

MEETING REPORTS

Sustainability and Biodiversity of Tropical Ecosystems Symposium

Held at Oregon State University, Corvallis, Oregon, USA, on 27 May 1999

A major paradox in conservation is that amongst the countries of the world biological wealth correlates poorly with economic wealth. That is, much biological diversity is concentrated in non-industrialized countries with large impoverished populations. This situation has historically created conflicts between the need for economic development to meet the basic needs of rapidly increasing populations and the desire to preserve the integrity of ecosystems and conserve biodiversity. To increase the awareness and understanding of these issues by students, faculty, and the community, the Oregon State University's Department of Forest Science invited experts from several disciplines to discuss the complex issues of sustainability and biodiversity in tropical ecosystems.

The symposium focused on the causes and consequences of, and solutions to, deforestation, and the nature of biodiversity. Although the biological and social systems differ amongst tropical areas, some common causes, consequences, and solutions exist.

Although indigenous peoples have sustainably inhabited tropical forests for millennia, current land-use practices, deforestation in particular, are threatening the systems' sustainability and biodiversity. As Kamaljit Bawa (University of Massachusetts, Boston, MA, USA) stated, the rate of deforestation is a hotly-contested issue with estimates spanning a two-fold difference. In Costa Rica, rainforests have been replaced by banana plantations and cattle ranches. In Brazil, large areas of forest are cleared and burned for ranching. In Borneo, forests are being replaced by farms for transmigrants and oil palm plantations. To understand the dynamics of deforestation, both the proximal and distal causes must be examined.

The proximal causes of tropical deforestation include conversion to crop land and pasture, fuelwood extraction, timber harvesting, and creation of hydroelectric dams. Mary Stockdale (Mulawaran University, Indonesia) made an important distinction between pioneer and indigenous farmers in Kalamantan, Indonesia. Indigenous farmers try to practise traditional swidden agriculture, involving the rotation of a fixed amount of land into and out of crop production. The pioneer farmers use less-sustainable practices, often including progressive land clearing followed by cropping and then abandonment.

The distal, or driving, causes of deforestation include population growth, the 'tragedy of the commons', lack of local political power, governments that are ignorant of local conditions, lack of adequate management policies or enforcement of policies, government corruption, greed, global commodities markets, and World Bank subsidies based on inappropriate development models. These distal causes are often multi-faceted and very complex. For example, Bawa noted that although logging has been banned in parts of India, deforestation in these areas is continuing at high rates due mostly to small-scale, incremental harvesting for fuelwood and fodder.

Due to the high rates of deforestation of tropical forests, the supply of amenities from these ecosystems is being threatened,

which in turn is threatening the welfare of both local and global communities. Deforestation negatively impacts natural disturbance patterns, soil fertility, carbon sequestration, biodiversity, the survival of native cultures, and the supply of forest products. J. Boone Kauffman (Oregon State University, Corvallis, OR, USA) discussed the consequences of one of the major deforestation mechanisms, namely fire. He presented evidence that carbon emissions from rainforest combustion can be substantial and converted systems contain much less carbon (with similar, often exaggerated trends for nutrients). He also highlighted the fact that alterations of the natural fire regimes are increasing the fragmentation of the remaining primary forest. This fragmentation may be a larger threat to the ecosystems' integrity than the direct losses of habitat due to deforestation.

In Malaysia, rainforest loss is directly related to the degradation of human health. Adela Baer (Oregon State University, Corvallis, OR, USA) discussed the negative impacts of deforestation on the indigenous Orang Asli people of Malaysia. Since they have no land rights, the encroachment of outsiders has forced them onto smaller plots of land and into crowded villages, and this has led to higher levels of malnutrition, diseases such as malaria, and infant mortality.

Ecosystem health is also degraded by deforestation, as evinced by declines in biodiversity. Phil DeVries (University of Oregon, Eugene, OR, USA) highlighted the importance of developing measures to compare biodiversity amongst sites that account for sampling biases. DeVries explained that most butterfly species he collected at two sites in Ecuador over a year of sampling were represented by fewer than 10 individuals, and many were represented by a single individual. These sites included one disturbed forest and an intact forest. Therefore, biodiversity estimates are extremely sensitive to sampling intensity and the data must be normalized for comparison between studies and sites.

David Peart (Dartmouth College, Hanover, NH, USA) studies mechanisms that maintain the extraordinary diversity of species in Bornean rainforests, where a single soil type may support 400 species of trees. Such remarkable species diversity cannot be explained by the classic 'niche specialization' hypothesis, because there are not enough different niches. Peart and his colleagues have provided evidence for density-dependent selection as a major force maintaining species diversity in Borneo. Seedling survival rates are inversely proportional to the abundance of a given species, so rare species are maintained in the system and no species attains exclusive dominance.

Although no universal solution to deforestation exists, a number of critical components of successful management plans were outlined at the symposium. They include incorporating the knowledge and needs of local peoples, changes in government priorities and policies, security about tenure and access to land, economically-based incentives for forest preservation, changes in agronomy and forestry practices, and financial and political support from the global community. Examples of sustainable management plans were presented for India, Borneo and Hawaii. Bawa presented an encouraging example of a 'participatory resource management' project

in India that included market-based incentives. Through empowerment of the local Soligas people and technical assistance provided by outside agencies, the local inhabitants had striven towards sustainable harvests of renewable resources by monitoring the local environment and producing value-added products such as honey and processed fruit.

David Perry (Oregon State University, Corvallis, OR, USA) outlined an approach to conservation that focused on ecosystem restoration using the best available science while remaining consistent with the local culture. He described a community of native Hawaiians who are looking to restore their lands as a mechanism for their own spiritual and cultural restoration. Stockdale discussed the shifting cultivation of the Dyak people in Borneo, who use all successional stages of the forest, grow a wide variety of crops in multi-species plots, and contribute rattan to global markets. These traditional practices are being threatened by strong institutional forces promoting forest conversion, and this has led to a loss of land tenure and disincentives for sustainable management.

In summary, Bawa outlined paradigm shifts that must occur if tropical deforestation is to be slowed. Current uses and perceptions must be changed from: (1) harvest of timber to low level 'harvests' of non-timber goods and services; (2) management of single-species to management of ecosystems; (3) forests as inexhaustible resources to the need for conservation; (4) management by forestry departments to management by many stakeholders; and (5) benefits to one entity to benefits to many groups.

The challenge for mitigating the effects of deforestation is to integrate scientific concepts with complex social issues to derive a workable strategy for conservation. Of course, we did not come close to accomplishing this with this one-day symposium, but strides were made in identifying significant issues and in sketching out promising strategies for conservation and restoration. Although some promising examples of sustainable systems were presented, it is uncertain how these models could be generalized in the face of strong institutional forces driving forest conversion. Understanding of tropical systems is still too rudimentary to allow elaboration of management schemes that can be sustained for generations, but a move in that direction has begun.

BRETT J. BUTLER
STEPHEN DIFAZIO
MAUREEN DUANE
TIFFANY NEAL
MARGO STODDARD
*Department of Forest Science
Oregon State University
Corvallis, OR 97331, USA*

Workshop on Integrated River Basin Management in Latin America

Held in Mexico City during 26–28 April 1999

Integrated river basin management is not a new concept; it was developed more than five decades ago, but its implementation has left much to be desired. For Latin America, interest in integrated river basin management was rekindled in the 1990s, and it has resulted in the establishment of river basin authorities in several countries. Knowledge and experience transfer within the Latin American coun-

tries have tended to be poor, and various Latin American advances in this area in terms of new ideas and technologies are often unknown within the same country. In order to distil the Latin American experiences on integrated river basin management, objectively review the status of implementation of the concept in the region, and consider what other feasible management alternatives may be available, the Third World Centre for Water Management (TWCWM) convened a high-level workshop on this issue with the support of the Committee on International Collaboration of the International Water Resources Association (CIC-IWRA), the Inter-American Institute for Cooperation on Agriculture (IICA), the British Council and the International Water Management Institute (IWMI).

Participation at the workshop was by invitation only, and was restricted to 25 senior policymakers and experts on water resources planning and management in Latin America. Thirteen background papers were specially commissioned to set the scene for the discussions. Amongst the papers commissioned were: global reviews on experiences of integrated river basin development planning and management; experiences of the Inter-American Development Bank in the region; the role of the governments in the integral management of basins in Latin America; and specific case studies from Argentina, Brazil, Chile, Mexico and Venezuela. Technical, economic, social and environmental issues, as well as legal and institutional perspectives were reviewed in depth.

The issue of sustainability within the context of integrated river basin management was an important focus of discussion. It was noted that even though sustainable development is a very attractive concept, its application to river basins has been mostly unsuccessful. Progress has been incremental thus far. Amongst other major issues discussed during the workshop were: lack of real public participation because of prevailing hierarchical decision-making processes; difficulties in integrated management of international river basins because of national sovereignty issues; development of water markets and other economic instruments for demand management; institutional weaknesses; preservation of social and cultural values; and environmental conservation. Integrated development of river basins unfortunately seems often to be more a reflection of the interests and priorities of the main institutions involved in the water management and planning processes than rational management of water and associated resources to maximize the benefits to the populations concerned on a long-term basis.

So far as the concept of efficient river basin management is concerned, it was agreed that a better conceptual framework is needed, with strong emphasis on its implementation potential within varying technical, social, economic, environmental and institutional conditions prevailing in the region. Broad generalized concepts are counterproductive, since people interpret them very differently and the implementation of vague ideas is very difficult, if not impossible. It is important to realize that the integrated management of river basins depends on political, economic, social, cultural, historic and environmental issues, which vary temporally and spatially. Only two countries in Latin America, namely Brazil and Mexico, are now required by law to consider river basins as units of management for national water resources. These management units were considered necessary for the optimal management of water resources by these two countries. While this arrangement appeared to work for a few cases such as the Upper Tiete Basin in Brazil, it was agreed that it did not in most cases represent the best practical alternative for the management of water resources. Regionalization was recognized as a more feasible option to achieve practical solutions.

It was noted that integrated management of river basins, irrespective of the rhetoric, has made limited progress. Integrated planning of river basins should be based on a dynamic methodology which can be adapted to specific conditions. There should be long-term plans but with clear short and medium-term goals. The authorities responsible for water management should not be isolated from the other ministries, which in reality is a difficult goal to achieve. For Latin America, water is a national priority, and its efficient planning should simultaneously include water requirements of different economic sectors as well as the impacts of these sectors on the water planning process. This again is difficult to achieve within the current overall political-institutional framework.

The present models of river basin management depend heavily on high initial investments for infrastructure, which may not be feasible for the Latin American countries due to the regular economic crises which they have faced in recent decades. This reality is likely to force the water planners to develop models which depend less on substantial financial investments and more on management-oriented solutions. The implementation of economic instruments requires special attention, since the absence of adequate regulation and surveillance could result in monopoly situations and/or improper management processes. Economic issues are very important, but they should not be automatically considered to be the only, or even the main, alternative for sustainable river basin management.

Legal frameworks related to river basin management should be congruent with the economic, social, political and institutional conditions of the different countries. Legislation should be redefined so that it is compatible with the present trends of increasing privatization and social participation. Emphasis should also be placed on implementation of existing legislation.

The meeting noted that sufficient qualified expertise currently does not exist in the Latin American countries to ensure integrated management of river basins. Capacity building, holistic vision and interdisciplinary approaches have now become essential for river basin management. A new generation of water professionals with a broader mind-set and appropriate management skills, is urgently needed to manage the river basins and Latin America is no exception to this global trend.

Although it was noted that social participation is essential for better water management, methodologically, it is still very difficult to ensure such participation in water management. Often, interest groups seek to manipulate the water management processes to promote their own ends. Access to data and information was also recognized as an important constraint.

The papers commissioned for the workshop and its results will be published by Oxford University Press, with Asit K. Biswas and Cecilia Tortajada as editors.

ENRIQUE CASTELÁN-CRESPO
Third World Centre for Water Management
Viveros de Tlalnepantla 11
Viveros de la Loma
Tlalnepantla, Mexico City 54080
Mexico

Criteria, Indicators and Tools for Monitoring Ecosystem Health

A Congress held at the Sacramento Convention Center, Sacramento, CA, USA, during 15–20 August 1999

Organized by the International Society for Ecosystem Health (David Rapport) and the University of California at Davis (William Lasley, Calvin Qualset) with the aim of discussing the state-of-the-art and future perspectives in this emerging field of science, the principal focus of this congress was on opportunities for averting further degradation and recovering the health of the planet's ecosystems in the next century.

One of the main issues raised by the speakers concerned the lack of a well-established, efficient and effective set of criteria, indicators and tools aimed at monitoring and managing ecosystem health, without which the development and implementation of management strategies directed at recovering health in degraded ecosystems may not occur. Since human health is affected by deterioration of ecosystem health, these are the instruments that will make it possible to develop preventive rather than curative measures. Implementing such measures will help re-establish the natural functions, diversity, services, and, ultimately, the quality of human life itself. David Jessup (California Department of Fish and Game, Santa Cruz, CA, USA) characterized healthy ecosystems as those that: do not have obvious environmental degradation, frequent pollution events or serious anthropogenic effects due to overharvest; do not have a high frequency of new or emerging diseases or intoxications with negative implications for human and wildlife health; have stable, or at least not declining, species abundance and diversity; and do not have frequent die-offs or similar stochastic events, particularly those involving indicator or keystone species.

As criteria most helpful in diagnosing ecosystem health, the following were discussed: viable population densities of native indicator species; great dispersal and migration capacity of native species; high genetic diversity within populations; great abundance and diversity of primary or climax species; low number and abundance of introduced, non-indigenous and pollution-tolerant species; a balanced predator-prey population ratio; balanced recruitment-mortality ratio; a high post-disturbance recovery and resilience potential (i.e. a low long-term ecosystem vulnerability); and a high connectivity level (J.K. Andreasen, Conservation Biology Institute, Corvallis, OR, USA; Flavio Gandara, University of Sao Paulo, Brazil; Maarten Kappelle, National Biodiversity Institute, Heredia, Costa Rica; Kenneth Lubinski, US Geological Survey, Onalaska, WI, USA; Ivan Vassenev, Russian Institute of Agronomy and Soil Erosion Control, Kursk, Russia; P.K. Yochem, Hubbs Sea World Research Institute, San Diego, CA, USA).

Recent research has demonstrated a reciprocal relationship between ecosystem health and specific plant and animal communities. Population sizes within such communities as well as the populations' reproductive success levels heavily depend on landscape features related to ecosystem health. For this reason, over the past few years, a range of taxonomic groups have been identified that can be used as sensitive biological indicators in criteria-based assessments of change in landscape and ecosystem health. Speakers discussed the usefulness of health indicators belonging to a variety of taxa such as temperate marine mammals, terrestrial rodents, breeding birds, fish, butterflies, algae and lichens, subtropical columnar cacti, subtropical and tropical zooplankton, and tropical frogs, anoles, and rainforest and mangrove tree species.

Deborah Shields (USDA Forest Service, Ft Collins, CO, USA) clearly pointed out that the degree to which selected indicators, defined and measured at one scale, can be applied to other spatial scales, will need to be determined. In addition to that, Joy Jacqueline

Pereira (Universiti Kebangsaan Malaysia, Bangi, Malaysia) recommended that future studies should use selections of potential indicators based upon an integrated approach involving a combination of biophysical, socio-economic and human health parameters.

A powerful new tool in monitoring ecosystem health at the policy level concerns the elaboration and implementation of national strategies and action plans for the conservation and sustainable use of biodiversity, as recommended by the UN Convention on Biological Diversity. Such strategies and plans may serve as a base reference for present health of ecosystems at a national scale (Victor Canton, Ministry of Housing, Land Planning and Environment, Montevideo, Uruguay).

Andreasen highlighted the fact that multiple biological indices calculated from ambient biological data can provide an integrated tool for diagnosing ecosystem health or integrity, and pointed out that a terrestrial index of ecological integrity gives decision-makers another tool to help with management decisions in watershed assessments, which will lead to further environmental improvement.

Many authors put forward Geographical Information Systems (GIS) and related multivariate statistics as promising decision-support tools in monitoring multi-scale, fragmentation-related changes in ecosystem health conditions (G.P. Patil, Pennsylvania State University, PA, USA; Ligia Noronha, Tata Energy Research Institute, New Delhi, India; Lester Yuan, US Environmental Protection Office, Washington, DC, USA). Improved understanding of change in landscape and vegetation spatial patterns, causative factors, and links with disturbance processes, will assist managers and policymakers in making informed decisions about how to address important ecosystem health issues (Paul Hessburg, USDA Forest Service, Wenatchee, WA, USA).

A rather new and complementary approach in quantifying landscape fragmentation is to measure the conditional entropy, or degree of dissimilarity, that is introduced when scale of measurement increases twofold for a given area. The variable measured is the dominance of specific land-uses (Karen Boomer, Pennsylvania State

University, University Park, PA, USA). As other speakers underlined, ecosystem health assessment may also greatly benefit from GIS-linked multi-modelling. This is an innovative approach that involves a mixture of modelling approaches based upon the inherent temporal resolution and spatial extent of various trophic components, linked together by spatially-explicit information on underlying environmental, biotic and anthropogenic factors (Philip Nott, The Institute for Bird Populations, Point Reyes Station, CA, USA). It enables development of alternative ecosystem health management scenarios, for example in restoration planning, that are linked to social and economic assessments.

Although criteria, indicators and tools for measuring and monitoring ecosystem health are currently being developed and consensus amongst their characteristics is being reached amongst scholars, the research-based application of the innovative method of ecosystem health diagnosis is still in its infancy and has become a challenge for the new century. The development of preventive rather than curative measures to maintain and improve ecosystem health and integrity is of particular importance to the planet. Will we be able to cope with the extent of current global environmental change and the dramatic impact it has and will have on human health? Today, it is of utmost importance to develop predictive, multi-scale models that assist in building scenarios with either positive or negative outcomes. Such models should be calibrated using input data from ecosystem health monitoring studies that have to be conducted over the next decade. The establishment of adequate criteria, useful indicators and innovative tools is crucial to this approach. The meeting in Sacramento, California, contributed significantly to that process.

MAARTEN KAPPELLE

Instituto Nacional de Biodiversidad (INBio)

Apartado Postal 22-3100

Santo Domingo de Heredia

Costa Rica

e-mail: mkappell@inbio.ac.cr