

49

LESSONS FOR OTHER TROPICAL FOREST LANDSCAPES

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In recent decades, governments and the general public have grown increasingly alarmed at the declining state of the world's environment. These concerns were first highlighted internationally by the Stockholm Conference on the Human Environment (1972). Equally important was the Brundtland Report *Our Common Future* (Brundtland 1987), produced by the World Commission on Environment and Development, which argued eloquently that, without fundamental changes in practices and innovation, further economic development would continue to exhaust natural resources and severely harm the global environment. This report defined sustainable development as that which 'meets the needs of the present without compromising the ability of future generations to meet their own needs'. This report also highlighted the striking inequity of economic progress and suggested that equity, growth and environmental maintenance are all simultaneously possible through enlightened technological and social change.

So, how well has the enlightened goal of sustainable development advanced in the past 20 years for tropical forests? Sadly, very little progress has been made, if we

are to interpret the results of the Millennium Ecosystem Assessment (MEA, 2005). This MEA resulted from an intensive effort between 2001 and 2005 to 'assess the consequences of ecosystem change for human well-being and to establish the scientific basis for actions to enhance the conservation and sustainable use of ecosystems and their contributions to human well-being'. Its reports indicate that almost all ecosystems on Earth, including tropical forests, have been severely altered by human activities, and that some 60% of the ecosystem services that nature provides to people are presently overexploited.

Here we highlight the implications of our long-term experience in the Wet Tropics for other parts of the world, in terms of progressing towards the sustainable use of tropical landscapes. We explore the differences and similarities of the Queensland Wet Tropics to other parts of the world and the degree to which the opportunities and challenges one encounters are similar.

Quite clearly there are parts of the world where, because of weak institutions, lawlessness, human conflict, poverty or rampant overexploitation, tropical forests and local peoples are simply being

overwhelmed. For a large part of the tropical world, however, there are informative similarities with the Wet Tropics, as one of us has already emphasized (Laurance, Chapter 28, this volume). Although the region has largely escaped certain threats: such as poaching, industrial logging and mining, because of its status as a World Heritage Area, it faces many other management challenges. Extensive habitat fragmentation, invasive organisms, fire, climate change and the rapid growth of tourism are all potentially important threats that endanger not only the Wet Tropics but many other tropical regions in the world.

So what key lessons have we learnt? Here we discuss these lessons under three main themes:

- 1 The value of research;
- 2 how to finance research;
- 3 how to apply our findings to global problems.

The value of research

Baseline data are essential for assessing change

An investment in collecting baseline data on the biodiversity of a region, its distribution and the services that this biodiversity and other components of the environment provide is essential to assessing the values of forested landscapes and determining the costs and benefits of alternative forms of forest management. Critically important in this regard are data on the flow-on benefits that forests provide to local and regional communities. Many attempts to implement conservation and development projects in tropical regions are bedeviled because we lack the rigorous baselines needed to assess changes in the environmental values of forests or the livelihoods of people who depend upon them (McShane *et al.* 2005; Sayer *et al.* 2006). Rainforests cannot be evaluated properly against land-use conversion and other possible economic activities until a dollar amount is placed on the ecosystem services they provide.

The key ecosystem services of tropical forests include carbon storage, flood amelioration, protection of freshwater supplies, soil conservation, impacts on local and regional climate and crop pollination, among others (see Cunningham & Blanche, Chapter 18; Curtis, Chapter 19, this volume). These data may not appear to be important at the time of collection but almost always are valuable in the long term. An outstanding example

of this is the several decades of research by Geoff Monteith from the Queensland Museum, who collected insects across the 30-plus mountaintops in the Wet Tropics and showed just how distinctive this fauna is (see Yeates & Monteith, Chapter 13, this volume). Most other tropical forests worldwide still contain large areas that are *terra incognita* from a biological perspective. One consequence of this is that the geographical distributions of species are often poorly understood and hence modelling of species distributions under a range of climate-change scenarios may be vague at best, and hence of limited utility. The scientific and natural-heritage values of tropical forests are continually enhanced via the collection of baseline data on biodiversity.

Long-term monitoring

Around the world few resources are being applied to monitor the health of tropical forests, in large part because governments have resisted the funding of long-term programmes. The dynamic processes of rainforest ecosystems are often slow and only long-term monitoring can reveal many kinds of environmental changes.

The historical value of many of the long-term data sets is limited by the fact that research methods often vary enormously among different studies and may even evolve over time within the same organization. Hence, the 2000 FAO Global Forest Assessment (FAO 2000) indicates that forests have expanded greatly in Australia since the previous assessment in 1990. However, this is in part because the definition of forest was broadened from areas with at least 20% canopy cover in 1990 to include those with at least 10% canopy cover in 2000.

Since Myers's (1992) report on the state of the world's rainforests, the use of remote sensing and GIS has developed enormously and, for some nations, such as Brazil and India, systems are now in place to monitor annual changes in forest cover. Despite new technical advances, however, many threats to tropical forests are not detectable, or are considered only marginally detectable using available remote-sensing techniques. Problems stem from having to deal with dense vegetation cover and many 'hidden' effects. Common threats that cannot be measured remotely include hunting or defaunation, harvests of many non-timber forest products, effects of pathogens, compositional shifts in plant communities due to climate change, non-recent selective logging, narrow roads and many secondary and higher-order effects (Laurance & Peres 2006).

These threats can only be adequately mapped and monitored with on-the-ground research, which can be expensive and logically challenging. A number of additional threats, such as recent selective logging, surface fires, the effects of climate change on plant phenology, small-scale mining and wider roads (Gillieson, Chapter 26, this volume), may be detectable but require specialized remote-sensing methods and algorithms. Remote sensing can, however, readily detect large-scale deforestation and habitat fragmentation, major forest fires and highways, and continues to be the most effective method for monitoring such threats (Laurance & Peres 2006; Phinn *et al.*, Chapter 47, this volume).

How to finance research: the value of environmental Cooperative Research Centres

Cooperative Research Centres (CRC) were first funded in Australia in 1991 to help to bridge the gap between science providers and users and to help to stimulate research in areas seen as key to Australia's economic survival. In the first phase a dozen centres were funded for 7-year cycles. Since then many new centres have been created and existing ones refunded for further periods. The environmentally focused CRCs were extremely successful but a more economic rationalist approach by government to support only centres with more direct industrial, commercial and economic outcomes has meant that these environmental CRCs have become extinct. Our experience has shown that the creation of a stable, long-term funding base for environmental researchers and stakeholders has been vital in enabling them to build meaningful programmes of research. Short-term contract research, which is becoming the norm in many places, means that it is difficult to deliver in the long term, particularly when this funding is often not available for collecting new data but instead is for synthesizing existing data. In such cases researchers effectively form part of the consultancy market. Three-year funding, such as that available for many doctoral theses, also has limitations and means that it is impossible to plan strategically for projects that can take five years or longer.

Another way of achieving outputs useful to management agencies is through cash contributions for specific research that management agencies believe to be of key relevance. In the Queensland Wet Tropics no

benchmark for cash-contribution investment in research by the user-community was identified, and the level of such additional funding was both minimal and disappointing, indicating that ad hoc methods of co-investment for long-term, cohesive and strategic research are ineffective. However, co-investment in research greatly increases the 'ownership' of that research by any user-organization with a financial stake in a project, and also enhances the likelihood that the organization will readily accept and adopt the research findings.

How to apply research results to global problems

Building regional collaboration

As emphasized by Laurance (Chapter 28, this volume), Australian tropical scientists have great potential to contribute to research, training and collaborative initiatives in the Asia-Pacific Region. This region encompasses some of the most biologically diverse and imperiled ecosystems on the planet, and faces an array of serious environmental and societal challenges. In Indonesia and Papua New Guinea, for example, science and environmental planning have an alarmingly small influence on the rampant, ongoing exploitation of forest resources (Laurance, 2007). Many international organizations now see training and capacity building for scientists and decision-makers in developing nations as a vital step in building a local constituency to promote the wise use of natural resources. Such initiatives would not only benefit Australia's northern neighbours, they would also foster new scientific alliances and create a world of research challenges and opportunities for Australian scientists. This is one way in which the many lessons learned from research in the Wet Tropics can be built upon and applied elsewhere.

The role of positive economic drivers for the conservation of rainforests

Around the world, tropical forests are being rapidly degraded by timber exploitation, infrastructure expansion and agriculture. In Brazil rainforests are being cleared for soya and cattle production and in Southeast Asia they are being burned to establish oil

palm plantations. These industries are poor ecological replacements for native forest and result in habitat fragmentation, a loss of biodiversity, reduced water retention, disturbed soils and often pollution via increased use of fertilizers. The impact of these industries on forest waterways, wetlands, estuaries and the marine environment has been devastating, as exemplified in the Australian north-east coast and the Great Barrier Reef (see Pearson & Stork, Chapter 45, this volume). In Australia both upland and lowland rainforests were replaced by pasture, sugarcane and other crops, particularly in the first part of the twentieth century. These industries have profoundly affected the environment, especially through the loss and fragmentation of forests.

Several authors in this book have demonstrated how other industries more compatible with tropical forest conservation can be developed and maintained. In particular, nature-based tourism has become the major industry of the Wet Tropics region (Pearce, Chapter 7, this volume). The industry itself has become highly engaged in the development of research and has lobbied governments to fund such work. As a result, tourism operators have become more informed and the quality of interpretation for visitors is leading the world. Tourism managers and operators have become involved in developing practical monitoring schemes, so that human impacts on the environment are minimal but visitor satisfaction is high (Turton & Stork, Chapter 27; Reser & Bentrupperbäumer, Chapter 34, this volume). Visionaries in the industry (such as John Courtenay and Guy Chester) have also seen a need for improved road design, so that roads are presented better for self-drive tourists, and have encouraged researchers and those that build and maintain roads to work closely together (Goosem, Chapter 36, this volume).

Recent research has also shown an as yet unfulfilled potential for developing a high-value plantation-timber industry that is in harmony with the regional fauna and flora and that could provide both ecosystem and economic benefits to the region (Harrison & Herbohn, Chapter 43, this volume). In the past this industry has been held back through lack of investment and investors, but this seems to be rapidly changing. As with tourism, major benefits can be delivered to the local as well as regional and national economies from the development of timber plantations and associated industries.

The importance of multidisciplinary research

As well as long-term research that encapsulates strategic and tactical perspectives, we also argue that cross-disciplinary approaches can provide solutions to some of the most critical questions. Research that links social and ecological systems and traverses ecosystem boundaries (e.g. forest catchment to reef) is now considered the most sensible way to tackle some of the most pressing research issues, such as climate change.

Ecological problems are reflections of social problems

To resolve ecological problems we need to engage with communities, management agencies, industries and policy-makers. Solving problems requires considerable change in attitudes and approaches at all levels and often solutions come from the grass-root communities. Inevitably there is a need for training and capacity building again at all levels to ensure that change is accepted and implemented. In this book we have shown that the integration of socio-economic and ecological research is essential to resolve forest-management issues and translate them into constructive human actions. This view echoes the message of other authors (Sayer & Campbell 2004; Sayer & Maginnis 2005).

Indigenous culture

Tropical forests are usually inhabited by indigenous peoples whose cultures are often closely linked to local forest resources. Their traditional knowledge and culture are not only the important heritage but also the sources of new inquiry and inspiration. If this knowledge and culture is to survive and to be used wisely then indigenous people must be integrated into management systems and their roles encouraged and accepted. In the Wet Tropics it has been rewarding to see this changes put into practice with benefits for all concerned.

Integrated natural resource management: a new paradigm

Australia has entered a new phase in the history of natural resource management with new 'catchment-authority' structures and government arrangements

(see Dale *et al.*, Chapter 32, this volume). Federally funded, these bodies are responsible at the regional level for the creation and implementation of strategies to improve the management of Australia's landscapes and coastlines. These bodies have built relationships with state and local government, as well as with a range of other organizations. Many have embraced research organizations to help to provide an improved scientific base and, in this way, research is playing a more constructive role and thereby informing many management decisions. This national experiment should be given more time to develop but could be usefully applied elsewhere in the world.

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