STUDY PERFORMANCE REPORT

State: Michigan **Project No.:** F-35-R-22

Study No.: 631 **Title:** Inventory and classification of warmwater river fish communities

Period Covered: April 1, 1996 to March 31, 1997

Study Objective: For the rivers of Michigan's Lower Peninsula:

(1) Develop operational models of site-specific fish habitat variables (e.g. temperature, substrate) using watershed- and landscape-scale habitat variables.
(2) Using key variables defined in (1), classify river sites into distinct "habitat types".
(3) Develop operational models predicting fish population and community characters from habitat variables.
(4) Building on the habitat classification in (2), classify fish communities into distinct types.
(5) Determine the effects of water temperature on the distribution and abundance of stream fishes.

Summary: We collected additional data for use in developing species--specific models for the most abundant fishes at MRI (Michigan Rivers Inventory) sites. For sites where fish abundance data were available, we measured the level of connectivity of sites to other streams within the drainage system and to the Great Lakes. We also developed a watershed-based database describing the pre-settlement distribution limits of all stream fishes in Michigan. Preliminary regression models of density for 32 species demonstrated the importance of July stream temperatures, drainage area, hydrologic stability, and degree of fragmentation in explaining patterns in species distribution and abundance at the spatial scale of Michigan's Lower Peninsula (Table 1). Future modelling will include more species and MRI sites, and utilize species-specific distribution information and improved predictions of hydrology and temperature characteristics. We continued to collect growth data from 21 smallmouth bass and rock bass populations, and from 12 brown trout populations, at sites having different thermal regimes. We also conducted a laboratory experiment to determine the importance of fish size and thermal regime on the overwinter survival of young of year smallmouth bass, rock bass and brown trout. A number of reports have been prepared from work accomplished in Jobs 1 through 6-2. This study was amended to continue for another year (into Segment 23).

Job 6-3. Title: Model fish community variables.

Findings: We collected additional data for use in developing species-specific models for the most abundant fishes at MRI sites. For sites where fish abundance data were available, we measured the level of connectivity of sites to other streams within the drainage system. We recorded the link value (number of first order streams feeding into the site), the d-link value (the link value at the junction of the stream containing the MRI site with the nearest downstream stream having a link value at least 10% greater than that of the MRI site), and whether there was a dam between between the MRI site and this junction. We also recorded whether each MRI site was connected to larger downstream rivers and the Great Lakes.

We also developed a watershed-based database describing the distribution of all stream fishes in Michigan. Data were collected by overlaying a watershed template on fish distribution maps housed at the University of Michigan's Museum of Zoology. This database will be used to provide an approximation of the pre-settlement distribution limits of Michigan fishes.

Preliminary regression models of fish abundance (biomass density) were developed for 32 species. Initial input variables for each model included each site's drainage area, predicted hydrologic stability, predicted July temperature characteristics, degree of fragmentation, stream gradient and sinuousity (both determined from topo maps), and various on-site habitat measurements. These models demonstrated the importance of stream temperature in explaining patterns in species distribution and abundance at the spatial scale of Michigan's Lower Peninsula (Table 1). Adjusted r-square values for these models ranged from 0.01-0.55, with an average of 0.24. Unexplained variation may result from various factors; including temporal variation in population levels, variation in fish sampling efficiency, and the use of modelled data as input variables. Future modelling will include more species and MRI sites, and utilize species-specific distribution information and improved predictions of hydrology and temperature characteristics.

Table 1. Frequency of occurrence for various categories of independent variables used in preliminary regression models describing the density of 32 common fishes in lower Michigan streams.

Variable	Numbers of occurrences
Temperature	
July weekly mean	25
July weekly minimum	8
July weekly variation	7
July weekly maximum	4
Drainage area	13
Streamflow stability	8
Level of connectivity	6
Reach gradient	3

Job 6-4. Title: <u>Classify fish communities.</u>

Findings: The findings of this job were summarized in the following report.

Zorn, T.G., P.W. Seelbach, and M.J. Wiley. 1997. Patterns in the fish communities of Lower Michigan streams. Michigan Department of Natural Resources, Fisheries Research Report 2035 Ann Arbor.

Job 7. Title: <u>Determine temperature effects.</u>

Findings: To determine the influence of temperature on fish distribution and abundance, we continued to collect growth data from 21 smallmouth bass and rock bass populations from sites

having different thermal regimes. In addition, we collected growth data from 12 brown trout populations from sites also having different thermal regimes.

We also conducted a laboratory experiment to determine the importance of fish size and thermal regime on the overwinter survival of young of year smallmouth bass, rock bass and brown trout. Each species was exposed to one of four thermal regimes which simulated the range of winter conditions experienced by fish in lower Michigan. The range in fish size tested also corresponds to the pre-winter size range of YOY fish found in the field. We measured weight loss, mortality, and changes in proximate composition over 160 days.

Job 8. Title: Write final report.

Findings: The following reports have been or will be prepared from work accomplished in Jobs 1 through 6-2.

Wiley, M.J., and P.W. Seelbach. 1997. An introduction to rivers – the conceptual basis underlying the Michigan Rivers Inventory (MRI) Project. Michigan Department of Natural Resources, Special Report 17, Ann Arbor.

Seelbach, P.W., and M.J. Wiley. 1997. The Michigan Rivers Inventory Project – an overview. Michigan Department of Natural Resources, Fisheries Technical Report in preparation, Ann Arbor.

Seelbach, P.W., M.J. Wiley, J. C. Kontanchik, and M. E. Baker. 1997. An ecological classification system for river valley segments in lower Michigan. Michigan Department of Natural Resources, Fisheries Research Report 2036, Ann Arbor.

Zorn, T.G., P.W. Seelbach, and M.J. Wiley. 1997. Patterns in the fish communities of Lower Michigan streams. Michigan Department of Natural Resources, Fisheries Research Report 2035, Ann Arbor.

Wiley, M.J., S.L. Kohler, and P.W. Seelbach. 1997. Reconciling landscape and local views of aquatic communities: lessons from Michigan trout streams. Freshwater Biology 37:133-148.

Prepared by: Paul W. Seelbach, Troy Zorn, and Kevin Wehrly
Date: March 31, 1997