

## **Using Indices of Biological Integrity to Assess River, Wetland and Habitat Health; and an Example of Habitat Evaluation for Non-wadeable Rivers**

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Biological integrity is highest when the biological community includes a full complement of native species, and ecosystem processes are maintained. A suite of protocols allows us to assign numerical scores to sampled sites. Originally developed for fishes, biological integrity 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. Ecological integrity better captures the multiple facets of a healthy waterway.

Habitat evaluation of wadeable streams based on accepted protocols provides a rapid and widely used adjunct to biological assessment. However, little effort has been devoted to habitat evaluation in non-wadeable rivers, where it is likely that protocols will differ and field logistics will be more challenging. We developed and tested a non-wadeable habitat index (NWHI) for rivers of Michigan, where non-wadeable rivers were defined as those of order  $\geq 5$ , drainage area  $\geq 1,000 \text{ km}^2$ , mainstem lengths  $\geq 100 \text{ km}$ , and mean annual discharge  $\geq 15 \text{ m}^3/\text{s}$ . This identified 22 candidate rivers that ranged in length from 151 - 825 km and in drainage area from 2,120 - 16,860  $\text{km}^2$ . The NWHI included seven variables: riparian width, large woody debris, aquatic vegetation, sediment deposition, bank stability, thalweg substrate, and off-channel habitat. This index correlated strongly with a riparian disturbance index ( $R^2 = 0.74$ ) and distinguished the 35 sites into the categories of poor (2), fair (19), good (13), and excellent (1). Habitat variables retained in the NWHI differ from several used in wadeable streams, and place greater emphasis on known characteristic features of larger rivers.

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