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Global Change Research

Co-managing a Landscape

The George Wright Society

Dedicated to the Protection, Preservation and Management
of Cultural and Natural Parks and Reserves
Through Research and Education

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The Boxley Valley of Buffalo National River: A U.S. National Park Service Historic District in Private Hands

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When Buffalo National River came into the U.S. National Park System on March 1, 1972, it included a settlement composed of 24 bottom-land farms, with more than 50 inhabitants. Most are descended from the early 19th-century pioneers who settled the seven-mile stretch of river once known as "Big Buffalo Valley"—now called "Boxley Valley."

Think of Boxley Valley as a Cades Cove, transplanted from east Tennessee to north Arkansas, because the two valleys are quite similar in size, heritage, and historical aspect. However, the human community of Cades Cove was displaced by land acquisition prior to the establishment

of Great Smoky Mountains National Park in 1930. As with other U.S. National Parks established earlier in the century (especially in the eastern half of the country), little or no recognition was given to the value of cultural landscapes—or their human creators.

Today the little valley of Abrams Creek in the Smokies is a ghost settlement, and, however poignantly attractive to park visitors (as evidenced by the numbers hiking, motoring, and bicycling the Cove's trails and roads), that remnant landscape conveys but a suggestion of the cultural vitality a visitor to the Cove would have experienced between 60 and 160 years ago.

Unlike the legislation establishing Great Smoky Mountains National Park, Buffalo National River's legislative history actually favored the retention of a living community and its lifeways. To help secure passage of a bill for the National River's establishment, former USNPS Director George B. Hartzog articulated the concept of setting aside a "private use zone," including Boxley Valley, where land could be left in private ownership and the USNPS acquire only scenic easements for maintenance of the rural community and its pastoral landscape. This concept, in addition to being clearly enunciated in the park's legislative history, was made part its master plan: "A private use zone containing 9407 acres, including some farmlands, should continue in private ownership subject to scenic controls and necessary rights-of-way for roads and trails." In an earlier day, this would be labeled heresy: a unit of the U.S. National Park System (and a natural area, at that) authorized to embrace ecologically sustainable human activities, on perpetual private holdings!

Following establishment of the park, however, for various reasons fully 75% of the lands within the private use zone were acquired in fee simple by the U.S. National Park Service. This destabilized the Boxley community and led to deteriorating relations. The USNPS was about to lose the opportunity to keep the Ozark folkways alive in a seven-mile stretch of the Buffalo River, where the rural community of Boxley had flourished for the preceding 150 years.

By 1982, ten years after the National River's establishment, Superintendent Alec Gould had decided it was time to come to grips with the challenge of perpetuating the park's most impressive cultural landscape, while improving relations between the park and the residents of Boxley Valley. Many of the once-proud houses and farms had been purchased by the USNPS, vacated, neglected, and some even removed. The remaining population of the valley, number some forty in all, was unsettled, even embittered, by a decade of land acquisition. Land status in the valley was a crazy-quilt of vacant USNPS-owned farms and structures, occupied farms acquired by the USNPS and leased back for up to 25 years under life estates and "rights of use and occupancy," farms for which the USNPS only acquired scenic easements, and others for which the no interest was acquired at all. Beginning in 1983, the USNPS Southwest Regional Director agreed to support the park in developing a formal plan to guide the agency toward improved management of the valley.

With much input from Boxley citizens and cultural resources specialists from the USNPS Denver Service

Center and the Regional Director's staff, a "Land Use Plan and Cultural Landscape Report" for the valley was completed and approved in 1985. Out of this planning effort came the realization that Boxley Valley was eligible for the U.S. National Register of Historic Places. Boxley Valley contains over 200 structures contributing to its historical significance. Some of its houses and barns, a grist mill, and a community building are considered fine examples of vernacular architecture; many date from the last century. In 1987, Boxley Valley was entered onto the National register as the "Big Buffalo Valley Historic District."

The two years of resources assessment, meetings, and informal talks with the Boxley citizens confirmed park managers' early inclinations that those Boxley Valley bottomland farms and associated houses acquired by the USNPS should indeed be returned to private ownership. With approval of the Boxley Land Use Plan, the stage was set for offering the former landowners—those who stayed on as life or term tenants—the opportunity to reacquire their lands, except for forested slopes and the river itself. The USNPS would also retain easements for farm management, water quality protection, historic structures preservation, and appropriate visitor access (the valley contains several historic features of value for interpretation, as well as a beautiful natural area, known as "Lost Valley," to which access is gained by a very popular hiking trail from a trailhead campground.)

The intent of the plan is not to require the people in Boxley Valley to rearrange their lives to serve any broader public interest, but to preserve the opportunity for the continuation of a population that has

developed distinctive ties to the land, as manifested in the valley's cultural landscape.

Since the plan's approval, negotiations have proceeded with a dozen families interested in buying back their farms and houses. The first such conveyance was successfully completed in June 1987 and two more land exchanges were executed in January 1990. (An "exchange" occurs in that the right of use and occupancy—a legal interest—is quit-claimed, in exchange for fee-simple title, after a cash payment is made to the United States, equalizing values set by an appraisal.) Four more such exchanges are awaiting appraisals, as are four "sell-backs" of vacant, USNPS-owned farms, which are expected to be sold on the open market in 1991, subject to easements for farm conservation and historic preservation.

Not all the valley is to be returned to private ownership. Along about one mile of the valley's north end there are no occupied farms; rather, there are open fields overlooked by uninhabitable structures of interpretive value, including two log houses pre-dating the Civil War. Near the valley's center stands the two-story grist mill (built in 1870) and the log house and barn of the first miller. The lands associated with these significant resources will be kept in USNPS ownership, made accessible to visitors, and maintained by "historic leasing," pursuant to the U.S. National Historic Preservation Act. Three such leases covering 100 acres were awarded in February 1988, and three more covering 96 acres in February 1990. This mechanism for land management is resulting in visible improvements in the landscape, such as more neatly maintained historic clearings and

associated fence rows, because the terms of historic leases are an incentive for performance by the lessees.

An equally gratifying effort is being put forth by the Boxley community on lands and for historic structures in private ownership. Owners of lands under the new historic preservation and farm conservation easements have worked in partnership with the park staff to not only rehabilitate historic structures, but to build new barns, fences, and other farm structures—and, in one case, a fine new family house. (The Boxley Land Use Plan allows for construction of some additional houses, on selected sites and in accordance with several restrictions in the easement, promoting construction that is in harmony with traditional landscape features.)

With ownership of land comes more pride and effort in its caretaking. Boxley's population and the amount of care given its structures and farms had declined for a decade and a half before the start of sell-backs. Now, things are definitely looking up for this 5% of Buffalo National River called Boxley Valley, a striking community of farms and houses, flanked by designated wilderness units. (Some 36,000 acres, or 37%, of the National River is designated by legislation as wilderness; almost all the rest is essentially a natural area.) The resulting landscape is a pleasing mosaic of contrasting patterns: forested slopes ascending from the pastoral valley floor, composed of small farms graced by historic houses and barns. From a valley vibrant with human activity, one can canoe, walk, or ride horseback into relative solitude in a matter of minutes. Thanks to the National River's non-traditional leg-

islative history, some of the river's pioneer tradition lives on. The river and the park are made all the more interesting by virtue of that variety and diversity.

Ed. note: The author, Jim Liles, has been charged with carrying out the Boxley plan at the park level for the last five years. Just as several people contributed to developing the plan, several have put forth an extra effort to make it work. On November 10, 1989, at an awards ceremony in Washington, D.C., Liles and Ric Alesch, a park planner with the Denver Service Center, accepted on behalf of the USNPS a Presidential Design Excellence Award for the "Boxley Valley Land Use Plan and Cultural Landscape Report." A start has been made in what promises to be a long-term but certainly worthwhile endeavor—applying this innovative plan to a special place.

Mobilizing Worldwide Action to Sustain the Living Resources of Our Planet:

The Biodiversity Conservation Strategy Programme

Organizers:

**International Union for the
Conservation of Nature and
Natural Resources**

**United Nations Environment
Programme**

World Resources Institute

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Within the past few years, news stories on habitat destruction and species extinction have made the worldwide erosion of biological diversity a topic of general conversation. People all over the world have at least a passing knowledge of what is happening to the moist forests of the tropics, the old-growth tracts of the North American Pacific region, and natural communities of sub-Saharan Africa—to name just a few critical areas.

Now, three international conservation organizations have launched an ambitious program of research and consultations that will lead to a global strategy and action plan to conserve the world's biodiversity. One of the organizations is private: the World Resources Institute (WRI), based in Washington, D.C., The International Union for the Conservation of Nature and Natural Resources (IUCN), headquartered in Gland, Switzerland, has both governmental and private groups as members. The third organizer is the United Nations Environment Programme (UNEP), whose main offices are in Nairobi. Below we have reprinted a program description written by IUCN, UNEP, and WRI, dating from September 1990.

A great deal of attention has been paid to establishing the economic value of conserving biodiversity. To be sure, money talks, and it may well be that the best way to get governments to pay attention to biodiversity conservation is to demonstrate that doing so is in their economic interest. Yet for many people, protecting biodiversity is a moral and spiritual imperative. In a brief article following this one, J. Ronald Engel of the IUCN Working Group on Ethics, Culture, and Conservation updates us on how ethical considerations can be incorporated into the Biodiversity Conservation Strategy and the forthcoming successor document to the World Conservation Strategy.

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PROGRAMME DESCRIPTION

The world is being impoverished by the loss and degradation of its most fundamental living resources—its genes, habitats, and ecosystems.

Some scientists predict that if present trends continue, up to 25 percent of the world's species will be lost in the next several decades, accompanied by an equally alarming degradation of habitats and ecosystems.

This loss of the planet's living richness is both wrong and dangerous. Wrong, because we should accept that all species have a right to exist, as the U.N. General Assembly stated when it adopted the World Charter for Nature in 1982. Dangerous, because the world's environmental systems are humanity's life-support mechanisms, and we do not know which components are key to maintaining their essential functions.

The loss of biodiversity undermines prospects for sustainable development. The world's renewable resources, such as forests, fisheries, wildlife, and crops, are of immediate use to people, while the genetic diversity of these resources allows continued adaptation to the world's changing conditions. What's more, the highly diverse natural ecosystems that support this wealth of species also maintain hydrological cycles, regulate climate, build soils, absorb and break down pollutants, and provide sites for spiritual enrichment, tourism, and research. To waste Earth's riches is to rob the world's rural poor of sustainable livelihoods and deprive future generations of the resources they will need to survive and prosper.

Traditional conservation activities are too disparate, fragmented, and limited to bring about the fundamental changes necessary to bring the loss of diversity to a halt. The best way to slow the loss of biodiversity is through a diverse, coordinated, and participatory program that attacks the problem at its roots,

builds support among wide-ranging institutions and individuals, draws on the best modern science, and establishes biodiversity conservation in its rightful place as a basic prerequisite of development policy.

To these ends, WRI, IUCN, and UNEP have organized a collaborative Biodiversity Conservation Strategy Programme. The Programme's ultimate goal is to help humanity use biological resources in a sustainable and equitable manner that does not critically reduce the biosphere's overall diversity. The immediate, practical goal is to take steps to keep losses of biological diversity to a minimum and to manage our living resource base wisely. Between 1990 and 1992, work will focus on:

1. Developing a *Biodiversity Conservation Strategy* that defines the options and opportunities for action that achieve global goals while addressing local priorities;

2. Developing and promoting a *Decade Action Plan* for an intensive and sustained worldwide effort by concerned institutions and individuals working locally, nationally, and internationally to defend, understand, and use biodiversity wisely;

3. Developing a *Biodiversity Status Report* that makes information on the state of biodiversity throughout the world available to scientists, NGOs [nongovernmental organizations], policymakers, and donors in a form they can use;

4. Analyzing the root causes of biodiversity loss and encouraging the development or reform of policies, laws, institutions, and administrative procedures to foster the understanding and maintenance of biological diversity;

5. Identifying and promoting the skills, management methods, and investments needed to provide local communities with more sustainable benefits from biological resources;

6. Developing methods of co-operating internationally in the conservation of biodiversity and promoting greater financial support for high-priority activities;

7. Establishing biodiversity conservation as a goal of development through the 1990s and beyond.

NETWORK OF PARTNER INSTITUTIONS

The Biodiversity Conservation Strategy Programme entails two years of collaborative research, dialogue, and workshops involving individuals, NGOs, governments, and international institutions. A critical mass of individuals and institutions, from North and South, will be mobilized to formulate complementary objectives and coordinate plans of action. In phase two, the *Strategy* will be implemented and promoted.

Critical to the *Strategy's* success are linkages being established with partner organizations. Through various mechanisms tailored to the objectives and style of the partner organizations, the Programme will develop a collaborative process that allows them direct input to the contents of the *Strategy* and *Decade Action Plan*. The materials issued will reflect this diversity of input and opinion. In many respects, the process of developing the *Strategy* is a test of the co-operation that will be needed later to carry it out.

Organizations associate themselves with the Programme by:

- Undertaking collaborative research with funds provided by the Programme or through other sources;
- Organizing and hosting workshops and regional consultations on topics of mutual interest to the host and the Biodiversity Programme, with financial support raised jointly;
- Participating in regional workshops and consultations;
- Contributing ideas and material for case-studies, policy recommendations, or needed actions.
- Promoting the *Strategy* and *Action Plan* and the implementation of specific projects and reforms locally, nationally, and internationally.

A number of organizations have already joined this partnership. (See Appendix 1.) The Programme partners will share responsibility for the content of the *Strategy* and the *Decade Action Plan*. Overall guidance will also come from an International Coordinating Group. (See Appendix 2.) (This group met for the first time in June 1990 in Caracas, Venezuela, and again the following November in Perth, Australia. It will meet every six months thereafter on different continents.) The International Coordinating Group will work with the Programme organizers to help coordinate the involvement of diverse regional perspectives and interests in the development of the Biodiversity Strategy Programme. In addition, IUCN's Environmental Law Centre and UNEP staff involved in the development of the International Convention for the Conservation of Biological Diversity will provide technical advice on the convention to

IUCN State Members. Linkages have already been established with the Ramsar Bureau [the secretariat which oversees the international treaty on wetland protection] and the Man and the Biosphere Programme. Collaboration with UNEP's Regional Seas Programme will take place through IUCN's Marine Programme.

Coordinated by the Chief Conservation Officer and the Chief Scientist for plant conservation, many parts of the IUCN Secretariat are also participating in the Programme. IUCN's Director General has established an Inter-Commissional Standing Committee for this purpose, though the Programme will draw on the products and expertise of the rest of the organization as well, both to promote its findings to a broader conservation community and to garner the broadest possible perspective. Among the IUCN programs and commissions closely involved will be:

- The Species Survival Commission (SSC);
- The Plants Office (focusing on species and sites of particular importance, conservation, and on the genetic aspects of conservation);
- The Commission on National Parks and Protected Areas (CNPPA);
- The Environmental Law Centre (ELC);
- The Tropical Forests, Coastal and Marine, and Wetlands Programmes;
- The Global Change Programme (focusing on the impacts of human population dynamics on biodiversity);

- The Women in Natural Resources Management Programme (focuses on women in the management and conservation of biodiversity in the tropics).

Along with IUCN, the World Wide Fund for Nature-International (WWF; known as World Wildlife Fund in the U.S. and some other countries) Plants Office, and, by extension, WWF's National Organizations (especially WWF-UK and WWF-US), are at work on some aspects of the Programme. Close links have been established with the U.K. Overseas Development Administration (ODA), the United Nations Food and Agriculture Organization (FAO) Commission on Plant Genetic Resources, the FAO Forestry Division, the Center for Plant Conservation, the Bureau de Ressources Génétiques (Paris), the Agricultural University at Wageningen (The Netherlands), and the University of California at Riverside.

Some of the participants in the overall Programme are themselves consortia, so the "ripple effect" should be considerable. The Botanic Gardens Conservation Secretariat runs a network of several hundred botanic gardens and other institutions. The IUCN-Smithsonian Institution Latin America Plants Project has a network of several hundred collaborators.

Financial support for the Biodiversity Conservation Strategy Programme is being provided by a number of organizations, including the British ODA, Government of Switzerland, U.S. Agency for International Development, and W. Alton Jones Foundation. Additional support is being sought.

PRODUCTS AND SERVICES OF THE BIODIVERSITY CONSERVATION STRATEGY PROGRAMME

Developing a Strategy for Conserving Biodiversity

A major result of the Programme will be the publication, promotion, and wide dissemination of the *Biodiversity Conservation Strategy*. This document will define the values of species, genetic resources, and ecosystems in terms of their importance to people and to biosphere maintenance, as well as identify the options and opportunities for action at local to international levels. It will view biodiversity conservation as a combination of three inextricably linked pursuits: the need to *understand* its role in the biosphere, *defend* the world's biological richness, and *use* it wisely through sustainable management systems that provide for human needs now and in the future—and promote that perspective.

Understanding biodiversity entails activities including the inventory and survey of biodiversity in the wild; biological and ecological research to increase our understanding of the behavior and function of species and ecosystems; and the development of data and information on species, genes, and ecosystems. It requires both modern science and traditional knowledge.

Defending biodiversity requires urgent action to slow or halt unsustainable development paths that are leading to the loss of biodiversity. It also requires a variety of approaches to maintain species, genes, and habitats (including strict nature reserves,

multiple-use extractive reserves, zoos, botanic gardens, experimental research stations, and collections of seed, embryos, and tissues). These approaches must be used within the context of regional landscapes to ensure the maintenance of minimum viable populations of flora and fauna, continuity of ecological functions including stream flows, and stability and biological health of agriculture, forestry, and fisheries. Thus, defending biodiversity is directly linked with development and human welfare.

Using biodiversity wisely and equitably means converting the unknown or little-appreciated wealth of nature into biological resources that contribute to human well-being and local community self-reliance, promote equity, and ensure environmental protection. This requires research and development to create new uses of biological resources, to enhance the properties of foods, trees, medicines, and industrial commodities; it requires management systems that promote the sustainable use of forests, crops, fisheries, and wildlife to meet the needs of local communities and development goals while preserving the environment; and it requires policies and mechanisms that ensure that the grass-roots innovators and custodians of the planet's biological wealth are provided incentives for continuing innovation and conservation.

Both marine and terrestrial ecosystems will be covered in the *Strategy*. As the United Nations *World Charter for Nature* states, each nation has a responsibility to ensure that the species, genetic diversity, habitats, and ecosystems within its borders are protected, properly studied, and managed for the benefit of human

populations now and in the future. At the same time, local communities are ultimately responsible for conserving biodiversity, and they hold the ultimate right to seek their livelihoods from it. Even in this hierarchy, though, the need for complementary international cooperation and coordinated global action is pressing.

The *Strategy* will be launched in early 1992 in time to contribute to the Fourth World Congress on Protected Areas (February 1992) and to discussions on biodiversity at the United Nations Conference on Environment and Development, to be held in Brazil in June 1992.

Stimulating Action to Conserve Biodiversity

The Programme will promote practical action during the 1990s through its various collaborating institutions and prepare and publish the *Decade Action Plan* for conserving biodiversity. This document will identify and promote the knowledge, skills, policy reforms, and investments needed to conserve biodiversity and will specify practical actions that can mobilize biological resources to meet human needs.

The *Decade Action Plan* will seek the key levers for changing the *status quo* of resource use and management, including:

- Identifying and addressing root causes, particularly through policy and institutional reform;
- Encouraging broad participation in resource management decisions and free access to information; and

- Developing local capacity for resource management and policy analysis.

The *Decade Action Plan* will focus on the urgent steps needed to identify areas of outstanding importance for biodiversity conservation and the options for planning, protecting, funding, and managing these areas through national and local action. Under IUCN's direction, areas that are critically important for conserving biodiversity—designated either as protected areas or other management regimes—will be identified. The *Decade Action Plan* will also specify quick actions needed to meet the needs of botanic gardens, zoos, aquaria, and seed banks.

Providing Information on Biodiversity

The Programme will work with the World Conservation Monitoring Centre and numerous other collaborating institutions to compile the information needed to support the conservation of biodiversity. The material will be made available on diskettes and through the *Biodiversity Status Report*, a compendium of information detailing the status of the world's biological diversity and the actions and investments underway to conserve it. This serial report will also provide essential data for monitoring the progress of actions stimulated by the *Strategy*. The first edition of the report will be in draft by November 1990. The data collection will be targeted to meet the needs of national and international institutions interested in improving biodiversity conservation activities and increasing funds available for investment in its conservation. The compendium will also provide a variety of users in resource management and develop-

ment fields with information on the status of biodiversity.

Improving Policies and Methods for Conserving Biodiversity

The Programme will conduct a number of studies and workshops in collaboration with partner institutions to improve policies and methods for overcoming social, economic, and political obstacles to conserving biodiversity. Suitable for application in the field, these studies will culminate in a series of publications released under the joint imprint of IUCN, WRI, UNEP, and other research partners. The "Biodiversity Conservation Series" will be promoted through WRI, IUCN, UNEP, and other participating organizations. All documents will be published in English, and, funding permitting, in Spanish, French, and other languages.

Providing Technical Advice on Biodiversity

On request, the Programme will provide advice to governments, development agencies, international development banks, and conservation organizations on biodiversity issues. Areas of expertise include protected areas, species, wildlife utilization, economics, planning, law, environmental impact assessment, and others.

Promoting Biodiversity as a Major Development Issue

The Programme will work with multilateral and bilateral development agencies and with NGOs to ensure that biodiversity receives full attention as a major development

issue. Activities will include participation in the preparations for the 1992 United Nations Conference on Environment and Development and preparations for the 1992 Fourth World Parks and Protected Areas Congress. Programme participants will also prepare lectures, presentations, and articles for journals and magazines to promote the Programme's objectives to a variety of audiences.

MAJOR PROGRAMME ACTIVITIES (1990-1993)

The following research, technical outreach, and workshops will be undertaken as the *Biodiversity Conservation Strategy* is developed and promoted. Many will yield separate publications as well as meeting the needs of the *Strategy* process.

Research and Technical Outreach

Research will be carried out to identify changes in policies, laws, institutions, and administrative procedures that will foster the maintenance and understanding of biological diversity. This research will be published in a series of reports on the most important sites for conservation attention, the major policy issues in conserving biodiversity, country or regional studies, technical manuals, and individual project case studies.

1. *Root Causes of Biodiversity Loss.* WRI will manage studies on the root causes of biodiversity loss and the mismanagement of biological resources. Heavy emphasis will be placed on the international political economy of biodiversity loss, national economic policy distortions, con-

straints and pathologies of government institutions, land and resource tenure issues, erosion of indigenous cultures and their resource management systems, inadequate access to information and policy processes, and the effects of inappropriate international development assistance.

2. *Genetic Resources.* Also managed through WRI, this research will address equity issues involved in the conservation of genetic resources, seeking clarity on who benefits and who is paying for their conservation. The ongoing dispute over intellectual property rights as they pertain to biodiversity conservation will be examined along with the mechanisms needed to ensure that biotechnology will meet human needs, ultimately strengthening rather than weakening the rationale for biodiversity conservation. A related project, this one under IUCN's Chief Scientist for plant conservation, will analyze the status of germplasm conservation of wild species, *ex situ* in seed banks and field gene banks, and *in situ*, in both small- and large-scale reserves. Special attention will be accorded to local crops (so-called minor species), medicinal plants, crop relatives, rare and endangered species, and species needed for habitat rehabilitation. A "Handbook of Plant Collecting" for wild species will be prepared in association with the International Board for Plant Genetic Resources (IBPGR).

3. *Defining Key Sites and Species for Conservation.* The *Biodiversity Conservation Strategy* and *Decade Action Plan* will provide international and national conservation agencies and NGOs with a set of internationally accepted priorities for action to conserve biodiversity. IUCN and its

governmental and non-governmental affiliates will:

- Identify Key Sites for Conserving Biodiversity. The Programme will draw on the IUCN network and collaborating organizations (especially the World Conservation Monitoring Centre) to identify the highest-priority sites for conservation. In addition, data sheets on selected sites of outstanding importance for plant conservation will be developed under IUCN direction, and a conservation and development strategy will be outlined for each site selected. Findings will be summarized in a book titled *Centres of Plant Diversity*. The Programme will also forge links to efforts already underway to identify vitally important sites, under the lead of IUCN's Tropical Forestry Programme, its Commission on National Parks and Protected Areas, and the Wetlands Programme.
- Identify Priority Species for Plant Conservation. If funding is available, IUCN will prepare a rank-ordered list of economically valuable plants, which will give governments and NGOs a basis for deciding which plants warrant priority in conservation and development projects.
- Identify Priority Species for Animal Conservation. This work will be carried out by IUCN's Species Survival Commission (SSC), and will feed into the *Biodiversity Conservation Strategy* and *Decade Action Plan*, which will in turn

promote the implementation of the SSC Species Action Plans.

4. *Finalizing the Global Protected Area System.* IUCN is establishing a task force to analyze the extent to which protected areas currently conserve biodiversity, to evaluate the quality of their management, and to identify gaps in coverage. The effort will build upon the considerable work already accomplished by IUCN Commissions, the International Council for Bird Preservation (ICBP), The Nature Conservancy (TNC), and the World Conservation Monitoring Centre (WCMC). In cooperation with local organizations, the Programme will develop an action plan that will specify the required activities and financial needs. The plan will be provided to the 1992 World Congress on Parks and Protected Areas and summarized in the *Decade Action Plan*.

5. *Biodiversity and Resource Management: Conserving Biodiversity Outside Protected Areas.* The following IUCN programs will describe the principles of conserving biodiversity in various habitats, specify the government policies required to maintain that diversity, provide specific guidelines for policy implementation, and recommend actions needed in the 1990s to conserve biodiversity in each particular habitat.

- IUCN's Wetlands Programme will review the principles of biodiversity conservation as applied to these ecosystems and identify the activities required over the next decade to improve wetlands management, paying particular attention to projects that help local communities adapt traditional systems of resource use to today's conditions. These invest-

igations will be summarized in a publication entitled *Conserving Biodiversity in Wetland Ecosystems*.

- IUCN's Tropical Forest Programme will focus its work on multiple-use management of tropical forests, sustainable use of tropical forest species, and how human population pressure affects tropical forests. Its research will be summarized in a book called *Conserving Biodiversity in Tropical Forests*.
- IUCN's Coastal and Marine Programme will describe what marine biodiversity is and how it is affected by fishing and other human activities. Drawing on experience with marine estuaries, mangroves, intertidal mudflats, seagrass beds, and coral reefs, the group will develop practical guidelines and principles for conserving marine biodiversity. A book, *Conservation of Biological Diversity in Coastal and Marine Systems*, will result from this work.

6. *Conservation Technology.* This conceptual and practical work on *in situ* and *ex situ* conservation tools and their linkages to development will be carried out under WRI's management. The partners in this research will analyze the elements and actions needed to foster intersectoral cooperation on resource management—a necessity since biodiversity can only be conserved if planning is undertaken at a regional, or “landscape” level.

7. *Economics and Biodiversity.* The Programme will analyze the linkages between market pressures and

the degradation and destruction of biological diversity. Research under WRI's auspices will examine conceptual issues underpinning the valuation of biological diversity, as well as market and policy failures that contribute to its loss. It will also analyze how the financial support for biodiversity conservation can be increased to ensure that costs and benefits are equitably distributed, and it will explore the obstacles to and opportunities for biodiversity conservation presented by international debt.

8. *The Role of Law in Conserving Biodiversity.* In the past, many rural areas were governed by customary law that *de facto* protected biodiversity, but most such laws have now been replaced by national legal systems, few of which have been designed with biodiversity conservation in mind. IUCN's Environmental Law Centre will examine legal techniques and mechanisms for promoting such conservation and publish a summary entitled *The Role of Law in Supporting the Conservation of Biodiversity*.

9. *Cross-sectoral Review of Wildlife Utilization.* The IUCN's Species Survival Commission (SSC) will identify mechanisms for enhancing the utility of biodiversity for local people. SSC will review a number of projects to see what it takes to make wildlife use sustainable. A central repository for information on sustainable use will be established so that donors, governments, and NGOs can have easy access to findings on the design and implementation of such projects. Results will be published in a work called *Guidelines for Sustainable Utilization of Wildlife*.

10. *Designing National Systems for Conserving Biodiversity.* The Pro-

gramme will identify the elements needed in any national plan to conserve biological resources and the wider biological diversity from which these resources derive. Research will identify the institutions that should be involved and the information needed for proper management, suggest comprehensive conservation policies, and explore ways to build institutions that will conserve biological resources. The team will also suggest long-term funding mechanisms and provide a model table of contents for a national plan to conserve biological resources.

11. *Global Change and Biodiversity.* IUCN's Programme on Global Change will investigate the potential impacts of climate and human change on biological diversity and the opportunities that biodiversity provides for adapting to these changes.

12. *Controlling Introduced and Invasive Species.* Drawing on its database on introduced species, IUCN will establish an information network and strategy for dealing with the threat that invasive plant species pose to natural ecosystems in many parts of the world, especially on islands. Work will focus on the distribution of these species, their effects on the ecosystem, reproductive biology, and control measures.

13. *Conserving Indigenous Medicinal Plants.* Strategies for conserving medicinal plants will be developed along with a global assessment of conservation needs. The strategies will describe collecting procedures and means of assessing supply and demand of medicinal plants, and will detail the steps needed to block genetic erosion and either cultivate or sustainably harvest these plants.

Workshops and Regional Consultations

Between August 1990 and June 1991, a series of experts workshops and regional consultations are scheduled to help develop the *Biodiversity Conservation Strategy* and *Decade Action Plan*. Both the experts workshops and the regional consultations will be three-day meetings, and where possible the two events will be held back-to-back at the same venue. The workshops and consultations are being organized in collaboration with partner organizations in the Strategy Programme (many of which are represented on the International Coordinating Group). Experts workshops will focus on a topic of particular concern to the region or institutions involved and most participants will be from the region. Regional consultations will include participants from the experts workshop but will draw on a broader array of individuals from a government, science, grass-roots groups, NGOs, and industry to review draft materials for the *Strategy* and *Decade Action Plan*. The following workshops are scheduled:

Scientific Basis for Marine Biodiversity Conservation (Center for Marine Conservation, Washington, D.C., October 28-30, 1990). Workshop participants explored the status of marine biodiversity, unique features of conservation in marine ecosystems, the new field of marine conservation biology, and scientific research needs for marine biodiversity conservation.

IUCN General Assembly (Perth, Australia, November 1990). The General Assembly of IUCN provided a special opportunity for dialogue among organizations and individuals from around the world on key bio-

diversity issues. At a two-day workshop, participants examined various components of the Biodiversity Strategy Programme, including the draft *Biodiversity Status Report*. A special session was held on women and biodiversity, and workshops on protected areas (including a review of world coverage and requirements for investment to strengthen sites and develop new areas), tropical forests, and extinction rates, will be featured. In a plenary session, the World Conservation Strategy for the 1990s, which includes a chapter on biodiversity, was discussed.

Information for Decision Making/Central American Consultation (National Institute of Biodiversity, Costa Rica). The workshop will identify practical methods that financially poor but biotically rich countries can use to inventory their wildlands, systematically explore their value and function, and support their development with appropriate information and knowledge. It will also identify needs for species inventory, institutional and training facilities, and strategies for increasing the amount and quality of biological information available to policymakers. It will elaborate a strategy for promoting new products and services from nature that meet development needs and increase community and national self-reliance.

Restoration of Degraded Lands and Biodiversity (Tentative location: India). The workshop will draw largely on the technical and political expertise in South Asia, but will also include scientists working in other parts of the world. It will explore strategies, techniques, and policies for the restoration of degraded lands that can make greater use of biodiversity, help in its conservation,

and broaden development options, especially for the benefit of local communities.

Managing Biodiversity/South American Consultation (FUNATURA, Brazil, in collaboration with BIOMA, Venezuela). This workshop will focus on the strategic integration of *in situ* and *ex situ* conservation methods—protected areas, corridors, transition zones, botanic gardens, zoos, seed banks, cryo-preservation—and the policies, laws, and institutional backing needed to make them work to support the study, maintenance, and sustainable use of biodiversity and biological resources. A major discussion topic will be how to raise planning and management of biological resources to a regional scale to ensure biodiversity conservation.

Property Rights and Genetic Resources (African Centre for Technology Studies, Kenya, March 6-9, 1991). Workshop participants will examine strategies for increasing the benefits that developing countries and custodians of genetic resources such as farmers and traditional healers derive from their genetic resources, and for insuring the worldwide conservation of those resources.

African Consultation (African NGOs Environment Network, Tanzania). Drawing on the unique network of grassroots NGOs that are members of the Network, this consultation will provide a key opportunity to ensure that grassroots perspectives are well represented in *Strategy* documents.

Redefining the Roles of Local Communities in Natural Resource Management/Southeast Asian Consultation (WALHI, Indonesia). Participants at this workshop will explore how to establish or re-establish stewardship

at regional and community levels of resource management, how to ensure that local people get the benefits, how to establish cooperative arrangements between local groups and government, and how to balance national interest and local rights.

Trade and Biodiversity/European Consultation. A workshop on "trade and biodiversity" is under preliminary discussion. Participants would explore the impact of trade patterns on biodiversity and also the impact of European economic integration in 1992 on biodiversity in Europe.

Economics and Biodiversity/North American Consultation. A workshop is under preliminary discussion with the Keystone Center on this topic. Participants would explore key issues of valuation, market failures, policy conflicts, and the integration of biodiversity into development planning.

Protected Areas Task Force and Workshop Series. The key needs of the existing global protected areas network and the gaps in the network will be analyzed by an international task force of experts from the several groups that have been working to identify sites of outstanding importance for biodiversity conservation. Through workshops and consultations, the task force will seek consensus on priorities for local, national, and international action—where required, on an emergency schedule. This work will be closely allied with similar efforts to support botanic gardens, zoos, and other key *ex situ* conservation needs.

Communications Strategy

The Biodiversity Conservation Strategy, Decade Action Plan, and

Biodiversity Status Report will be published by early 1992 in time to contribute to the Fourth World Congress on National Parks and Protected Areas and at the United Nations Conference on Environment and Development. All of the documents will be aggressively promoted by all the partner institutions. A new "Biodiversity Conservation Series" will be established to handle the numerous publications expected from the Programme. The publications are expected to include:

- *The Biodiversity Conservation Strategy* (February 1992)
- *The Decade Action Plan for Conserving Biodiversity* (February 1992)
- *The Biodiversity Status Report* (November 1991)
- *Root Causes of Biodiversity Loss* (Summer 1991)
- *Equity in the Conservation and Use of Genetic Resources* (Summer 1991)
- *The Economics of Biodiversity Conservation and Use* (1992)
- *The Role of Law in Conserving Biodiversity*
- *Centres of Plant Diversity*
- *Conserving Biodiversity in Wetland Ecosystems*
- *Conserving Biodiversity in Tropical Forests*
- *Conserving Biodiversity in Coastal and Marine Ecosystems*
- *Guidelines for the Sustainable Utilization of Wildlife*

IUCN also plans to publish a general text on plant conservation and a book on the conservation of medi-

nal plants. The Programme publishes a newsletter, "Biodiversity Conservation Strategy Update," two to three times per year and distributes it to the mailing lists of each of the organizing institutions. A descriptive leaflet has been produced and is being widely distributed.

FOR FURTHER INFORMATION, CONTACT:

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APPENDIX 1:

PRELIMINARY LIST OF PARTNER ORGANIZATIONS

These institutions have indicated their interest in the Biodiversity Conservation Strategy Programme, asked to be listed as partner organizations, and will contribute materials and be invited to participate in workshops.

Asian Development Bank
Association of Systematics Collections
Australian Department of the Arts,
Sport, the Environment, Tourism,
and Territories
Botanic Gardens Conservation
Secretariat
Caribbean Natural Resources
Institute
Center for Marine Conservation
Commonwealth Science Council
Conservation International
Fundação Pró-natureza
(FUNATURA)
Fundación de Parques Nacionales
(Costa Rica)
Fundación Natura (Ecuador)
Fundación Neotrópica (Costa Rica)
Fundación Pro-Sierra Nevada de
Santa Marta
Fundación Venezolana para la
Conservación de la Diversidad
Biológica (BIOMA)
Indigenous Food Plants
Programmeme

International Council for Bird
Preservation

Kenya Institute for Organic Farms

Keystone Center

Missouri Botanical Garden

National Institute of Biodiversity
(INBio)

National Museums of Kenya

Plant Genetic Resources Centre/
Ethiopia

Ramsar Conservation Secretariat

Smithsonian Institution

Society for Conservation Biology

The Nature Conservancy

WALHI (Indonesian Environmental
Forum)

World Bank

World Conservation Monitoring
Centre

World Wide Fund for Nature (WWF)

World Conservation Monitoring
Centre

In consultation with:

Food and Agriculture Organization
of the United Nations (FAO)

International Board for Plant Genetic
Resources (IBPGR)

International Council for Research in
Agroforestry (ICRAF)

Unesco (United Nations Educational,
Scientific, and Cultural
Organization)

APPENDIX 2:
INTERNATIONAL COORDINATING
GROUP, BIODIVERSITY
CONSERVATION STRATEGY

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(Indonesian Environmental Forum)
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Dra. Maria Teresa Jorge Padua
Executive Director
Fundação Pró-natureza
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China
To be determined

USSR
To be determined

The Ethical, Cultural, and Spiritual Dimensions of Conserving Biodiversity

J. Ronald Engel

Chair

**IUCN Working Group on Ethics,
Culture, and Conservation**

Meadville Theological School

Chicago, Illinois

WRI, IUCN, and UNEP are launching a two-year program of research and consultations for the purpose of developing a global *Biodiversity Conservation Strategy* and *Decade Action Plan*. Based on our work on ethics for *Caring for the World: A*

Strategy for Sustainability (the successor to the *World Conservation Strategy*, which was published in 1980), the IUCN Ethics, Culture, and Conservation Working Group has been asked to write a proposal for how to develop the ethical, and spiritual dimensions of this program and to participate in its implementation.

"Culture" is being used here in the broad sense, inclusive of all human value-bearing activities, social, economic, and political, as well as the arts, sciences, humanities, and religion.

Three phases of work are anticipated.

PHASE I: PROPOSAL,

AUGUST 1990—JANUARY 1991

The first task is drafting a proposal for *how* we believe this area of the biodiversity program should be developed over the next two years and *what* directions of research and action in the area of ethics and culture will prove most effective.

To facilitate this process, I was invited to make a presentation on behalf of the Working Group at Workshop 3, "Designing and Implementing the Biodiversity Conservation Strategy," at the IUCN General Assembly meeting November 30 in Perth, Australia, and to submit a first draft of our proposal to the International Coordinating Group by January 30, 1991.

In order to draft this proposal, I have suggested that we look for answers to the following three questions:

1. What is the best procedure for making ethics and culture effective components of the biodiversity strategy and action plan over the next two years?

2. In what ways (if any) does the current concept of the biodiversity

strategy program need to be modified in order to effectively incorporate ethics and culture?

3. What directions for research and action in ethics and culture will most effectively help conserve biodiversity? What are examples of specific projects in these areas?

My own thoughts on these matters run along two lines. First, a serious approach to the ethical and cultural dimensions of biodiversity conservation raises important questions about the nature of the program as a whole: how broadly is "biodiversity" being *defined* (does it include cultural diversity as part of life's diversity and therefore internal to the issue?), what *constituencies and interests* are involved (who is writing the program? for whom? to what end?), what *ecological model* is guiding the strategy, what *theory of social and political change* (or "development") is operative, how may we conceive of *economic activity* as inherently moral rather than amoral, etc. To think along this line means that persons in the humanities will need to be engaged in a dialogue with persons working on other aspects of the program and there will need to be opportunities to hold this dialogue.

At the same time, there are many specific research and action projects that need not await the conclusion of this larger dialogue, and which could substantially contribute to achieving the goals of the strategy. I am thinking, for example, of collecting case studies that show how deliberate attention to ethics, culture, and religion positively impacts biodiversity; the issues involved in the privatization of the biotic commons and the professional and commercial uses of traditional knowledge; the development of a philosophy of democracy and

human rights that includes the values of biodiversity.

PHASE II: TASK FORCE

If the Phase I Proposal is well received, I anticipate the formation of a Task Force on the Ethics of Biodiversity to work with WRI, IUCN, and UNEP in the regional consultations and other activities that will lead to the writing of the *Biodiversity Strategy and Decade Action Plan*.

We also know that it will be important for the Task Force to be represented at the major international fora that will review the biodiversity strategy, e.g., the IV World Congress on Protected Areas (Venezuela, 1992), and the United Nations Conference on Environment and Development (Brazil, 1992).

PHASE III: IMPLEMENTATION

It is hoped that support for funding of the specific research and action proposals in ethics and culture will be developed in the course of Phases I and II of our work.

RESOURCES

In addition to such basic works as *Biodiversity*, E.O. Wilson and Frances M. Peter, eds. (Washington: National Academy Press, 1988), and *The Preservation of Species: The Value of Biological Diversity*, Bryan Norton, ed. (Princeton: Princeton University Press, 1986), there are several new publications by WRI and IUCN staff that are important resources for this topic.

I especially recommend Jeffrey A. McNeely, Kenton R. Miller, W.V. Reid, R.A. Mittermeier, and T.B. Werner, *Conserving the World's Biological Diversity* (1990), available for US\$18 ppd. from either: IUCN Publi-

cations Services, Avenue du Mont-Blanc, 1196 Gland, Switzerland; WRI Publications, P.O. Box 4852, Hampden Station, Baltimore, MD 21211; or World Bank Publications, P.O. Box 7247-8619, Philadelphia, PA 19170-8619. This readable book provides the basic conceptual framework and rationale for the biodiversity program. You will also find that each chapter can be fruitfully expanded once the cultural and ethical dimensions of biodiversity are taken into consideration.

Also very valuable is Walter V. Reid and Kenton R. Miller, *Keeping Options Alive: The Scientific Basis for Conserving Biodiversity*, WRI 1989.

Another basic document is the June 1990 draft of *Caring for the World: A Strategy for Sustainability*, the new title for the successor to the *World Conservation Strategy* of 1980. This new draft is available from IUCN Publications. The *Biodiversity Conservation Strategy* is conceived of as a companion to this document. Chapter 2 of *caring for the World*, which follows, spells out the ethical presuppositions of the new world conservation strategy and draws heavily upon materials generated by our working group.

You may contact J. Ronald Engel at Meadville Theological School, 5701 Woodlawn Ave., Chicago, IL 60637.

The Global Change Research Program and the U.S. National Park Service: Six Essays

Jill Baron

Raymond Herrmann

Stephen C. Nodvin

Maury Nyquist

David J. Parsons

Robert Stottlemeyer

The U.S. Global Change Research Program is an interagency effort spanning six departments of the federal government, including those with primary

responsibility for space exploration, agriculture, public land management, environmental protection, and energy policy. The goal, to establish a scientific basis for policies on global change, is to be achieved by meeting four general objectives: observing global change, understanding it, predicting its future course, and managing data related to it. The Program is coordinated by the Working Group on Global Change of the interagency Committee on Earth and Environmental Sciences (CEES). The CEES has divided the Program into interdisciplinary elements: Climate and Hydrologic Systems, Biogeochemical Dynamics, Ecological Systems and Dynamics, Earth System History, Human Interactions, Solid Earth Processes, and Solar Influences. Research under each element is to be coordinated by a separate group, with additional groups devoted to modeling, data management, international coordination, industry and global change science, outreach and communications, and education and training.

The USNPS is to do population, community, watershed, and landscape ecology studies (under the heading of Ecological Systems and Dynamics); paleoecology, paleoarcheology, and other similar studies (Earth System History), ethnographic studies of how climate change might affect the subsistence of native and other small-scale societies (Human Interactions), and possible effects of climate-induced changes in sea level and storm intensity on coastal areas (Solid Earth Processes).

All this is covered in greater detail the Fall 1990 issue of Park Science. Also writing in that issue, Bill Gregg, USNPS's Man and the Biosphere Coordinator, further explained how the Program will be carried out within the agency. With the biosphere reserve concept as the model, the United States has been divided into biogeographic regions,

each defined by physical, biological, and human coordinates. Research under the global change program is keyed to these regions. Within regions are one or more parks serving as "core research areas." Other parks will also be involved, however.

To complement Park Science's special section on the Global Change Research Program, we asked several people interested in or involved with the Program to share their personal thoughts on this important initiative with us in a brief essay. We'd welcome your reactions too, whether informally, by means of a letter to the editor, or in your own essay.

A Model for Global Change Research

Stephen C. Nodvin

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Studies Unit
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In 1988 and 1989 I was a new USNPS scientist without specific commitments to ongoing research projects. This unique position allowed me the opportunity to focus on new areas of research for the development of my research initiatives at the Cooperative Parks Studies Unit (CPSU) at the University of Tennessee. This opportunity allowed me to develop a major focus of my efforts and that of the CPSU on the area of

global change. I was able to take initiatives in the review of materials and documents on global change at the park, regional, and national levels and to expand my expertise in the area of global change through extensive readings, attendance at symposia, and meetings focused on global change, and by developing a student seminar which had global change as its major focus. These efforts led further to opportunities to serve on an interagency panel to the Committee on Earth and Environmental Sciences, to be asked by the Washington Office of the U.S. National Park Service to serve as a member of the USNPS Global Change Committee, and to be asked by the USNPS Southeast Regional Office to develop the operations plan for the Southern Appalachian bio-regional global change site.

There is probably no individual anywhere who is a stronger proponent for long-term monitoring and research. I have conducted research efforts at a number of long-term research sites and my dissertation was on processes at the Hubbard Brook Experimental Forest, one of the best-known long-term watershed research programs in America. However, there are certain realities to long-term research and monitoring which are not obvious to those who have not had the opportunity to attempt to establish or maintain such a program. I have found a tremendous tendency to underestimate the time and funding necessary to establish long-term monitoring and research. Because projects like the Hubbard Brook Ecosystem Study are fully functional now, I have found that agencies and researchers feel they should be able to replicate this kind of effort in as little as a year or two. What most fail to realize is that a re-

search program such as Hubbard Brook's was 30 years in the making. Even the U.S. National Science Foundation (NSF) Long-Term Ecological Research Program was developed over a period of about 15 years. The experience we have gained in the development of these programs means that we are "up on the learning curve" and it should not take the same length of time as originally to implement similar programs. Yet I have worked on projects which attempted to implement Hubbard Brook-type studies where the investigators and funding agencies expected full implementation in as little as one year—and were frustrated when it did not happen.

What I have found is that research programs which sought to be extensive and which began by initiating efforts on many fronts simultaneously became overextended. These projects became very susceptible to changes in funding and in personnel with the potential for disastrous results. With short-term funding, no robust commitments for long-term funding, and overextensions of objectives and goals relative to actual funding, I have seen "long-term" projects suffer dramatic cutbacks and even terminate at a single crisis point.

The USNPS is in the throes of developing conceptual efforts relative to long-term research (Inventory and Monitoring) and global change research. I see the same types of errors and assumptions being made in planning at the park, regional, and national levels. I see programs being proposed by NSF and other agencies that are "too much, too far, and too fast" given present funding for Fiscal Year 1991, not to mention the lack of clearly defined and dependable funding beyond '91.

To focus my concerns, I've developed the following brief model for global change research.

Dramatic changes in global carbon dioxide levels (a 25% increase since the Industrial Revolution began roughly 200 years ago), model predictions of global climatic change, and the blazing summer of 1988 have helped to bring the concept of and concern for global change to the forefront of national and international policy and debate. Key timing of selected incidents: the '88 heat wave, the Yellowstone fires, the 20th anniversary of Earth Day, revelations regarding the ozone hole, and some of the campaign focuses in the 1988 U.S. presidential race. Together, they have spawned renewed environmental concerns and efforts in the public, private, and science sectors. But knowledge about potential global warming, elevations in carbon dioxide and other greenhouse gases, adverse effects to the ozone layer from chlorofluorocarbons, and other global environmental problems has been extant (at least within the scientific community) for one to two decades for each of these issues. The timing of recent environmental, scientific, and political events may have been the key in allowing recommendations from the Committee on Earth and Environmental Sciences (the inter-agency advisory committee), to have great effect in allowing the U.S. government and federal agencies and bureaus to propose and participate in what is being called global environmental research. The momentum in developing and continuing these research efforts will depend partly upon further short-term environmental and political events. The current drought in the western United States and particularly in California will emphasize the potential effects of

global warming (whether or not the event can be directly tied to long-term global change). Elevated demands by the European Community for further accords from the United States toward targeting reduced emissions of carbon dioxide will continue to prompt, at the least, further emphasis on global change research if not, quite yet, further direct action on reducing greenhouse gas emissions. One other factor could have a major impact on the progress, extent, and potential expansion of global change research during the next decade. This factor will reflect the approaches and efficiencies of actions taken by each agency to produce tangible contributions to the study of global change.

Global change can be studied from the perspective of either (1) the mechanisms contributing to and regulating change; or (2) the impacts of change on natural and cultural resources. Clearly, research on the mechanisms which induce global change would not be a part of the purview of the USNPS; neither do we have scientific expertise in this area nor would this area be part of our mission of preserving and protecting natural and cultural resources. We should invite those experts pursuing this line of questioning to utilize USNPS resources and information which would contribute toward understanding mechanisms and developing models of global change. However, we should concentrate our own efforts within the area of global change impacts.

Research on global change impacts can be classified into three major categories: (1) elucidation of the relationships between environmental change (including climatic change) and natural and cultural impacts through the utilization of historical

and geologic records; (2) assessment of potential future global change impacts on natural and cultural resources through experimental studies, modeling, and risk assessment; and (3) long-term monitoring and detection of global change impacts on natural and cultural systems.

According to the CEES, U.S. appropriations for global change research for Fiscal Year 1991 are expected to be over \$1 billion. This is in contrast to the approximately \$500 million which was spent during the 1980s on acid rain research as part of the National Acid Precipitation Assessment Program. FY91 USNPS funding for global change research is about \$2.1 million. From this funding, the USNPS Associate Director of Natural Resources has announced (in a memo dated June 6, 1990) that eleven core research areas will be funded during FY91 for operational support for program planning and coordination with a minimum of \$60,000 to fund one full-time employee; additional support for research projects in seven of the areas will be made available on a competitive basis.

A prudent scenario on developing global change research for the USNPS would proceed by focusing on Approaches 1 and 2 above to develop an extensive understanding of the implications of global change for USNPS biogeographic regions, develop first-step policies for management relative to potential global change, and implement long-term monitoring (Approach 3) to certify the magnitude and extent of projected impacts and guide long-term policy.

Given sufficient funding, current monitoring programs could perhaps be enhanced while studies using Approaches 1 and 2 are developed.

However, even if appropriate funding were or becomes available to initiate such monitoring, it must be realized that monitoring programs designed to detect global change signals will likely have to operate decades if not scores of years to ascertain definitive links of real-time observations with global change parameters.

Scientific, financial, and political realities dictate that, if there is an overemphasis on monitoring approaches at the current time, not only will the monitoring likely be poorly or incorrectly focused, but any global change program which is too focused on monitoring will be subject to criticism for lack of concrete products after the first few years. This must be taken in the context of the fact that an established monitoring program is not in itself a justifiable product. Data from such a program would be a partial product, but the most important products delivered by research programs are data synthesis and analyses. In the case of a monitoring program, the data must be used for trend analyses. The dilemma for the USNPS and other agencies proposing studies for global change is that impacts of global change will likely require 10-40 years of monitoring data to convincingly ascertain trends in impacts associated with global change. Such a monitoring effort should be extensively and clearly established to be supported for the long term by the U.S. federal government and the agencies. Those organizations that jump too fast into limited monitoring programs without making the effort to develop a defensible plan for long-term monitoring and then seeking proper long-term funding for such an initiative could find themselves in several years with a small amount of data and no way

to defend, maintain, and expand their programs on global change.

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Is the USNPS Prepared for the Global Change Program . . . GIS-wise or Otherwise?

Maury Nyquist

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Denver, Colorado

The goals of the Global Change Program (GCP) are certainly lofty and laudable and the U.S. National Park Service (USNPS) has much to offer to and receive from such a program. In addition to their other attributes, parks are vestiges of the natural, as well as examples of recovering or altered ecosystems in this country. Parks, therefore, are the perfect natural laboratories in which to perform many types of global change research, especially if the question is "Change from what?" Park scientists and resource managers, many of whom have worked daily for several years in the same park, can contribute insights not attainable by intermittent data gathering activities. They are also privy to the institutional scientific memory that resides in old files and dusty boxes or that has been passed down by word of mouth. Of course

the USNPS hopes to gain better data on, insights into, and understanding of the extent, condition and functioning of the systems and constituent species under its management through the special funding made available by the GCP.

So how does all this relate to this article's somewhat rhetorical title? Simply stated, my opinion is that the NPS is only marginally prepared—GIS-wise and otherwise. This situation is only partially the result of the USNPS's own doing and partially symptomatic of the GCP, in general. I would like to examine a few pertinent areas that from my own experience demonstrate why I have come to these conclusions.

First let's examine the "otherwise." The GCP is a cross-cutting, gigabuck, fast-track program. Momentous plans seem to develop spontaneously and decisions are made quickly. In my role as USNPS representative on the Earth Systems Measurement and Data Management Task Force of the Working Group on Global Change of the Committee on Earth Sciences, plans related to the entire GCP data management strategy come in with review due dates typically ranging from yesterday to tomorrow. The NPS's ability to deal with this frenetic pace, is somewhat analogous to my having been asked by the Society, two weeks before the end of the fiscal year, to try to collect my thoughts on this subject and have them in to the *Forum* by the first of October. We try and sometimes do make the deadlines, but are they our best efforts. Many researchers, who are competing for GCP research funds, honestly feel they need more time to do the job right, yet are forced to deal with what many times are unrealistic deadlines when

one considers everything else they are supposed to be doing. Should a program of such purported significance be so strongly driven by schedules at the expense of good science? Things like the Hubble Space Telescope come to mind!

As one can also see from the title of the GCP group with which I am involved, the program has taken on the characteristics of an onion, with layer (Task Forces and Peer Review Groups) upon layer (Steering Committees and Working Groups), *ad infinitum*, of direction and coordination. Some of this bureaucracy is normal and necessary for a program as large as this one. Nevertheless it appears to be hitting one of the USNPS's Achilles heels: maintaining good direction, coordination, and communication throughout a small, over-committed and widely dispersed science program. This of course affects our responsiveness and preparedness.

In all candor, the GCP is just the latest and greatest initiative the USNPS's limited science program is, of necessity, chasing in order to augment our collection of data, which just happens to be of mutual interest. Although the GCP is certainly better funded and may have greater duration and effect, the efforts of USNPS scientists are fragmented by a fundamental deficiency of funds and staff and a non-systematic approach to basic data gathering and analysis. Synergisms and efficiencies should be gained through stronger programmatic links with the USNPS Inventory and Monitoring Program (I&M), Natural Resources Preservation Program (NRPP), the Biodiversity Program and other USNPS science and natural resource activities. In most cases these

programs are looking to develop many of the same basic data sets, but will analyze them differently for program-specific applications.

For now, maybe we can't do much more about the "other-wise" situation other than what we've always done—muddle along the best we can. The USNPS needs to act as proactive managers of the resources it holds in trust, not just the benign caretakers. Until the USNPS makes a commitment to become and is recognized as a major player in the arena of environmental sciences, we will continue to dance to someone else's tune.

The situation "GIS-wise" is somewhat different in that we know what to do in most cases but haven't done it yet. Geographic Information System (GIS) technology, *per se*, is mature enough today for broad-scale implementation within the USNPS. GIS technology is viewed as a necessity by the GCP community because it is the only practicable way to develop, store, integrate, and analyze the large and disparate data sets envisioned for the GCP. Although the USNPS has come a long way in the last few years toward implementing GIS technology, its full implementation (i.e., data and staff in addition to hardware/software) is approaching adequacy at only a few sites.

Most parks don't even have the "nominal data base" (the "I" in the USNPS's current I&M program or the long-defunct Resources Basic Inventory program) required for scientifically sound park management, much less GCP research. Many of the data themes in the nominal data base (e.g., vegetation, landcover, geology, soils, and topographic variables including watersheds, hydrography, etc.) are absolutely essential for developing

sampling designs, landscape characterizations and other analyses. The nominal data base for the parks and their environs will enable us to examine the larger whole instead of just the parts. This is essential because "the whole is greater than the sum of its parts" and much of the GCP is directed at understanding and modeling systems. The ongoing I&M surveys on data will indicate what information exists, in what form (i.e., digital or analog) and provide an estimate of its quality. This should indicate the magnitude of the task required to fill the data gaps. (For what it's worth, if the GIS Division's FY91 budget isn't significantly cut, steps to build the nominal data base at a rate of 100 7.5-minute quads [standard topographic maps] of themes per year will be in place. However, there are approximately 7,000 quads of themes for the 249 parks and environs encompassed by the I&M Program. So much for early retirement!)

There is already a critical need for additional GIS staffing USNPS-wide, not to mention the additional impact of the GCP. The USNPS is at the same juncture today, in terms of training and staffing for GIS, as it was about a decade or more ago when it started to move away from centralized office automation to distributed use of spreadsheets, data base management, and word processing. Gradually, a cadre of new people was hired and existing staff were trained to function in the personal computer environment. That level of attainment vis-à-vis GIS staffing does not appear to be on the near horizon and the USNPS must also be cautious not to continue to take new programs out of the hides of existing ones.

Meanwhile, we should also try to deal with developing or improving data dictionaries and directories, data exchange formats, data access procedures, data distribution mechanisms and communications, and data networks. Much of the aforementioned as it relates to the GCP will be developed through the GCP or other government-wide task forces and steering committees, but the USNPS also should have a data management infrastructure in place to fulfill its own needs, as well as respond efficiently and effectively to the GCP.

Much of what is written here has already been said by others. In Stanley Cain's 1972 writings to the Director of the NPS as reported in Vol. 7, No. 1 of the *Forum*, he indicated that neither the USNPS nor Congress fully appreciated the importance of basic information or their voids (e.g., vegetation cover-type maps) and that there was a need for a "well-funded, intensive, broad and continuous research program." He also lamented that similar points made in an earlier U.S. National Academy of Sciences report had not been acted upon by the USNPS. Decades have now passed and the USNPS still hasn't gathered most of the nominal data base. So how is the USNPS, the GCP or anybody ever going to answer the "Change" question, if there is never a concerted effort made to know the "What"? In a phrase, the USNPS needs to *institutionalize resources data collection and management*. A well-respected (former USNPS) scientist, who was kind enough to review my first draft of this article, put it another way: "This [situation] is incredible, and may cause folks to stop thinking pop

science and deal with the reality of the Stone Age in inventory. . . ."

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An Ecosystem Approach to Long-term Inventory and Monitoring

Robert Stottlemyer

INTRODUCTION

The need to protect and preserve the natural heritage of the United States is increasing at a rapidly accelerating pace. Many units of the U.S. National Park System could make a major contribution in ensuring perpetuation of this heritage.

A principal component in carrying out the USNPS mandate of conservation, research, and public education is resource inventory and monitoring (I&M). The USNPS recently went through another, but overall constructive, attempt at outlining what might be an acceptable I&M program for the diverse resources of the U.S. National Park System. This included an assessment of present I&M activities nationwide, and what conceptual approaches might be employed to establish I&M priorities. In many written responses from all levels within the organization there were expressions of concern over the USNPS's considerable deficiencies in I&M and research capacity. The inability of many

within the USNPS rank and file to comprehend the complexity of such a task as I&M and to professionally assess conceptual alternatives were also evident. But, it must be noted that no organization has found I&M program implementation a simple task (NTIS 1977).

Along with a resurgence of national interest in environmental conservation, there appears to be a basic reaffirmation by the research community as to the scientific necessity of long-term, systematic environmental monitoring to provide a context within which to formulate and test meaningful hypotheses regarding ecological processes and impacts. The need for monitoring and research at the ecosystem level has received additional impetus from the Man and the Biosphere (MAB) program, the U.S. National Science Foundation through its Long Term Ecological Research (LTER) program, and several other national research and monitoring programs.

Thus, this may be a good time to initiate a new conceptual approach for research and monitoring in national parks and similar reserves. The challenge has two parts: 1) the need to appreciate the importance of understanding ecosystem structure and function which will, in turn, require long-term study, and 2) what practical tools and experimental design can we employ for such study?

PAST APPROACHES IN ECOSYSTEM I&M

Aquatic Ecosystems

Historically, there have been very few true ecosystem studies in aquatic systems. Further, there has been little long-term monitoring of aquatic ecosystems except for commercially

important species. There are some exceptions such as the early long-term research and monitoring efforts of Birge and Juday in the Upper Midwest. But these were clearly the result of dedicated scientists—not government or funding agency clairvoyance. To date, successful long-term inventory efforts around the world have almost exclusively been the result of a dedicated principal investigator (Strayer et al. 1986).

The narrow emphasis on monitoring population numbers of commercially important species often has created the misperception that comprehensive study of the organism and its environment is underway. As we have clearly seen by examples such as the collapse of the North Atlantic fishery, the loss of environmental integrity in the Chesapeake Bay, early dramatic declines in sea urchins (a major laboratory research organism), and the likely decline in the fishery of the Gulf of Alaska, the early indicators of ecosystem change were not being monitored. Is there a lesson here to learn when emphasizing threatened or endangered species?

In more recent years there has been considerable emphasis on the use of relatively short-term bioassays of single species and impact assessment studies (Schindler 1987). Funds spent on impact assessment studies tend to be very short-term in nature, and the resultant study conducted primarily to confirm a decision already made. Such studies rarely, if ever, deal with species interaction with the environment, and only by chance lead to furthering ecological knowledge. Also bioassays generally focus on species which are convenient to study rather than those which might be the most sensitive to the compound being tested.

Terrestrial Ecosystems

The traditional approach to study of the terrestrial ecosystem has focused on selected components. These components have tended to be biological, especially the large herbivores and carnivores. The manipulation of large carnivores has been fashionable for some time, and the sport value of the large ungulates undoubtedly has helped focus attention on their kind and fluctuation. Unfortunately, large animals are integrators of many factors, and therefore generally not the most sensitive indicators of incipient change in an ecosystem. There may be exceptions. The American alligator in the Everglades, as a sensitive indicator of hydrologic regulation, may be an example.

Another, and increasingly important, practical consideration is how large of a mesocosm would be required to study the relationships of large carnivores to herbivores, and their response to humans? Such a unit, if it were to be established today, would likely contain sub-units for which there is no true protection or which are not immune to externally imposed change.

As with aquatic ecosystems, there have been few terrestrial ecosystem-level studies of natural or anthropic stress which have included a broad array of organizational and process-oriented research and monitoring. Therefore, with few exceptions the results from true ecosystem studies can not yet be meaningfully compared. While there is free use of the term "ecosystem level" research, most such studies are not truly that. In reality, we are either biased or forced for financial reasons toward ecosystem process (function) or component (community) analyses—but

rarely both. This is particularly true in long-term study.

There must be steps taken to correct this absence of ecosystem study. As an example of this need, globally every place where atmospheric inputs have been sampled airborne contaminants have been found. So the question today is not whether there is air pollution, but what is its effect on terrestrial ecosystems? It is likely that widespread forested regions, particularly in eastern North America, are already in stages of ecosystem decline (Bormann 1985). But it is very difficult to assess the status of terrestrial ecosystems because of their complexity; the poor record of anthropic stress, such as change in land use and air pollution; and the natural variation which occurs within their components and processes.

Further, consideration must also be given to energy relationships in such ecosystems and the linkages of the terrestrial ecosystem to interconnected ecosystems and climate. The importance of the terrestrial ecosystem in regulating other biotic systems must not be underestimated. Forested ecosystems dictate much of the behavior of stream and lake ecosystems (Bormann and Likens 1985) and regional climate (Reifsnnyder 1985).

THE ECOSYSTEM CONCEPT

Odum (1963) defined the ecosystem as a biological community plus its nonliving environment. It is increasingly evident that the composite assessment of organisms interacting with the abiotic components and processes has the greatest potential for early detection of anthropic-induced stress. Further, this approach ap-

pears to offer the best opportunity to assess the magnitude of impact.

Ecosystem study requires assessment and observation over the long period to develop meaningful and testable hypotheses (Likens 1983). Without such knowledge of temporal variation and complexity, it is not likely that meaningful questions can be developed or tested. As we have seen with atmospheric contaminant impacts, it may take decades for aquatic and especially terrestrial ecosystems to show significant deviation from natural fluctuation in the variable(s) measured. What remains largely unquantified, and even less understood, is the cumulative influence on the ecosystem resulting from this deviation in one or a few variables.

Microcosm and Mesocosm

Microcosm and mesocosm studies have proven useful in the study of species interaction. But they are limited when testing interactions, say, between or among large ungulates and carnivores. In aquatic studies, it is well known that common mesocosm techniques rather quickly bring about conditions atypical of the remainder of the water body. For example, aquatic studies at this level typically ignore or eliminate natural variation in terrestrial nutrient input (Schindler 1987). Efforts to include even fish in aquatic mesocosm studies have largely proven unsuccessful. The magnitude of impact on lake integrity through introduction of non-indigenous fish species was not recognized for many years because of the absence of true ecosystem-level study.

Determining Ecosystem Status

Perhaps no other single written work more clearly defines the need

to have some appreciation of ecosystem status before locking into a long-term research or monitoring strategy than Odum's "The strategy of ecosystem development" (1969). Many ecosystem conditions, i.e., species diversity, ecosystem biomass distribution, and energy and nutrient cycling, are fundamentally influenced by ecosystem successional status. An ecosystem not being exposed to abnormal perturbation, natural or anthropic in origin, demonstrates well-defined developmental trends (Odum 1985). Conversely, stressed ecosystems show certain modified trends in primary productivity, decomposition rates, nutrient and energy cycling, and efficiency of energy and nutrient use. But considerable improvement in the level of knowledge regarding such processes as they change with succession is yet needed.

Sensitivity of Ecosystem Components and Processes

As previously mentioned, there are very few long-term ecosystem-level research programs from which general conclusions can be drawn regarding what may be the most sensitive components or processes to monitor. Indeed, such generalities are best left as such, and should not be considered conclusions.

In aquatic ecosystems, it presently appears that the most sensitive and earliest indicators of stress are changes in plankton community numbers and composition (Goldman 1981; Likens 1983, 1986; Schindler 1987, 1988). Processes such as primary production and nutrient cycling do not appear effective in detecting incipient change. It appears that chemically-induced stress, such as on planktonic herbivores, occurs very early and long before signifi-

cant trends may be observed in the lake or stream chemistry itself. But detecting such change is easily aggravated by factors such as altered watershed land use and fish stocking which can preclude assessments of more subtle stress, as from atmospheric contaminants. With more true ecosystem-level research in aquatic systems, we may yet find that selected processes will also prove valuable in detecting incipient change due to anthropic-induced stress.

To be most effective, ecosystem study should be complemented by whatever historical data exist. Here the best information source is likely lake benthic cores which are effective in quantifying past chemical inputs and, in some instances, biotic response to those inputs.

Conversely, in the terrestrial ecosystem, processes such as primary production, decomposition, and nutrient cycling appear to be the most sensitive early indicators of system stress (Bormann 1985). Again, the history of anthropic-induced stress is helpful in interpreting present data and in developing an I&M strategy. Likely the best source of such data is soil cores and change in their chemical composition. Unfortunately, few such analyses exist in natural-reserve baseline data sets. With more study, we may find that soil microbiota will prove to be sensitive indicators of stress. However, the taxonomy of such communities is quite difficult and this presently limits their use.

Thus, in assessing ecosystem response to stress, a fundamentally different conceptual approach should be used depending upon whether an aquatic or terrestrial ecosystem is the primary focus.

Assessing Natural- and Anthropically-Induced Variation

A number of potentially significant findings, common to most ongoing monitoring and research programs as the National Acid Precipitation Assessment Program (NAPAP) and LTER, are emerging. First, the testing of germane hypotheses on ecosystem structure and function requires an ecological context which can only be provided through long-term monitoring. Second, many of the "index" biological and chemical species studied for detecting human-induced change have considerable annual natural variation in occurrence, magnitude, and frequency. Separating human-induced change in ecosystem structure and function from natural change requires detecting statistically significant trends against what may be very "noisy" baselines. This raises the need for long-term commitment to ecosystem research and monitoring. Third, ecosystem studies permit the analysis of processes operating between and among biotic and abiotic components. There is increasing evidence that understanding the magnitude and variation within such processes can provide an earlier indication of environmental change or trends attributable to human sources. Fourth, a holistic view of the ecosystem better permits assessment of the full magnitude of impact which can serve as a stronger basis for possible mitigation. This is particularly important if more than routine bureaucratic response is required, as in the case of resource threats arising external to reserve boundaries. Fifth, to be effective, studies at the ecosystem level need to be truly multi-disciplinary in design.

The goal of ecosystem-level study is the understanding of ecosystem

structure and functioning. The focus is both on more static indicator components, often measured on a periodic basis as permanent plots, and dynamics as the quantification of factors affecting the transfer among biotic and abiotic components of energy and nutrients. For the latter the medium of choice is water. The "ecosystem" may be a laboratory or greenhouse container, a field plot, or increasingly a watershed.

LONG-TERM INVENTORY AND MONITORING

Monitoring programs employed in the future must have a number of characteristics. They should be relatively simple, which increases the likelihood they can be conducted in a consistent manner. This improves the probability that the data collected will be of good quality. Programs must be easily verifiable—another key component in good quality assurance. Both these characteristics decrease the impact on data collection and quality resulting from the inevitable changes in personnel. Monitoring programs must be properly budgeted to ensure some minimal level of continuity even during budget cuts. They should, as a minimum, include the monitoring of sensitive components or processes. Finally, the monitoring should be done with some knowledge of what stresses may have occurred in the past.

Obviously, present monitoring programs are not conducted with major consideration given to many of these characteristics. This is most evident when it comes to monitoring sensitive aspects of ecosystem integrity, and possessing knowledge of historical disturbance or stress. Re-

searchers tend to downplay monitoring and inventory as not essential to their personal research interests since their involvement is often relatively short-term. Also it is difficult, if not impossible, to obtain funding for I&M through traditional sources. Government agencies, the logical unit to pick up long-term monitoring costs in view of their public policy and regulatory role, have a very short memory when it comes to providing for continuous monitoring over periods beyond three years.

Poor knowledge of ecosystem structure and function greatly limits the effectiveness of our present monitoring efforts. There is still much room for good science associated with inventory and monitoring. While there have been efforts, notably the LTER, selected Federal experimental areas, and, perhaps, MAB, these alone will not suffice. It is ironic that this situation exists for had there been perhaps eight national sites with the long-term monitoring record of a Hubbard Brook, New Hampshire, the issue of acid rain may never have reached the "sledgehammer" phase where public consternation and the lack of Federal credibility demanded the immediate expense of a NAPAP.

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Addressing Global Change— From a Global Perspective

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This is a discussion about perception and scale. It is also about the USNPS and the U.S. Global Change Program. What I hope to illustrate is how our perception of scale strongly colors our response to problems and our role in solving those problems. Participation in the U.S. Global Change Program offers an opportunity to revise our perception of our-

selves as an agency, and we should take it.

I recently wrote an article with a colleague wherein we stated that ecology, and especially ecosystem science, has undergone a revolution over the past three decades because of the explosion of new technology (Baron and Galvin 1990). As our problem-solving capability has grown, so has our perception of humanity's role on Earth. Environmental damage at a local level was widely recognized 20 to 30 years ago, and prompted the environmental movement of the 1960s. Regional-scale environmental problems with multiple effects and difficult political solutions have been perceived more recently; the issue of acidic deposition provides an example of such a "second-generation" concern (Clark and Holling 1985). Today there is a growing awareness of human interference in global atmosphere-biosphere cycles brought about by the combined actions of all peoples on Earth (Clark 1989).

These three levels of concern (local, regional, and now global) have not replaced one another (Clark and Holling 1985). Instead, the effects are superimposed one upon another, creating a complex web of interactions and threats that must be frightening indeed to managers of public lands.

As with any federal bureaucracy, there has been lag time between scientific discovery and implementation of policy, but the USNPS has responded to the different generations of concern. There was an induction of biologists in the 1960s as part of the "Mission 66" planning and development program. Many of these biologists were brought in to manage large animal populations within parks. Threats to national parks, such

as overpopulation by large ungulates, were perceived as local, and local solutions were tried. In the 1970s and 1980s perception of regional-scale problems crept into management policies with the understanding that parks were affected by many problems extending from far outside park boundaries. These included urban and suburban encroachment, worsening regional air quality, and water pollution. USNPS Regional and Washington Office programs were added to help achieve understanding of the consequences of acid deposition, loss of visibility, increasing demands for water, migration of animals over long distances, and other regional-scale issues. During the 1970s many parks were designated as Biosphere Reserves. For many, this inaugurated the idea that parks contain important ecosystems that need to be protected for their intrinsic value.

Now Congress has launched a grand new program to observe, understand, and predict the causes and consequences of global-scale change (CES 1990). We in the USNPS are part of it, thanks to Bill Gregg. How should we respond? What is our role?

When our perspective was local (and some parks still view themselves this way) we tried to manage our resources based upon perceptions of national parks as islands of raw nature, vignettes of primitive America. As our understanding increased, management perspectives enlarged to cover the concepts of airshed and watershed. Many parks today perceive themselves as part of a greater regional ecosystem with commonly shared resources and problems. We now have an opportunity to enlarge our perspective still further, and view ourselves in a global context.

What do we see when we step back and look at Earth? Vast areas have been altered by human activity. Remaining natural lands are dwindling in size. Industrial emissions are altering global climate more rapidly than at any other time in the past 100,000 years. Against this gloomy backdrop, national parks and natural preserves have an important role. It doesn't take a crystal ball to foresee a time when national parks will preserve some of the few remaining examples of naturally operating ecosystems. We may need these examples in the years to come for our very survival.

Our founding fathers asked us to preserve and protect national parks for the enjoyment of future generations. Our founding fathers did not perceive that increased awareness of local, regional, and global interactions would bring a host of philosophical questions and management choices. Park management is no longer a practice of letting nature take its course. The revolution in ecological understanding has given us the ability to dimly predict and thus prepare for change. And *change will occur*, by local, regional, and global-scale causes. We are the stewards of the premier natural lands of this country. Stewardship carries responsibility. Our responsibility as an agency is to develop paradigms for wise, long-term preservation of natural lands, *and then employ them*. We must adopt a global perspective, in addition to our local and regional perspectives. The role of the USNPS is to husband the national natural heritage that is contained in our parks. It follows naturally, then, that our role as USNPS scientists is to provide the ecological understanding upon which sound management can be based.

The U.S. Global Change Program can provide a strong push in this direction by helping us adopt a global perspective. The current USNPS Global Change Program asks individual parks to address how global change will affect them and their surroundings. I think it would also be beneficial to ask some questions at a national scale. We can ask questions by looking *in* at our resources: Which national park resources are at the most risk from global-scale changes? Will some parks experience the effects more rapidly than others? How vulnerable are parks that were created to preserve certain specific ecological communities and organisms? And we can also ask questions looking *out* at the greater community: What questions do we need to address regarding our resources *that no one else will address for us*? How valuable are our resources to the rest of the world? What can we offer to the international global change research community? How can we work together with that community to protect the national legacy? If we ask these questions in the true vein of searching for the best ways of managing our natural legacy, we may emerge with a sound, flexible, natural resource management policy dedicated to maintaining the integrity of our national parks through the 21st century.

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Global Change: An Opportunity for the 1990s

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USNPS involvement in the U.S. Global Change Research Program (USGCRP) provides a unique opportunity to prepare our national parks for future environmental threats while strengthening the role and im-

age of science in USNPS decision making. Saddled with an image of restricted access, limited potential for experimental study, and inconsistent research support, national parks have frequently been overlooked as sites for conducting quality science; for example, the U.S. National Science Foundation's Long-Term Ecological Research Program has avoided funding research in national parks largely due to their inconsistent record of scientific production and management support. Opportunities to undertake significant new research aimed at improved understanding of the potential effects of climatic change on natural ecosystems provide a mechanism for developing scientifically based management strategies while catapulting USNPS research into the mainstream of science in America.

Threats of human-induced climatic change must be taken seriously. In addition to the prospects of an increase in average global temperature (i.e., "global warming"), we must be concerned about changes in atmospheric circulation patterns leading, directly or indirectly, to changing patterns of disturbance. The frequency and severity of storms, drought, and fire can significantly alter species distributions and abundances, ecosystem processes, and run-off characteristics, thus changing the very nature of many parks. It is critical that the USNPS develop the ability to predict the consequences of alternative climatic scenarios on park ecosystems.

National parks provide an increasingly rare resource: large tracts of relatively undisturbed land provide opportunities to understand influences that shape natural ecosystems. They provide the opportunity to observe interrelations between climate,

biota, and disturbance (such as fire, drought, and hurricanes). The ability to carry out baseline studies of community composition, structure, and process in unmanipulated ecosystems will constitute a key component of the USGCRP. National parks have an opportunity to be an integral part of this program.

A principal goal of USNPS global change research should be to understand and predict biotic hydrologic changes under different climatic scenarios. This will require understanding the basic relationships between climate, disturbance, and biota, as well as development of models to predict how these relationships, and ultimately the distribution and abundances of habitats and species, will be influenced by different climatic and management scenarios. Similarly, we must be able to predict changes in hydrology and human interactions as well as recommend strategies for mitigation and adaptation. To be successful, such programs must be coordinated with surrounding land management agencies into a regional approach.

A comprehensive study of the potential effects of global change on park ecosystems must integrate disciplines and time periods. For example, paleoecological studies of past climate, biota, and disturbance regimes can improve understanding of how species and communities respond to changes in climate and disturbance, and provide a retrospective test for predictive models. Modern studies of vegetation, fauna, climate, and environmental controls of species distributions provide information necessary to (1) parameterize plant succession, fire behavior, climatic, and hydrological models; (2) determine species-environment relationships; and (3) detect early changes,

thereby providing a further check for model validation. Finally, predictive studies integrating information from paleoecological and modern studies will be necessary to forecast changes in vegetation, species vulnerability to local extinction, and hydrologic changes under different climatic and management scenarios. The USNPS must recognize that assessment of the effects of climatic change will require well-designed, statistically valid, interdisciplinary research. This may require concentrating available funds in a few sites to assure more significant results can be obtained. Such an approach is a tall order for an agency that historically has felt most comfortable with a modest science program focusing on basic natural history.

In carrying out such a program the USNPS must recognize its limitations. The USNPS science program lacks much of the expertise and credentials to successfully implement integrated predictive research without considerable assistance. It is important that we branch out, forming cooperative ventures with scientists skilled in such disciplines as climate modeling, paleoecology, ecosystem and landscape ecology, and forest simulation modeling. Research results must be highlighted at national meetings and in refereed journals. Peer review must be sought and seriously incorporated at all levels of the program, since it will ultimately determine the success of the program as well as the overall reputation of USNPS-sponsored science in coming decades. Finally, sufficient resources must be committed to assure that comprehensive scientific programs can be developed and continuity in funding and personnel assured.

The USNPS should look at the global change program as an oppor-

tunity: an opportunity to assure a respected place for its research program both in guiding future park management and as a significant contributor to the nation's scientific legacy.



Global Climate Change:
Ecological Research and
Monitoring for Resources
Management

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Worldwide concern for the health of Earth's biosphere has been frequently expressed during the ongoing global climate change debate. The scientific community, in spite of limited knowledge of global processes and trends, as well as continuing—and often considerable—dispute, has been able to reach some agreement. Evidence obtained from ice cores demonstrate carbon dioxide (CO₂) increases during industrial times. A conclusive modern record of atmospheric CO₂ increases since 1958 has been accumulated (FIGURE 1). Further, Richard Kerr reports in *Science, Research News* (1990a), the In-

ternational Panel on Climate Change (IPCC), in their Scientific Assessment, has concluded:

- Average global temperature will increase from 1.5°C to 4.5°C or at a best guess of 2.5°C.
- Sea level, without strict controls, will rise 8 to 29 cm by 2030.
- Continental interiors might *dry* during the summer.
- Warming during the past century is real and is between 0.3°C and 0.6°C since the 1800s.
- Detection of current global warming with high confidence will likely require a decade or more.
- There is virtual unanimity among greenhouse experts that "a warming is on the way and that the consequences will be serious."

This perceived "ticking clock" has spawned a worldwide interest in environmental conservation, maintenance of genetic diversity, and education of the world's populace about a planet that is increasingly being altered by human activities.

There is little doubt that in the past there have been any number of dramatic short- and long-term climatic events. These are thought to depend on various periodicities. They range from the newly recognized two-year or four- to five-year cycles that may affect El Niño events (Kerr 1990b) or the Amazon River discharge (Richey et al. 1989); to the Milankovitch cycles of 22,000, 41,000, and 100,000 years and sunspot cycles of 11 years that have been recognized for some time; or, to the everyday cycles that control our activities: seasons over one year, diurnal of one day, or tidal of about 12

hours. Of note, however, are "abrupt climate changes" that have been observed in the geologic record, which likely represent events that occurred over thousands or even hundreds of thousands of years. Today we are concerned by the speed with which change is occurring (FIGURE 2) and the capability of the biosphere to respond, given the degree of modern habitat modification.

Broad concern about taking the long perspective and the need for long-term environmental monitoring of global ecosystems has led to efforts to institutionalize the collection of environmental data not just for the purpose of expanding our understanding of ecosystems and natural resources, but also for dealing with environmental surprises—inexplicable changes or environmental disasters. I have been impressed by the similarity of global themes and corresponding trends that concern diverse groups. I find a common conviction that we will be required to shed our isolation and to deal interactively with a number of globally important "trends" and pervasive problems that will affect all resources decisions in the future. Our world will be marked by change; understanding the nature of change may be the key to dealing with surprises and in coming to "correct" resources decisions. The importance of maximizing interdisciplinary goals with our vision of the future cannot be overstated.

The nature of our global concerns has been expounded upon in a number of recent scientific articles and in the four global change reports of the International Geosphere-Biosphere Program (IGBP) issued between 1986 and 1988 (ICSU 1986, 1987, 1988a, 1988b). These reports and that of the U.S. Committee on

Earth Sciences (1989) have repeatedly articulated the need for studies of global change phenomena. They reiterate the need to forecast anthropogenic effects and to acquire improved knowledge of "natural" background change. These committees have further discussed the need to better understand the nature of physical, chemical, and biological processes that affect the hydrologic cycle and balance the "Earth System."

Previous programs have recognized analogous needs. The Unesco Man and the Biosphere Program (MAB) began in 1971 owing to the deliberations of many countries about the need to protect and understand representative ecosystems and to put *humans* in their proper place in global conservation discussions. The U.S. Long-Term Ecological Research Program (LTER) officially began in 1979 for the purpose of better understanding the nature of subtle ecological processes. Both the MAB and LTER programs acknowledge the need for a network of monitoring and research sites to carry out comparative experiments, if long-term trends or cyclic changes of ecological phenomena are to be discovered, and to foster an interest in integrated ecological research and monitoring pertaining to global trends and processes (LTER 1990, Herrmann 1990).

Long-term information about our environment is essential to understand global issues such as the ramifications of deforestation or other land use changes, the build-up of greenhouse or other gases, changes of oceanic and atmospheric circulation, desertification and other changing weather and precipitation patterns, rising or falling sea levels, and the alteration of biogeochemical cycles, to mention but a few. The resources

management community has become used to dealing with large variability and the requirement for long records, but what is now called for may be the ability to contend with rapid deviations from the historical trends, from the expected. It will be important to future resources knowledge and planning that we understand both the spatial and temporal ramifications of these global influences. Such considerations directly affect the land management community. Human as well as natural perturbations act over long periods of time upon already highly variable ecological systems. Whether to preserve, conserve, or plan the wise use of future developments we must understand the various complex aspects of geosphere-biosphere interactions and apply this knowledge to site-specific issues.

The World Commission on Environment and Development (1987) warned that "the present decade has been marked by . . . complex problems bearing on our very survival: a warming globe, threats to the Earth's ozone layer, deserts consuming agricultural land." The Commission proposed that the international community prepare "long term environmental strategies for achieving sustainable development by the year 2000 and beyond." This recognition of the need for understanding interrelationships between "people, resources, environment and development" signals a move away from treating natural resources solely as commodities.

During recent years a number of forums concerned with preparing for the 21st century have convinced me of the continuing and expanding role for resources information transfer. Resources managers require a more in-depth understanding of global is-

ues if humankind is to have the ability and the foresight to sensibly and effectively manage for the optimal use of resources in light of many uncertain, complex, and interactive global trends. The research community has an important role to play in providing a forum to identify, discuss, exchange, and evaluate new concepts relative to individual management needs. Cooperation and communication within the resources management community between scientist, manager, planner, and developer at both the national and international levels, and among the resources disciplines, will also be required to meet these new challenges. Many changes in how we think and how we approach resources problems are possible.

The foregoing argument selectively surveys and emphasizes a few—but, I believe, important—long-term activities related to our global climate change debate. A common theme is the expansive interdisciplinary approach that prompts improved resources knowledge and improved solutions to resources management problems. In this context, our future resources decisions become a part of a larger decision structure, one that considers the geosphere-biosphere (the Earth System) as well as the local and regional settings. Many common resources management questions have so far eluded solution because they have been framed too narrowly; thus, our current inability to predict or understand ecosystem-level responses to incremental anthropogenic influences. Interdisciplinary efforts directed toward developing basic watershed and ecological knowledge and understanding linkages between climate, the hydrologic cycle, chemical processes, and the biota, will as-

sist our progress toward solutions to these difficult environmental problems.

Thus, looking ahead, the issues are complex but the problems are not insoluble. They do require that we share our capabilities and our understandings between scientists (physical, biological, and social), managers, planners, legislators, jurists, and the others who make up our 21st-century resources management community. New knowledge thus obtained and shared will assist us to better manage both our preserves and our developed lands.

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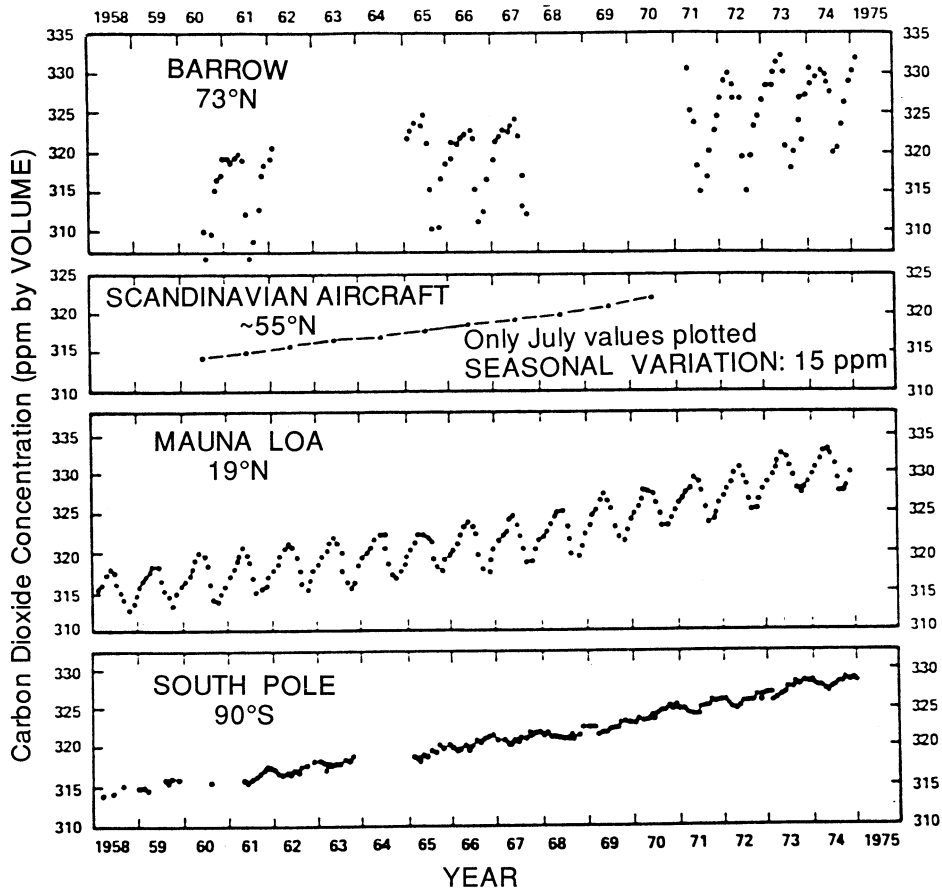


Figure 1. Atmospheric carbon dioxide monitoring levels, 1958-1975 (ORNL Drawing 78-1937, Olson et al. 1978, from: Machta et al. 1977).

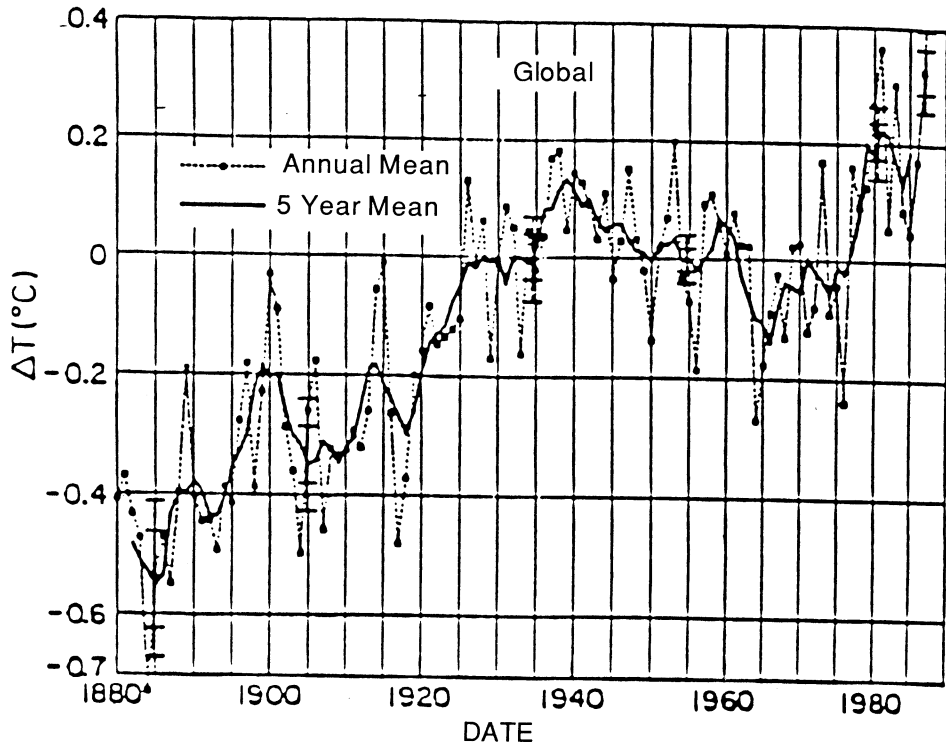


Figure 2. Normalized mean global temperatures, 1880–1987 (Linns et al. 1988, source: Hansen and Lebedeff 1988).

Society News, Notes & Mail

The George Wright Society • 1990

Forum Welcomes Researcher Queries

Let's say you're working on restoring a portion of the landscape of your park to its the appearance it once had during a certain historical period. You've studied the literature, picked the brains of your co-workers, —in short, run down all the usual sources. Yet you've got a feeling that there may be more out there; maybe somebody in another park knows something you can use. But how do you reach them?

Whether the topic is historic preservation, genetic diversity, GIS, interpreting archeological sites . . . you name it, there's expertise on it in the U.S. and Canadian Park Services. To help you tap into that knowledge, we're beginning a "Research Quer-

ies" column in the Forum. You know what we mean: "For a study of historic landscapes in the Great Plains region, I would appreciate hearing from anyone with helpful documents or firsthand experience. . . ." Your query will reach like-minded professionals from all over North America, because the Forum is sent to every national park unit in the USA and Canada. No other publication reaches such a wide range of park professionals working in *both* cultural and natural resource issues.

So send us your queries (fewer than 100 words, please), along with your name, address, and phone number. They will be printed in the next issue after they are received.

Members Approve Revision of Articles of Incorporation

At the October 11 Membership Meeting in Sacramento, it was announced that the membership (paid-up members only were eligible for voting) had approved the proposed revisions to the Society's Articles of Incorporation. The revision of Article VII permits the three-year terms of the elected Board of Directors to be staggered, and the elected Directors will have the right to appoint others to the Board. The vote was 100 to 3.

At their meeting in El Paso on November 11, the Board also approved a revision of the By-Laws

of the Society, which serves to bring the By-Laws into line with the Articles and with other realities. The Board will be increased to nine elected directors (up from eight), and additional (fewer than eight) directors may be appointed to the board by the elected board members. The Board may also appoint an Executive Director to carry on the day-to-day business of the Society. It's a bit dull reading, but members may request a copy of the new By-Laws at any time.



Membership in the Society

The George Wright Society was founded August 18, 1980. It is chartered in the State of Delaware, in accordance with the laws of the State of Delaware and of the United States of America, as a nonprofit educational and scientific organization dedicated to the protection, preservation, and maintenance of cultural and natural parks and reserves through research and education.

Membership is open to those who are "interested in promoting the application of knowledge, understanding, and wisdom to the management of the resources of natural and cultural parks, sites, and equivalent reserves." Annual dues are: Regular Member, \$25; Student Member, \$15; Sustaining Member, \$500. Life Memberships are \$250. Annual subscription rates to The George Wright Forum only (without membership in the Society) are: Libraries, \$25; Individuals, \$20. Dues, contributions, and subscriptions are tax-deductible for US citizens.

Materials Submitted for Publication

The editorial board welcomes articles that bear importantly on the objectives of the Society—promoting the application of knowledge, understanding, and wisdom to policy making, planning, management, and interpretation of the resources of natural and cultural parks, sites, and equivalent reserves around the world. The Forum is distributed internationally; submissions should minimize provincialism and aim to broaden international aspects and application.

Language of Submission Current readership is primarily English-speaking, but submissions in other languages will be considered; in such cases an English summary should be prepared.

Form of Submission We strongly urge authors to submit articles on computer disk. This eliminates troublesome re-keying. Almost any Apple Macintosh disk can be read in its original format (please indicate the version of the software). Otherwise, send an ASCII-file disk; both 3.5" and 5.25" double-density formats are acceptable. (No high-density disks, please.) A double-spaced manuscript must accompany all submissions in case there are compatibility problems.

Style The Forum contains articles in varied fields: history, geology, botany, zoology, archeology, management, etc. Please follow your field's conventions for citations, bibliographies, and so on. Normally these various styles will be retained in the Forum.

Illustrations Submit line drawings, charts, and graphs as nearly "camera-ready" as possible. If submitted in a size that exceeds the Forum's page dimensions, please make sure the reduction will still be legible. The preferable form for photographs is black-and-white (matte or glossy) prints. Medium contrast makes for better reproduction. Color prints and slides may not reproduce as well, but are acceptable. Half-tones from newspapers and magazines should be avoided if at all possible. Please secure copyright permissions as needed.

Correspondence

All correspondence, requests for information, and Forum submissions should be sent to:

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[The telephone number of the Hancock office is (906) 487-9722.]

Mobilizing Worldwide Action to Sustain the Living Resources of Our Planet:

The Biodiversity Conservation Strategy Programme

Organizers:

**International Union for the
Conservation of Nature and
Natural Resources**

**United Nations Environment
Programme**

World Resources Institute

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Within the past few years, news stories on habitat destruction and species extinction have made the worldwide erosion of biological diversity a topic of general conversation. People all over the world have at least a passing knowledge of what is happening to the moist forests of the tropics, the old-growth tracts of the North American Pacific region, and natural communities of sub-Saharan Africa—to name just a few critical areas.

Now, three international conservation organizations have launched an ambitious program of research and consultations that will lead to a global strategy and action plan to conserve the world's biodiversity. One of the organizations is private: the World Resources Institute (WRI), based in Washington, D.C., The International Union for the Conservation of Nature and Natural Resources (IUCN), headquartered in Gland, Switzerland, has both governmental and private groups as members. The third organizer is the United Nations Environment Programme (UNEP), whose main offices are in Nairobi. Below we have reprinted a program description written by IUCN, UNEP, and WRI, dating from September 1990.

A great deal of attention has been paid to establishing the economic value of conserving biodiversity. To be sure, money talks, and it may well be that the best way to get governments to pay attention to biodiversity conservation is to demonstrate that doing so is in their economic interest. Yet for many people, protecting biodiversity is a moral and spiritual imperative. In a brief article following this one, J. Ronald Engel of the IUCN Working Group on Ethics, Culture, and Conservation updates us on how ethical considerations can be incorporated into the Biodiversity Conservation Strategy and the forthcoming successor document to the World Conservation Strategy.

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PROGRAMME DESCRIPTION

The world is being impoverished by the loss and degradation of its most fundamental living resources—its genes, habitats, and ecosystems.