# STUDY PERFORMANCE REPORT

**State:** Michigan

**Project No.:** F-35-R-24

**Study No.:** 680

**Title:** Patterns in community structure, life histories, and ecological distributions of fishes in Michigan rivers

**Period Covered:** April 1, 1998 to September 30, 1999

**Study Objectives:** 1) To develop models that explain abundance patterns of the most common fishes in Lower Michigan streams; 2) to evaluate the role of landscape-scale characteristics of streams in favoring fishes having particular life history characteristics; 3) to develop an atlas describing the geographic and ecological distributions of fishes in Lower Michigan streams.

**Summary:** We finalized the fish, streamflow, channel habitat, and fragmentation databases needed for final modeling; the temperature database is nearly complete. We collected site-specific habitat data at 81 Michigan Rivers Inventory (MRI) sites on Lower Michigan streams. We developed a modeling strategy for fishes that includes logistic regression models to explain species' presence-absence and multiple regression models to identify physical and biological factors influencing species' abundance. Preliminary models were 84% correct in predicting occurrences of the 64 most common stream fishes. These models demonstrated the importance of landscape-scale variables (such as stream size, hydrology, valley character, and habitat fragmentation) in explaining species occurrences.

**Job 1. Title: Model species abundances.**

**Findings:** Data from 675 MRI sites were used to explain fish abundance patterns in Lower Michigan streams. Observational data on channel habitats, streamflow, stream temperature, and estimates of fish abundance do not occur at all sites, and often do not occur at the same sites. We have been collecting field data and updating model predictions in an attempt to provide physical data at all MRI sites or at least those sites with fish abundance estimates. We collected site-specific habitat data at 81 Michigan Rivers Inventory (MRI) sites on Lower Michigan streams. Observational data recorded at sites included percent of reach as riffle, pool, and run; substrate characteristics; instream and bankside cover conditions; bank stability; and riparian corridor characteristics. Site-specific habitat data now exist for 282 of 307 MRI sites having fish abundance estimates. We used the latest streamflow models to make predictions of the 90% and 10% exceedence flows at all MRI sites. We developed improved models for predicting weekly mean and range in July stream temperatures, and will use them to make temperature predictions at MRI sites. Real and modeled streamflow and temperature data will be used in modeling distribution and abundance of fishes. Modeled data flows and temperatures will be used when real data are unavailable.

We developed a modeling approach for explaining patterns in fish distribution and abundance in Michigan streams. We will be developing two sets of models for the 60+ most common fishes. Logistic regression models of fish presence-absence will examine the influence of landscape-scale variables on fish occurrence. Landscape-scale features of aquatic habitats (such as stream size, hydrology, temperature, valley character, and connectivity to other aquatic habitats) provide the coarse-scale template (Southwood 1977) for explaining occurrence of fishes. Outputs from preliminary logistic regression models for 64 species (using old flow and temperature predicted values) demonstrate the relative importance of these variables and explain considerable variation in species' occurrences (Table 1). These 64 models were 84% correct (average of all models) in explaining species' presence or absence. The ability of individual models to correctly predict presence or absence also appeared to be influenced by how rarely or commonly a species occurred in the dataset.

The second set of models will identify important variables that influence a species' abundance at sites where a species occurs. For each of the common species, we will use MRI sites where the species occurs to develop multiple linear regression models that relate fish biomass to physical and biological attributes available in the MRI databases.

**Job 2. Title: Model life history parameters.**

**Findings:** Relations between fish life history attributes and the physical characteristics of streams will be addressed through analyses of models developed in Job 1. Important relations could also be presented in the ecological atlas of Michigan fishes that will be produced later in this study (Job 3).

**Job 4. Title: Write progress and final reports.**

**Findings:** This progress report was written on schedule.

**Literature cited:**

Southwood, T.R.E. 1977. Habitat, the templet for ecological strategies? Journal of Animal Ecology 46:337-365.

**Prepared by:** Troy G. Zorn
**Date:** September 30, 1999

Table 1.–Number of times variables were significant ($P < 0.10$) in preliminary logistic regression for 64 species of fish in Lower Michigan rivers. Type of data for variable is binary (B) or continuous (C).

| Variable Description | Number of significant occurrences | Type of data |
|---|---|---|
| **Size and hydrology** | | |
| Catchment area | 31 | C |
| Predicted July mean temperature | 20 | C |
| 90% exceedence flow yield | 22 | C |
| 10% exceedence flow yield | 11 | C |
| **Valley character** | | |
| Gradient | 21 | C |
| Sinuosity | 11 | C |
| **Connections to** | | |
| Larger rivers (draining >1000 $km^2$) | 14 | B |
| Similar- or larger-sized downstream tributaries | 15 | B |
| Lentic habitats <5 km upstream | 15 | B |
| The Great Lakes | 19 | B |