

# **The Mission, Scope, and a Five Year Vision for the Indiana Biological Survey**

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## 1.0 Introduction

### *1.2 Foundations for the Biological Survey*

A comprehensive understanding of the interrelationships of the species of plants, animals, and microorganisms have been a primary focus for the United States in the biological sciences for over two centuries. A national association of systematists, ecologists, and environmental biologists decided at a national meeting of the Association of Systematic Collections (ASC) during 1984 that a need for a complete discussion among the systematic community was necessary to focus attention on the need for a broad-based survey of North America. A primary focus of the 1985 ASC Conference on the establishment of a national biological survey was to 1) describe the scientific and technical basis for a survey, 2) determine the relationships of various scientific disciplines to a national survey, 3) establish linkages between a survey and diverse users, and 4) describe the scope and benefits of a national biological survey (Kim and Knutson, 1986). This document is the primary basis for the re-establishment of the Indiana Biological Survey and in formulating new goals and objectives. In addition, we utilized several resolutions and position papers that have been written by national organizations to describe their membership positions relating to biodiversity loss in North America (American Fisheries Society 1998; Ecological Society of America 1997).

The success of the 1985 ASC Symposium was based on attention to the details of a biological survey including specimens, museum collections, and data bases. Specimens are the basic unit of interest for study of the fauna and flora of an area. Collections are maintained largely to provide information for research and service purposes. Data bases are the end result for obtaining, storing, managing information about specimens and data is to be provided and used.

### *1.2 History of the Indiana Biological Survey*

The Indiana Academy of Science has been developing goals and objectives for implementing the Indiana Biological Survey (Survey). The primary purposes of the Survey were developed through the Biological Survey Subcommittee and, most recently, the Biodiversity and Natural Areas Subcommittee where many of the academic, governmental, and private scientists are members. Meetings over the last six years have been held annually at Butler University and at Academy of Science Annual Meetings to develop procedures, goals and objectives, and a data base model for implementation (Hellenthal 1999).

## 2.0 Mission

### 2.1 Mission of the Indiana Biological Survey

The mission of the Indiana Biological Survey is ***to study the fauna and flora of Indiana and to preserve the State's natural history for future generations***

This mission will be accomplished through the following activities, goals, and objectives:

- 1) Develop a complete listing of Indiana's biota and accumulate knowledge about the distribution, abundance, and biology of the species;
- 2) Complete biological surveys of all federal, state, and other natural areas of Indiana;
- 3) Develop a network of museums and research stations that will provide research materials for training the future organismal biologists in Indiana; and
- 4) Establish a database from vouchered material that will provide information for protecting the future heritage of Indiana biological resources.

### 2.2 Role of the Indiana Biological Survey and Areas of Research Concentration

The role of the Survey will be focused into six research areas that will be used to train future generations of organismal biology students on the fauna and flora of Indiana. These six research areas include: 1) systematic and biotic inventory, 2) environmental protection research, 3) biological diversity, 4) long-term ecological research, 5) conservation, and 6) information management.

*2.2.1 Systematic and biotic inventory* – A fundamental question of biological studies involve the need to know the taxa that are present and their habitat requirements (Chernoff, 1986). In order to preserve the native fauna and flora of Indiana we need to know those species that were historically and currently found within the State's political boundaries. Classification of organisms and the interrelationships among species is necessary to determine the biological constituents of Indiana. The study of systematics and ecology are fundamental building blocks for any future education of organismal biologists. These two disciplines comprise a large portion of what is regarded as comparative and evolutionary biology..

Systematics is the scientific study of the kinds and diversity of organisms and of any and all relationships among them (Simpson 1961). Mayr (1969) defined systematics as the science of the diversity of organisms. Taxonomy is generally considered a subcomponent of systematics since it considers the theory and practice of classifying organisms.

The relationship between ecology and systematics is predicated on process level inferences that depend on phylogenetic patterns. These phenotypic expression and character covariances are a function of genealogical and ecological factors. Proper species identifications provide the basis and predictions for ecological studies. Genealogical information is crucial to inferences about taxon cycles and is determined from coevolution of evolutionary relationships.

The Survey will conduct surveys and inventories with the purpose of discovering additional species not previously known from the State and identifying organismic diversity. This information will be used to estimate phylogenetic relationships among organisms, and enable members to study the evolutionary processes that account for phylogenetic patterns and diversity. Two questions are apparent for the Survey to address:

- 1) *How well is the fauna and flora of Indiana known?* The geographic limits of the Survey will be contained within the State of Indiana. The distribution of scientific effort across groups of organisms is differentially determined with little effort having been spent on development of poorly known species and the use of modern systematic techniques.
- 2) *Does the rate of human-induced extinctions effect the diversity of Indiana's fauna and flora?* The fragmentation of wilderness areas cause an understanding of island biogeography and extinction theories to take on a sudden urgency (Simberloff 1983, 1984). Changing habitats and land uses effect species compositions causing an extinction debt in Indiana that is teetering on the brink of a biological diversity crisis. Without knowledge of the composition of Indiana's biological members how can we effectively manage and conserve species that we do not know?

*2.2.2 Environmental protection research* – The increase in anthropogenic induced stresses on the environment has escalated impacts to biodiversity and biological integrity of Indiana's terrestrial and aquatic resources. Basic research information need for applied environmental protection and management includes development of biological indicators for assessing water quality conditions; provide baseline data for site specific modifications and establish models for ecological process changes; reduce redundant data collection; and provide a forum for data collection in resource types often less studied.

The role of the Survey will be to conduct applied research capable of providing adequate information about the fauna and flora of Indiana as it relates to toxic chemical pollution, acid deposition, land disturbance, pesticide resistance, and environmental impacts of introduced species. The contribution of the Survey will include:

- 1) Conduct basic research on the structure, status, and trends of managed species to understand harvest rates that may affect management decision and non-target species for effective population management;
- 2) Conduct biological monitoring studies that assess environmental condition using targeted approaches and probability based study designs; and
- 3) Complete ecosystem classification and inventory;

2.2.3 *Biological diversity* – There are groups of organisms for which we lack even the fundamental taxonomic knowledge to know where problems exist. Major systematic efforts are necessary for most taxonomic groups occurring in Indiana. Few efforts have even begun to document the kinds of species occurring within Indiana’s boundaries. The loss of many systematic biologists through retirement or attrition within the State has left many gaps in our knowledge.

The Survey will be committed to establishing research centers that will provide materials necessary for the training and study of Indiana’s fauna and flora for future students, aspiring organismal biologists, and the public. These centers will possess state-of-the-art collections and will serve as depositories for vouchered materials from biological inventories. These materials will be curated and studied by specialists in each discipline for the purpose of publication and study of biological relationships.

- 1) The Survey will serve as an umbrella for orphaned or abandoned collections, as well as, collect original materials for study;
- 2) Produce publications of interest to biologists that are not appropriate for the *Proceedings of the Indiana Academy of Science* through an *Occasional Papers* series that will be coordinated through the Publications Committee of the Indiana Academy of Science;
- 3) Establish relationships between academic, governmental, and private collections for the expressed purpose of preserving the natural history heritage of Indiana.

2.2.4 *Long-term ecological research* – Ecology is a hierarchic level of study, e.g. individual, population, community, ecosystem, or ecosystem interactions. Some ecological research can be performed in the laboratory but most depend on active field programs. As undisturbed field sites diminish, field programs are even further hampered.

Few agencies devote sufficient time to long-term ecological studies. In addition, studies need to be scaled to the needs of the particular question as it related to response of organisms. Seldom are ecological studies conducted for sufficient time to decipher pattern from noise and distinguish the total shape of the pattern. The role of the Survey will be to evaluate the effects of physical environmental variables on the structure of biotic communities. Two questions that will be researched include:

- 1) *By which functional processes are ecological relationships stratified?* Trophic interactions among various trophic levels are regulated by the rates of accumulation and transport of decomposing organic matter. The processes that influence the rates at which inorganic nutrients are taken up, utilized, and released by the biota is a foundational premise to understand productivity and cycling in the environment and affects to upper trophic levels;
- 2) *How are communities structured within the natural areas, natural divisions, and ecoregions of Indiana?* By understanding the structure of biological assemblages in “least-disturbed” habitats a more complete understanding of reference sites can be used to model the environments of Indiana for restoration and mitigation of environmental stresses.

2.2.5 *Conservation* -- Few of the natural habitats on State, Federal, and privately managed lands have adequately described the biodiversity of these managed areas. In addition, the restoration and protection of species cannot be accomplished without an understanding of the species that occur on these preserves. Priorities for conservation research in Indiana include the need for conservation planning; understanding species autecology and synecology; environmental impact assessment; cataloging genetic resources; land, ecosystem, species, and natural resource management; and expanding knowledge of native biota and organizing knowledge base.

The role of the Survey includes providing a mechanism for data gathering, principally on a widely distributed, multi-institutional (but coordinated basis). The Survey will act as an information and biological repository and will provide standard methodology for conducting surveys. The Survey will differ from other existing conservation management agencies in the following manner:

- 1) The Survey will be a permanent and dynamic atlas and database on the existence, characteristics, numbers, conditions, status, locations and distributions of biological species;
- 2) The Survey will not be limited to rare and threatened species;
- 3) Databases will be based on vouchered records and specimens;
- 4) Specimens will be available for study and training of future systematic, ecologic, and management biologists.

2.2.6 *Information management* – The model for the information management of the Indiana Biological Survey is based on numerous workshops on biological collections and data standards (ASC, Committee on Computerization and Networking, 1992). The information that can be obtained from an information management model is crucial for integrating information in ways that permit effective answering of environmental and natural resource management questions. The Survey has invested a significant amount of time into the formation of a proposed information model (Hellenthal 1999). This model is discussed elsewhere and will include complete cataloguing of information that refers to the basic unit of specimen. In addition, records from the database will be based on curated and vouchered specimens. Two requirements were pertinent for implementing the information model:

- 1) Develop a relational database that will permit much of this information to be queried by the public, researchers, and policy makers over the internet;
- 2) Information must be organized in a way that permits it to be integrated with Geographic Information System (GIS) software and non-biological resources databases that can perform mapping and geographic analysis of the State's biological, physical, and cultural resources.

### **3.0 Five Year Vision**

The Indiana Biological Survey will be based on innovative and provocative management strategy that will be an unique avenue for the management of professional memberships. These new

directions and strategies were presented at the Indiana Academy of Science Annual Meeting at the University of Southern Indiana during a Special Symposium Session on the Indiana Biological Survey.

The Indiana Biological Survey will be an intercollegiate and interagency collaboration between public, private, government agencies, and academic institutions. The Survey will not have any permanent staff but will provide opportunities for research and collaboration among members. The Survey will provide strong publication outlets for members interested in the six research areas outline beneath section 2.2. The Survey will include a Board of Directors that will include members from the Biodiversity and Natural Areas Committee of the Indiana Academy of Science and will receive instruction and direction from its membership through two panels that include a representative member from each of their sponsoring institutions and the academic and research centers that comprise the collection and depository portion of the Survey.

#### *Need for the Survey Pertaining to Natural History Collection Preservation*

Many natural history collections within Indiana have either been sold or destroyed, received inadequate funding causing them to be orphaned or neglected. Due to this unfortunate situation, many researchers have left or are unwilling to pursue careers in Indiana because of the lack of sufficient materials for conducting biological research. Few academic institutions are retaining their study collections and have instead sold them to out-of-state institutions or have just discarded them not knowing the worth of these irreplaceable materials. In addition, limited research opportunities are available for students wanting to study organismal biology with a focus on biodiversity or ecological studies. Those professionals remaining in Indiana have been unable to raise funds necessary for maintaining collections because these small collections are either fragmented or unfindable by the large governmental agencies able to provide funding. A recent survey of systematic biologists and ecologists of Indiana found that the majority of collections remaining in Indiana are in the possession of private individuals.

Collections and research centers are the building blocks of our past and bridges to our future for studying biological diversity and integrity of Indiana's fauna and flora. Databases are insufficient alone for studying biodiversity without vouchered materials and opportunities for study and training. In addition, numerous taxonomic groups have been poorly studied or need major revisions. The role of the Survey will be to bring together those remaining collections whether they are private, public, or in personal collections. The Survey will provide an umbrella of support to enable these collections permanent curation stability by providing sponsorship for orphaned collections and act as repositories for State surveys.

The Survey will accomplish this mission by not limiting membership to select institutions or large agency sponsorship. Small museums and personal collections will not be prohibited from becoming members with larger institutions. The Survey will enable the small museums and personal collectors the opportunity to donate their materials to the Survey in the event that they are either incapable of curating their material or they no longer desire to retain the materials. The Survey will provide a rich network of in-kind support that will be advantageous to small- and medium-sized collections. This will include, but not be limited to, database support, publication opportunities, and curation advice. A membership logo will be developed that will

be displayed among the membership institutions. The Survey will also encourage specialized facilities to develop on a regional scale to facilitate training, education, and provide regional opportunities for the public and private sector to learn more about the fauna and flora of Indiana. The primary management goal of the Survey, as it pertains to biological collections, is to retain these valuable collections in the hands of the professional specialists that are best able to work with them. Collections will not be moved unless orphaned or professional staff are unavailable to curate and use them for research.

The benefits of this model include uniting all of the public and private collections in the state quickly becoming a large resource within the Midwest. Providing opportunities for the membership by establishing an umbrella organization that will be identifiable to the State and Federal Agencies needing the services of biological specialists.

### *Strategies for Management*

The Survey will utilize the existing framework of the Indiana Academy of Science to establish its purpose and fulfill its mission. The Academy will provide valuable 501©(3) certification for the Survey that will assist the membership by not incurring the expenses of additional management overhead. The future development of the Survey will require the establishment of membership dues that will assist in the recovery of specialized publication costs for such activities as the *Occasional Papers* series.

The overall management of the Survey will be by the members for the members. A Board of Directors will be established using the members of the Biodiversity and Natural Areas Committee of the Indiana Academy of Science. These members have been those professional biologists interested in furthering the ideas behind the Indiana Biological Survey and have been instrumental in furthering the mission within the Academy. The Board of Directors will be responsible for review of products, providing leadership and decision making focus for the Survey, produce a newsletter, review and contribute to the development of a web site, and provide effective communication to the Indiana Academy of Science executive committee.

Each member institution (i.e., museums, research centers, etc.), government agency, zoo, aquarium, and academic institution will provide a representative to local management boards that will report to the Survey Board of Directors. These two committees, which will include a) research centers and collections and b) member institutions, will provide the necessary dialogue between the Academy and the biologists of the State for facilitating educational outreach, training of students, and specialized programs for the public sector. The purpose of these programs will be to provide the citizens of Indiana with an appreciation for the rich legacy of the natural history in our State. The Survey will facilitate information exchange between State agencies (e.g., Indiana Department of Environmental Management, Indiana Department of Natural Resources), private agencies (e.g., The Nature Conservancy, Sierra Club, Save the Dunes Council), and academic institutions and public and private zoos and collections through the use of its data management model. In addition, the Survey will not duplicate existing efforts and will pursue media promotion that will publicize the new direction of the Survey and provide opportunities for outreach to the public. These will include the development of taxonomic

workshops for training of students and professional biologists, hosting national symposiums or meetings on important biodiversity issues, and facilitating coordination between biologists interested in similar areas of research.

### *Phased Implementation*

The development of the Survey has not been developed with the concern for raising monies since the membership will be the coordinating force behind the management of the roles and responsibilities and mission. The Biodiversity and Natural Areas Committee has begun the implementation of the five year mission by requesting a budget for the Survey from the Academy. The funds from the Academy will be used to establish the following:

#### *Phase I: Data Management Model Testing and Implementation*

Development and Implementation of the Data Management Model – Acquisition of databases of Indiana’s fauna and flora for testing and refining the information model developed by the Survey. The first year’s project will be to attempt to obtain sponsorship from ORACLE to obtain licenses and other professional courtesies that will assist in formulating and developing input screens and specialized queries. Test efforts will include the acquisition of several data sets from potentially 2-3 sources that will be used to beta-test the model. *Five year vision:* \$5,000 per year + \$10,000 one time purchase of ORACLE license and hardware needs.

#### *Phase II: Establishment of the Indiana Biological Survey Board of Directors*

The establishment of the Board of Directors will include formation of a newsletter, web page, and establishment of several datasets to be made available via the internet. This will include linkages to web pages for each of the member research centers, museums, and facilities. In addition, a logo and corporate identity will be established for the Survey that will provide instant recognition among biologists. Sets of guidelines, research goals, and outreach programs will be established. Funding for this phase will include the hosting of taxonomic workshops, lecture series with guest lectures from recognized scientists, logo development, and sponsorship of the web page. Several data sets that will be made available via the internet. These will include the list of systematic biologists and ecologists in the State and the systematic and taxonomic biodiversity collections of the State. The list of member biologists will be modeled after the Illinois Natural History Survey model, which includes email and mailing addresses, biological specialization, and organism specialization. Annual requests will include the development of taxonomic workshops for training of students and professional biologists, hosting national symposiums or meetings on important biodiversity issues, and facilitating coordination between biologists interested in similar areas of research.. *Five Year Vision:* Costs are estimated at \$2,000 per year.

#### *Phase III: Establishment of the Occasional Papers of the Indiana Biological Survey Series*

The Survey Board of Directors will work with the Indiana Academy of Science Publications Committee to produce limited quantity publications that are specialized in the botanical and

zoological fields of ecological and systematic study. These publications will be stand-alone publications that include site specific studies of nature preserves, checklists of organism groups, and specialized taxonomic treatises that may be either too large for the *Proceedings* or that are of limited interest to the Academy other than to biologists. The goal for the *Occasional Papers of the Indiana Biological Survey* is to produce three publications per year. These will be coordinated with the Publications Committee to maintain high publication quality and integrity of the materials published. *Five Year Vision:* The cost to produce three publications will be coordinated with the Publications Committee of the Academy. Budget needs will be requested through this Committee to ensure consistency with Academy standards.

#### *Phase IV: Establishment of Competitive Grants for Collection Infrastructure Improvements*

The loss of major museums and institutions that possess curated biological specimens has caused a void for students and researchers in Indiana to easily work with specific taxonomic groups. For example, a student wanting to study fishes of Indiana would have to go to either the California Academy of Science in San Francisco, California, or the Museum of Biodiversity at Ohio State University, Columbus, to see specimens collected by David Starr Jordan or Shelby Gerking. Likewise, many important botanical materials can only be obtained from the Missouri Botanical Garden or Field Museum of Natural History herbarium. These become insurmountable obstacles for students or the public when wanting information on Indiana fauna or flora. The establishment of a competitive grants program for enhancing research centers and museum collections in the State are important seed monies for small and medium sized facilities to complete capital improvements for their collections. These monies would be important sources for matching grant requirements that these facilities would be then able to apply for individually through national chains and coordinated through their host institution. In addition, these monies could be used for biodiversity displays, renting traveling museum collections from places such as the Smithsonian Institute, or in providing basic cabinetry, security systems, and implementing design needs for collections. The only stipulation for these grants is that they must be used to enhance a collection within the State and must be used for furthering the biodiversity of Indiana. *Five Year Vision:* The need for this area is great because no other opportunities exist for small- to medium-sized research centers or museums in the State. The request is for \$12,000 per year for five years. This will not be sufficient to meet the need in this area but will be a start to provide seed monies for necessary capital improvements.

#### *V: Develop curriculum and training programs for furthering study of biodiversity in Indiana*

Specific activity will be directed at developing opportunities for education and outreach to students in elementary, middle school, and high schools on a regional basis through the research centers and for providing exhibits, lecture series, and special symposia for the public on various topics. Attention to target audiences in urban centers of the State will bring the natural history of the State to places where limited opportunities exist. Volunteer monitoring programs will be established and field biology experiences will be provided for secondary teachers to further their experience and assist in developing environmental biology and biodiversity curriculums for high schools. Experiments and easy to demonstrate techniques will be taught during these training

sessions. Additional emphasis will be towards working with state and federal agencies to tap into their funding pots for outreach opportunities. *Five Year Vision*: The estimated costs for this phase include a competitive grant process for educational outreach development for \$15,000 per year.

#### **4.0 Conclusions**

The Indiana Academy of Science has been a leader in the State on issues pertaining to biological diversity through the former Biological Survey Committee and current Biodiversity and Natural Areas Committee. The mission of the Survey is to study the fauna and flora of Indiana and to preserve the State's natural history for future generations.

The establishment and implementation of the Indiana Biological Survey will further research on the fauna and flora of Indiana and will facilitate outreach, training, and specialized programs for the student and public citizens of Indiana. The Survey will conduct inventories on species and habitats of the State. The Survey will assist in the coordination and long-term protection of valuable biodiversity material through working with established research centers and collections and by providing an umbrella of support for small- to medium-sized collections and especially those in private and personal care. The Survey will produce original research and training for future organismal biologists and will become a leader in the State on issues pertaining to biodiversity and the environment. The Survey will be the clearinghouse for the State through the establishment and implementation of the information database model. Implementation of the five phases of the Survey will fully implement the strategy for the Indiana Biological Survey.

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