



ILLINOIS NATURAL  
HISTORY SURVEY

T E C H N I C A L   R E P O R T

**Developing a multi-metric habitat index for wadeable  
streams in Illinois (T-25-P-001).**

Annual Segment Report to the Illinois Department of Natural Resources.

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**Illinois Natural History Survey  
Division of Ecology and Conservation Science**

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**(May 1, 2007 - April 30, 2008)**

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Submitted to

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Illinois Natural History Survey Technical Report 2008/22

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Annual Project Report 2008  
Project: T-25-P-001

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# **Developing a multi-metric habitat index for wadeable streams in Illinois.**

## **Summary:**

This project was initiated to describe key aquatic habitat characteristics and their association to anthropogenic disturbance by developing a field based, rapid assessment method for qualitatively monitoring instream conditions using a multi-metric habitat index. We have developed and applied a method for rating disturbance in wadeable streams throughout Illinois and collected information on physical habitat at 299 sites to date. Index development is in the preliminary stages with field work to continue during the summer of 2008. This report summarizes work performed for the period ending April 30, 2008 (Appendix A contains Eastern Illinois University subcontract annual report).

## **JOB 1. Sample metrics at chosen sample sites.**

### **1.1 Investigate utility of using existing disturbance ratings developed by Smogor 2000.**

Assessment of the Smogor (2000) ratings suggested that an alternative approach would better meet the needs of our study by removing factors that influence fish directly but may not alter the physical structure of the stream channel (e.g., sewage outflows or hazardous waste locations) and by localizing the landscape summaries to the sites. This job has been completed.

### **1.2 Develop alternative disturbance rating scheme if needed.**

We have developed a disturbance rating based on arc (stream confluence to confluence) local watershed, upstream catchment, and riparian zone perturbations (Figure 1). This rating process was described in the previous annual report and has been applied to stream arcs throughout Illinois. This job has been completed.

### **1.3 Select sites with range of disturbance for sampling.**

Sites were chosen for the summer 2007 field season based on the disturbance ratings developed in Job 1.2. Each potential site was assigned the disturbance rating of the corresponding stream arc. Sites that had been previously sampled (for fish, macroinvertebrates, habitat, mussels or for the project T-13-P-001 [Evaluating water temperature, habitat, and fish communities in candidate coolwater streams in Illinois.]) were given priority over sites without associated historical data. Because they offer a broad and relatively detailed coverage of the state we used the fish IBI regions developed by Smogor (2000) as a starting point for site stratification. Although our regionalization may ultimately be based on something else this gives us an excellent state-wide coverage. We selected a total of 30 sites from each IBI region: 10 least disturbed, 10 most disturbed and 10 with moderately disturbed conditions.

## **JOB 2. Identify potential metrics.**

### **2.1 Identify a list of candidate metrics by reviewing existing indices and the literature.**

While reviewing the literature, it became apparent that several common methods of habitat characterization might be appropriate for use in this project. However, most of these methods collect information at a physical scale that either did not fit with our objective for a rapid assessment method (e.g., point transect method) or lost potentially important information by summarizing throughout the reach (e.g., SHAP [IEPA 1994]). To address these issues we collect data from each site at two scales: (1) the entire reach, and (2) individual channel units (Table 1). This job has been completed.

### **2.2 Develop sampling techniques for each candidate metric.**

Metrics and data sheets were finalized before the beginning of the field season in 2007. We used the substrate definitions from SHAP (Table 2), and defined cover to indicate how we were recording these attributes (Table 3). This job has been completed.

### **2.3 Sample metrics at chosen sample sites.**

We have sampled candidate metrics at 71 sites in 2006 and 233 sites in 2007 for a total of 299 sites to date (several sites were repeated to look for consistencies between crews, Figure 2, Table 4). At the conclusion of the 2007 field season we had not sampled 10 sites of each disturbance class in any region (Table 4). Drought conditions in several areas of the state precluded many sites from being sampled as they were pooled or dry by late summer.

Therefore, additional sampling is necessary to reach our goal of 10 least-disturbed, 10 most-disturbed, and 10 moderately disturbed sites for each IBI region. To meet this target we will focus on regions that have been undersampled (Table 4) and on least disturbed sites during the 2008 field season (Table 5) to ensure sufficient data for index development under low disturbance conditions. As the summer field season progresses, and we have obtained information from 10 least disturbed sites in each region, we will work on collecting information at sites with other levels of disturbance (Table 5).

## **JOB 3. Determine Regions**

### **3.1 Identify possible regionalization schemes (e.g., watersheds, natural divisions).**

Regionalizations used in Illinois are generally based on Natural Divisions (Schwegman 1973), Ecoregions (Woods et al. 2006) or some modification of these (Smogor 2000). We are investigating using these methods and in defining Ecological Drainage Units for Illinois streams based on similarities of faunal characteristics within major catchments (see Sowa et al. 2007 for analogous work in Missouri).

### **3.2 Identify degree to which metrics sample at least-disturbed sites differ among regions.**

No work was scheduled for this Job.

### **3.3 Select final regions.**

No work was scheduled for this Job.

#### **JOB 4. Select Final Metrics.**

##### **4.1 Select final metrics based on those that reflect levels of disturbance in each region.**

No work was scheduled for this Job.

#### **JOB 5. Develop scoring criteria for each region.**

##### **5.1 Establish regional scoring criteria for each metric.**

No work was scheduled for this Job.

#### **JOB 6. Prepare Final Report.**

##### **6.1 Prepare final report including a “how to” manual.**

No work was scheduled for this Job.

##### **6.2 Conduct a training workshop.**

No work was scheduled for this Job.

#### **Literature Cited**

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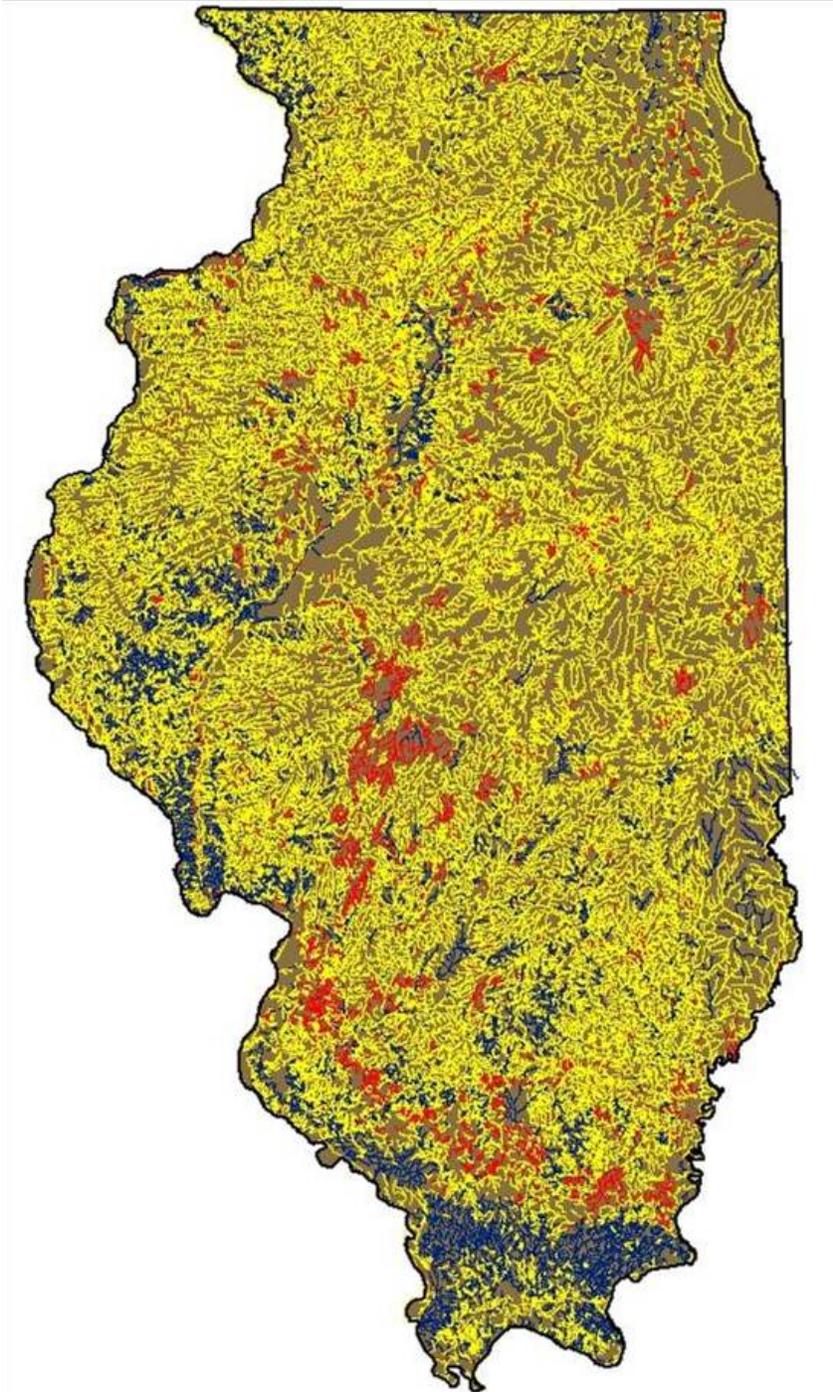
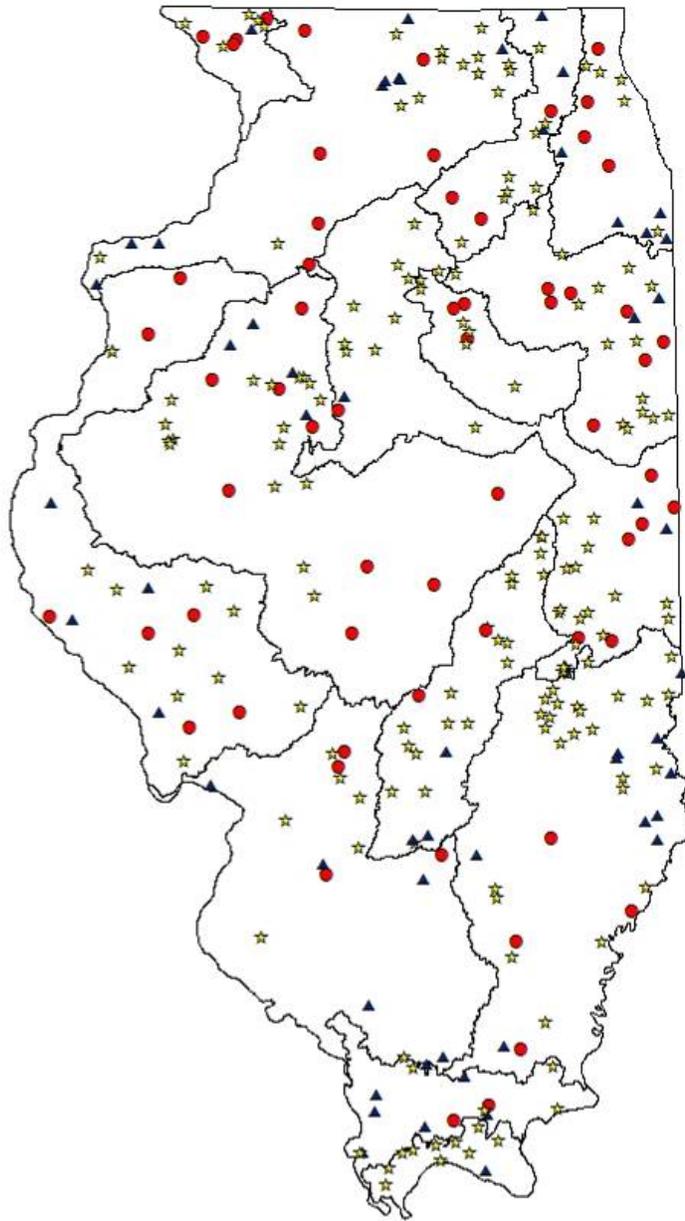


Figure 1. Streams in the State of Illinois color coded by disturbance rating. This rating was developed to reflect anthropogenic disturbance in the watershed and riparian areas that could potentially affect stream habitat. Red streams are most disturbed, yellow streams, green streams are less



### Total Disturbance Rating

| Symbol | Disturbance (range)          | # Sampled |
|--------|------------------------------|-----------|
| ▲      | Least Disturbed (9 - 26)     | 57        |
| ★      | Middle Disturbance (27 - 52) | 180       |
| ●      | Most Disturbed (53 - 91)     | 62        |

Figure 2. Map of Illinois depicting the location of all sites sampled in 2006 and 2007. Sites are coded according to the respective disturbance level. Red circles are most disturbed, blue triangles are least disturbed sites and yellow stars are moderately disturbed.

Table 1. Candidate metrics that are currently collected by field staff. Scale defines at which level we collect the metric (Each channel unit, whole reach or both the channel unit and reach scales)

| Metric                         | Definition  | Scale |
|--------------------------------|---|-------|
| Buffer Width                   | Width of the undeveloped buffer on each side of the stream  | Reach |
| Riparian Type                  | Type of vegetation growing in the buffer zone               | Reach |
| Stream Bank Vegetation         | Type of vegetation growing on the stream banks              | Reach |
| Predominant Channel Type       | Pool, Riffle, or Run  | Reach |
| Predominant Substrate          | Most abundant type of substrate (see Table 2)               | Both  |
| Predominant Flow               | Fast, Moderate, Slow, or No detectable flow                 | Both  |
| Shading of Water Surface       | Completely, mostly, half, most light, all light             | Reach |
| Thalweg Depths                 | 10 approximately equidistant depths taken                   | Reach |
| Channel Evolution              | Per Schumm et al. 1984                                      | Reach |
| Water Level                    | Rising, base flow, decreasing or pooled                     | Reach |
| Stream Modifications           | Any human perturbations are noted                           | Reach |
| Wetted Width                   | Taken at the downstream, mid and upstream points            | Reach |
| Thalweg Depth                  | Taken at the downstream, mid and upstream points            | Reach |
| Channel Unit Type              | Lateral pool, mid-channel pool, riffle, run or transitional | Unit  |
| Cover                          | Abundance of cover (see Table 3)                            | Unit  |
| Substrate embeddedness         | Only applied to substrates fine gravel and larger           | Unit  |
| Depth of fines as bottom cover | None, 1-25mm, 25-50, 50-75, and >75mm                       | Unit  |
| Cross section depths           | Eight depths are taken across pools                         | Unit  |
| Max depth                      | Deepest point of a unit                                     | Unit  |

Table 2. Substrate and bottom type categories used in stream habitat assessment (taken from Illinois' Stream Habitat Assessment Procedure (SHAP)) (IEPA 1994).

| Substrate type | Particle size  |
|----------------|----------------|
| Bedrock        | Solid rock     |
| Silt           | <0.062 mm      |
| Hardpan        | Compacted soil |
| Sand           | 0.062-2 mm     |
| Fine Gravel    | 2-8 mm         |
| Gravel         | 8-64 mm        |
| Cobble         | 64-256 mm      |
| Slab Boulder   | >256 mm        |
| Boulder        | >256 mm        |

Table 3. Cover definitions for channel units. Amount of each cover type is estimated as none, sparse, intermediate or abundant.

| Cover Type                | Definition  |
|---------------------------|---|
| Aquatic macrophytes       | Non-terrestrial, emergent, floating, or submerged macrophytes, not including algae  |
| Undercut bank             | Bank with a cavity below the waterline  |
| Overhanging vegetation    | Plant foliage suspended over the wetted channel and within one meter of the water's surface   |
| Rootwads                  | Root mass from a tree that is in wetted channel and diverting water flow  |
| Rootmats                  | Fibrous roots from trees and other plants extending into the wetted channel   |
| Boulder                   | Substrate particle larger than 250 millimeters (modified Wentworth scale) along the second shortest axis                                      |
| Large woody debris (LWD)  | Woody material (e.g. log or tree) with a diameter greater than 10 cm, length greater than 1 meter, in wetted channel and diverting water flow |
| Aggregate of woody debris | Two or more LWD, must be in wetted channel and diverting water flow   |

Table 4. Sites sampled within each Fish IBI Regions by disturbance type for this study. We sampled at 71 Sites in 2006 and 233 sites were sampled during the summer of 2007.

| IBI Region | Least Disturbed | More Disturbed | Most Disturbed | Total Sampled |
|------------|-----------------|----------------|----------------|---------------|
| 1          | 1               | 5              | 4              | 10            |
| 2          | 9               | 13             | 6              | 28            |
| 3          | 5               | 6              | 4              | 15            |
| 4          | 3               | 14             | 6              | 23            |
| 5          | 2               | 14             | 7              | 23            |
| 6          | 3               | 33             | 7              | 43            |
| 7          | 4               | 17             | 9              | 30            |
| 8          | 4               | 13             | 7              | 24            |
| 9          | 3               | 21             | 2              | 26            |
| 10         | 6               | 6              | 4              | 16            |
| 11         | 10              | 23             | 4              | 37            |
| 12         | 6               | 6              | 2              | 14            |
| 13         | 1               | 10             | 0              | 11            |

Table 5. Expected sites to be sampled in each Fish IBI Region during the 2008 field season. Collections at these sites will bring the total number of sites sampled to 30 for each Region.

| IBI Region | Least Disturbed | More Disturbed | Most Disturbed |
|------------|-----------------|----------------|----------------|
| 1          | 9               | 5              | 6              |
| 2          | 1               | 0              | 4              |
| 3          | 5               | 4              | 6              |
| 4          | 7               | 0              | 4              |
| 5          | 8               | 0              | 3              |
| 6          | 7               | 0              | 3              |
| 7          | 6               | 0              | 1              |
| 8          | 6               | 0              | 3              |
| 9          | 7               | 0              | 8              |
| 10         | 4               | 4              | 6              |
| 11         | 0               | 0              | 6              |
| 12         | 4               | 4              | 8              |
| 13         | 9               | 0              | 10             |

## **APPENDIX A. Annual report from Eastern Illinois University.**

### **PROJECT #: Eastern Illinois University Sub – Contract**

**PROJECT TITLE:** Developing a multi-metric habitat index for wadeable streams in Illinois

#### **Summary:**

In Illinois, existing methods for sampling stream habitat can be time consuming for staff to routinely collect, or are not sensitive enough to detect meaningful differences in stream quality. The following project will result in a qualitative, multi-metric habitat index that will help refine Illinois' Plan by: describing relative conditions of key aquatic habitats, establishing restoration benchmarks, prioritizing survey efforts, and provide a tool for monitoring the effectiveness of conservation actions. Work performed by Eastern Illinois University has focused on sampling habitat metrics in least-disturbed, moderately-disturbed, and most-disturbed sites throughout Illinois. This report summaries work performed by Eastern Illinois University for the period ending June 1, 2008.

#### **JOB 1. . Sample metrics at chosen sample sites**

The Eastern Illinois University research staff assigned to this project `working with the research scientist of Illinois Natural History Survey have identified metrics at both the reach and channel unit spatial scale to be determined from sample sites throughout the state in varying degrees of disturbance. Following metric identification, researchers and students at Eastern Illinois University have sampled candidate metrics at a total of 71 sites in 2006 and an additional 233 in 2007 from least-disturbed, moderately-disturbed, and most-disturbed sites throughout Illinois. Habitat samples were collected at existing Illinois Environmental Protection Agency (IEPA) stations when possible to ensure compatibility with existing data. For samples collected at other sites, the locations were well documented and staff requested station code designations from the IEPA. Habitat data collected from the sites sampled were photocopied and the originals sent to the Illinois Department of Natural Resources (IDNR) where data was entered into a database, designed by the project research scientist.

#### **JOB 2.**

In addition to sampling habitat metrics, we coordinated with IDNR and IEPA staff conducting the state's cooperative basin survey program. During these basin surveys, fish, macroinvertebrates, and existing habitat indices were sampled in association with the candidate habitat metrics. We have also continued sampling at additional sites to fill in gaps in statewide coverage through all levels of disturbance. Fish data was collected via electrofishing using standard IDNR collecting protocols. Macroinvertebrates were sampled according to IEPA sampling protocols. Fish data collected as part of this project were entered into IDNR's Fisheries Analysis System database to facilitate compatibility with other Departmental data.

#### **JOB 3. Prepare final report**

No work was scheduled for Job 3.

Prepared by:

Bud Fischer, Associate Chair, Department of Biological Sciences, Eastern Illinois University.