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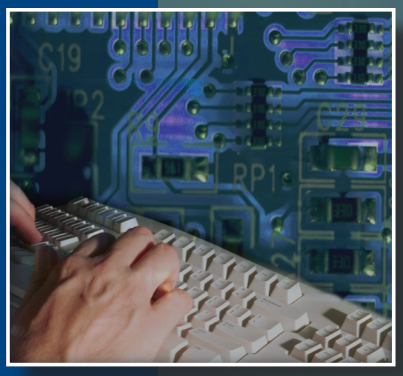

# Strategic Plan for the USGS National Biological Information Infrastructure

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U.S. Department of the Interior
U.S. Geological Survey

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## Executive Summary

The U.S. Geological Survey (USGS) Strategic Plan for the National Biological Information Infrastructure (NBII) for 2003 to 2008 reflects a renewed commitment to the USGS´s role as the nation's principal natural sciences and information agency. USGS and many other organizations from all sectors of society conduct research, monitoring, and assessments to contribute to our understanding of the natural world – land, water, and biological resources. In order for the data and information created through these activities to be used by scientists, managers, planners, and citizens to understand, respond to, and plan for changes in our environment, they must be easily accessible in a useable form. The NBII seeks to make such data and information available, and to provide the tools through which decision-makers may interact with them. This Strategic Plan discusses the USGS´ goals for the NBII and the strategies that will be used to achieve them. It reflects the high priority the USGS places on meeting customer needs for reliable and impartial information.

Within the USGS Strategic Plan, the Environment and Natural Resources goal emphasizes delivery of data and information in ways that provide decision-makers a better understanding of current environmental conditions, develop predictions about the future, and provide options for adopting a course of action or response to these conditions (decision support systems and other data interpretation tools). The NBII responds directly to this goal by providing a large, distributed yet interconnected network of people, technologies, standards, data, and organizations that together form a federation. The goals of this federation are aimed at optimizing the nation's investment in research and monitoring activities through greater accessibility to the results of these activities. The multi-sector nature of NBII partnerships, with each partner contributing expertise, data, equipment, facilities and funding, ensures that the benefits derived from the use of appropriated funds are multiplied through leveraging of these valuable in-kind resources and results in a greater return on USGS' investment in the NBII. In addition, the participation of more than 200 partners provides a large pool of experience from which to draw "best practices" to be incorporated into the network's ongoing development to ensure efficient and effective management of data and information throughout its life cycle.

Development of this Strategic Plan included user, partner, and stakeholder involvement through focus groups, conferences, feedback forms, and stakeholder meetings. Written review comments were solicited and received from experts in the USGS, Department of the Interior (DOI), and other federal and state agencies, private corporations, the university community, and environmental and other non-government organizations (NGOs).

This Strategic Plan is a concise guide for achieving USGS goals for the NBII through the development of a vast array of digital environmental and natural resources data and information products that are easy to access, apply, and integrate into analytical and decision-making activities while retaining their quality and integrity. The strategies for achieving these goals, detailed herein, are:

- Continue strong national leadership of the NBII through the USGS.
- Implement and maintain three advanced nodes.
- Implement and maintain regional nodes to cover the entire country to facilitate local stakeholder involvement and participation, ensuring that their information needs are met.
- Provide national coordination for overarching science issues through thematic nodes.
- Leverage resources through partnerships.
- Support biological informatics research and development.
- Provide outreach, training, and technical support to NBII users.
- Invest in pilot projects in high priority emerging issues.

## Who We Are and How We Serve You

The National Research Council (NRC) reported in 1993, "There is wide agreement on the urgent need to organize existing biological information and make it more readily available and to coordinate future data collection and exchange."[1]

The NBII grew from two key recommendations articulated in that NRC report: 1) initiate a federation of data resources from many diverse organizations using technology to make scientific data and information more easily accessible to those who need it, and 2) acknowledge and act on the fact that government data and information are not solely sufficient for the informed creation of future environmental policies for the United States. Through active partnerships between the NBII and organizations in all sectors of society – public and private, non-profit and commercial, specialized and general – the USGS integrates industry standard information management and computer science principles into the development of applications for the biological sciences community that improve knowledge diffusion and promote scientific advancement.

In response to the need for scientific information, the NBII provides a framework for making this vast storehouse of biological information accessible. It also provides the tools for analyzing and synthesizing data quickly and efficiently so that the knowledge resulting from scientific research can be useful to a wide audience and can be brought to bear on decisions, issues, and policies that affect the natural resource base of the nation. The NBII links biological databases, information products, and analytical tools maintained by partners from all sectors including federal, state, local, and tribal government agencies; academic institutions; NGOs; international agencies and initiatives; and private industry. The NBII and its partners engage in applied information science research to develop state-of-the-art technologies and methodologies for data collection and analysis, data mining and access, modeling, simulation, forecasting, interpretation, and visualization of biological data and information (see Figure 1). Through these capabilities, the NBII increases the return on investment in scientific research by ensuring that the resulting knowledge is accessible worldwide and is available to enhance our ability to understand the nation's living resources.

In 2001, the NRC affirmed the NBII's progress in achieving the objective of organizing existing information and making it available: "By developing a national approach for using the Internet to distribute biological information – the National Biological Information Infrastructure – the USGS has been at the forefront of these efforts and is playing a key role in encouraging other nations to develop similar, linked capabilities."[2]

In accordance with the vision articulated by Secretary of the Interior Gale Norton for effective Interior program management, the USGS manages programs including the NBII by applying the "4 C's": Conservation through Cooperation, Consultation, and Communication.

Within the NBII, application of the 4 C's is achieved by conducting business according to the following guidelines:

- **Collaboration** – Value the contributions of our partners and recognize that the NBII is built in the spirit of multi-sector cooperation.
- **Inclusiveness** – Work constructively with a variety of federal, state, local, international, academic, non-government, and private partners to add useful data, and develop and implement products and services that will benefit all users.
- **Integrity** – Maintain professionalism in our partnerships and in the development and delivery of products and services. Treat partners and users with respect.
- **Quality** – Affirm a commitment to data quality and an infrastructure that ensures data integrity.
- **Technological Excellence** – Produce and provide the best possible state-of-the-art tools and technologies needed by our partners.
- **Responsiveness** – Demonstrate an awareness of the specific needs of users and partners. Seek to serve those needs as thoroughly and effectively as possible, providing all users efficient access to information in its most useful form.
- **Flexibility** – Emphasize innovation and responsiveness in approaches to service and in

[1] National Research Council, A Biological Survey for the Nation, (Washington, DC: National Academy Press, 1993), p. 12.

[2] National Research Council, Future Roles and Opportunities for the U.S. Geological Survey, (Washington, DC: National Academy Press, 2001), p. 79.

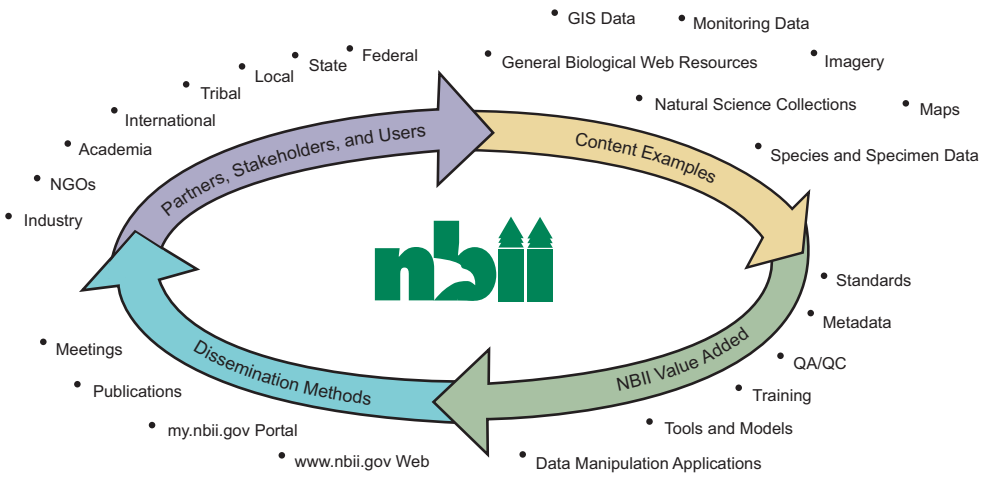



**Figure 1. Through the NBII, the USGS collects and organizes biological information from partners, adds value, and provides information products and services back to these users to meet their needs.**

the development of technically advanced and adaptable information products, services, and partnerships.

- **Attribution** – Ownership and control of information and data available through the NBII remains with the data provider, intellectual property rights are respected, and source attribution and standardization are required whenever data or information of others is used.

Adhering to these principles and values helps to ensure integrity, excellence, and the ultimate success of USGS efforts to realize the biological community's vision for the NBII.

## Why We Are Here: Vision, Mission, and Strategic Direction

### Vision

The NBII will be a fully digital, interactive, distributed system for accessing integrated biological and ecological information. This user-friendly Web-based system provides natural science data and information that are scientifically reliable to the public.

During the period from 2003 through 2008, the USGS will maximize the current resources of the NBII to respond to priority partner needs and where significant contributions from partner organizations are most likely to address critical issues such as invasive species and emerging diseases.

### Mission

The USGS NBII provides the nation with a mechanism for accessing the vast amount of existing biological and natural resources data, information products, and analytical tools that support and enhance science-based decision-making. It is the cornerstone for the gathering and efficient transfer of research and monitoring information from all sectors of the global biological community to those who make decisions regarding the study, use, and conservation of natural resources.

## What We Expect To Accomplish

### Data Sharing

One of the long-term goals of the USGS Strategic Plan is to "ensure the continued availability of long-term environmental and natural resource information and systematic analysis and investigations needed by customers, …for informed decision-making about natural systems."

Through the NBII, the USGS has begun making the nation's biological data and information accessible through the Web, so that research data and information can be readily identified, accessed, and applied to help solve natural resource problems. In recent years, USGS planning activities have increasingly recognized and focused on the value of

its information assets, the role the USGS should play in natural science information, and the importance of accessibility and usability of natural science information for its customers who need readily available and integrated biological information.

The NBII is an integral part of USGS' overall information services, functioning as the biological component in the range of natural sciences information services. NBII goals and strategies are aligned with those of the USGS, and serve as a model for the direction in which the USGS is moving. By developing a national approach for using the Internet to distribute natural science information, the USGS has been in the forefront providing credible and readily accessible information, and encouraging other nations to develop similar, linked capabilities.

The NBII supports USGS' data and information sharing goal by:

- Integrating with the National Map and other geospatial information systems,
- Promoting National Spatial Data Infrastructure/ Federal Geographic Data Committee (FGDC) standards for metadata through development of the Biological Profile (an extension of the standard), training and support programs in use of the standard, and data entry software to facilitate the creation of metadata,
- Developing a vocabulary for consistent access to the nation's biological information,
- Incorporating the USGS and other partner biological data sets into the NBII Metadata Clearinghouse, and
- Maintaining consistency with the USGS Enterprise Architecture, Enterprise Web, and Enterprise GIS.

**National Objectives**

National objectives for natural resource management were clearly articulated by President Bush: "All of us have a responsibility to be stewards of our land. When we use the land, we must do so wisely and responsibly, balancing the needs of the environment with the best interests of those who live and work on the land."[3] To meet the President's mandate, we must act responsibly to manage the data and information generated through natural science research, development, and management in order to ensure that past efforts yield the answers to present and future questions. This requires coordination and integration of those data and information, according to common standards for describing, disseminating, and using them efficiently. These objectives that underpin the NBII Strategic Plan step down from the DOI Strategic Plan.

USGS personnel, including NBII Program staff, stay abreast of and participate in framing the natural science priorities of the research and management communities. These priorities are then reflected in the ongoing development of the NBII as guidance for the formation of thematic or regional node projects to address information needs on critical resource issues. Published documents that lay out the framework for addressing national issues and provide guidance for NBII development and priority setting include:

- Conservation Biology: Research Agenda for the Next Decade (Society for Conservation Biology, 2001),
- Ecological Forecasting: Agenda for the Future (CENR Subcommittee on Ecological Systems, 2001),
- Monitoring Ecosystems (Island Press, 2003),
- Our Common Journey: A Transition Toward Sustainability (NRC, 1999),
- Precious Heritage – The Status of Biodiversity in the United States (The Nature Conservancy and NatureServe, 2000),
- State of the Nation's Ecosystems (Heinz Center, 2002), and
- Systematics Agenda 2000: Charting the Biosphere (American Museum of Natural History and the New York Botanical Gardens, 2000).

NBII priorities also reflect USGS priorities, as documented in:

- Status and Trends of the Nation's Biological Resources (USGS, 1998),
- USGS Future Science Directions, and
- USGS 5-year Strategic Program Plans.

The USGS seeks to address environmental, biological, and natural resource information priorities by guiding the NBII with the following national-level objectives:

[3] G. Bush, January 11, 2002, "President Signs Bill to Clean Urban Brownfields," <http://www.georgebush.com/Environment/read.aspx?ID=1415>. Accessed February 4, 2004.

- Entering into partnerships with collaborators who produce high-quality scientific information, as well as partnerships with users of scientific information to ensure the relevance and application of the information to real problems ("Building Knowledge Through Partnerships" is the NBII motto),
- Leading the development and application of technologies needed to synthesize, analyze, and disseminate biological and ecological information,
- Providing USGS Science Centers and others with the information technologies needed to enhance scientific understanding and support the sound management and conservation of our nation's biological resources,
- Developing the ability and resources to transfer the information gained in research and monitoring to resource managers and others concerned with the study, use, and conservation of the nation's resources,
- Providing reliable scientific information to the public, while recognizing a special obligation to serve the biological information needs of the DOI bureaus, and
- Creating a greater awareness of the NBII and its capabilities through outreach and training.

**International Objectives**

Biological resource issues cross many political boundaries and, therefore, must be addressed at regional, hemispheric, or global levels. Organisms including disease vectors and invasive species, can be transported anywhere in the world within 24 hours. Invasive species, for example, exist in all U.S. ecosystems. They pose potential threats to the integrity of our nation's landscapes and biodiversity, and are estimated to cost more than $100 billion per year. Information management efforts in this area are performed cooperatively with the National Institute of Invasive Species Science at the USGS Fort Collins Science Center. Migratory bird species cross country borders and even continents. One nation's actions in addressing migratory issues may impact another nation's resources. The NBII Bird Conservation Node works in partnership with the USGS Patuxent Wildlife Research Center and the U.S. Fish and Wildlife Service to coordinate information management activities related to migratory bird science and management.

The United States has made commitments to participate in a number of biodiversity network initiatives that seek to facilitate the exchange of biological data and information among partners worldwide. These initiatives include the Global Biodiversity Information Facility (GBIF), the Inter-American Biodiversity Information Network (IABIN), the North American Biodiversity Information Network (NABIN), and the Clearing-house Mechanism (CHM) of the Convention on Biological Diversity, the NATO Information Management Committee (IMC), among others. The NBII represents the U.S. contribution to these initiatives, and the NBII Program Office at USGS has been officially designated by the State Department as a U.S. focal point for GBIF, IABIN, and the CHM.

Acknowledging these responsibilities, as well as global biodiversity concerns, NBII international objectives build on its national objectives and include:

- Making biological data freely and quickly available to a broad variety of users around the world, facilitating global access to U.S. information resources and U.S. access to global information resources,
- Participating in the development and promulgation of common standards and protocols to facilitate the exchange of information across political, linguistic, and institutional boundaries, and
- Emphasizing respect for intellectual property rights by advocating the principle that ownership and control of these data remain with their sources, who have designated all such non-sensitive data as being available for free public access.

Recently, the NBII was evaluated by the International Council of Scientific Unions and designated as the World Data Center (WDC) for Biodiversity and Ecology in October 2002. The NBII is the first and only biology/ecology data center of the approximately 50 WDCs worldwide, 14 of which are in the United States.

Through the NBII, USGS provides leadership for the development of regional, hemispheric, and global biodiversity information networks and works to obtain funding for these networks and initiatives. For example, in response to proposals developed by the NBII, the World Bank has awarded over $1 million toward the implementation of IABIN, and another

proposal seeking an additional $5–10 million is in preparation. The NBII has also received funding from the Department of State to develop a biosafety clearinghouse mechanism that is related to the Convention on Biological Diversity. The Organization of American States (OAS) is providing funding for a metadata project.

### Strategic Direction: The Development of NBII Nodes – What They Are; What They Do

NBII nodes are focal points through which system-wide information and services are made available. Nodes comprise computer equipment and software, a network of partners, personnel, data and information, catalogs and tools, and other functional capabilities that allow users to efficiently locate, manipulate, and use data from diverse sources worldwide. Nodes provide users with the capability to maximize the value of previously collected data by making it accessible and by providing key support functions. These functions include analytical tools, secure sites for scientific collaboration, and new processes for locating and utilizing large, disparate data sets.

Each node provides its own unique focus while integrating into the national context. Each node must also provide a minimum level of service and support to meet national objectives.

A fully functional NBII node will provide:

- Content delivery – An NBII node must provide rich content with high informational value for the targeted user community; content should include downloadable data such as the time sensitive results of invasive species monitoring, as well as other types of information. In the NBII context, this is closely related to …

- Data warehousing – The system provides data from many diverse sources in order to present integrated information that is as complete and coherent as possible. The warehouse supports decision-making with up-to-date information at any given time. Warehoused data are enhanced through …

- Data mining – Special software that continually searches content to spot trends and previously unknown (or not obvious) relationships among data. This includes data exploration tools to identify areas potentially worth mining. Regardless of observed trends, users have unique requirements for the data depending upon questions they are trying to answer. To assist users, the NBII system must provide …

- Analysis and synthesis tools – These tools assist users in combining data from disparate sources into a single result. For example, users may wish to view bird migration data on a map, along with locations of wildlife refuges. Such a tool allows the two data sets (plus many others) to exist as layers that users may turn “on” or “off” depending upon their needs. Other examples of an analysis and synthesis tool might be a decision support system, or modeling or visualization tools. But to analyze or synthesize data effectively, users must be able to rely on the tools working properly in their own computing environment. To ensure this, the NBII provides …

- Technical support – This ensures that users are able to interact effectively with the NBII, tools, and its content. To provide this support, the NBII taps into the expertise of partners in addition to USGS resources. Users may request technical support by phone, e-mail, letter, or in person. When users attempt to combine data from disparate sources, proper functioning of the tool is not the only critical factor. Data must also be calibrated in some fashion so as not to lead to erroneous conclusions. This ability to combine data effectively is called …

- Data interoperability – The ability to share and combine data from different sources, with software tools to automatically convert data features such as scale to make the data compatible, increases their usefulness. Interoperability is also enhanced through the development and use of a controlled vocabulary for taxonomy. The Integrated Taxonomic Information System (ITIS), a part of the NBII, is supported by the USGS, Environmental Protection Agency (EPA), the Smithsonian Institution, the National Oceanic and Atmospheric Administration, the United States Department of Agriculture, DOI, NASA,

and many others. Sometimes data sets contain the information a user wishes to explore (i.e., species population and range) but not in the way the user needs. Combining data sets that have not been calibrated to one another is like trying to match up the borders of maps at different scales. At times, more information may be needed from the original collector data collector. At these times, or when any other interested members of a discipline or community find it useful to contact one another, the NBII provides …

- Collaboration capabilities – This virtual capability provides a mechanism for online communities of interest – those interested in similar topics – to find and communicate with each other through online discussions, exchange documents, share task lists, and contribute to group or private calendars, all in a secure, password protected digital setting. Users may request this capability through the NBII Portal at <my.nbii.gov>. Users of the Portal or of other NBII provided tools also may request …

- Training and education – Available upon request for topics such as the use of tools, the NBII Portal, the creation of compliant metadata, and the use of metadata creation software. Selected NBII nodes also engage in other training and education projects, such as the development of a biological informatics curriculum.

The NBII has established three types of nodes that are interconnected, mutually supportive, and overlap to an efficient degree in topical focus areas because biological and environmental issues recognize no political boundaries, and no single organization houses all of the relevant data and information. Node types are regional, thematic, and infrastructure.

**Regional Nodes**

Regional nodes focus on and provide services within a particular geographic area of the country. Within a region, activities address broad biological themes as well as issues that are uniquely regional. The focus areas of a regional node are based on an assessment by the local (regional) partners to determine the biological and natural resource challenges that are most critical to that particular geographic area. For example, the initial focus in the Pacific Northwest has been forestry. As resources for this node grow, the focus will expand to include other regionally important topics such as fire, anadromous fish, and sagebrush ecosystems. This is quite different from the initial focus in the Northeast, which will be urban biodiversity. Regional nodes are encouraged to be flexible and work together across node boundaries.

Regional nodes, which together cover the entire nation, have been delineated based on characteristics such as ecological uniformity, shared regional biological issues, and availability of high quality biological and information science capabilities, data, and expertise within the region. Nine of these regional nodes have been initiated thus far. This Strategic Plan maps the course for the growth of the network to ensure national coverage of priority biological resource challenges, and for achieving full functionality in all of the nodes. A map of the regional nodes is shown on page 12.

**Thematic Nodes**

In addition to regional nodes, USGS has instituted thematic nodes within the NBII. A thematic node is created to provide national coordination for issues that are pervasive in all or many regions, and have a high level of importance to the nation. This ensures inter-regional cooperation and avoids duplication of effort on specific themes. All of the current thematic nodes were selected for national level focus due to their importance and high priority within DOI and the states. These themes include Invasive Species, Bird Conservation, Fisheries and Aquatic Resources, Wildlife Disease (including West Nile Virus and Chronic Wasting Disease), and Amphibians. These themes also are considered to be highly critical to other federal agencies, NGOs, and the private sector. This allows the USGS to leverage information, expertise, and support available from partners across the country.

This Strategic Plan describes the potential for creation of new thematic nodes over time, as well as charting thematic node growth toward full functionality, just as with regional nodes. New thematic nodes are being planned based on emerging priorities expressed by DOI and other organizations, as well as in national framework documents that highlight the need for concentrated biological research and information management efforts. Updates to this Strategic Plan will reflect new and changing thematic priorities as

they emerge. If node utility becomes limited, it will be migrated into another existing node.

**Infrastructure Nodes**
Infrastructure nodes provide the foundation of the system. Infrastructure nodes are vitally important for achieving the mission of the NBII and for the efficient functioning and security of all nodes within the network. They include the computer hardware, software, systems, tool suites, and technical and training support that underlie the entire national network. The work and research performed within the infrastructure nodes ensures that all nodes in the network use the same metadata development tools and platforms, as well as Web site design features. It is the infrastructure nodes that create the standards and operating protocols that enable individual nodes to manage data efficiently. They provide a vast array of services to NBII users and seamlessly connect each node to the overall network so that the NBII functions as a unit. For this purpose, USGS established two infrastructure nodes: 1) Knowledge Integration, and 2) Network Standards and Technology.

## Goals and Strategies

Goals for the NBII are to:

- Develop the framework to support knowledge discovery and creation for the nation's biological and ecological resources.
- Create an integrated library of biological knowledge by systematically discovering, acquiring, organizing, storing, updating, and making available scientific data and information from diverse sources. Ensure that this library responds to the information needs of land and resource managers and other stakeholders and users.
- Lead the development, selection, and distribution of tools and standards necessary to facilitate system-wide interoperability and allow meaningful interactions with scientific data and information.
- Empower NBII users by creating an awareness of the NBII and its capabilities and providing support to enable users to directly apply NBII products and services within their own areas of concern.

Responding to critical challenges facing resource management agencies, public and private decision-makers, researchers, and others who are involved in the care and use of our environment requires access to high quality data and information. As new challenges are identified, new data and information are created, which must be effectively managed for immediate access. Add to that the legacy data and information held by many organizations, and the challenge of effectively managing these data and information reaches nearly overwhelming proportions.

In order to deal effectively with the sheer volume of data and information relevant to the NBII's scope and mission, the USGS develops and applies strategies to maximize the impact of informatics efforts and to ensure the availability of critical natural resource data and information. In the next five years, the USGS intends to maximize the utility of the resources of the NBII, fully leveraging the resources of partners wherever possible, to address such critical national issues as invasive species and human/wildlife diseases.

The NBII adheres to USGS strategies for achieving its scientific leadership goal. This is implemented by: 1) taking advantage of resident expertise through regular consultation with the USGS Geographic Information Office staff and Biological Research and Monitoring Programs; 2) focusing on customers, partners, and stakeholders, who are key users of environment and natural resources information, such as federal, state, and local managers and scientists; and 3) improving the efficiency of systems that deliver environmental and natural resources data and information. This is achieved by fostering a programmatic culture within the NBII that is flexible and responsive to the user community. To do this, the USGS endeavors to remove barriers to resource sharing and increase the use of cooperative agreements and partnerships.

In the next five years, NBII personnel will ensure that the program:

- Provides data and information on regional biological resource issues for the entire nation,
- Coordinates data and information strategies at a national level for biological issues of national concern,
- Plays a key role in the global development, adoption, and implementation of data and

information standards that enhance delivery and use, and
- Ensures that users can meaningfully interact with data and information through the provision of tools, technical support, training, and interoperability.

Priorities for activities/projects within nodes are established through a detailed proposal development and review process that includes input and peer reviews by regional stakeholders. Node teams in the field determine the scope and priority of biological information needs for the region or theme. This is accomplished by working with stakeholders to perform an initial inventory and assessment of regional thematic data resources, expertise, and biological issues. From this inventory, projects are designed and described in a proposal submitted to the NBII Steering Team. The Steering Team, through an iterative review process, evaluates proposals to assure consistency with USGS and NBII goals for the node, and with stakeholder-driven priorities for the region.

Once approved, projects are funded, implemented, and monitored. Node managers are key to this process by assuring the operational functionality of the node and the timely and successful completion of projects. Node teams measure and report progress through node manager meetings and in a written annual report to the Steering Team (see Strategy 1).

Application of these overall USGS strategic directions to the NBII result in the following specific programmatic strategies:

### Strategy 1. PROVIDE STRONG NATIONAL COORDINATION AND LEADERSHIP.

The USGS is responsible for the administration and management of the NBII. In order to preserve an appropriate balance across the NBII's widely distributed, partner-based federation, strong national coordination and leadership are required. This national leadership is provided through a governance structure that is led by the NBII Program Office. This ensures strong national oversight and direction, informed by the continuous participation of stakeholders.

Figure 2 (page 10) depicts the NBII's national management structure. The elements of this structure are:

**USGS NBII Program Office:** The Program Office serves as the instrument for program implementation, action, and change. Office staff maintain continuous liaison with guiding and priority setting bodies such as the Office of Science and Technology Policy (OSTP), other USGS and DOI organizations, and partner and stakeholder organizations ensuring that communication with each is factored into future activities, products, and deliverables. The Office implements policies and strategies through a Steering Team, which comprises a board of senior USGS managers. National Program Office responsibilities include the following:

**Operational activity monitoring and assessment.**
The Program Office assigns a USGS manager to each node in the NBII network. The Steering Team continuously interacts with node teams through the node managers. Node managers function as the primary point of contact for the principal investigator(s) of each node, who oversee projects undertaken by the node. Node managers coordinate and monitor node projects, and maintain liaison between the node and the Program Office, as well as with other node managers to ensure network-wide coordination. In addition, node managers are required to establish review panels of regional/national experts and partners to review each proposal based on established evaluation criteria.

**Evaluation and review.**
The Steering Team reviews, advises on, and ultimately approves (or rejects) all projects proposed by nodes. This process ensures that field activities remain on target with national goals and objectives. The Team also monitors the progress of these activities for cost, schedule, and performance, as well as their use, value, and benefit.

To ensure that the NBII continues to meet the needs of its users and to make appropriate progress toward its stated goals, the Program is reviewed every five years by an independent panel. The next review is scheduled for 2005. The Program review performs the following functions:

- Assess accomplishments to evaluate the

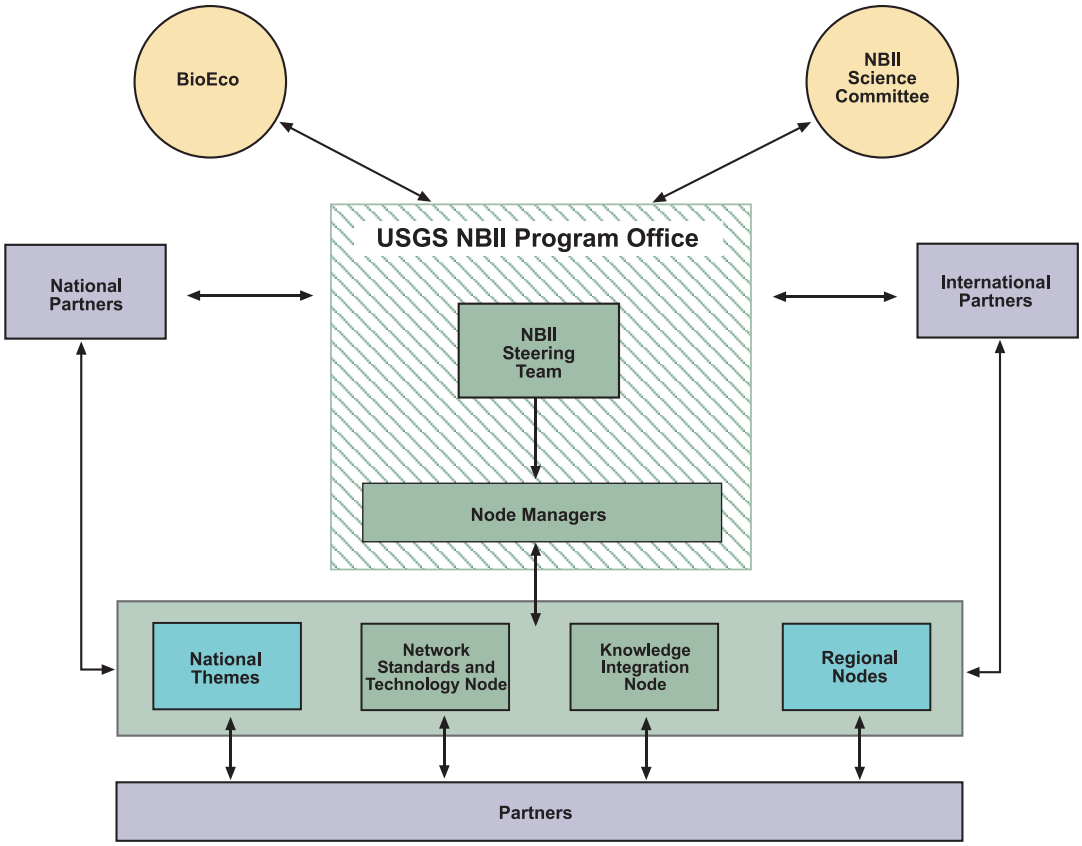



**Figure 2. The NBII is managed by the USGS NBII Program Office with input from partners, advisors, and the user community.**

success in meeting existing Program goals and objectives.
- Determine the significance and relevance of the biological informatics work being performed by the Program.
- Enhance communication and collaboration among Program participants.
- Facilitate the development of goals, objectives, and priorities for future work.
- Provide input into the annual updates of the NBII Strategic Plan.

**Policy formulation and implementation.** The Steering Team establishes and implements program specific policies that address important topics such as data quality, valuation of leveraged resources, and network security. It also ensures adherence to USGS and DOI overall policies.

**Program and budget accountability.** The Program Office develops and implements metrics and engages in performance measurement, in compliance with DOI and USGS direction. As part of this accountability process, the Program Office ensures that all technical and regulatory requirements are met. Direct cost and schedule accountability for the NBII results in more tightly controlled and productive expenditures. Further, the NBII is subject to rigorous program review requirements established by the USGS.

**National level projects and partnerships.** The NBII Program Office manages and coordinates efforts that require national oversight or have enterprise-wide implications, including activities (e.g., infrastructure and thematic nodes, and biological informatics research), projects (e.g., prototype or proof-of-concept process development), and national-level partnerships (e.g., International Association of Fish and Wildlife Agencies [IAFWA], U.S. Fish and

Wildlife Service, National Park Service, and NatureServe).

**Standards and infrastructure.** Through participation in standards-setting bodies, such as the International Standards Organization and the National Information Standards Organization, Program Office staff represent USGS and engage in the development and/or adoption of standards related to information content and technology. The Steering Team convenes working groups within the NBII partnership network, as needed, to help implement adopted standards enterprise-wide. The NBII enterprise-wide taxonomic authority is ITIS. Standards and infrastructure activities are implemented through the following two infrastructure nodes.

- Network Standards and Technology Node: Led by the USGS Center for Biological Informatics (CBI), this node ensures the development and adoption of a core set of standards and delivers the tools, applications, processes, and systems to support overall network development and operation. CBI conducts these activities in partnership with other organizations with relevant expertise.

- Knowledge Integration Node: This node is led by CBI with key partnerships with ITIS and CSA. It focuses on identifying, selecting, developing, and implementing network-wide methods and techniques for organizing content to enhance the identification, retrieval, and use of information. This is achieved through the use of tools such as content-rich, standards-compliant metadata to document data sets and information products. Other applied tools include controlled vocabularies, taxonomies, and authorities developed by ITIS.

**International initiatives:** The USGS Program Office represents the United States in international biodiversity networking initiatives such as the GBIF, the IABIN, and the CHM of the Convention on Biological Diversity. It ensures that NBII development and international network implementation proceed in directions that promote interoperability at a global scale. The Program Office also works closely with international funding organizations like the World Bank and the U.S. Agency for International Development to help secure resources to support the development of these multi-national networks, that are critical for issues such as invasive species and diseases from other countries.

**Biodiversity and Ecosystems Informatics Working Group (BioEco):** Established under the committee structure of the White House's OSTP, BioEco's charge is threefold: 1) to provide a focus for federal biodiversity and ecosystem informatics activities, 2) to coordinate federal products and activities with those of the nonfederal sector, and 3) to ensure U.S. coordination with international and global efforts. BioEco developed a framework for the NBII[4] and monitors NBII activities, providing continual assessment of progress and results to USGS through the NBII Program Office. The Program Offices keeps BioEco apprised of activities through frequent briefings.

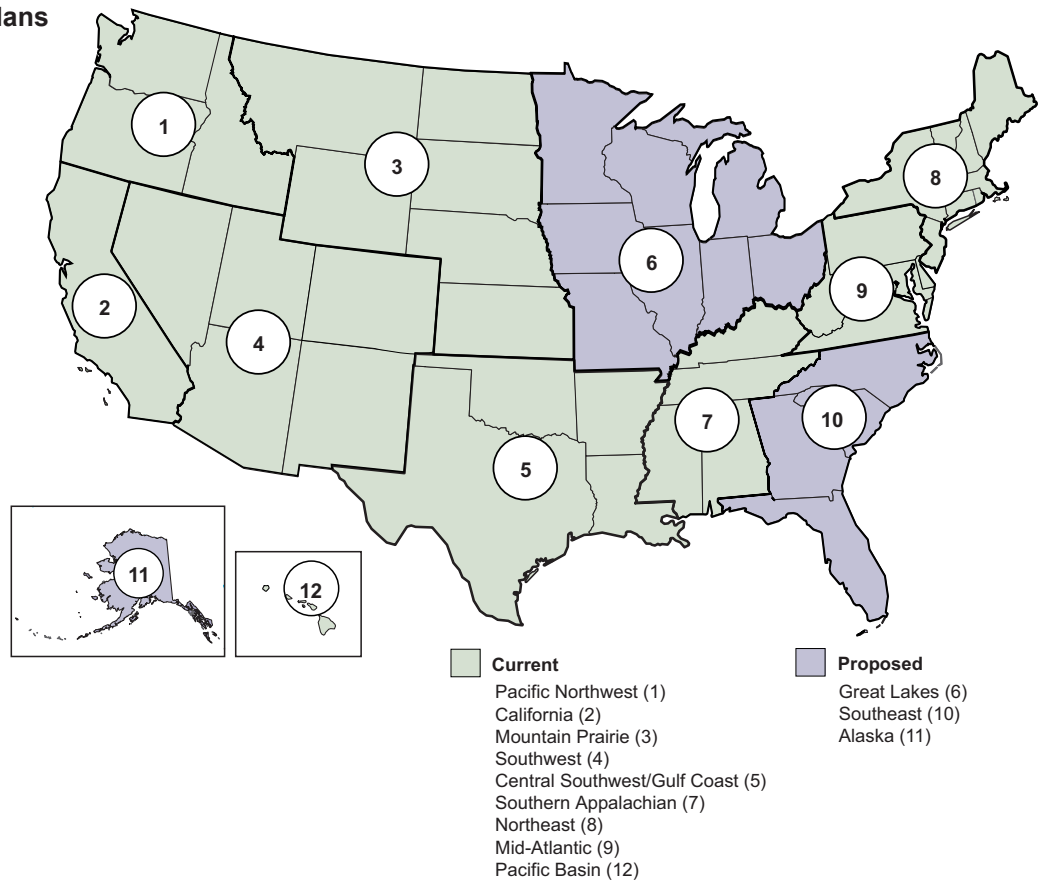
**NBII Science Committee:** To ensure continued responsiveness to user and stakeholder needs, and to provide scientific and technical guidance, the USGS has commissioned a Science Committee. This group is made up of nationally and internationally known experts from the fields of biology and other natural sciences, information science, and computer science and includes representatives from all relevant USGS disciplines, EPA, NASA, and the National Science Foundation (NSF), as well as the museum and university communities. The Committee will advise on the technical and scientific content of the NBII, identify emerging scientific issues, recommend long- and short-range strategies, and identify partners who can further NBII scientific efforts.

### Strategy 2. PROVIDE RESOURCES FOR THREE ADVANCED REGIONAL NODES.

Biodiversity and ecosystems data present unique, highly complex challenges to information validation, management, delivery, and application. NBII nodes are working toward providing sophisticated services that will enable the simultaneous querying and analysis of multiple, large databases, and methods for integrating data mining tools and applying ever better data visualization technologies. USGS has provided additional resources to three regional nodes to enable them to serve as test beds for concepts,

[4] <http://www.nbii.gov/about/partner/bioeco/nbiiframework.html>

**Figure 3. USGS plans a total of 12 NBII Regional Nodes.**




technologies, and methodologies before network-wide implementation. This allows USGS to perfect technologies on a smaller scale, avoiding the potential high costs and risks associated with re-working across the entire network. The three advanced nodes are the Pacific Basin Information Node, Central Southwest/ Gulf Coast Information Node, and Southern Appalachian Information Node.

**Strategy 3. EXPAND THE NETWORK OF REGIONAL NODES TO ENCOMPASS THE ENTIRE UNITED STATES, AND PROVIDE A BASELINE LEVEL OF SERVICE AT EACH NODE.**

Figure 3 depicts the USGS plan for national coverage of local and regional issues through an interconnected network of regional NBII nodes. This strategy calls for the regional network to increase both geographically, through the establishment of the remaining regional nodes, and functionally, through the continuing evolution of the range of services each node provides. As this evolution occurs, nodes will become more like regional service centers, where users can turn for assistance in the form of training and education, information synthesis analysis, and community-building capabilities.

A baseline level of node functionality is defined as having a configuration that provides: 1) pertinent regional data and other content via the Web; 2) training to stakeholder groups; 3) virtual collaboration capabilities; 4) basic tools to enable regional data collection and management; 5) educational and outreach materials on NBII network-wide capabilities; and 6) Web services for data and application delivery. Full functionality for the nodes includes: data and information analysis and synthesis, data visualization, data mining, technical assistance, and the development of tools for data integration and interoperability.

Several of the existing nodes have been initiated, but have not achieved a baseline level of functionality. This baseline is taken to mean that the node can perform all of the functions described on pages 6 and 7. (Note that some functions are provided through implementation of a national solution on behalf of the entire network.) Those nodes that must be enhanced to achieve the baseline include the California Information Node, the Southwest Information Node, and the Mountain-Prairie Information Node (formerly Northern Rockies). Regions of the country that have not yet been

addressed include Alaska, the Great Lakes region, and the Southeast.

**Strategy 4. PURSUE A THEMATIC APPROACH TO MANAGING THE INFORMATION RELEVANT TO BIOLOGICAL ISSUES OF NATIONAL CONCERN.**
A thematic approach to issues of concern allows the USGS to focus NBII resources toward national level coordination and avoid duplication of effort within regions. NBII thematic nodes are established to accelerate national coverage of issues that are of priority national concern and that can benefit from coordination at the national level. Areas for thematic focus are selected by USGS in partnership with key leaders in the natural resources community based on expressed assessments and/or designations by the DOI and other government agencies responsible for the monitoring or management of the nation's natural resources. Whenever possible, NBII thematic nodes build on frameworks developed by those already engaged in addressing an issue of concern. For example, the NBII Bird Conservation Node was built on the informatics framework developed by the North American Bird Conservation Initiative. To date, several thematic areas of national concern have been identifed by DOI bureaus and the NBII cooperators. These include: wildlife disease, botany, genomics, protected areas, threatened and endangered species, natural history collections, and pollinators.

**Strategy 5. LEVERAGE RESOURCES THROUGH PARTNERSHIPS.**
Fundamental to the structure of the NBII is its capacity to build and strengthen partnerships across federal, state, local, international, academic, non-profit, and private sectors. In order for the NBII to succeed in providing qualitative and quantitative natural resources data and information to decision-makers, it must incorporate all of these interests to ensure a complete picture drawn from the best possible sources. NBII strategic partnerships are established to:

- Increase NBII content.
- Give stakeholders a voice in NBII strategic directions for the future.
- Promote the development and implementation of advanced technology.
- Leverage resources among all partners.

In 2002, NBII leveraged contributions from partners at a ratio of 1:3 (one USGS dollar leveraged by the monetary or in-kind equivalent of three contributed dollars from partners). It is anticipated that partner support will continue at this ratio. Partner contributions include:

- Personnel,
- New technologies, models, and applications,
- Metadata records prepared for legacy or new data,
- Real property, space, equipment, and software,
- Educational materials,
- Computational tools and capabilities, and
- Newly digitized data and databases.

The USGS has built partnerships with organizations through which the major biological resource data and information management activities of the country are linked. This enables the NBII to coordinate a single, successful strategy for the sharing and management of natural resource knowledge. Such partnerships include:

State agencies and organizations holding state data and information. States and associated organizations (such as IAFWA) have key responsibilities for managing the nation's natural resources. In line with these responsibilities, they gather and maintain large quantities of natural resources data and information. These organizations also have a significant role as users of the NBII. USGS is responsible for developing partnerships with individual states for collaboration on regional nodes, and the NBII Program Office seeks to develop broad partnerships with national organizations that represent state interests. Examples: State Heritage programs, USDA Extension Offices, State departments of Fish and Game and Natural Resources.

Biological and ecological research organizations. Numerous organizations across the nation and around the world are engaged in scientific research in the biological/ecological realm. In order to access this vast source of data and information, partnerships are needed that facilitate unifying and synthesizing science information to address critical biological issues. Greater access to these information resources will invigorate the scientific process, which in turn informs and benefits resource management decisions. Examples: federal research agencies, universities, biological/ecological organizations.

Federal and other land management organizations. One USGS key objective for the NBII is to provide

information and tools to resource managers for decision-making. To do that, the NBII develops national level partnerships with agencies responsible for land and resource management to understand their information needs, to make their natural resources information accessible, and to leverage resources to achieve NBII and agency objectives. Examples: Bureau of Land Management, National Marine Fisheries Service, U.S. Department of Transportation, Department of Defense, and state fish and wildlife agencies.

Leaders of biological networks and systems. To achieve the USGS vision for a "national" infrastructure, the NBII partners with other networks to facilitate complete content coverage, data access, standards development, and technology deployment. Examples: Ocean Biodiversity Information System, National Spatial Data Infrastructure, and USGS National Water Quality Assessment Program.

Leaders of information science research and development (R&D) activities. In order for the NBII to achieve functionality, the NBII partners with organizations leading or conducting information science R&D that can be leveraged and applied to the biodiversity and ecosystems domain. Examples: Institute of Museum and Library Services, Los Alamos National Laboratory, National Center for Ecological Analysis and Synthesis, Long Term Ecological Research Network, and NatureServe.

Stewards of natural science collections. Natural history museums, herbaria, botanical and zoological gardens, and other natural science collections have been identified as important contributors to and users of the NBII, providing both taxonomic expertise and specimen data. Examples: Academy of Natural Sciences, American Museum of Natural History, and Natural Science Collections Alliance.

International initiatives. Serious and costly issues such as invasive species and zoonotic diseases require the sharing of knowledge with other countries. Participation in continental, hemispheric, and global biodiversity networking initiatives provides the opportunity to make U.S. biological information and data resources available to the world and to make the world's biological knowledge available to the United States through the NBII. Additionally, as the U.S. contribution to these multinational initiatives (see Figure 4), the NBII helps the nation fulfill its international commitments. Examples: IABIN, OAS, and World Bank.

**Strategy 6. SUPPORT BIOLOGICAL INFORMATICS RESEARCH AND DEVELOPMENT.**

To fulfill broad needs for new information technologies to support the biological science community, the USGS supports biological informatics R&D through NBII partnerships. The scientific community needs advanced computer modeling; multi-scale analysis and synthesis; learning systems; data collection, mining, and visualization; and other applications to support research and the natural resources decision-making process. These tools are required, for example, to address ecological forecasting.[5]

In 2000, the USGS, NSF, and NASA sponsored a workshop that brought together leading computer scientists, biologists, and natural resource managers to develop an approach for focusing computer science research on the complex and often unique challenges found in the biodiversity and ecosystems domain. As a result of this workshop, a research agenda was developed[6] that outlined areas where computer science research would benefit the natural resource/biology discipline. The NBII supports the fulfillment of the biological informatics research priorities of the community in the following key areas:

- Joint NSF/NASA/USGS activities to stimulate and/or fund competitive research proposals responding to the research agenda,
- Partnerships between nodes and universities having advanced computer science capabilities to develop grant proposals that address research priorities,
- Participation in reviews and on steering groups related to biological informatics proposals, and
- Increased awareness within the computer science research agenda and the challenges it presents.

[5] Committee on Environment and Natural Resources Subcommittee on Ecological Systems, "Ecological Forecasting: Agenda for the Future," p. 6.

[6] D. Maier, et al., eds,. "Research Directions in Biodiversity and Ecosystem Informatics: Report of an NSF, USGS, and NASA Workshop on Biodiversity and Ecosystem Informatics held at NASA Goddard Space Flight Center, June 22-23, 2000" (Greenbelt, MD: NASA Goddard Space Flight Center, 2001).

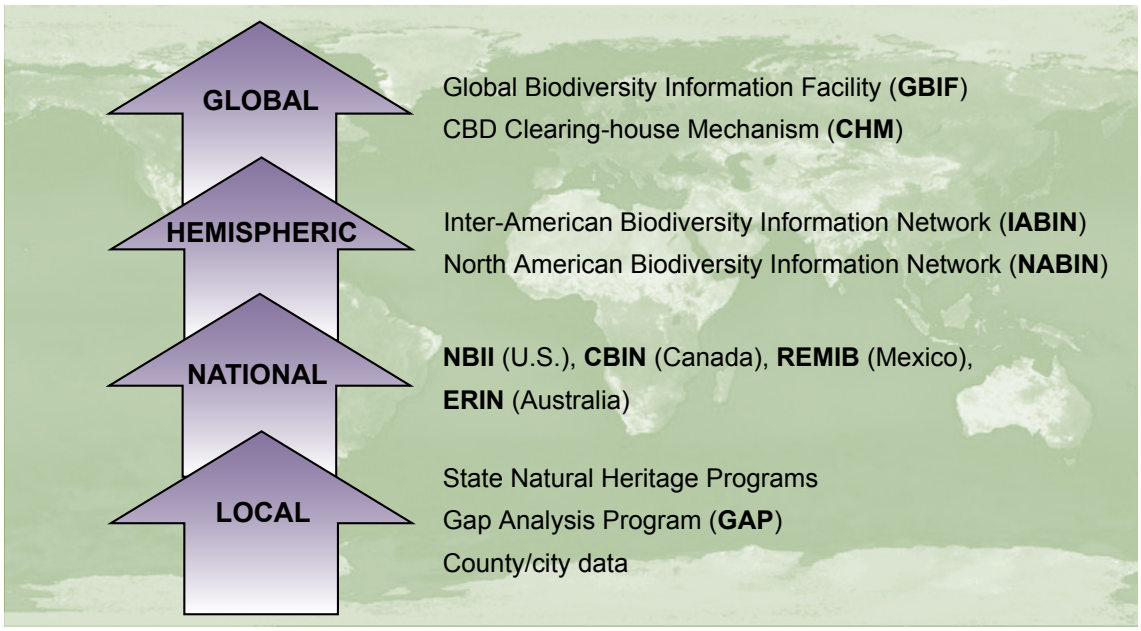



**Figure 4. USGS provides international leadership through the NBII, which organizes U.S. biological information and makes it available worldwide through multinational initiatives.**

**Strategy 7. EDUCATE NBII USERS AND POTENTIAL USERS THROUGH OUTREACH, TRAINING, AND TECHNICAL SUPPORT.**

NBII Program Office staff work with partner agencies and organizations to ensure that users have the knowledge they need to interact effectively with and document data and information served via the NBII. Data contributors need to reflect accurately the purpose, methods, taxonomy, coordinates or location, and other pertinent information associated with their data sets. The NBII ensures this knowledge by providing outreach, training, and technical assistance to partners, stakeholders, and customers to ensure successful interaction with NBII tools and data.

Outreach efforts include briefings and presentations by staff and partners, the Web-accessible NBII Portal, exhibits at natural resources conferences and other gatherings of the biological community, conference papers and journal articles, press releases and media interviews, and the production and distribution of a variety of educational materials. The type and level of training and technical assistance provided to users is dependent upon: 1) the application or tool needed; 2) the amount of assistance required; and 3) the specific request made. NBII nodes strive to provide as much assistance as possible through online documentation; but significant personal assistance, including one-on-one help, also is provided within available resources.

**Strategy 8. INVEST RESOURCES IN PILOT PROJECTS TO ADDRESS HIGH PRIORITY NEEDS AND TO ESTABLISH VALUE AND FUNCTIONALITY OF FURTHER INVESTMENTS.**

From time to time, critical issues of biological concern emerge, creating an urgent need for data and information to be made available. An example of such an emerging issue is wildlife disease and its impact on human health and the economy. More specifically, Chronic Wasting Disease, and the West Nile virus, virtually unheard of even five years ago, have in the last two years become national concerns. When the USGS and others identify such issues as requiring national attention, the NBII responds by investing resources to make critical data and information through a pilot project available as quickly as possible. Such resources come from USGS, as well as from other sources such as the U.S. Departments of State or Defense, World Bank, NSF, and others. Work conducted as a pilot project often establishes the value of providing information and tools targeted to specific issues, and sometimes results in resources being specified for that area in future funding cycles. When this happens, the initial resources invested in the pilot project become available for reinvestment in another area that needs to

be addressed. This flexibility allows the NBII to remain responsive to high priority national needs.

## Achieving the Plan

Achieving this plan's ambitious vision for the NBII requires a dedicated effort as well as significantly increased capacity. Such capacity building can only occur through the continued support of the USGS and DOI, teamed with the significant contributions made daily by the entire federation of partners. NBII efforts must be channeled toward support of its goals and mission. Through such efforts, valuable biological data and information will become available in an unprecedented volume – and the ability of decision-makers and scientists to interact with those data will be greatly enhanced. It follows, then, that in the presence of data and tools, decision-makers and scientists will be able to use the NBII to invigorate the scientific process, and in turn generate new knowledge to be passed on to the nation's natural resource managers and stewards. It is in this ultimate implementation that the NBII fully supports and embodies Secretary Norton's vision of conservation through cooperation, consultation, and communication.

# Notes

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