

BEYOND PARADISE

MEETING THE
CHALLENGES IN
TROPICAL BIOLOGY
IN THE
21ST CENTURY



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TROPICAL BIOLOGY TODAY

THE TROPICAL FORESTS of the Americas, Africa, Asia, and the Pacific Islands are teeming with life and intricate ecological processes unparalleled anywhere else on Earth. The extraordinary richness and complexity of life in these ecosystems have fascinated scientists for hundreds of years.

As the 21st century opens, several facts have become startlingly clear. Billions of people in tropical regions rely on local ecosystems for food, clean water, and medicines. In addition, the vast forest canopies and the ancient soils beneath them hold an immense quantity of carbon, which plays a key role in climate regulation and nutrient cycling throughout our biosphere. Maintaining these ecosystems is thus critical to the survival of humanity and all life on Earth.

Yet as human populations burgeon, resource consumption and pollution emission by people everywhere continues to grow. The result? Between 1980 and 2000, 21 percent of tropical forests were destroyed. In biodiversity hotspots, the majority of which are in the tropics, up to

half of the species may be threatened with extinction.

It is now apparent that tropical ecosystems have entered a critical state of decline. Fortunately, policy responses to the loss of tropical biodiversity are increasing. The Convention on Biological Diversity — now ratified by most of the nations of the world — recognizes the global significance of biodiversity and the need to safeguard our natural heritage.

Nevertheless, enormous challenges loom ahead. Many of the losses and changes in tropical ecosystems are not easily reversible, because human disturbance can persist for centuries. Moreover, much of the information needed to conserve, restore, and manage these ecosystems remains unknown.



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The vast tree canopies and ancient soils play a key role in worldwide climate and nutrient dynamics.

Tropical forests are critical to the very survival of life on Earth.

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Much of the information needed to conserve, restore, and manage these ecosystems remains unknown.

LOOKING TOWARD THE FUTURE

The calls for new knowledge and information about tropical ecosystems have taken on greater urgency.



The guidelines in this report will enable tropical biologists to move beyond the current vision of protecting an undisturbed paradise.

AS AWARENESS THAT TROPICAL ECOSYSTEMS ARE CRITICAL to humanity's survival has grown, the calls for new knowledge and information about them have taken on greater urgency. For this reason, tropical biologists, conservationists, ecologists, and social scientists began to assess the expanding scope of their professions. Tropical biologists started this process in 2000, exploring the changes needed in the priorities and practice of their field.

The Association for Tropical Biology and Conservation (ATBC), the largest professional society for tropical biologists, spearheaded the effort. Organizers conducted discussions at international meetings, workshops, and retreats over a three-year period, with more than 150 scientists participating. Although the researchers recognized the need to set priorities for a wide variety of tropical habitats, they focused on their primary area of expertise: tropical forests.



The participants based their work on a 1980 report entitled "Research Priorities in Tropical Biology," which defined research

and funding priorities in tropical biology for the first time. Its recommendations, listed below, have guided the profession until the present day.

The scientific discussions made it clear that major shifts are now required in the mission, principles, and infrastructure of tropical biology. Following the guidelines in this report over the next two decades will enable tropical biologists and funding organizations to move beyond the current vision of protecting an undisturbed paradise. Now more than ever, scientific perspectives must be integrated with social realities.

Recommendations from the 1980 Report "Research Priorities in Tropical Biology"

This National Research Council report defined priorities that have guided tropical biologists for the past two decades. The recommended focus areas were:

Biological Inventory

The international effort in completing an inventory of tropical organisms should be greatly accelerated, especially during the next 25 years.

Tropical Ecosystem Studies

Tropical ecosystems should be investigated in depth at places selected because they are representative, diverse, and capable of experimental manipulation and because of scientific and societal importance. These studies should investigate both

natural and experimentally manipulated ecosystems and should emphasize solutions to problems in areas of general ecological interest.

Studies of Tropical Aquatic Systems

Tropical freshwater systems should be studied much more intensively than at present in view of their scientific and economic importance.

Monitoring Forest Conversion

National schemes for monitoring the rates of conversion of tropical moist forests and other tropical vegetation types should be encouraged and, when appropriate, aided by competent international bodies.

THE MISSION OF TROPICAL BIOLOGY THROUGH 2025

TROPICAL BIOLOGISTS MUST NOW PROVIDE THE KNOWLEDGE needed to sustain humanity as well as nature in the tropical areas of the world. While the primary research focus will continue to be diversity and ecosystem function, scientists must also actively assist in developing action plans for long-term conservation, use, and management of tropical landscapes.



THE MISSION:
Tropical biologists must now provide the knowledge needed to sustain humanity as well as nature in the tropical areas of the world.



Understanding diversity, function, and maintenance remains the foundation of biological research in the tropics.

TO ACCOMPLISH THIS MISSION, biological studies must be integrated with research in the social sciences, with emphasis on three priority areas: 1) understanding the diversity, function, and maintenance of tropical ecosystems, 2) evaluating human impacts on tropical ecosystems, and 3) studying the social drivers of change and social responses to conservation. Each of these topics is described in detail below.

RESEARCH PRIORITY 1
Understanding the Structure and Maintenance of Tropical Ecosystems

Understanding the diversity, function, and maintenance of tropical ecosystems remains the foundation of all biological research in tropical forests. Biodiversity must be described at the species level as well as at scales ranging from genes to landscapes. Other key areas include the origin and maintenance of biodiversity and ecosystem responses to natural and manmade changes.

Tropical biologists must also accelerate their efforts to inventory species in unexplored regions and habitats around the world. Tropical forest canopies and soils — which are critical to carbon storage, climate stability, and nutrient dynamics — are two examples of these little-known habitats.



RESEARCH PRIORITY 2
Evaluating Human Impacts on Tropical Ecosystems

Humans have evolved in concert with the environment for thousands of years and now have an overwhelming impact on tropical ecosystems. Deforestation, non-native species, fragmentation, and climate change already threaten many habitats. There is compelling evidence that these trends will accelerate in the future.

Research priorities must include evaluating a multitude of human impacts on tropical forests. Responses of these ecosystems to management strategies designed to conserve and restore them must also be assessed.

RESEARCH PRIORITY 3
Studying the Social Drivers of Change and Social Responses to Conservation

Studying the social forces that degrade tropical ecosystems requires as much emphasis on landscapes with significant human impact as on pristine environments, where tropical biologists have traditionally studied basic ecological and evolutionary questions. Improved understanding of the complex drivers of change both inside and outside the tropics will contribute to better policies and actions for conservation and sustainable use.

Tropical biologists must also begin to seek concrete evidence of the link between sustainable use of tropical diversity and human well-being. Such findings can increase the motivation and support for conservation, especially in agricultural lands or other areas that people use.



Research priorities include evaluating how tropical forests respond to human impacts and management strategies.

Studying the social forces that promote ecosystem degradation and the complex drivers of change will support conservation and sustainable use.



Now more than ever, scientific perspectives must be integrated with social realities.

KEY QUESTIONS WITHIN THE RESEARCH PRIORITIES

UNDERSTANDING THE STRUCTURE AND MAINTENANCE OF TROPICAL ECOSYSTEMS

Describing Tropical Diversity

- What are the levels and patterns of genetic and species diversity in poorly known regions of the tropics, in poorly known groups (e.g., epiphytes, fungi, and microorganisms), and in little-explored habitats (e.g., soils, forest canopy)?
- What factors and processes explain the current patterns and distribution of tropical diversity at the population and species levels?
- How have history and spatial heterogeneity influenced genetic and species diversity?

Origin, Patterns, and Maintenance of Tropical Diversity

- What factors explain relative abundances and species richness over time and space?
- What is the role of biotic interactions in the structure and function of tropical ecosystems?
- How did diversity originate in natural tropical ecosystems and how can it be maintained in human-impacted landscapes?

Functioning of Tropical Ecosystems

- How are biodiversity and ecosystem functioning linked in different habitat types?
- How are soil biodiversity, nutrient cycling, and productivity inter-related?
- What is the relationship between ecosystem structure and ecosystem services, particularly watershed and pollination services?



EVALUATING HUMAN IMPACTS ON TROPICAL ECOSYSTEMS

- What are the effects of changes in land use and land cover, economic globalization, invasive species, genetically modified organisms, habitat fragmentation, pollution, and resource use on the composition, structure, and function of tropical ecosystems?
- What are the links between tropical ecosystems and local, regional, and global climate regimes; specifically, what is the role of tropical forests in the global carbon budget and can tropical ecosystems serve as indicators of climate change?
- What are the relative impacts of conservation and restoration strategies — such as protected area networks, controlled harvesting, controlled burning, and selective breeding or careful reintroduction of species — on tropical ecosystems?

STUDYING THE SOCIAL DRIVERS OF CHANGE AND SOCIAL RESPONSES TO CONSERVATION

- How is human well-being related to the structure and functioning of tropical ecosystems across regions, communities, and time; what are the economic and non-economic “valuations” of these linkages and how do they change over time and space?
- What is the role of traditional knowledge and community-based management in conservation of tropical ecosystems?
- What are the effects of over-consumption, poverty, property regimes, migration, and macro-economic policies on degradation of tropical ecosystems?
- What is the relative effectiveness of conservation paradigms and policies, management and governance regimes, and restoration efforts in curtailing habitat degradation while improving the welfare of local communities?



GUIDING PRINCIPLES FOR TROPICAL BIOLOGISTS

Conservation must be seen as part of the larger agenda of sustainable and equitable development of tropical countries.

TO SUCCESSFULLY PURSUE THE UPDATED RESEARCH PRIORITIES, tropical biologists must broaden their activities and approaches. These guiding principles are intended to support relevant biological research while also integrating biological knowledge with the social sciences, facilitating interdisciplinary approaches, and linking science with policy.

PRINCIPLE 1 Develop Broader Values and Concerns

Tropical research must arise from a more inclusive set of values and concerns than it has in the past. Rural people throughout the tropics are the largest users of tropical ecosystems, and they often pay a

Research in tropical biology and conservation must address the economic issues confronted by local communities.

high opportunity cost for maintaining biodiversity. Research in tropical biology and conservation must be integrated into the social fabric of these communities and address the economic issues they confront. Conservation must be seen as part of the larger agenda of sustainable and equitable development of tropical countries.

PRINCIPLE 2 Adopt Interdisciplinary and Participatory Approaches

Tropical biologists must adopt interdisciplinary and participatory approaches. They will have to collaborate extensively with social scientists, and “pure” biologists will have to coexist with interdisciplinary specialists such as ethnobiologists, economic ecologists, conservation biologists, and ecological anthropologists.

Simultaneously, tropical biology research will have to become more participatory. Scientists must involve local communities and accord respect to their knowledge systems. Partnerships with local communities may be an important key to the success of conservation and restoration efforts.

Collaborating with social scientists and involving local communities will promote success in conservation and restoration efforts.

PRINCIPLE 3 Link Science with Policy

The practice of tropical biology must include both “curiosity-driven” basic research and “action-oriented” studies designed to address specific environmental threats. This new inclusiveness means that researchers must share their findings not only with other scientists, but also with the lay public, activists, and policymakers. Furthermore, participation in follow-up action must be recognized as an important contribution to society. This approach will require that scientists accept the opportunities presented by their multiple roles in society and that the incentive structure within academia be adjusted to encourage these activities.

Progress in incorporating these principles should be consistently monitored, and the results should be incorporated into future efforts in education, habitat management, and policymaking.

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RECOMMENDATIONS TO ADVANCE TROPICAL BIOLOGY IN THE 21ST CENTURY

FOUR BROAD RECOMMENDATIONS FOR EXPANDED PARTNERSHIPS and infrastructure are fundamental to all biological and social sciences in the tropics. Immediate action on these recommendations is required to enable tropical biologists to accomplish the new mission by 2025.

RECOMMENDATION 1 Assemble and Disseminate Biodiversity Data Using Advanced Technologies

The urgent need for a complete inventory, description, and classification of tropical plants, animals, and microorganisms demands a marriage of traditional biology with advanced information technologies. The vast amounts of data collected in the field must be assembled and organized so that researchers can easily locate existing information and submit new entries. In addition, researchers everywhere must have instant access to the vast store of biodiversity information contained in libraries, museums, zoos, and botanical gardens.

Biodiversity informatics — the emerging discipline of assembling, organizing, and indexing diversity data on standard platforms — has tremendous potential to accelerate tropical biology and help researchers communicate their findings to a variety of audiences.



The vast amounts of biodiversity data must be assembled and organized so that researchers can easily locate existing information and submit new entries.



An expanded system of tropical field stations must be linked through a global “mega-network” with field sites, libraries, museums, non-governmental organizations, policymakers, and others.

RECOMMENDATION 2 Create a “Mega-Network” for Tropical Researchers and Others

A global “mega-network” with real-time connectivity is needed to bring various tropical constituencies together. An expanded system of well-supported field stations throughout the tropics — linked with individual researchers at their field sites in both human-impacted and pristine areas — will greatly enhance collaborative work across ecosystems, continents, and disciplines. Coalitions of scientists, non-governmental organizations, and policymakers in turn must be linked with the field networks.



RECOMMENDATION 3 Strengthen Research Institutions in Tropical Countries

The field of tropical biology must be firmly rooted in the tropics. More biologists must originate from local communities, so tropical training sites, research institutions, biological collections, journals and more will have to be created or strengthened. This new orientation will involve substantial redirection or augmentation of funds provided to tropical countries, enabling students from those regions to attend both local and northern universities, and strengthening faculty exchange between the north and south.

Because many tropical countries are small, partnerships between institutions in these countries and those in larger tropical countries and the temperate zones will be critical to building cadres of resident biologists. Tropical field stations and networks such as the Global Canopy Programme, the Center for Tropical Forest Science, and the Organization for Tropical Studies can play an important role in strengthening local institutions and promoting partnerships.

RECOMMENDATION 4 Increase Interdisciplinary Interactions

Opportunities for information exchange among the many parties interested in tropical habitats must be proactively arranged. University faculty must make a concerted effort to introduce tropical biologists to social scientists at various levels. Particularly important are cross-training programs that introduce undergraduate and graduate biology students to the social sciences and encourage interdisciplinary research initiatives. Organizing dialogue among tropical biologists, civil-society representatives, and policymakers will also be critical.



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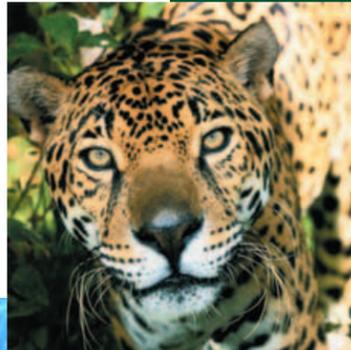
MEETING THE CHALLENGE

BECAUSE OF THE OVERWHELMING IMPACT OF HUMANITY ON ECOLOGICAL SYSTEMS, tropical biologists, conservationists, ecologists, and social scientists are together moving toward more socially relevant research. Their hope is that this contemporary approach will be met by broad support from international development agencies, national agencies, and private donor agencies.

Clearly, both existing and new resources must be marshaled to address the critical issues in tropical biology. Support by national agencies must be encouraged and augmented by environmental and international development agencies, such as the Global Environment Facility and the World Bank. Private donor organizations and non-governmental groups also have important roles to play.

Scientists, government, and non-governmental agencies must engage in greater collaboration and coordination.

The current convergence of interests among scientists, professional organizations, government, and non-governmental agencies must be transformed into greater collaboration and coordination. Our common interest and resolve will be instrumental in achieving our goal: understanding, conserving, restoring, and enhancing tropical ecosystems for the perpetual benefit of humanity.



Our common goal is understanding, conserving, restoring, and enhancing tropical ecosystems for the perpetual benefit of humanity.

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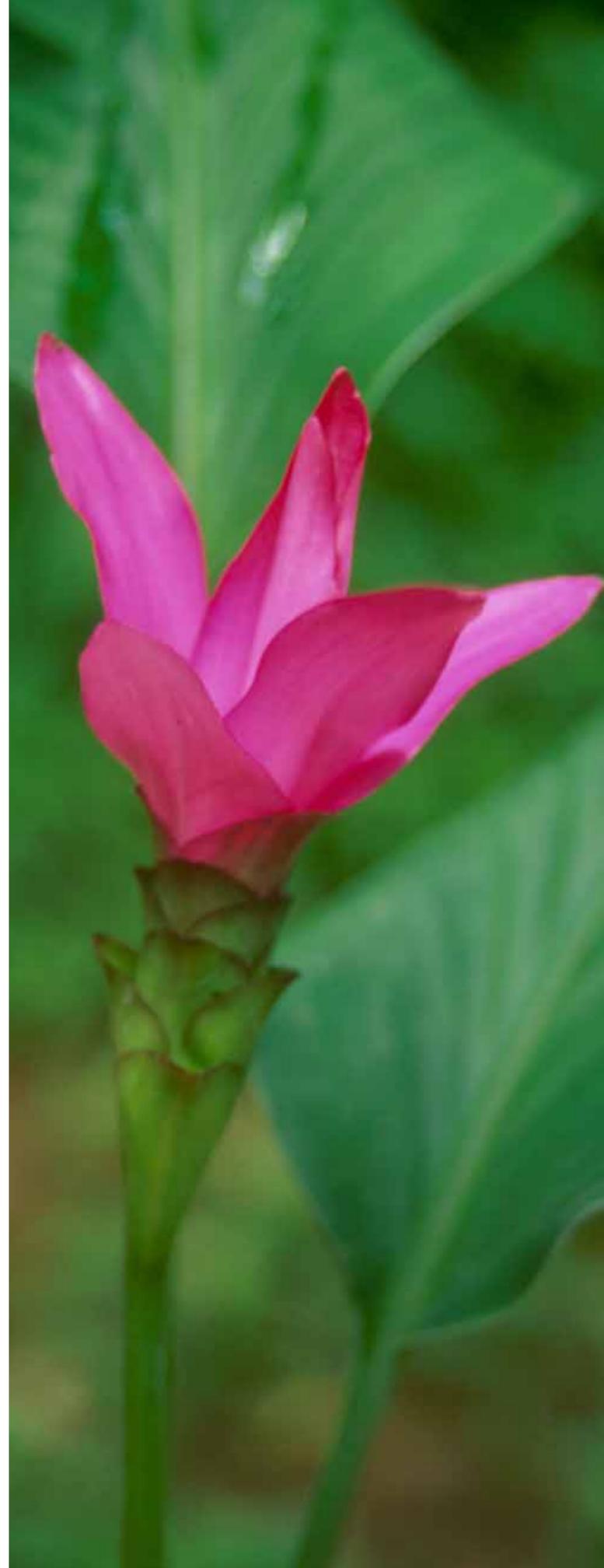
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