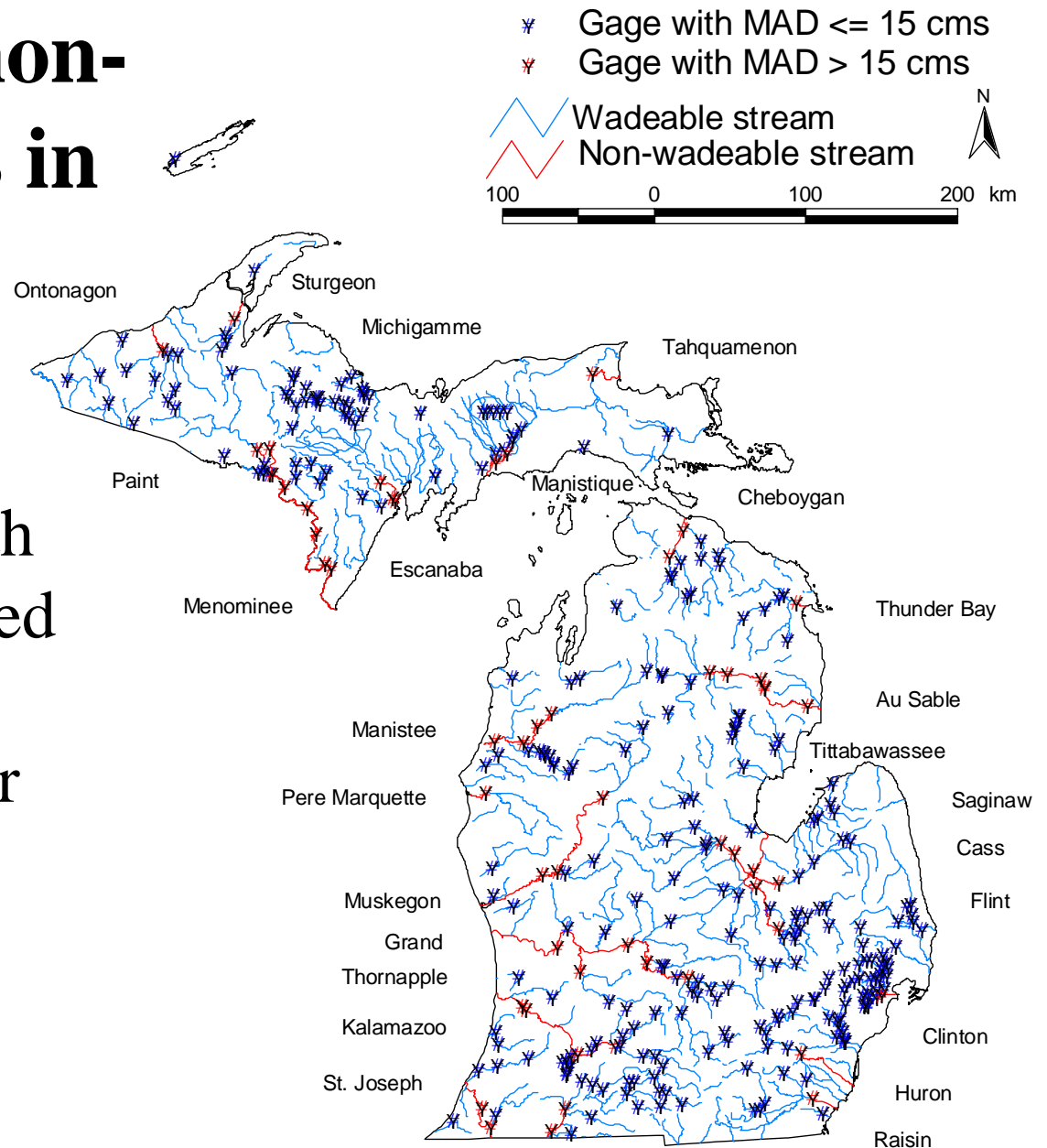
- Biological and habitat assessment methods primarily target small, wadeable streams
- Due to their size, complexity and the challenges of sampling larger rivers, assessment protocols are largely lacking
- With support from MDEQ, Jennifer Wilhelm and Kelly Wessell developed protocols for sampling Michigan's rivers to assess habitat and biotic integrity

The Importance of Habitat

- Habitat links physical environment to its residents, influencing composition, diversity and productivity of biota
- Habitat degradation is one of the leading causes of biodiversity decline in fluvial ecosystems
- Habitat criteria can provide a rapid and independent assessment of the condition of rivers and streams

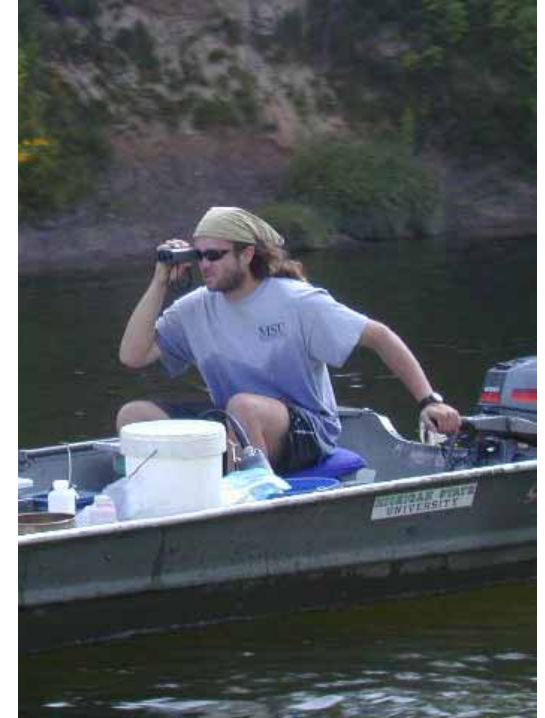
Distribution of non-wadeable rivers in Michigan

We defined non-wadeable as rivers with a MAD > 15 cms, based on field experience. Stream gages and river segments meeting this criterion are shown in red.



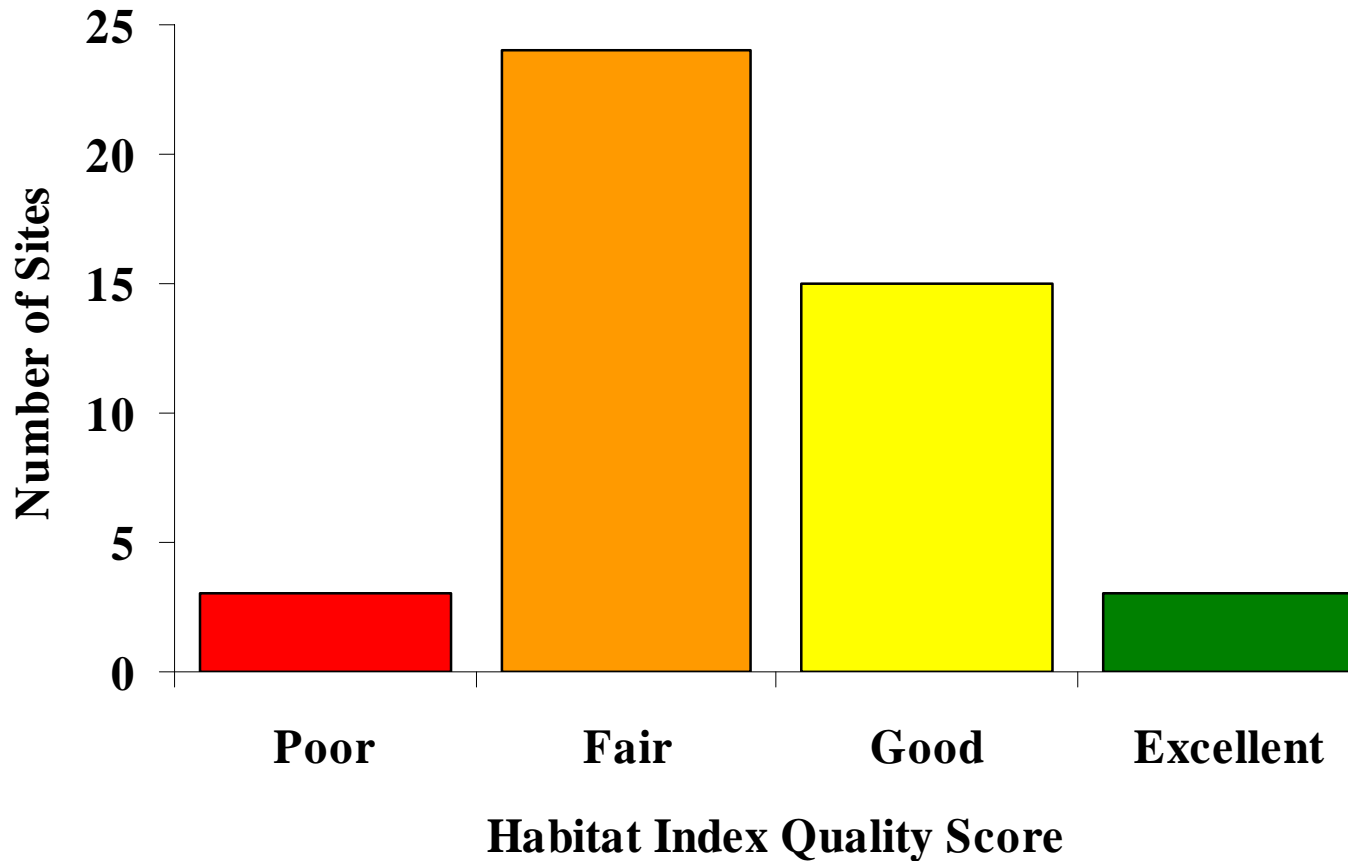
194 Candidate Variables

Geomorphology and hydrology
substrate
instream cover
riparian and bank condition
water quality



Final Habitat Index

Habitat variable	Poor	Fair	Good	Excellent
Riparian Width	Mean riparian width <10 m	Mean riparian width 10-17.5 m	Mean riparian width 17.5-24 m	Mean riparian width >24 m
	0-5	6-12	13-19	20-25
LWD	Fewer than 50 pieces of LWD	Between 50 and 100 pieces of LWD	Between 100 and 200 pieces of LWD	Greater than 200 pieces of LWD
	0-5	6-10	11-15	16-20
Vegetation	<5% coverage of aquatic vegetation	5-15% coverage of aquatic vegetation	15-25% coverage of aquatic vegetation	> 25% aquatic vegetation
	0-5	6-10	11-15	16-20
Bottom Deposition	>50% of the bottom affected by deposition and sedimentation	25-50% of the bottom affected by deposition and sedimentation	5-25% of the bottom affected by deposition and sedimentation	0-5% of the bottom affected by deposition and sedimentation
	0-2	3-5	6-8	9-10
Bank Stability	P51 scores of 0-6 (unstable)	P51 scores of 7, moderately stable	P51 scores of 8, moderately stable	P51 scores of 9-10, stable
	0-2	3-5	6-8	9-10
Thalweg Substrate	<15% gravel or larger substrate	15-35% gravel or larger substrate	35-60% gravel or larger substrate	>60% gravel or larger substrate
	0-2	3-5	6-8	9-10
Off-Channel Habitat	<2 off-channel habitats	2-3 off-channel habitats	4-5 off-channel habitats	>5 off-channel habitats
	0	1-2	3-4	5

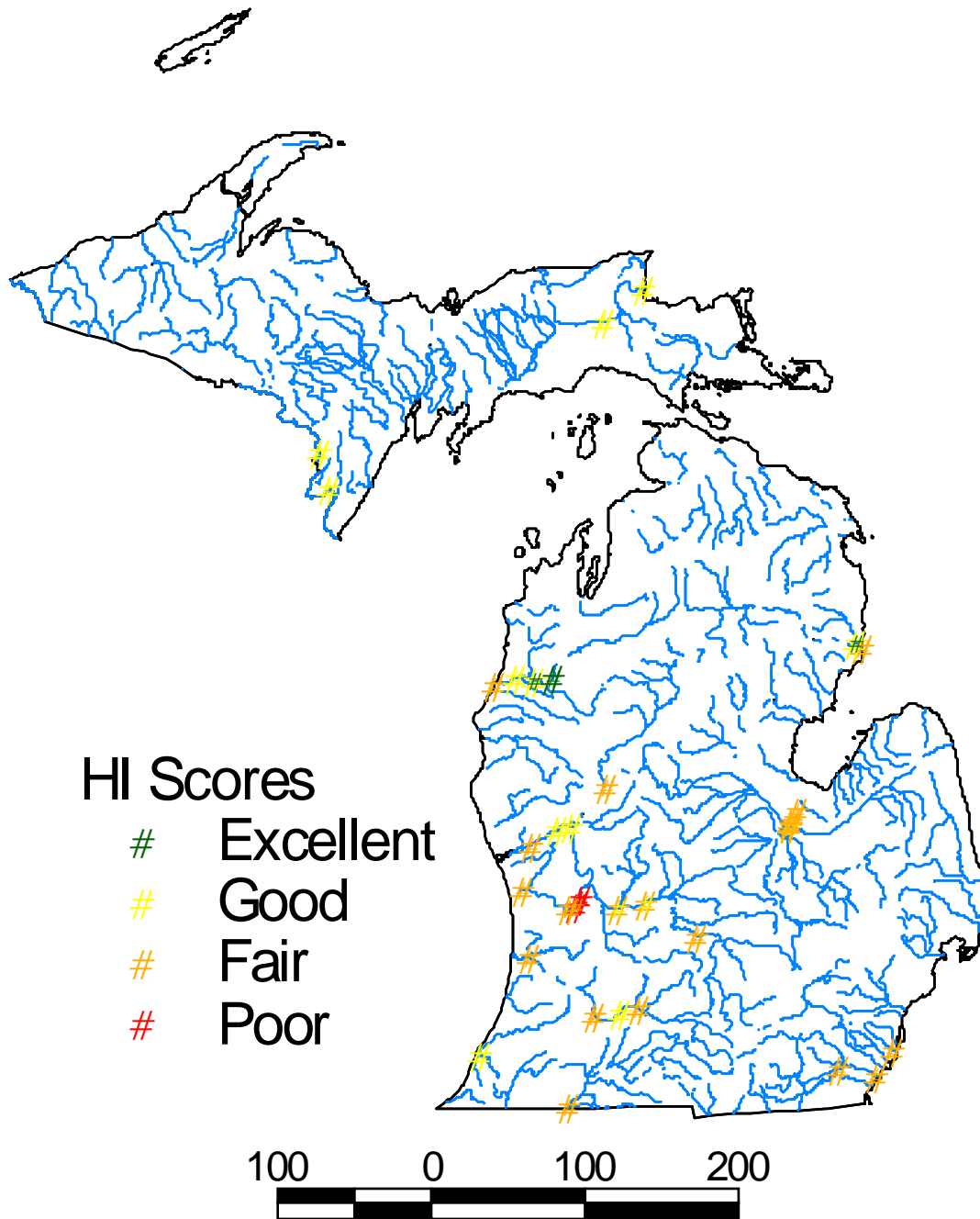


The majority of the 45 non-wadeable sites across 14 Michigan rivers were fair or good.

Excellent: 84-100, good: 56-84, fair: 28-56, poor: 0-28

Spatial Distribution of HI Scores

HI scores suggests are not particularly location-dependent. Both the Manistee and Grand Rivers had sites that fell in three of the four categories. Note that sites in the Southern Lower Peninsula generally have lower HI scores.



Acknowledgements

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