Science and Society

An International Biodiversity Observation Year

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The International Geophysical Year (IGY), which took place between July 1957 and December 1958, helped us to rethink the world. At a time when there was a major paradigm shift in our understanding of the physical world, the international collaboration of the IGY helped to reset the discipline. The International Biodiversity Observation Year (IBOY) is now occurring at a time when our dependence on, and understanding of, biodiversity is being acknowledged as a paradigm shift in our present view of the world. Although the benefits of IGY were initially intellectual with practical effects remaining unknown until many years later, the benefits of greater knowledge of biodiversity will support efforts towards sustainability and affect the quality of life, both now and in the future. By providing the framework for international collaborations between scientists involved in every aspect of life on Earth, IBOY has the potential to redefine our current understanding of biodiversity in a manner similar to how IGY helped redefine the geophysical world.

January 2001 marks the start of the International Biodiversity Observation Year (IBOY), which is an initiative of DIVERSITAS, the international program of biodiversity science that seeks to promote and integrate the various dimensions of research. During 2001 and 2002, scientists, informatics specialists, the media and educators from across the world will collaborate to focus attention on biodiversity, its status and trends.

Why an IBOY?

Globally, biodiversity is being lost at all levels: (1) genes, species and landscapes that provide goods such as food, fuels, fibers and medicines; (2) ecosystem services such as purification of air and water and renewal of soil fertility; and (3) natural environments that provide a foundation for art, culture and recreation. As has been abundantly documented in the scientific literature, the rate of extinctions of plant and animal species has increased to between 50 and several hundred times the rates expected on the basis of geological data[1–3], with 50% of mammals and birds predicted to be extinct within 100–1000 years[3]. As Myers *et al.*[4] note: 'the number of species threatened with extinction far outstrips available conservation resources'.

Biologists generally believe that these losses represent a threat to the well-being of human societies[5] yet no sector of society is equipped with sufficient knowledge to evaluate this erosion of natural capital and its goods and services. Only a small fraction, ~1.75 million, of the 14 million species estimated to be on the planet, have been taxonomically described[6]. In addition, the distribution, abundance, status, trends and contribution to ecosystem goods and services of many of these species, not to mention the remaining 80–95% of species yet to be taxonomically described, are unknown. Awareness of biodiversity and its many connections to our daily lives is limited across the globe, thereby completely undermining the ability of the public and policy-makers to make decisions for sustainable development and conservation.

During IBOY, biologists, educators and media professionals will collaborate to collate and increase the availability of accurate biodiversity information that is essential for informed decision-making. In doing so, they hope to make the compelling, scientific case for increased general concern and action about losses of biodiversity. The ultimate goals of IBOY, as eloquently stated in Article 13a of the Convention on Biological Diversity (1992), are to: 'promote and encourage understanding of the importance of and the measures required for the conservation of biological diversity, as well as its propagation through media and the inclusion of these topics in educational programs'. Indeed, IBOY has the potential to achieve multiple goals.

Pushing the frontiers of science: the IGY model

The IBOY was inspired in part by the enormous success of IGY which brought together many of the geophysical sciences to derive a more synoptic view of geophysical phenomena of the Earth and its atmosphere. Studies were made of the aurora, airglow, cosmic rays, geomagnetism, glaciology, gravity, ocean-floor soundings, the ionosphere, solar activity and, most notably, the ozone concentrations in the upper atmosphere[7]. The studies of ocean-floor soundings and the upper atmosphere led to our understanding of plate tectonics and the discovery of the Van Allen radiation belts, respectively. In a large sense, the IGY paved the way for space-age research.

Thus, the hallmark of the IGY was innovative geophysical science that integrated both scientific disciplines and global expertise. Longer term research efforts were also initiated, adding to the data gathered during the single intensive year. Furthermore, the IGY was a great unifying force for the relevant sciences, bringing together unprecedented cooperation among the world's scientists and even leading to a remarkable political gain: the Antarctic Treaty[8].

IBOY is set to play similar roles for biodiversity science, advancing our understanding of the nature and functioning of biological diversity, and conveying the importance of biodiversity to societal welfare. Projects within IBOY are exploring the frontiers of biodiversity – from the taxonomic diversity of the abyssal plains of the Atlantic Ocean to the dark and microscopic world in the soils beneath our feet (Box 1). Some projects are examining the relationships between biodiversity and ecosystem functioning from patch to landscape scales and others will identify biotic indicators of marine and terrestrial ecosystem sustainability. Many projects are combining previously fragmented datasets to provide new information on

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Box 1. Representative Core Projects of The International Biodiversity Observation Year (IBOY)*

What biodiversity do we have and where is it?

- Survey of forest, freshwater and coastal biodiversity of West Pacific and Asia [DIVERSITAS Western Pacific and Asia (DIWPA)-IBOY (http://ecology.kyotou.ac.jp/~gaku/diwpaindex.html)]
- Worldwide exploration of fauna of anchialine caves (http://www.cavebiology.com)
- Search for new species and biogeographical patterns in the deep sea of the Atlantic Ocean (DIVA)
- First atlas of marine life [Ocean Biogeographical Information System (OBIS) (http://marine.rutgers.edu/OBIS)]
- Mapping the taxonomic 'Tree of Life'
- Public participation to monitor frog and toad populations [FrogWatch USA (http://www.mp2pwrc.usgs.gov/FrogWatch/index.htm)]
- School contest to computerize Namibian biodiversity information [Insect@thon (http://www.natmus.cul.na/insectathon.html)]

What goods and services does biodiversity provide?

- Global Litter – Invertebrate Decomposition Experiment (GLIDE)
- Assessing the metabolic diversity of ecosystems [FLUXNET (http://daac.ornl.gov/FLUXNET/)]
- Describing relationships between biodiversity and net primary productivity [GTNET–NPP demonstration project (http://www.ilternet.edu/gtnet/demoproject/projects.html)]
- Analysis of the capacity of global ecosystems to provide needed goods and services [Millennium Ecosystem Assessment (http://www.ma-secretariat.org/)]
- IMAX film describing the links between biodiversity and societies (Lost Worlds)

How is biodiversity changing?

- Implementation and networking of large-scale, long-term marine biodiversity research in Europe [BIOMARE (http://www.marsnet.nl/EC/Biomare.htm)]
- Web-based directory of status of the world's amphibian species [Amphibia Web (http://www.amphibiaweb.org)]
- Library of digital images of endangered and extinct species, preserved in perpetuity [ARKive (http://www.arkive.org.uk)]

How can we conserve it?

- Global attempt to locate and store DNA Banks for Endangered Species
- Focus by global faiths on their contributions to conservation [Sacred Gifts for a Living Planet (http://panda.org/livingplanet/sacred_gifts)]
- Explaining biodiversity issues and community approaches to conservation (OUTREACH Biodiversity Series)

*Further details of projects and contact information for project leaders can be found at http://www.nrel.colostate.edu/IBOY/projects2.html

global biodiversity patterns and their relationships with ecosystem goods and services.

Forging links among disparate elements to develop a new cohesive science: the IGBP model

In 1986, the 25th anniversary celebrations of the IGY led to the launch of the International Geosphere–Biosphere Program (IGBP), which aimed to develop an understanding of the Earth as a system, bringing together information from biogeochemistry and elements that drive climate. The IGBP program has focused on the links between components of the Earth System (for example, those between geology, soil physics and plant physiology), rather than on the isolated disciplines themselves. Thus, a new scientific concept has been developed, one that has a holistic view of the interactions and feedbacks between the physical and biological components of the Earth. Such an integrated science is needed for comprehensive understanding of biodiversity and its interactions with ecosystems, and societal concerns such as global change, economics and health. DIVERSITAS is embarking on the necessary long-term program to integrate biological, physical and social sciences, to learn how the diversity capital of the Earth originates and is maintained, how it contributes to ecosystem functioning and human services, and how we can preserve and protect it. IBOY will boost the launch of this program, initiating dialogue, increasing understanding and information transfer across disciplines, and raising awareness within the scientific and policy communities of the urgent need for funding and research institutions to support such an integrated structure.

In the early months of IBOY, leading international researchers from fields including taxonomy, genetics, ecology, conservation biology, oceanography and biogeochemistry will meet to present an overview of their contributions to IBOY. Together, the meeting participants will describe the breadth and status of biodiversity research and help identify: (1) where disciplines intersect (potentially yielding new information on interrelationships); (2) which recent technologies can be 'borrowed' from one discipline and applied to another; (3) where synergy of disciplines can provide urgently needed answers to complex, cross-disciplinary questions; (4) gaps in knowledge; and (5) research priorities.

Educating the public

As Jane Lubchenco reported: 'All too many of our current environmental policies and much of the street lore about the environment are based on the science of the 1950s, 1960s and 1970s, not the science of the 1990s'[9]. Informed decision-making within civil society is crucial because species and their activities within ecosystems are intrinsically connected with the concerns of society, through provision of ecosystem goods and services and the foundation of natural resource-based economies[10]. To make such decisions, access to a breadth of science-based, accurate information on biological diversity is required.

During IBOY an eclectic group of education and media projects will explain the status and trends of biodiversity, and its implications, to the

public worldwide. IBOY will also launch new efforts to increase the availability of first-hand biodiversity data to the public, via the internet, CD-ROM databases and traditional media.

The unprecedented collaboration of scientists and 'gatekeepers of knowledge' in both education and media during IBOY provides a unique opportunity to improve communication of scientifically accurate information on biodiversity. A recent report of The World Conservation Union (IUCN) Commission on Education and Communication reported that:

> '[some of the major] challenges facing biodiversity communication and education are…to make a large issue small enough to be solved, as biodiversity tends to be all inclusive and is hard to narrow down: therefore, translate it from something complex to something easy to grasp…[to] change the communication from wordy arguments about why biodiversity is important to communicating what results are wanted'[11].

Planning is underway for an IBOY workshop in early 2001, in which scientists and media professionals will identify the scientific information on biodiversity that is most needed by decision-makers and develop effective communication strategies to disseminate these findings. The workshop will maximally exploit opportunities provided by the recent explosion in communication technologies and initiate a platform for long-term partnerships between scientists and 'communication' specialists.

What will happen during IBOY?

At the core of IBOY is a diverse portfolio of international biodiversity projects from over 50 countries, with participation by the global scientific community, the media and educators. During 2001 and 2002, these projects will have a peak of activity and yield products such as new data, syntheses and assessments, scientific and popular articles and books, curriculum guides, web pages, and television and film documentaries. Throughout IBOY, synergistic activities including meetings, films, web-based interviews, internet chat-sessions and a media campaign, will highlight these projects and explain the implications of the information on biodiversity that they deliver. The IBOY web page (http://www.nrel.colostate.edu/IBOY) provides a wealth of information on biodiversity, including a science-based background to biodiversity issues, interviews with researchers and film-makers that explore biodiversity, and constantly updated information on activities and findings of IBOY projects occurring around the world. The web page will link to activities such as national 'Science Weeks' in numerous countries, providing a single point of entry to global information on biodiversity, around which classroom and other activities can be built.

The core projects contributing to IBOY fall into three categories – Scientific Voyages of Discovery, Informatics, and Education and Outreach – which address crucial biodiversity questions, outlined in Box 1. More detailed information and a comprehensive list of projects, along with the breadth of biodiversity knowledge and observations these projects represent, can be found at the IBOY website.

These and other international 'Core Network Projects' will be the focus of IBOY-synergistic activities and media campaigns. However, IBOY recognizes the vital role of smaller scale, local, regional and national biodiversity research and education projects, particularly for providing information at scales that are relevant to management decisions, and for demonstrating the relevance of biodiversity to peoples' daily lives. Through IBOY, an interoperable web page will be maintained to highlight and provide information on local, national and regional biodiversity activities occurring around the world during 2001 and 2002. Users will be able to click on the map and pull up descriptions of, and links to, biodiversity activities occurring in that area. We invite you to submit a description of your biodiversity research, informatics or educational activities to post on the IBOY map. For more information, please contact Diana Wall (e-mail: iboy@nrel.colostate.edu).

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