Appendix B:

Biological and Habitat Survey for the Salt Creek and East and West Branches of the DuPage River s

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A Proposal Submitted to:

DuPage-Salt Creek Work Group
10S404 Knoch Nolls Rd.
Naperville, IL 60565

Submitted by:

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May 3, 2006

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I. Introduction

In response to the Request for Proposals (RFP) announced by the DuPage-Salt Creek Workgroup on April 13, 2006, the Midwest Biodiversity submits this proposal. The work will be carried out by the Institute's Center for Applied Bioassessment and Biocriteria (CABB), which is the applied research arm of MBI dedicated to the development and implementation of biological assessments and biological criteria in support of water quality management. CABB is fully qualified, staffed, equipped, and experienced to carry out the type of assessment described in the RFP. Furthermore, CABB was selected by the Workgroup to develop the biological and water quality assessment plan on which the RFP is based.

II. Project Scope

CABB proposes to accomplish the following in fulfillment of the tasks outlined by the RFP:

- development of a detailed plan of study;
- complete a project quality assurance project plan (QAPP);
- secure all necessary scientific collection permits;
- pre-survey reconnaissance of sampling sites;
- collection of fish and macroinvertebrate samples;
- collection of habitat data using the Qualitative Habitat Evaluation Index (QHEI);
- collection of field chemical/physical data;
- GPS and photographic documentation of all sampling sites regardless of whether they are sampled or not;
- data management using a relational database translatable to Excel or Access;
- completion of a detailed assessment report of the biological resource organized by major basin including, but not limited to, IBI, MBI and QHEI calculations for each site, integration of biological, habitat and water & sediment chemistry for each site, and delineation of impairments and determination of associated causes and sources.

The above tasks are organized in a chronological order with each successive task being dependent on the completion of the prior tasks. Each task is further described as follows.

Study Plan

A detailed study plan provides the essential "road map" for the field sampling crews. It is specific in that it details the proposed sampling sites in a spatial context so that they can be more easily found on maps, located using GPS tools, and verified in the field. It also specifies the types of biological, habitat, and allied chemical/physical measurements that will be collected. This in turn determines the types of sampling equipment that will be needed such that the logistics of the field season can be more efficiently organized.

Quality Assurance Project Plan (QAPP)

A QAPP is essential for several purposes perhaps the most important of which is to provide the oversight and funding entities an opportunity to examine the quality and credibility of the sampling methods and study design. It also details the strengths and inherent limitations of the methodologies which influences data analysis and interpretation. A QAPP template has already been developed and it will be used as the core of the QAPP that will be developed along with the detailed plan of study.

Scientific Collecting Permits

CABB personnel are recent holders of Illinois scientific collecting permits (2004-5), thus we are familiar with the renewal process. CABB will also conduct the necessary coordination with local jurisdictions to determine which additional permits are necessary and take the steps necessary to secure them prior to conducting field work.

Pre-Survey Reconnaissance

A pre-survey reconnaissance will be conducted in June immediately preceding the initiation of field sampling. This will serve two important purposes; 1) to locate each sampling site and evaluate site-specific and access issues; and 2) to familiarize the crew leaders with the watershed setting and the logistics involved in transporting the sampling crews and equipment to the sites. It also serves the purpose of making final adjustments to the plan of study.

Biological, Habitat, and Water Quality Sampling

Biological sampling will consist of utilizing two assemblages, fish and macroinvertebrates (Figures 1 and 2). The biological assessment plan specifies the methods and equipment that will be need for different sizes of stream in the study area. Table 1 shows a general breakdown of sites in accordance with the application of the different fish and macroinvertebrate field methods described in the biological assessment plan. These estimates are based on the anticipated application of the specific protocols that will likely be used – some adjustments may be required based on the pre-survey reconnaissance and during sampling. These estimates were then used to develop the project budget (Tables 2 and 3). A QHEI will be collected at each fish sampling site and will be completed by the fish crew leader. Field chemical/physical parameters will be collected using a commercially available field meter capable of measuring temperature, dissolved oxygen (D.O.), conductivity, and pH. Biological laboratory methods will also follow the assigned methods and will include fish voucher verification and macroinvertebrate taxonomy to the lowest practicable level (Figure 2) as specified by the RFP. All methods and their specifications will be described in detail in the project QAPP.

Each site will be georeferenced using a commercially available GPS unit. This will include the beginning, center point, and terminus of each fish and multi-habitat macroinvertebrate site, and the center point of the qualitative macroinvertebrate sites. Representative photographs of each site

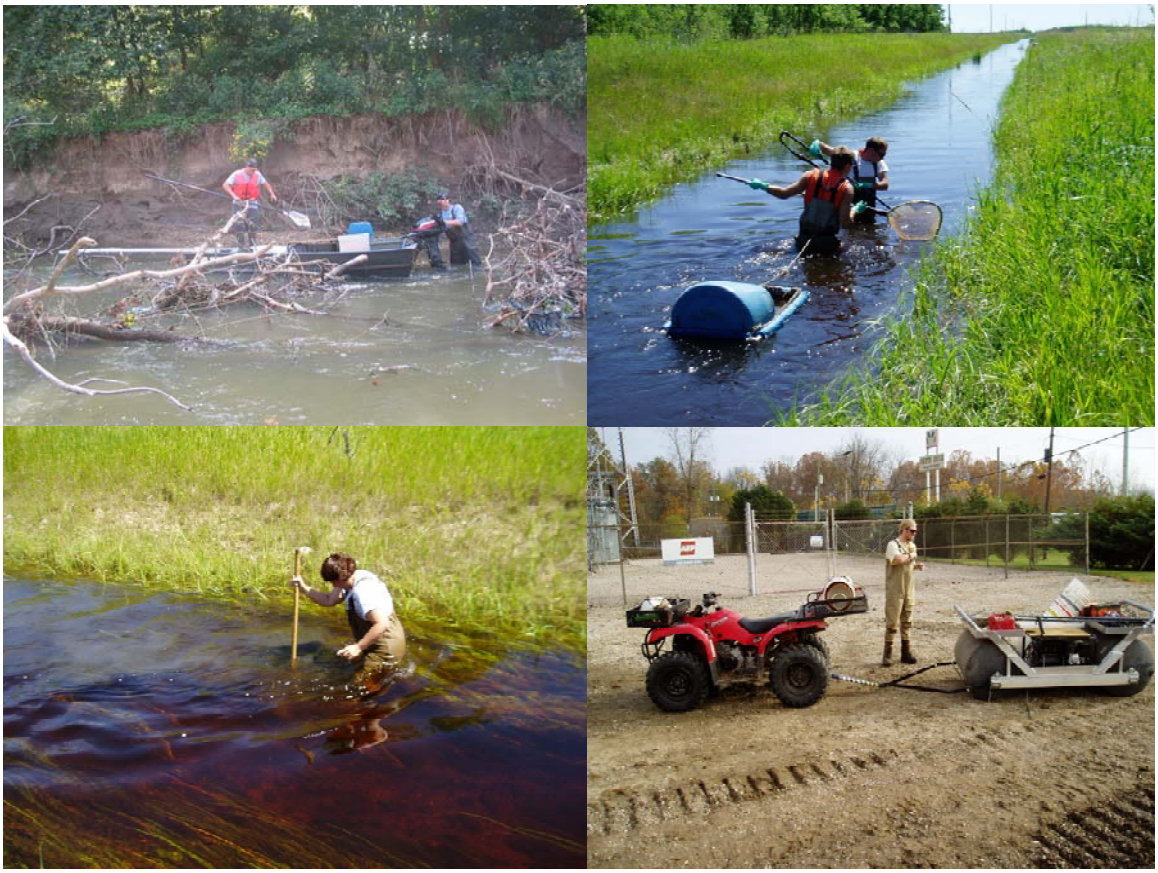

Figure 1. Fish and macroinvertebrate field methods specified by the DuPage-Salt Creek biological assessment plan. Upper left: boat electrofishing method used at non-wadeable sites. Upper right: Long-line method used in small wadeable streams. Lower right: Tow boat method rigged for off road access. Lower left: Multi-habitat macroinvertebrate method used in the National Wadeable Streams Survey.

will be recorded using a digital camera and will include representative habitats and any other noteworthy items such as visual evidence of potential impact sources.

Data Management

Data entry, storage, and retrieval will be accomplished using CABB's modifications to the Ohio ECOS biological and habitat data management system. The current system operates in a FoxPro format and data can be reported as Excel files. Ohio ECOS contains the essential routines for calculating basic biological parameters, metrics, and index values. It is presently being modified to accommodate the Illinois IBI and MBI indices as part of the Wadeable Streams Assessment.

Assessment Report

CABB will produce a detailed assessment report that will generally follow the format of the example watershed assessments that are being submitted as an addendum to this proposal. This

format will fulfill the specifications of the RFP. In addition CABB will use its extensive resources that have been developed via other projects for delineating the relationships between biological responses and multiple stressors. This includes categorical and specific habitat and chemical/physical thresholds related to the response of fish and macroinvertebrate assemblage metrics and indices and watershed level stressors.

Figure 2. Macroinvertebrate laboratory methods used for a multi-habitat protocol. Upper right: Samples are grid sorted on a Caton tray. Upper right: A standard subsample is produced by sorting organisms from organic and inorganic debris. Lower left: Samples labeled by site and ready for identification. Lower right: Taxonomy is determined by a qualified practitioner to the lowest practicable level (genus/species).

III. Project Budget

The project budget was developed based on our interpretation of the biological sampling plan and the RFP. As requested by the RFP, two budgets are provided. The first budget (Table 2) assumes that all sites identified in the biological sampling plan will be sampled – this includes all of the sites and samples identified in Table 1. An average time per site was developed that incorporates the time required to produce a sampling of a site from arrival through the unloading and loading of equipment to departure, all travel time, and a modest contingency for unforeseen

Table 1. Estimate of the stratification of fish and macroinvertebrate sampling sites by method and protocol for each major basin in the DuPage-Salt Creek watershed study area. Fish sites are expressed as number of samples with two sampling passes at boat and tow barge sites; single pass sampling will be performed at longline and backpack sites.

Assemblage Method (hrs./site)	E. Branch	W. Branch	Salt Cr.	Reference Samples	Total Samples	Total Hours
Fish - Boat/ Tow Barge (6 hrs.)	20	28	46	10	104	624
Longline (3 hrs.)	9	18	11	5	43	129
Backpack (3 hrs.)	17	13	19	-	49	147
Totals	46	59	76	15	196	900
Macroinvertebrates – Multi-habitat (4 hrs.)	19	32	34	10	95	380
Qual./MAIS (2 hrs.)	17	13	19	5	54	108
Totals	36	45	53	15	149	488

circumstances. As a frame of reference CABB uses a 5 hour/site estimate for boat and tow barge fish sampling sites for local surveys; this was increased to 6 hours/site given the logistics of the study area and travel requirements for CABB field crews. The time estimates are stratified to reflect the level and difficulty of each site. The hours/sample or site includes the cost of each level of employee and an administrative indirect rate of 25%. Fish assemblage sites are broken down into three categories, boat and tow barge sites, longline sites, and backpack sites (Table 1). The latter two categories are estimated at 3 hours/site as smaller streams usually require less effort than larger wadeable and non-wadeable sites. The estimate for macroinvertebrate sites was broken down by the two major methodologies, the multi-habitat protocol and the qualitative/MAIS protocol. The second budget (Table 3) deleted the sites in the vicinity of the Kerr-McGee restoration project and all of the level 6 and 7 sites. This resulted in an approximate 25% reduction of effort in applicable categories; however, some categories contain fixed costs and were not affected. Hence the cost differences between the two estimates reflect the reduction in sampling effort and the commensurate impact on the related functional aspects of the project.

Table 2. Proposed budget for the DuPage-Salt Creek biological assessment by CABB assuming all sites in the biological assessment plan are sampled (project period June 1, 2006 – March 31, 2007).

Category	Effort	Cost/Unit	Total
Mobilization & Planning (includes QAPP):			
Principal Investigator	60 hrs.	$75.00/hr.	$4,500
P.I. Travel (1 meeting)	-	-	500
Fish Crew Leader	60 hrs.	$20.00	1,200
Macroinvertebrate Crew Leader	40 hrs.	$20.00	800
Field Technicians (3)	40 hrs.	$15.00	1,800
Supplies	-	-	5,000
Mobilization & Planning Subtotal			$13,800
Reconnaissance:			
Fish Crew Leader	120 hrs.	$20.00	$2,400
Field Technician	100 hrs.	$15.00	1,800
Vehicle mileage & use	1600 mi.	$0.50/mi.	800
Lodging/food/misc. (2 persons)	10 days	$80/day	1,600
Reconnaissance Subtotal			$6,600
Field Sampling:			
Fish Crew Leader	900 hrs.	$20.00	$18,000
Field Technician (2)	900 hrs.	$15.00	27,000
Equipment Use	900 hrs.	$5.00/hr.	4,500
Vehicle mileage	15,000 mi.	$0.50/mi.	7,500
Lodging/food/misc. (3 persons)	90 da.	$80.00/da	21,600
Fish Crew Subtotal			$78,600
Macroinvertebrate Crew Leader	500 hrs.	$20.00	$10,000
Field Technician (1)	500 hrs.	$15.00	7,500
Equipment Use	500 hrs.	$5.00/hr.	2,500
Vehicle Mileage & Use	8,000 mi.	$0.50/mi.	4,000
Lodging/food/misc. (2 persons)	50 da.	$80.00/da.	8,000
Macroinvertebrate Subtotal			$32,000
Field Sampling Subtotal			$110,600

Table 2. (continued)

Category	Gross Hours	Cost/Unit	Total
Laboratory:			
Fish Vouchers	200 hrs.	$20.00/hr.	$4,000
Macroinverts.- Multihabitat	1200 hrs.	$25.00/hr.	30,000
Macroinverts. – Qualitative/MAIS	300 hrs.	$25.00/hr.	7,500
Laboratory Subtotal			$41,500
Data Management:			
Fish & Habitat Entry (200 samples)	200 hrs.	$15.00	$3,000
Macroinvertebrate Entry (150 samples)	150 hrs.	$15.00	2,250
QA/QC	50 hrs.	$25.00	1,250
Data Management Subtotal			$6,500
Data Analysis/Synthesis/Reporting:			
Report Sections	300 hrs.	$20.00	$6,000
Final Report & Synthesis	200 hrs.	$75.00	15,000
Data Analysis/Report Subtotal			$21,000
Project Summary:			
Mobilization & Planning Subtotal			$13,800
Reconnaissance Subtotal			$6,600
Field Sampling Subtotal			$110,600
Laboratory Subtotal			$41,500
Data Management Subtotal			$6,500
Data Analysis/Report Subtotal			$21,000
PROJECT TOTAL			$200,000

The budget is organized by major functional task as follows:

- mobilization and planning (includes QAPP) and an initial meeting with the Work Group reconnaissance trip to locate sites and become familiar with the study area;
- field sampling for fish, macroinvertebrates, QHEI, field chemistry, and GPS/photographic documentation;
- laboratory analysis of fish vouchers and macroinvertebrate identification to genus/species;
- data entry and management; and,
- data analysis, synthesis, and reporting.

Mobilization and Planning

This includes all tasks related to the development of a detailed plan of study, the QAPP, procurement of supplies, equipment preparation, field crew briefing and orientation, and working

Table 3. Proposed budget adjustments for the DuPage-Salt Creek biological assessment by CABB deleting 8 sites in the W. Branch and all Level 6 and 7 sites in the biological assessment plan.

Category	Effort	Cost/Unit	Total
Mobilization & Planning (includes QAPP):			
Principal Investigator	60 hrs.	$75.00/hr.	$4,500
P.I. Travel (1 meetings)	-	-	$500
Fish Crew Leader	60 hrs.	$20.00	1,200
Macroinvertebrate Crew Leader	40 hrs.	$20.00	800
Field Technicians (3)	40 hrs.	$15.00	1,800
Supplies	-	-	5,000
Mobilization & Planning Subtotal			$13,800
Reconnaissance:			
Fish Crew Leader	90 hrs.	$20.00	$1,800
Field Technician	75 hrs.	$15.00	1,125
Vehicle mileage & use	1200 mi.	$0.50/mi.	600
Lodging/food/misc. (2 persons)	8 days	$80/day	1,280
Reconnaissance Subtotal			$4,805
Field Sampling:			
Fish Crew Leader	675 hrs.	$20.00	$13,500
Field Technician (2)	675 hrs.	$15.00	20,250
Equipment Use	675 hrs.	$5.00/hr.	3,375
Vehicle mileage	12,000 mi.	$0.50/mi.	6,000
Lodging/food/misc. (3 persons)	68 da.	$80.00/da	16,320
Fish Crew Subtotal			$59,445
Macroinvertebrate Crew Leader	375 hrs.	$20.00	$7,500
Field Technician (1)	375 hrs.	$15.00	5,625
Equipment Use	375 hrs.	$5.00/hr.	1,875
Vehicle Mileage & Use	6,000 mi.	$0.50/mi.	3,000
Lodging/food/misc. (2 persons)	38 da.	$80.00/da.	6,080
Macroinvertebrate Subtotal			$24,080
Field Sampling Subtotal			$83,525

Table 3. (continued)

Category	Gross Hours	Cost/Unit	Total
Laboratory:			
Fish Vouchers	150 hrs.	$20.00/hr.	$3,000
Macroinverts.- Multihabitat	1200 hrs.	$25.00/hr.	22,500
Macroinverts. – Qualitative/MAIS	100 hrs.	$25.00/hr.	2,500
Laboratory Subtotal			$28,000
Data Management:			
Fish & Habitat Entry (150 samples)	150 hrs.	$15.00	$2,625
Macroinvertebrate Entry (100 samples)	100 hrs.	$15.00	1,500
QA/QC	40 hrs.	$25.00	1,000
Data Management Subtotal			$5,125
Data Analysis/Synthesis/Reporting:			
Report Sections	300 hrs.	$20.00	$6,000
Final Report & Synthesis	200 hrs.	$75.00	15,000
Data Analysis/Report Subtotal			$21,000
Project Summary:			
Mobilization & Planning Subtotal			$13,800
Reconnaissance Subtotal			$4,805
Field Sampling Subtotal			$83,525
Laboratory Subtotal			$28,000
Data Management Subtotal			$5,125
Data Analysis/Report Subtotal			$21,000
PROJECT TOTAL			**$156,255**

directly with the project sponsors. One trip is budgeted for the Principal Investigator to meet with the Work Group and watershed coordinator after completion of the study plan and QAPP.

Reconnaissance

This task will involve a detailed visit to the study area for the purpose of locating sites, locating access, obtaining permission, and meeting with the watershed coordinator and other stakeholders. Ten days including travel to and from Ohio is budgeted.

Field Sampling
This is the largest task of any budget item which is not unexpected. The hours allotted to the fish and macroinvertebrate crews are based on the estimates in Table 1. Mileage and field days are based on our prior experience in conducting out-of-state field projects of a similar scope and size. The fish and macroinvertebrate crews will operate in a cooperative fashion, but will be flexible regarding their mutual independence in terms of needing to be at the same sites at the same time.

Laboratory
This task involves the post-field season processing of fish voucher collections and the sorting and identification of the macroinvertebrate samples. Fish vouchers are processed following standard QA/QC practices and identifications will be verified by The Ohio State University Museum of Biodiversity and/or equivalent entity in Illinois. The estimates for the macroinvertebrate samples are stratified by the two major protocols. Each reflects the requirements of the RFP for level of taxonomy, the Illinois EPA protocols, and the direct experience of CABB with similar methods and it is the second largest budget item.

Data Management
This task covers the direct entry of data from field and laboratory data sheets and the estimates are based on our prior project experience with executing this task. It includes fish data, QHEI data, macroinvertebrate data, chemical/physical data, and georeferenced data. After initial data entry, raw data tables are produced for proofreading, which may lead to the need to make corrections. All data management is overseen by the PI.

Data Analysis/Synthesis/Reporting
This task concerns the production of the report as requested by the RFP. Baseline report sections concerning the fish, macroinverbrate, and habitat results will be compiled by a lead biologist. The synthesis and assessment of associated causes and sources will be completed by the PI and a senior level researcher.

IV. CABB Statement of Qualifications

CABB offers the personnel and staffing qualifications to execute the biological assessment plan that is appended to the RFP; curriculum vitae (CV) for the Principal Investigator and Senior Scientists appear in Section VII. CABB also provides the infrastructure for supporting the field sampling and laboratory analyses required by the RFP. A compendium of recent projects is described here and in the CV of the Principal Investigator. As requested by the RFP, two examples of completed watershed assessments are also included with the submittal.

Organization
The Midwest Biodiversity Institute's Center for Applied Bioassessment and Biocriteria (CABB) performs applied research concerning biological assessment and biological criteria development

and implementation and in support of multiple water quality and natural resource management objectives. Research is focused on improving the science and technology used to classify, assess, and diagnose problems in watersheds, and making it more widely available to a variety of potential users. CABB is also dedicated to addressing the significant shortfall in the capacity to conduct the quality and quantity of chemical, physical, and biological assessments that are needed to ensure meaningful end outcomes (i.e., environmental results) from watershed management activities (e.g., TMDLs, nonpoint source abatement, stream restoration, etc.). The DuPage-Salt Creek watershed assessment is one such example. MBI and CABB do much of this via cooperative agreements and contracts with federal, state, local, academic, and non-governmental organizations.

The Midwest Biodiversity Institute, Inc., is 501[c][3] nonprofit corporation with a membership of 125 institutions and corporations and its primary affiliate, the Ohio Biological Survey. The membership institutions are located across 12 states and the Province of Ontario; institutions and corporations from outside of Ohio join MBI and become affiliates of OBS. The goals and objectives of MBI are to advance the natural sciences, applied ecology, and field biology. MBI is presently executing cooperative agreements and applied research grants with U.S. EPA in support of biological criteria implementation and environmental indicators development at the statewide, regional, and national levels. Major projects include:

- the development of an EPA methods manual for the implementation of tiered aquatic life uses (TALU);
- a methodology for evaluating the comprehensiveness and accuracy of biological assessment methods and programs;
- "best practices" for state and tribal biological assessment programs;
- using biological assessments to assess NPDES program effectiveness;
- adapting tiered aquatic life uses to large and great rivers;
- an ongoing assessment of the Region V state and tribal bioassessment programs;
- the development of monitoring strategies for the state of Rhode Island, the Miami Conservancy District (Ohio), and the DuPage-Salt Creek Work Group (DuPage Co., Illinois);
- evaluation of demographics, life history, and distribution of burrowing crayfish in Indiana; and,
- temperature criteria development for rivers and streams (ORSANCO, Illinois EPA).

MBI has also provided expertise via consulting agreements to a number of other governmental and non-governmental organizations and presently facilitates a working group comprised of U.S. EPA, Region V and six states (Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin) dedicated to the development and implementation of improved state bioassessment and biological criteria programs.

The Center for Applied Bioassessment and Biocriteria (CABB) was established in July 2001 as an applied research entity for the purpose of improving the use of biological assessments and biological criteria in and among State, Federal, and local government agencies and institutions and non-governmental organizations. CABB is one of three such regional centers nationwide. CABB offers the unique capability to apply the management and technical expertise from the 25+ years of experience gained by the Ohio EPA bioassessment, biocriteria, and WQS programs in addition to the experiences of U.S. EPA, other State and Federal agencies, and non-governmental organizations. CABB initiated a cooperative agreement with U.S. EPA in 2002 for the in-depth analysis of applied research and technical issues and questions relevant to State and U.S. EPA monitoring and assessment, TMDL, and WQS programs. Major research and field projects include:

- direct participation in the National Wadeable Streams Assessment (2004-7);
- bioassessment methods comparability studies in Region V (2004-7);
- a regional EMAP assessment of the large river tributaries of the Ohio and Upper Mississippi Rivers (2004-7);
- application of EPA's TALU methods to large rivers (2004-6);
- the development of methods and a biological index for large rivers in Maine and New England (2002-6);
- a macroinvertebrate assessment on behalf of the city of Elkhart, IN (2004-6);
- watershed bioassessments for the Indiana Chapter of The Nature Conservancy (St. Josephs and Tippecanoe River watersheds in Indiana and Ohio; 2000-2005);
- an in-depth analysis of watershed stress:response relationships for The Nature Conservancy in three watersheds in Illinois (Mackinaw R.), Ohio (Fish Creek), and New York (French Creek; 2003-4).
- stream restoration projects with Oxbow, Inc. at multiple sites in Ohio (2004-5);
- developing improved understandings about the effects of urbanization on watershed health (sponsored by WERF; 2003-6);
- using biocriteria to assess and develop water quality criteria including dissolved oxygen, nutrients, heavy metals, and mine drainage parameters;
- providing on-demand technical assistance to the Region V water program.

Each field project is supported by a detailed Quality Assurance Project Plan (QAPP) designed to meet the data quality specifications of the scientific research and assessment questions and the project sponsors.

CABB and MBI cooperatively conduct two-day training sessions on biological assessments, criteria, and habitat assessment techniques in cooperation with U.S. EPA, Region V and Ohio EPA each summer. In addition, CABB personnel instruct in an Ohio EPA biological assessment and criteria course designed to certify professionals as competent for producing data sufficient to use the Ohio EPA biological indices and conduct integrated biological and water quality assessments.

Institutional Partnerships

MBI and CABB have executed memoranda of agreement with the Institute for Local Government Administration and Rural Development (ILGARD), which is part of Ohio University's Voinovich Center for Leadership and Public Affairs located in Athens, Ohio. MBI and CABB senior scientists assist ILGARD and Ohio University in developing the capacity to conduct biological assessments, utilize adequate monitoring and assessment approaches in their specific projects, the development and execution of research proposals, and participation in curriculum development. Presently, MBI and CABB are conducting biological and habitat assessments in multiple watersheds in southeast Ohio as part of Acid Mine Drainage Treatment and Abatement (AMDAT) projects and for the development of TMDLs in cooperation with Ohio EPA through grants to ILGARD and watershed groups. The products of these efforts are biological assessments that meet the specifications of the Ohio Water Quality Standards and the Ohio Surface Water Monitoring Strategy. CABB is also co-leading an EPA funded Science to Achieve Results (STAR) research grant on watershed classification in southeast Ohio in cooperation with Ohio University faculty and ILGARD staff. This project was initiated in 2004 and will be completed in 2007-8. The purpose of the research is to evaluate and develop existing and new methods for classifying and assessing surface water quality on a watershed scale, which should lead to refinements in the way streams, rivers, and watersheds are classified and assessed in the near future.

Facilities and Experience

CABB maintains the technological and hardware infrastructure necessary to the collection of high quality data for biological and water quality assessment purposes. CABB is housed at offices provided by MBI, which is the administrative center of the organization. CABB also maintains a field facility where sampling equipment and vehicles necessary to carry out a multi-state sampling program are housed and serviced. CABB provides logistics and expertise in all aspects of bioassessment and biocriteria including administrative support, field sampling and laboratory procedures, spatial sampling design, data management, data analysis, index development and calibration, interpretation of results, establishing indicator linkages, development of new and refined tools, reporting, and training for professionals, administrators, and non-technical individuals and institutions. A full time macroinvertebrate taxonomist and full and part time ichthyologists conduct field, laboratory, data processing, and data analysis tasks associated with conducting bioassessments that meet the quality objectives of project sponsors. A fully equipped benthic macroinvertebrate laboratory located at Ohio University is operated in cooperation with the College of Biological Sciences and a smaller laboratory dedicated to sample processing for fish and macroinvertebrates is located at the MBI office address. CABB conducts biological field assessments primarily for fish and macroinvertebrate assemblages and is developing a capacity for algal assessments. CABB has also performed analyses using bivalve mollusks and adult insects. Field crews are composed of a field crew leader and 2-3 field technicians. Field crew leaders are fully trained and educated in their respective fields of expertise and have demonstrated skills and proficiency in field sampling, QA/QC, and data custody and management. All have completed

the Ohio EPA Biocriteria/habitat (QHEI) training and are scheduled to complete the first certification training under the Ohio Credible Data Law in late June 2006. This broad capability meets the baseline of that defined by the Ohio EPA bioassessment and biocriteria methods manuals and those of the U.S. EPA EMAP program and wadeable streams assessment.

Key Personnel

The principal investigator is Chris O. Yoder, Research Director, CABB. He is involved in the national development of biological assessments and biocriteria, including multimetric index development for wadeable streams and non-wadeable large rivers. He is presently the principal investigator of a cooperative agreement with the U.S. EPA, Office of Water for monitoring and assessment, indicators, training, and biological criteria development and implementation. He was most recently Manager of the Ecological Assessment Section at Ohio EPA (1989 – 2001) and supervisor and staff member since 1976. His professional experience includes service on national, regional, and state working groups and committees dealing with monitoring and assessment, environmental indicators, biological assessment, biological criteria, and WQS development and implementation. Recently he served as a member of the National Research Council committee on the role of science in the TMDL process (NRC 2001). He has 35 years of experience in the assessment of fish assemblages and other aquatic organism groups, their associated habitats, their responses to stressors, and 30 years experience in water quality management including the integration of multiple indicators of stress, exposure, and response. He is also affiliated with the Voinovich Center for Leadership and Public Affairs at Ohio University where he is involved with watershed research. He most recently authored the DuPage-Salt Creek biological assessment plan and strategy.

Edward T. Rankin, Senior Research Associate, CABB will serve as the project senior scientist being responsible for data management and data analysis. He develops and maintains the electronic databases that CABB relies on for all biological assessment related projects. This includes access to state and regional databases within U.S. EPA, Region V and other locales where CABB is conducting active research (e.g., Maine Rivers, WERF urban watersheds). He is the primary author of the Qualitative Habitat Evaluation Index (QHEI; Rankin 1989, 1995; Ohio EPA 1989) and he conducts two-day training sessions in cooperation with the Ohio EPA four to fives times each year. His research interests include the effects of multiple stressors on aquatic life in streams and rivers, the development and application of stream habitat assessment methodologies, the development and application of biological criteria, development of biocriteria-based chemical criteria for aquatic life (e.g., nutrients, sediment, metals, etc), and developing processes to improve the accuracy and efficacy of TMDLs for nutrients and sediments. He has served and is serving on numerous EPA working groups related to these research interests since 1990, both as a former staff member at Ohio EPA and as a senior scientist with CABB since February 2002. He is also affiliated with the Voinovich Center for Leadership and Public Affairs at Ohio University where he is the co-Principal Investigator of an EPA funded STAR grant focused

on the development of watershed stress-response indicators, relationships, and modeling. He is also involved in two WERF funded research grants focused on urban watersheds.

Tracy Morman is a Senior Research Associate with CABB and serves as the lead macroinvertebrate biologist. He manages the macroinvertebrate laboratory in cooperation with Ohio University. He has 10 years of experience identifying aquatic invertebrates from all areas of the United States using standard taxonomic principles, dichotomous keys, extensive literature review, and colleague interaction. He has completed training workshops in the identification and ecology of Chironomidae, Tipulidae, crayfish, freshwater mussels, Odonata, and limnephilid caddisflies. He has the ability to sight identify numerous families, genera, and species of freshwater and terrestrial invertebrates including Mollusca, Crustacea, Annelida, Ephemeroptera, Odonata, Plecoptera, Hemiptera, Megaloptera, Lepidoptera, Trichoptera, Coleoptera, and Diptera. He also is trained in riparian and instream habitat evaluation and wetlands delineation using plants and soils. Since being employed by MBI he has overseen the processing of nearly 500 macroinvertebrate samples identified to the lowest practicable level of taxonomy. This includes samples generated by the Ohio EPA (1989) modified Hester-Dendy artificial substrate method, the EPA EMAP multi-habitat protocol, and the MAIS protocol.

Lon Hersha is a fish field crew leader and has been with CABB since March 2005. His research interests include biological assessment and biological criteria development for headwater streams, effects of stressors on aquatic assemblages, development of environmental indicators and diagnosis of cause and effect, impacts of natural and anthropogenic stressors on aquatic assemblages, non-wadeable rivers bioassessment methods and design, and the assessment of protozoa in headwater streams. He is fully qualified as a fish crew leader having completed the Ichthyology course at The Ohio State University (Spring Quarter 2005) and the sampling of nearly 150 stream and river sites in 6 states in 2005.

Alex Johnson is a fish crew leader and has been with CABB since May 2005 as an assistant crew leader. He is trained in techniques of field biology, fish tagging, spawning, otolith and scale aging, gill netting, rotenone application, turtle tagging capture/recapture, amphibian, fish, and macroinvertebrate taxonomy, experience in large river and small stream electrofishing, experience in aquatic macroinvertebrate collecting, and the following indices: Qualitative Habitat Evaluation Index (QHEI), the Invertebrate Community Index (ICI), and the Index of Biotic Integrity (IBI). He is fully qualified as a fish crew leader having completed the Ichthyology course at The Ohio State University (Spring Quarter 2005) and the sampling of nearly 150 stream and river sites in 6 states in 2005. He worked previously on the Ohio River as a field crew member for the Ohio River Valley Water Sanitation Commission.

Laura Mills is a research assistant who specializes in macroinvertebrate sample collection and sample processing. She has been with CABB since May 2005 and was the lead macroinvertebrate biologist for the collection of approximately 100 EMAP multi-habitat samples in 5 states in

association with the EPA sponsored National Wadeable Stream Assessment (NWSA) in 2005. She has experience with the laboratory sorting and analysis protocols common to multi-habitat methods. She is currently completing a Masters thesis at Austin-Peay University.

In addition to these senior level scientists, CABB employs field technicians who assist the crew leaders in the execution of field sampling. These are largely junior and higher level college students who are engaged in a relevant curriculum of study. CABB recruits from member institutions of MBI, which includes universities and colleges in Ohio and throughout the Midwestern U.S.

V. Project Timeline

The RFP calls for all work to be completed between June 2006 and march 2007. The following timeline was developed to meet that directive.

Table 1. General project timelines, milestones, and outputs.

Time Period	Description of Activities/Products
June 1, 2006 – June 30, 2006	Development of detailed study plan and QAPP, assignment of key personnel, coordination with Work Group and other stakeholders, mobilize equipment, procure supplies, conduct pre-survey reconnaissance.
July 1, - Sept. 30, 2006	Conduct field sampling within IEPA seasonal index period.
Oct. 1 – Nov. 30, 2006	Post-survey sample processing, fish vouchers, macroinvertebrate sample sorting.
Dec. 1, 2006 – Jan. 31, 2007	Data entry and proofing of fish and QHEI data, laboratory processing of macroinvertebrate samples, receive water quality data from Work Group.
Feb. 1 – March 1, 2007	Data analysis and report drafting.
March 1 – 31, 2007	Finalize report, present to Work Group.

VI. References

National Research Council (NRC). 2001. Assessing the TMDL approach to water quality management. National Academy Press, Washington, D.C.

Ohio Environmental Protection Agency. 1989a. Biological criteria for the protection of aquatic life. volume III: standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities, Division of Water Quality Monitoring and Assessment, Columbus, Ohio.

Rankin, E. T. 1995. The use of habitat assessments in water resource management programs, pages 181-208. in W. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL.

Rankin, E. T. 1989. The qualitative habitat evaluation index (QHEI), rationale, methods, and application, Ohio EPA, Division of Water Quality Planning and Assessment, Ecological Assessment Section, Columbus, Ohio.

VII. Curriculum Vitae of Senior Personnel

Chris O. Yoder

Email: yoder@rrohio.com	Research Director/Senior Res. Assoc.	Phone: (614) 457-6000
	CABB/Midwest Biodiversity Institute	Fax: (614) 457-6005
Email: yoderc@ohio.edu	Senior Research Assoc.	Phone: (740) 597-1755
http: ilgard.ohiou.edu	Institute for Local Govt. Admin/Rural Dev.	Fax: (740) 593-4893

Research Interests:
Biological assessment and biological criteria development; effects of stressors on aquatic assemblages; development of environmental indicators and diagnosis of cause and effect; impacts of natural and anthropogenic stressors on aquatic assemblages; non-wadeable rivers bioassessment; assessment design.

Education:

1973	B.Sc.	The Ohio State University, Columbus, Ohio
1976	M.A.	DePauw University, Greencastle, Indiana

Professional Experience:

2003 – present	Res. Dir./Sr. Res. Assoc.	Midwest Biodiversity Institute/Ohio U.-ILGARD
2001 – 2003:	Senior Res. Assoc.	Midwest Biodiversity Institute/Ohio U.-ILGARD
1997-1999:	Principal Investigator	Ohio EPA, Coop. Agreement with U.S. EPA
1990-2001:	Manager	Ohio EPA, Ecological Assessment Section
1986-1990:	Asst. Manager	Ohio EPA, Surface Water Section
1979-1985:	Supervisor	Ohio EPA, Evaluation and Standards Section
1976-1979	Staff Scientist	Ohio EPA, Industrial Wastewater Section
1976	Staff Scientist	Indiana DEM, Permits Section

Professional Activities/Awards/Certifications:
American Fisheries Society (1975 - present)
Ohio Academy of Science (1977 - present)
North American Benthological Society (1993 - present)
Certified Fisheries Scientist (Tier II) - American Fisheries Society (February 1986)
Sigma Xi (November 1974)
Water Management Assoc. of Ohio, Wayne S. Nichols Outstanding Public Servant Award (Nov. 1997)
The Nature Conservancy, Outstanding Public Service Award (April 2002)

Relevant Publications:
Yoder, C.O. and 9 others. 2005. Changes in fish assemblage status in Ohio's nonwadeable rivers and streams over two decades, pp. 399-429. *in* R. Hughes and J. Rinne (eds.). Historical changes in fish assemblages of large rivers in the America's. American Fisheries Society Symposium Series.

Yoder, C.O. and E.B. Emery. 2004. Updating a temperature criteria methodology for the Ohio River mainstem, pp. 4-1 to 4-13. *in Proceedings from the EPRI Workshop on 316(a) Issues: Technical and Regulatory Considerations:* October 16-17, 2003, EPRI, Palo Alto CA, and American Electric Power Company, Columbus, OH: 2004. 1008476.

Karr, J.R. and C.O. Yoder. 2004. Biological assessment and criteria improve TMDL planning and decision-making. Journal of Environmental Engineering 130(6): 594-604.

Yoder, C.O. and B.H. Kulik. 2003. The development and application of multimetric biological assessment tools for the assessment of impacts to aquatic assemblages in large, non-wadeable rivers: a review of current science and applications. Canadian Journal of Water Resources, 28 (2): 301 - 328.

Miltner, R.J., D. White, and C.O. Yoder. 2003. The biotic integrity of streams in urban and suburbanizing landscapes. Landscape and Urban Planning 69 (2004): 87-100

Emery, E. B., T. P. Simon, F. H. McCormick, P. A. Angermeier, J. E. DeShon, C. O. Yoder, R. E. Sanders, W. D. Pearson, G. D. Hickman, R. J. Reash, J. A. Thomas. 2003. Development of a Multimetric Index for Assessing the Biological Condition of the Ohio River. Trans. Am. Fish. Soc. 132:791-808.

Yoder, C.O. and J.E. DeShon. 2003. Using Biological Response Signatures Within a Framework of Multiple Indicators to Assess and Diagnose Causes and Sources of Impairments to Aquatic Assemblages in Selected Ohio Rivers and Streams, pp. 23-81. *in* T.P. Simon (ed.). BIOLOGICAL RESPONSE SIGNATURES: patterns in biological integrity for assessment of freshwater aquatic assemblages. Lewis Publishers, Boca Raton, FL.

National Research Council. 2001. Assessing the TMDL approach to water quality management. National Academy Press, Washington, DC. 109 pp.

Yoder, C.O., M.J. Knapp, E.T. Rankin, and C.E. Boucher. 2001. Using biological assessments and criteria within a framework of environmental indicators to assess impairments from mine drainage. *in* B. Stuart (ed.), National Association of Abandoned Mine Lands Conf., Ohio University, Athens, OH.

Yoder, C.O., R.J. Miltner, and D. White. 2000. Using biological criteria to assess and classify urban streams and develop improved landscape indicators, pp. 32-44. *in* S. Minamyer, J. Dye, and S. Wilson (eds.), National Conference on Tools for Urban Water Resource Management and Protection. U.S. EPA, Cincinnati, OH. EPA/625/R-00/001.

Barbour, M.T and C.O. Yoder. 2000. The multimetric approach to bioassessment, as used in the United States of America, pp. 281-292. *in* J.F. Wright et al. (eds.), Assessing the biological quality of fresh waters. RIVPACS and similar techniques. Freshwater Biol. Assoc., Ambleside, UK.

Barbour, M.T., W.F. Swietlik, S.K. Jackson, D.L. Courtemanch, S.P. Davies, and C.O. Yoder. 2000. Measuring the attainment of biological integrity in the USA: A critical element of ecological integrity. Hydrobiologia 00:1-12.

Yoder, C.O. and E.T. Rankin. 1999. Biological criteria for water resource management, pp. 227-259. *in* P.C. Schulze and R.A. Frosch (eds.). Measures of Environmental Performance and Ecosystem Condition. National Academy of Engineering, National Academy Press, Washington, DC.

Yoder, C.O., R.J. Miltner, and D. White. 1999. Assessing biological quality and limitations to biological potential in urban and suburban watersheds in Ohio, pp. 139-148. *in* M. Malone (ed.), Comprehensive Stormwater & Aquatic Ecosystem Management, First South Pacific Conference, Volume I. ISBN 1-877134-18-X. Auckland Regional Council, Auckland, New Zealand.

Yoder, C.O. and M.A Smith. 1999. Using fish assemblages in a state biological assessment and criteria program: essential concepts and considerations, pp. 17-56. *in* T.P. Simon (ed.). Assessing the Sustainability and Ecological Integrity of Fish Assemblages. Lewis Publishers, Boca Raton, FL.

Yoder, C.O. and E.T. Rankin. 1998. The role of biological indicators in a state water quality management process. J. Env. Mon. Assess. 51(1-2): 61-88.

Yoder, C.O. and E.T. Rankin. 1995. Biological criteria program development and implementation in Ohio, pp. 109-144. in W. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL.

Yoder, C.O. and E.T. Rankin. 1995. Biological response signatures and the area of degradation value: new tools for interpreting multimetric data, pp. 263-286. in W. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL.

Yoder, C.O. 1995. Policy issues and management applications for biological criteria, pp. 327-344. in W. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL.

40 other publications; 200+ oral presentations.

Current Research:

1. 2001-present. U.S EPA. Cooperative Agreement. Biological assessment and biological criteria development and implementation in the U.S. C.O. Yoder (PI).
2. 2002-present. U.S. EPA. Cooperative Agreement, Fish Assemblage Assessment and Index Development in Maine and New England Large Rivers. C.O. Yoder (PI).
3. 2002-2004. New England Interstate Water Pollution Control Commission. Monitoring strategy and biological assessment program implementation in Rhode Island. C.O. Yoder (PI).
4. 2002. Miami Conservancy District. Implementation of a biological assessment program in the Great Miami River basin. C.O. Yoder (PI).
5. 2002. Great Lakes Environmental Center. Development of a biological trend monitoring and assessment program for the Michigan DEQ. L. Fore, C.O. Yoder, D. McIntyre, R. Merrit (co-PIs).
6. 2002-3. GLEC. Analysis of technical issues in the implementation of biological criteria and refined uses and criteria in water quality standards. D. McIntyre (Work Assignment Leader), C.O. Yoder, E.T. Rankin, K. Dickson, J. Stevenson. R. Hughes (Technical Consultants).
7. 2003-4. ORSANCO. Review and reassessment of temperature criteria development for the Ohio River mainstem. C.O. Yoder (PI), E.T. Rankin and B. Armitage (Co-PIs).
8. 2004-present: U.S. EPA methods for tiered aquatic life uses in state and tribal WQS.
9. 2004-present: Ohio University Watershed-based classification and prediction method development, U.S. EPA STAR grant, E. Rankin and S. Miller (Co PIs); member of project team.
10. 2004-present. Evaluation and Development of Large River Biological Assessment Methods and Standardized Protocols for Region V. E.B. Emery (PI) and C.O. Yoder (Co-PI).
11. 2005-present. Evaluation and Development of Tiered Aquatic Life Uses for Large Rivers. C.O. Yoder (PI).
12. 2005-present: Development of a bioassessment plan for the DuPage-Salt watersheds. C.O. Yoder (PI).
13. 2006-present. Determining transition between wadeable and non-wadeable lotic habitats using a combined probabilistic and targeted monitoring design. C.O. Yoder (PI).

Service Work:

Speaker at various environmental organization weekend and evening events.
Field day demonstrations for area schools, conservation organizations.

Edward T. Rankin

Center for Applied Bioassessment and Biocriteria (CABB)

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Columbus, OH 43221-0541
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e-mail: qhei@aol.com or rankine@ohio.edu

RESEARCH INTERESTS
Effects of multiple stressors on aquatic life in streams, development and application of stream habitat assessment methodologies, development and application of biological criteria, development of biocriteria-based chemical criteria for aquatic life (e.g., nutrients, sediment, metals, etc), developing processes to improve the accuracy and efficacy of TMDLs for nutrients and sediments

PERSONAL
Birth date: May 11, 1956
Married, 3 children

EDUCATION
St. Bonaventure University - B. S. 1978 Major: Biology
Ohio State University - M.S., 1983 Major: Zoology

RECENT EXPERIENCE
February 2002-Present: Senior Research Associate, Center for Applied Bioassessment & Biocriteria (CABB)
April 1984 – January 2002: - State of Ohio Environmental Protection Agency Environmental Specialist II, Ecological Assessment Section

PROFESSIONAL SOCIETIES:
· Ohio Chapter American Fisheries Society (past Secretary-Treasurer)

RECENT SERVICE ON COMMITTEES/WORKGROUPS:
· USEPA Workshop on Consolidated Assessment & Listing Methodology (Chicago, Nov 2000)
· Society for Environmental Toxicology and Chemistry (SETAC), Multiple Stressors in Ecological Risk Management Workshop (Pellston, MI - Sept 1997)
· Water Environment Research Foundation (WERF) - Multiple Stressors Workshop (Lansdowne, VA - Aug 1997)
· Water Environment Research Foundation (WERF) - Project subcommittee for the "Ability to Discriminate Chemical vs. Habitat Limitations to Biological Communities (May 97 - present).
· National Watershed Assessment Project (NWAP) - Review Meeting (Washington DC - May 1997)
· National Watershed Assessment Project (NWAP) - Invited Experts Meeting (Washington DC - Oct 1996)
· Ohio DNR, Scenic Rivers Program - ongoing technical assistance.
· U.S. EPA, 305(b) Consistency Workgroup, Monitoring Consistency Subgroup (1994-present)
· Intergovernmental Task Force on Water Quality Monitoring - Reporting Task Group (1993 - 1995).
· Intergovernmental Task Force on Water Quality Monitoring - Ohio River Basin Regional 305(b) Report Workgroup (1993 – 1995).

· Review of Environment Canada's Interpretive Review of the Adult Fish Survey Used for Aquatic Environmental Effects Monitoring (May 1993).
· Provided Data and Participated in Demonstrating Surface Water Indicators for Monitoring and Managing Environmental Results and Strategies (SWIMMERS) and Ecoview.
· State-U.S. EPA Workgroup, Environmental Monitoring & Assessment Program (EMAP; Habitat Methods Subgroup, 1992).
· WBS (USEPA Waterbody System) Advisory Group (1992)
· USFWS BEST (Biomonitoring of Environmental Status and Trends) Community Structure and Function Workgroup (May 1992).
· USEPA Environmental Indicators for the Surface Water Program Workgoup (1989-1990).

SERVED AS A MANUSCRIPT REVIEWER FOR THE FOLLOWING:
· Transactions of the American Fisheries Society.
· Ecology.
· North American Journal of Fishery Management
· American Midland Naturalist
· Canadian Journal of Fisheries and Aquatic Sciences
· Ohio Journal of Science
· numerous "friendly" reviews

Selected Publications and Technical Reports:

Rankin, E. T. and Simon, T. P. 2003. Pioneer Species metric changes as a result of increase anthropogenic disturbance. Pages 165-186 in: Biological Response Signatures: Indicator Patterns Using Aquatic Communities, T. P. Simon, Editor, CRC Press, Boca Raton, FL.

Simon, T. P., Rankin, E. T., Dufour, R., and Newhouse, S. A. 2003. Using Biological Criteria for Establishing Restoration and Ecological Recovery Endpoints, Pages 83-96 in: Biological Response Signatures: Indicator Patterns Using Aquatic Communities, T. P. Simon, Editor, CRC Press, Boca Raton, FL.

Yoder, C. O., Knapp, M. J., Rankin, E. T., Boucher, C. E. In Press. Using Biological Assessments and Criteria Within a Framework of Environmental Indicators to Assess Impairments From Mine Drainage. Proceedings of 2001 National Association of Abandoned Mine Lands Annual Conference, August 19-22, 2001, Athens, Ohio

Rankin, E. T. 2001. Associations between aquatic life and total and dissolved metals in Ohio streams and rivers. Ohio EPA, Division of Surface Water, Ecological Assessment Section.

Ohio Environmental Protection Agency. 2000. 2000 Ohio water resource inventory. Volume I, Status and Trends. E.T. Rankin, C.O. Yoder, D. Mishne (eds.) Division of Surface Water, Ecological Assessment Section, Columbus, Ohio.

Ohio Environmental Protection Agency. 2000. Water Resource Inventory fact sheet: streams and rivers status. Division of Surface Water, Ecological Assessment Section, Columbus, Ohio. FS-1-EAS-2000.

Ohio Environmental Protection Agency. 2000. Water Resource Inventory fact sheet: streams and rivers causes and sources of impairment. Division of Surface Water, Ecological Assessment Section, Columbus, Ohio. FS-2-EAS-2000.

Ohio Environmental Protection Agency. 2000. Water Resource Inventory fact sheet: Trend analysis. Division of Surface Water, Ecological Assessment Section, Columbus, Ohio. FS-3-MAS-2000.

Rankin, E. T. and C. O. Yoder. 1999. Methods for deriving maximum species richness lines and other threshold relationships in biological field data, pp. 611-624. in T. Simon (ed.). Assessing the Sustainability and Biological Integrity of Water Resources Using Fish Communities. CRC Press, Boca Raton, FL.

Rankin, E. T. and C. O. Yoder. 1999. Adjustments to the Index of Biotic Integrity: A summary of Ohio experiences and some suggested modifications, pp. 625-638. in T. Simon (ed.). Assessing the Sustainability and Biological Integrity of Water Resources Using Fish Communities. CRC Press, Boca Raton, FL.

Sanders, R. E., Miltner, R.J., Yoder, C.O., and E. T. Rankin. 1999. The use of external deformities, eroded fins, lesions, and tumors (DELT anomalies) in fish assemblages fro characterizing aquatic resources: A case study of seven Ohio streams, pp. 225-248. in T. Simon (ed.). Assessing the Sustainability and Biological Integrity of Water Resources Using Fish Communities. CRC Press, Boca Raton, FL.

Rankin, E. T., Miltner, B., Yoder, C.O., and D. Mishne. 1999. Associations between nutrients, habitat, and the aquatic biota in Ohio rivers and streams. Ohio EPA, Division of Surface Water, Monitoring and Assessment Section MAS/1999-1-1.

Suter, G., Antcliffe, B. L., Davis, W., Dyer, S., Gerritsen, J., Linder, G., Munkittrick, K., and E. Rankin. 1999. Conceptual approaches to identify and assess multiple stressors (part 1.1). Chapter 1 in Multiple Stressors in Ecological Risk and Impact Assessment. Jeffery A. Foran and Susan A, Ferene, editors. Proceedings from the Pellston Workshop on Multiple Stressors in Ecological Risk Assessment, 13-18 September 1997, Pellston, MI. Society of Environmental Toxicology and Chemistry

Ohio Environmental Protection Agency. 1997. Water Resource Inventory fact sheet: streams and rivers status. Division of Surface Water, Monitoring and Assessment Section, Columbus, Ohio. FS-1-MAS-97.

Ohio Environmental Protection Agency. 1997. Water Resource Inventory fact sheet: streams and rivers causes and sources of impairment. Division of Surface Water, Monitoring and Assessment Section, Columbus, Ohio. FS-2-MAS-97.

Ohio Environmental Protection Agency. 1997. Assigning aquatic life use designations to small Ohio streams. Division of Surface Water, Monitoring and Assessment Section, Columbus, Ohio. FS-3-MAS-97.

Ohio Environmental Protection Agency. 1997. Associations between the Index of Biotic Integrity and unionized ammonia in Ohio rivers and streams: a preliminary analysis, Division of Surface Water, Monitoring and Assessment Section, Columbus, Ohio. FS-4-MAS-97.

Ohio Environmental Protection Agency. 1997. 1996 Ohio water resource inventory. Executive Summary & Vol. I. E.T. Rankin, C.O. Yoder, D. Mishne (eds.) Division of Surface Water, Ecological Assessment Section, Columbus, Ohio.

Yoder, C.O. and E.T. Rankin. 1997. The role of biological indicators in a state water quality management process. *in* Developing the Tools to Meet the Nation's Monitoring Needs: The Evolution of EMAP, Third EMAP Research Symposium. J. Env. Monit. Assess (in review).

Yoder, C.O. and E.T. Rankin. 1996. The development and role of biological criteria based on multimetric indices in water resource management. Third Workshop on Industrial Ecology, National Academy of Engineering, Washington, D.C.

Yoder, C.O. and E.T. Rankin. 1996. Assessing the condition and status of aquatic life designated Uses in urban and suburban watersheds, pp. 201-226. *in* L.A. Roesner (ed.). Effects of Watershed Development and Management on Aquatic Ecosystems, American Society of Civil Engineers, New York, NY.

Yoder , C. O. and E. T. Rankin. 1995. Biological Criteria Program Development and Implementation in Ohio, pp. 109-144 (Chapter 9). *in* W. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL.

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Yoder, C.O. and E.T. Rankin. 1995. The role of biological criteria in water quality monitoring, assessment, and regulation. Environmental Regulation in Ohio: How to Cope With the Regulatory Jungle. Inst. of Business Law, Santa Monica, CA. 54 pp.

Rankin, E. T. 1995. The use of habitat assessments in water resource management programs, pp. 181-208 (Chapter 13). *in* W. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL.

Rankin, E. T. (editor) 1994. Ecological recovery endpoints for streams affected by the Meigs #31 Mine discharges during July-September 1993. Ohio EPA, Division of Surface Water, Ecological Assessment Section, OEPA Report No. EAS/1994-1-1.

Ohio Environmental Protection Agency. 1994. 1994 Ohio water resource inventory. Executive Summary & Vols. I & II. E.T. Rankin, C.O. Yoder, D. Mishne (eds.) Division of Water Quality Planning and Assessment, Ecological Assessment Section, Columbus, Ohio.

Ohio Environmental Protection Agency. 1992. 1992 Ohio water resource inventory. Executive Summary & Vols. I & II. E.T. Rankin, C.O. Yoder, D. Mishne (eds.) Division of Water Quality Planning and Assessment, Ecological Assessment Section, Columbus, Ohio.

Rankin, E. T. 1991. The use of the qualitative habitat evaluation index for use attainability studies in streams and rivers in Ohio. Ohio EPA, Division of Water Quality Planning and Assessment, Ecological Assessment Section, Columbus, Ohio.

Rankin, E. T. 1991. The use of biocriteria in the assessment of nonpoint and habitat impacts in warmwater streams. Ohio EPA, Ecological Assessment Section, Columbus, OH .

Rankin, E.T. and C.O. Yoder. 1991. Calculation and uses of the Area of Degradation Value (ADV). Ohio EPA, Division of Water Quality Planning and Assessment, Ecological Assessment Section, Columbus, Ohio.

Osborne, L. L. and others. 1991. Stream habitat assessment programs in North Central Division States of the AFS. *Fisheries* 16: 28-35.

Whittier, T. R. and E. T. Rankin. 1991. Regional patterns in three biological indicators of stream condition in Ohio.

Rankin, E.T. and C.O. Yoder. 1990. The nature of sampling variability in the index of biotic integrity (IBI) in Ohio streams, pp. 9-18. in Davis, W.S. (ed.). Proc. 1990 Midwest Poll. Biol. Mtg., Chicago, Ill. EPA-905-9-90/005.

Ohio Environmental Protection Agency. 1990. 1990 Ohio water resource inventory. Executive Summary & Vols. I & II. E.T. Rankin, C.O. Yoder, D. Mishne (eds.) Division of Water Quality Planning and Assessment, Ecological Assessment Section, Columbus, Ohio.

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Ohio EPA (Multiple Contributors). 1989. Addendum to biological criteria for the protection of aquatic life: Volume II. Users manual for biological field assessment of Ohio surface waters. Division of Water Quality Monitoring and Assessment, Surface Water Section, Columbus, Ohio.

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Rankin, E. T. 1986. Habitat selection by smallmouth bass in response to physical characteristics in a natural stream. Transactions of the American Fishery Society 115: 322-334.

Sechnick, C. W., R. F. Carline, R. A. Stein, and E. T. Rankin. 1986. Habitat selection by smallmouth bass in response to physical characteristics of a simulated stream environment. Transactions of the American Fishery Society 115: 314-321.

Rankin, E. T. 1983. Behavior and microhabitat of the smallmouth bass in the Flat River, Michigan. Master's Thesis. The Ohio State University, Columbus, Ohio.

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EDUCATION
B.S. Zoology
Ohio University – Athens, OH 1984
Enrolled in MSES program at Ohio University from 1993-1997.

SPECIALIZED EXPERIENCE

- 10 years of experience identifying aquatic invertebrates from all areas of the United States using standard taxonomic principles, dichotomous keys, extensive literature review, and colleague interaction.
- Training workshops in the identification and ecology of Chironomidae, Tipulidae, crayfish, freshwater mussels, Odonata, and limnephilid caddisflies given by experts in these groups.
- Ability to sight identify numerous families, genera, and species of freshwater and terrestrial invertebrates including Mollusca, Crustacea, Annelida, Ephemeroptera, Odonata, Plecoptera, Hemiptera, Megaloptera, Lepidoptera, Trichoptera, Coleoptera, and Diptera.
- Training in riparian and instream habitat evaluation and wetlands delineation using plants and soils.
- Strong background in ornithology, herpetology and botany.

WORK EXPERIENCE

6/96 – 8/98
COLLEGE INTERN
Ohio EPA Division of Surface Water - Biological Assessment Unit
Columbus, OH

- Assisted staff biologists with collection of macroinvertebrate and fish samples all over the state of Ohio including site selection and placement of artificial substrates.
- Processed, subsampled and identified (to lowest level) quantitative and qualitative macroinvertebrate samples in the lab using OEPA protocols.
- Slide mounted and identified Chironomidae to species level.
- Identified non-insect groups including Porifera, Mollusca, and Crustacea to lowest taxonomic level.
- Participated in population and maintenance of reference and voucher collections.
- Passed all QA/QC procedures.
- Data entry for macroinvertebrate, fish community, fish tissue, and turtle tissue databases.
- Trained and supervised incoming interns in second field season.

8/98 – 6/00
BIOLOGIST
USGS National Water Quality Lab
Denver, CO

- Processed, subsampled, and identified macroinvertebrate samples from all over the US using USGS National Water Quality Assessment Program (NAWQA) guidelines.
- Provided taxonomic identifications and QC for other taxonomists.
- Data entry and QC.

7/00 – 12/00
SENIOR STAFF SCIENTIST
Environmental Science and Engineering
St. Louis, MO

- Collected and processed macroinvertebrate samples from Missouri.
- Certified by Missouri DNR to do invertebrate taxonomy in the state.
- Conducted survey of two endangered crayfish species.
- Helped delineate wetlands and survey for highway construction projects.
- Wrote portions of technical reports.

12/00 – 4/04
ENVIRONMENTAL BIOLOGIST
NC Department of Environmental and Natural Resources - Biological Assessment Unit
Raleigh, NC

- Wrote study plans and selected sites for basinwide assessment and special studies.
- Collected, processed, and identified macroinvertebrate samples from all over the state of North Carolina. Collaborated with colleagues in South Carolina, Tennessee, and Virginia on multi-state projects.
- Crew leader for basinwide assessments and TMDL studies.
- Analyzed data and wrote technical documents including basinwide assessment and TMDL reports.
- Collected fish community and fish tissue samples from around the state and helped with processing.
- Trained consultants, engineers and citizen monitoring groups in field and lab methods
- Participated in training of new biologists.
- QA/QC of field and lab methods.
- Maintained and populated reference collection.

4/04 – 3/06
RESEARCH ASSOCIATE
Midwest Biodiversity Institute
Athens, OH

- Crew leader for qualitative and quantitative macroinvertebrate sampling in Ohio, Indiana, and Michigan.
- Processing and identification of samples in the lab.
- Supervision and training of technicians and students in the lab
- Data entry and QA/QC.