

The National Biodiversity Information Center

**A Consensus Paper prepared by
the National Biodiversity Information Center Advisory Planning Board**

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THE NATIONAL BIODIVERSITY INFORMATION CENTER:

A Consensus Document by the National Biodiversity Information Center Advisory Planning Board

Prepared by the National Biodiversity Information Center Advisory Planning Board

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EXECUTIVE SUMMARY

Currently there is no easy way for users to know what biodiversity information exists or how to get to it. When one considers the worldwide variety of locations where biodiversity information is being collected and stored, the need for the United States to establish a National Biodiversity Information Center (NBIC) is compelling.

The idea of NBIC is simple: a focal point where the many parties that generate, manage, or use data on biological resources can collaborate and make decisions leading to broader access to that information. The Center will point users to sources for the data they seek, while working with funding agencies to encourage development of tools and strategies to make data more accessible. The Center will not duplicate existing databases or information, but will provide directory services for the large array of available information. It will also identify gaps where new databases are needed, and help development, transfer, and application of new technologies. Further, the Center could coordinate access to data outside the usual realm of the biological sciences.

NBIC's mission will be to provide leadership and a neutral venue to facilitate collaborative discussions about the availability of biodiversity data and information. It will also be a clearinghouse to provide knowledge of, enable access to, and facilitate the use and exchange of biodiversity data and information. NBIC's objectives will be to promote and encourage the use of well-documented biodiversity data and information; address the full scope of biodiversity from molecular data through ecosystems; connect those seeking information and data on biodiversity to those having data custody; and facilitate structured identification of and access to data pertinent to a user's needs. This will be accomplished through an interactive computer system that uses metadata (data about the data) information on geographic location, species, ecosystem, or other keywords to sort, aggregate,

and/or integrate data sets; identify gaps in existing data and knowledge; and provide a forum for collaborative approaches to biodiversity information issues.

NBIC must be responsive to user needs, providing both data and information services tailored for different audiences. NBIC must also be responsive to the needs of providers, and must offer incentives and encouragement for them to offer their data on the NBIC system. It will facilitate development of metadata standards (minimum criteria for data documentation and format) and the establishment and provision of data collection and reporting protocol. Guidance on appropriate uses of data or information will also be provided. NBIC will facilitate the improvement of data set quality with a feedback system that allows comments on data quality and utility. Data custody will reside largely with primary data collectors and producers, and users will be referred to original data sources. Therefore, data holdings by NBIC will be reduced. NBIC will use appropriate information integration and analysis technologies and promote the adoption and use of appropriate information standards.

NBIC will have a distributed structure that will function based on a democratic, consensus-building, partnership approach. The Center will serve as a convener, facilitator, and host. Center experts will move discussions along and involve key constituencies. An Advisory or Governing Board from the broad community of contributors and users will provide general direction. A Technical Advisory Committee will ensure that NBIC receives computer and technical advice. NBIC must establish partnerships with the other organizations, such as the National Biological Survey (NBS), whose activities include data and information collection and assessment of biodiversity issues.

NBIC's location should be decided by open competition with a review after three years and recompetition every five years if so recommended by the review. NBIC should be designed to be moved if needed. Individual institutions or consortia of institutions should be invited to apply for selection as the Center host. Desirable characteristics of the host institution should include strong computational and information management services support; a creative and active program in biological sciences, especially involving the use of computers in biodiversity information management; broad-based expertise or strong links to systematics, ecological research, and collections information management; understanding of modern and historical North American collections; history of user service and support; reasonable access to national and international transportation; and comfortable, modern facilities for conferences and Center staff.

Yearly costs are estimated at \$1.5 million to support an Executive Director, two biologists, six technicians, two office support staff, meetings for the Advisory Board and Technical Advisory Committee, workshops, maintenance, overhead, and administration. Depending on the institutional site, yearly costs might also require up to \$100,000 for connectivity to the Internet. First-year costs would include an additional \$400,000 for instrumentation and furnishings, for a total of \$2 million.

PREAMBLE

Background

Many in the academic, conservation, and governmental communities have recommended that the United States establish a National Biodiversity Information Center (NBIC) with several unique roles: (1) to function as a directory or "card catalog" for the vast and growing body of biodiversity information collected by cooperating government and non-government organizations (NGOs) and maintained in myriad databases; (2) to function as a facilitator and server of this broad-based information network; and (3) to identify gaps in data that need to be filled. Since "biodiversity" refers to the variety within the living world at all levels of organization from genetic to ecosystem, these databases include the full scope of diversity of all organisms—from molecular through ecosystems.

The concept of NBIC is simple: a focal point where the many parties that generate, manage, or use data on biological resources can collaborate and make decisions leading to broader access to that information. The Center will point users to the sources for the data they seek, while working with funding agencies to encourage development of tools and strategies to make data more accessible. The NBIC will not duplicate existing databases or information, but will provide directory services for the large array of available information. It will also identify gaps where new databases are needed, and facilitate development, transfer, and application of new technologies. Further, the Center could coordinate access to data outside the usual realm of the biological sciences, such as climatic data from the National Weather Service (NWS) and data on demography and trends in international trade from the Department of Commerce (DOC).

History

For more than a decade, discussions have been ongoing about the need for a focal point to understand and sustainably manage the Nation's biodiversity. These discussions covered a broad array of activities designed to improve biodiversity management, including regulation, conduct of government activities, and improvement in the amount and availability of information. Both the Executive Branch and Congress have given attention to legislation that would help to carry out this idea.

At the June 1992 Earth Summit in Rio de Janeiro, the U.S. government embraced the idea of a national biodiversity center with three general functions: (1) to develop methods in getting to widely-scattered biodiversity information; (2) to assess the state of knowledge and identify gaps; and (3) to provide leadership in understanding and communicating about biodiversity. Plans were developed to establish the Center at the Smithsonian Institution by Executive Order but the Executive Order was not signed before President Clinton took office. Both the 1993 National Research Council (NRC) study on the National Biological Survey (NBS) and Systematics Agenda 2000 recognize that decentralized computer networks of databases are absolutely pivotal to biodiversity study and conservation. The NRC study further emphasizes the need for partnership structures to carry out its recommendations, including the distributed database concept.

The Need for a Center

The effective sustainable management of natural resources is a major challenge facing the United States and the world in the next century. Solving the intellectual and managerial problems related to biodiversity will require a comprehensive and coordinated approach that targets essential research issues and develops workable management tools. Readily accessible and credible scientific information on which to base management decisions must be made available. Organizing and using the knowledge that has already been developed and that will be generated in the future is one essential component. NBIC would address this critical need.

Because environmental systems transcend national boundaries, this information must be shared internationally. In the United States, it will be impossible to have a credible classification of the species of a group of organisms, community classification, and the like without also having knowledge of related species and communities outside our national borders.

Existing information is widely scattered, fragmented, and documented in various formats. Numerous federal, state, and nongovernmental initiatives are underway to develop national and global environmental databases, standard sets of spatial data, taxonomic and species distribution data from museum collections, and natural resources databases, among others. Geographic Information Systems (GIS) have diverse functions such as the integration of data sets for habitat modeling. Despite these efforts, users have no easy way to find out about the existence of and the means to get the information they seek.

To understand the magnitude of the problems associated with biodiversity information, consider the Federal government's involvement with biodiversity. The Federal activity alone requires

integration of its biodiversity efforts. Such efforts include:

- Establishment of the NBS by the Department of the Interior (DOI);
- Programs at the National Science Foundation (NSF) that support biotic surveys and computerization of biotic collections in U.S. museums;
- Increased emphasis on marine biodiversity by the DOC's National Oceanic and Atmospheric Administration (NOAA);
- The vast holdings of biodiversity collections at the Smithsonian Institution; and
- Efforts to list all North American insects and plants by the Department of Agriculture (USDA).

These efforts by the federal government are coupled with additional activities by the states, the Association of Systematics Collections and the museums it represents, and NGOs such as The Nature Conservancy and the Center for Marine Conservation. Our museums and herbaria contain an excess of 200 million specimens that provide historical records of the distribution and phenology of plants and animals and record dates of introduction of agricultural and pest species. Thousands of ecological data sets also exist—most of which are inaccessible. The Nation needs access to these data. When the total efforts being directed at biodiversity are considered along with the wide variety of locations where biodiversity information is being collected and stored, then the case for NBIC—a single focal point for locating available biodiversity information—becomes compelling.

MISSION AND OBJECTIVES

Mission

The Center's mission is to provide leadership and a neutral venue to:

- Provide knowledge of available biodiversity data and information;
- Enable and improve access to such data and information;
- Enable and improve ability to assess data quality;
- Facilitate the use and exchange of data and information;
- Foster collaborative discussions about the information;
- Identify potential providers of biodiversity databases and facilitate the provision and maintenance of their information in electronic form; and
- Function as an information clearinghouse.

These functions will meet the needs of public and private customers for information relating to conservation, sustainable use, education, and scientific inquiries.

Objectives

The objectives of the Center are to:

- Promote and encourage the provision and use of biodiversity data and information of known quality;
- Focus on biodiversity through the full scope of abstraction levels, from molecular through

species and ecosystems, including terrestrial, aquatic, and marine—macroscopic and microscopic. A primary focus will be on biodiversity and information sources in the United States as well as selected, high-priority, international data and information;

- Serve as a clearinghouse that connects those seeking information and data on biodiversity to those having data custody;
- Facilitate structured identification of and access to data pertinent to a user's needs. This will be accomplished through an interactive computer system that uses metadata information (data about the data) on geographic location, species, ecosystem, or other keywords to sort and/or aggregate data sets;
- Provide metadata that includes a description of the ecological matrix from which the data have been derived. Information on site and temporal factors, climate, and location will be included whenever possible to allow comparison across a wider range of situations;
- Facilitate the establishment and provision of data collection and reporting protocol, that is, identification of the specific methodologies employed in collecting and interpreting the data, including methodological biases and assumptions, as well as changes in methodologies;
- Meet the needs of a wide range of providers and customers, including researchers (in academia, government, and other institutions and entities); industry and non-governmental organizations; private citizens (including land owners, managers, and users); policy- and decision-makers (in all institutions and entities); and educators;

- Facilitate integration of key data sets to a point where essential information is made available to researchers, land managers, and policy-makers—in recognition of the fact that managers and policy-makers often have a need for more information rather than actual data—and organize existing information with identification of its data source;
- Identify gaps in existing data and knowledge; and
- Provide a forum for discussion and collaborative approaches to resolution of biodiversity information management issues.

The mission of the Center does **not** include establishing or implementing U.S. biodiversity policy; conducting research in conservation, systematics, or ecology; generating physical collections of species; developing major data archives; or providing grants.

GUIDING PRINCIPLES

Several guiding principles will provide a foundation for the functioning of the Center. These principles relate to the Center's general operations and its approaches to information management and dissemination.

Operational Principles

A primary purpose of NBIC is to be a clearing-house, facilitating access to biodiversity information for diverse users. To accomplish this, the Center must have a strong user focus and be responsive to current and evolving user needs. Users should be viewed as those seeking biodiversity information as well as those individuals and institutions that are actively collaborating with the Center through the development and management of such information. To create and maintain

a high level of responsiveness to user needs—thus ensuring user satisfaction—the Center must establish mechanisms for continuous feedback and improvement. For example, the Center can track the number and type of requests and solicit user feedback. Maintaining flexibility in management and technological systems will be particularly important for providing this type of quality focus.

Another basic operational principle is that the Center should seek to unite, complement, and strengthen existing efforts, rather than duplicate them. Duplicating efforts would not only waste money, but would also weaken the efforts of Center collaborators. To ensure that the Center focuses on complementing and strengthening existing efforts and filling needed information gaps, community governance should be instituted. The governing body should take the form of an Advisory Board with broad representation from users and data custodial communities.

Information Management Principles

Understanding the relationship between data and information—terms that are too often used interchangeably—is essential in outlining guiding principles for the Center. An often-used continuum to describe this relationship hierarchically links data, information, knowledge, and finally wisdom. Data generally refer to the raw observations or measurements describing a particular entity or process. Information, however, usually refers to data that have been organized, integrated, and to some extent analyzed. Knowledge can be derived from information through further analysis, interpretation, and understanding. The ideal product of this continuum is wisdom, achieved through the intelligent application of this knowledge.

Given this continuum, the Center must provide access to both data services and information services directed at different audiences. The biodiversity research community is generally more

interested in data access, which allows them to carry out their own analyses and interpretations to address particular research questions. Most policy-makers, land-use planners, and other general users are more interested in information or knowledge access. That is, they want data that have been organized, interpreted, or otherwise analyzed. Simply providing raw data to many of these users is an ineffective way of informing those involved in the decision-making process.

The Center must achieve and maintain a reputation for scientific credibility and objectivity. Therefore, documenting and understanding the pedigree of information or databases accessed through the Center will be extremely important. Facilitating the development of metadata standards (minimum criteria for data documentation) will be an important function for the Center and enable it to institute a "truth-in-labeling" policy. While the ultimate responsibility for appropriate and responsible use of information must rest with the end-user, the Center should provide guidance about the appropriate uses of data. The Center should acknowledge the importance of primary data sources, such as collections, since primary data are the means of verifying information. NBIC will have mechanisms to improve the quality of available data sets, by instituting a feedback system where users can comment on the utility and quality of particular data sets and information they have received.

Given the decentralized and distributed nature envisioned for this effort, data custody should reside largely with the principal sources and producers of information and data. These data collaborators generally will be in the best position to maintain and update databases, provide quality control, and supply accurate interpretation. Giving proper acknowledgment and credit to original data sources will be essential in this effort and, when possible and appropriate, data users will be referred or electronically directed to these original sources. Information users may be referred to other sources

that have compiled and analyzed data, but that acknowledge the original source.

Additional information management principles that must be considered include maximizing the use of appropriate information integration and analysis technologies; recognizing the need to participate in the developing information superhighway; and promoting the adoption and use of appropriate information standards.

CONCEPT OF OPERATIONS

The concept of operations is derived from understanding the environment in which the Center will function, identifying principles and modes for operation, and identifying the staffing and skills required to achieve short- and long-term goals.

In addition, the key questions to be answered to decide how the Center will be organized and function are:

- What are the overall needs for biodiversity information?
- How can effective access to existing information be facilitated?

The answer to these questions, in the context of what is currently being done, will define the role of NBIC by identifying the gaps in needs that can be filled by the Center.

Environment of Operations

The key consideration in determining the Center's niche is understanding the environment in which the Center will function. Knowing what it takes to effectively fill the niche and establish partnerships and cooperative arrangements with the other players will provide answers to how the Center should be organized, staffed, and function. There are various activities and ongoing programs assessing the issues, collecting data, deriving information, and developing approaches for resolution of biodiversity issues. Key activities, entities, and framework documents include:

- The 1993 NRC report, *A Biological Survey for the Nation*;
- The Convention on Biological Diversity; international clearinghouse concept, including Biodiversity Information Network (BIN21) and Australia's Environmental Resources Information Network (ERIN);
- The NBS and its National Biological Information Infrastructure (NBII) program;
- The National Science and Technology Council (NSTC) Committee on Environment and Natural Resources R&D (CENR)— Subcommittee on Biodiversity and Ecosystem Dynamics (SBED);
- The Federal Geographic Data Committee's (FGDC) National Spatial Data Infrastructure (NSDI), National Aeronautic and Space Administration's (NASA) Earth Observing System Data and Information System (EOS-DIS), Department of Energy's Human Genome Project, Brookhaven's Protein Data Bank (PDB), NSF's Long Term Ecological Research (LTER) sites, NSF's Center for Ecological Analysis and Synthesis, Global Climate Data System, and similar efforts of the USDA, DOC, the Environmental Protection Agency (EPA), and others;
- Interagency Taxonomy Steering Committee, whose members represent the EPA, NBS, NOAA, USDA, U.S. Geological Survey (USGS) and the Smithsonian Institution;
- Information Technology—National Information Infrastructure (NII), Information Infrastructure Task Force (IITF) and its Committee on Applications and Technology;
- State programs including, Biological Surveys and Departments of Natural Resources, Fish and Game;
- NGOs such as The Nature Conservancy, the Ecological Society of America and the Association of Systematics Collections;
- The *Systematics Agenda 2000* report;
- The Association for Biodiversity Information and its member Natural Heritage Programs and Conservation Data Centers; and
- Individual investigator projects in the biological sciences.

Many of these activities include several aspects of development and use of biodiversity information. What is missing in these activities and this environment is a broadly-accepted partnership to serve as a convener, clearinghouse, and cooperative forum. The Center should be organized and staffed to fill this niche.

NBIC and the National Biological Survey

The newly-created NBS has as a significant component of its mission the augmentation of access to biological information, relying upon a "distributed federation of databases" in accordance with NRC

recommendations. To achieve this goal, NBS plans to gather and make available information on sources of biological information (an electronic "card catalog" will be available in late 1994), encourage the development of metadata standards, and make investments in both its own and its partners' hardware and software capabilities to move toward a highly-distributed communications and access environment.

These activities and objectives closely complement those of the NBIC. That is, the Center will assume the clearinghouse function of the NBII as envisioned by the NBS. In fact, NBS views the Center as a powerful tool for achieving key NBS objectives. The development of the "national partnership for biological survey" requires that a wide range of partners meet regularly to work toward common strategies for achieving specific partnership goals (in this case, increase access to information). NBIC provides the "neutral forum" around which those common strategies can be developed. The relationship between NBS and NBIC will evolve, with a shared goal of improving the accessibility of data and information on biodiversity.

In addition, the Center—by not solely representing a single government agency or the Federal government, but the entire U.S. biological information community—can provide important international linkages and make an important statement regarding the need for broad collaboration. The Convention on Biological Diversity encourages nations to develop such integrated information networks. Collaboration with the nongovernmental sector provides a powerful example to other nations.

Mode of Operations

The Center will facilitate the availability of, and access to, biological information related to the understanding, use, and protection of biological diversity. Such information will include the taxonomy and distribution of the biota, its interac-

tions, and its organization into ecosystems and landscapes. The exact range of data will be provider- and user-driven, but will be subject to quality assessment and bounded by the areas of responsibility already occupied by other organizations with data directory functions (such as physical global change databases; data sets under the purview of the USGS Earth Science Data Directory).

The NBIC will seek to identify important categories of biodiversity information that are valuable to users and that are poorly represented electronically. The Center will facilitate including such information in the electronic data network. The Center's Advisory group, along with users and providers, will assist the Center in setting priorities and in developing sources of support:

- Articulate appropriate standards useful or essential for data providers;
- Provide users with appropriate tools to facilitate navigation through the data accessed via the Center; and assist groups of data providers and users who may wish to integrate data from different sources, understanding that, under the distributed data model, data providers retain control over the databases.
- Identify biodiversity data and information needs (such as types, scale, format, etc.);
- Ensure that data of known quality are being provided;
- Ensure access to the full scope of biodiversity data and information;
- Promote the use of biodiversity data and information;
- Promote and exchange information and approaches to the resolution of biodiversity issues;

- Serve as the hub for numerous biodiversity information nodes, directing users to data and information sources;
- Encourage electronic archival practices relevant to biodiversity data;
- Facilitate rescue actions for important "orphaned" databases that are no longer being maintained;
- Identify gaps in existing data and knowledge;
- Serve to coordinate fora for scientific discussion surrounding biodiversity needs; and
- Identify incentives for building partnerships among data generating organizations, and between those organizations and the Center.

Center Function and Its Evolution

Initially, the Center will focus its efforts on:

- Identifying the information management efforts of others;
- Housing and expanding the "inventory of inventories/database of databases" developed by the NBS;
- Convening and participating in discussions to define what metadata standards, data exchange standards, and communication formats are needed;
- Participating in the development of metadata standards, data exchange standards, and communication formats; and
- Working on policy issues (such as pricing, data ownership, and requirements of the Freedom of Information Act).

As the Center matures, the nature of its work will encompass additional responsibilities, including:

- Educating users and contributors on data and metadata standards;
- Dealing with new policy issues as they arise;
- Developing the capability to integrate key data sets; and
- Providing technical support to the distributed network of biodiversity databases.

NBIC will function based on a democratic, consensus-building, partnership approach. The Center will serve as a convener, facilitator, and host. Center experts will function to move discussions along, and involve key constituencies.

STRUCTURE AND ADMINISTRATION

Structure

A distributed structure is envisioned for NBIC: a "gateway" with pointers to other databases. The Center should comprise an electronic catalog of existing databases (with appropriate address pointers) rather than establish a duplicate set of databases. Assembling all relevant data sources will not be a trivial task. Within the center, the "structure" must also address metadata issues to maximize data utility for those unfamiliar with the data. The establishment of a Mosaic/Worldwide Web for the Center that "points" to data at many other sites would be appropriate.

Governance

The governance of the Center must emphasize service by minimizing bureaucracy and maximizing accessibility. The Center's governing structure should reflect its institutional makeup (i.e., government, academic, consortium) and should be responsive to the needs of the broad community of information providers and users. In its proposal to house the Center, the potential host institution must show a governing structure that ensures shared responsibility for setting and maintaining center policy or direction. To be successful, the Center must truly be a national partnership, not merely a nationally funded entity directed by a single institution. The Center should have a Governing Board or Advisory Board (depending upon the host institution) that should be drawn from the broad community. This community includes:

- Federal, state, tribal, and local governments;
- Academia and other institutions such as zoos, museums, botanical gardens, and private research institutions that produce biological information;
- Environmental nonprofits and other citizens groups including those that maintain databases on biological diversity;
- Private sector entities that use biotic resources including forestry, agriculture, fisheries, biotechnology, pharmaceuticals, and recreational users;
- Library and information professionals; and
- The general public.

Besides setting broad policies for the Center, the governing structure must ensure that the Center receives competent and timely technical (including computer and scientific) advice. The Govern-

ing/Advisory Board may wish to establish a Technical Advisory Committee to ensure that the Center can keep up with the rapidly changing technology for information management.

Funding

The location of the Center should be determined by an open competition through a Request for Proposals (RFP). The competition should be open to federal, state, private, and nonprofit institutions, including universities. It is important to establish a "level playing field" for initiating the Center. An open competition sends this message to the community. To avoid conflicts of interests, the competition would be managed by an agency that itself could not be a candidate for the Center. The actual mechanism for funding—whether by an inter-agency agreement, cooperative agreement, contract, or grant—would be contingent upon final selection of the awardee. While it is recognized that funding to establish the Center will be from the Federal government, creative proposals that incorporate and maximize cost-sharing approaches are encouraged.

The conceptual design for the Center should allow it to be moved if needed. After three years, there should be a review that would reflect the status, performance, and progress of the Center. The three-year review could be structured as a workshop of Center clients asked to evaluate the Center. The funding strategy should allow for a recompetition every five years if recommended during the review of the Center.

During the review process, it will be crucial that reviewers separate the "value" of the Center to the larger community from the efficacy of long-term Center management (that is, according to its management plan). A panel of actual or potential users of a resource often find it difficult to distance themselves from the value of the resource in order to provide an unbiased review of how the resource is managed.

Host Institution

Individual institutions or consortia of institutions should be invited to apply for selection as the Center host. Desirable characteristics should include, but not to be limited to:

- Strong computational and information management support services, including databasing, GIS, image processing and Internet connectivity;
- Creative and active program in biological sciences, especially involving use of computers in biodiversity information management;
- Broad-based expertise, or strong links to expertise in systematics, ecological research, and collections information management;
- Demonstrated understanding of modern and historical collections of the North American biota;
- Demonstrated history of user service and support in the public and private sectors, including the scientific community;
- Reasonable access to national and international transportation; and
- Provision of comfortable, modern facilities for conferences and Center staff.

Staffing Considerations

After reaching consensus on the concept for the Center (presented in the preceding sections of this paper), the NBIC Advisory Planning Board deliberated further on staffing needs, cost estimates, and an estimated budget for the Center. The final three sections of this paper provide the thoughts of the Advisory Planning Board on these topics. It should be stressed that these estimates by the Advisory

Planning Board are first approximations for staffing, setting up, and operating the Center. They are not meant to be binding requirements for an RFP. Institutions responding to an RFP for the NBIC will be free to propose their own plans for numbers and kinds of staff and for setting up and operating the Center, based on their particular institutional setting and how they propose to implement the goals of the NBIC. The budget should reflect the detailed plans developed by the institutions in response to the RFP.

The Center initially will be staffed with people whose skills can firmly establish the organization and implement its operations. Staff would include an Executive Director, who should be a broadly-educated biologist, and others who could represent the Center, apply for grants, market concepts, and facilitate meetings. The Executive Director should review, and recommend to the Advisory Board if appropriate, sources of funding to defray operating costs and enhance capabilities of the Center once it has been established. In the long-term, the Center must have the expertise to carry out all its modes of operation and must employ staff whose expertise is appropriate for developing approaches to biodiversity information issues. Additionally, the Center must reflect the scientific communities that will be involved in biodiversity issues.

The Executive Director will need a support staff: an administrative assistant and one secretary. It is envisioned that the technical staff of the Center might include two biologists with substantial experience in those areas addressed by the Center, information specialists (a database administrator and a systems administrator), one networking specialist, and three computer programmers. In staffing the Center, it is important to foster liaison between the computer group and biologists. Since the operating environment where the Center is housed will provide access to a broad range of biologists, systematists, and computational scientists (as noted in the above section on "Host Institu-

tion"), the Center *per se* would not initially require a large staff. At a later stage in its development, the Center might desire to expand its staff to include more biologists, a statistician, and perhaps a librarian.

Cost Estimates

Cost recovery issues should be addressed in the RFP. The annual salaries and benefits for an Executive Director, two biologists, and technical staff (nine people) will likely cost \$900,000. Salaries and benefits for office support staff (two people) will require \$100,000. Support for meetings of the Advisory Board and Technical Advisory Committee, including travel, would require approximately \$30,000. Money for workshops, about \$120,000, should be included. The operating budget should include adequate resources of about \$100,000 for maintenance (including upgrading and replacement of equipment), \$200,000 for overhead (e.g., space rental, heating, electricity) and \$50,000 for other administrative functions (e.g., mailing, phone, copying, publication), for an estimated total of \$350,000.

There would also be some initial requirements for instrumentation and furnishing (about \$400,000). Depending on the institutional site, there may or may not be costs associated with connectivity to the Internet; this might cost as much as \$100,000.

Estimated Budget

Executive director and technical staff	\$900,000 (nine people)
Office support staff	\$100,000 (two people)
Meetings of Advisory Board/ Technical Advisory Committee	\$ 30,000
Workshops	\$120,000
Maintenance, overhead, and administration	\$350,000
Possible Internet connectivity	\$100,000
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TOTAL YEARLY COSTS	\$1.6 million
Instrumentation and furnishing (first year only)	\$400,000
TOTAL FIRST-YEAR COSTS	\$2 million

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