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## INTERNATIONAL PERSPECTIVE: ECOLOGICAL PROCESSES AND ECOSYSTEM SERVICES IN THE WET TROPICS

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Humans and the natural world affect one another wherever they come together. The natural world is structured by interactions among wild species and between wild species and their physical environment. Humans benefit from many of these interactions, suffer from others and potentially alter them all. This is especially true wherever humans create a mosaic landscape where fragments of the original, natural vegetation are interspersed among crops, pastures and towns. This describes the Wet Tropics World Heritage Area, and the chapters in the present part explore interdependencies among humans, wild species and the physical environment in the Wet Tropics.

The natural world provides a wide range of benefits free of cost that sustain all human societies (Costanza *et al.* 1997). The clearest example is our water supply. In the first chapter of this section, McJannet *et al.* (Chapter 15, this volume) contrast hydrological processes – essentially what happens to precipitation after it reaches the vegetation – and forest water yields for four contrasting rainforests and cloud forests from the Wet Tropics. They find that El Niño events reduce forest water yields in two ways, with greater

evaporative losses as well as lower precipitation inputs. Their precise measurements are essential to develop a mechanistic understanding of forest water balance. This mechanistic understanding will, in turn, permit the development of predictive models for effective water management throughout the region. McJannet and colleagues are well on the way towards this goal.

A perhaps less obvious benefit of the natural world is provided by the insects, birds, bats and other animals that pollinate economically important crops. The native pollinators in neighbouring rainforest fragments are likely to play an important role in the pollination of nearby crops. This is particularly true for the many crops that have been introduced throughout the world without their original pollinators. Boulter and her colleagues (Chapter 17, this volume) describe the diversity of types of flowers, when they are produced and what is known of their pollinators for the rainforests of the Wet Tropics. This information sets the stage for the pollination of agricultural crops throughout the Wet Tropics. Boulter *et al.* conclude that the state of knowledge is limited – pollinators have been identified

for just a handful of Wet Tropics plant species – and that much more needs to be learned.

The movement of seeds, like the movement of pollen, is crucial for the conservation of natural plant populations because seed and pollen movement offers the only opportunity for genetic material to move among plant populations, and, in addition, seed dispersal offers the only opportunity for plants to colonize new habitats. Westcott *et al.* (Chapter 16, this volume) describe a powerful approach to understand the movement of seeds throughout the rainforests of the Wet Tropics. They focus on the animals that move seeds. They have accumulated a remarkable database recording how often and how far each of 65 species of birds, bats and other mammals carries the seeds of 1268 rainforest plant species. They then integrate seed movements over the entire community of fruit and seed-eating animals to model the distances seeds are dispersed for each plant species. Many of the more important animal species that disperse seeds are absent from forest fragments in the mosaic landscape of the Wet Tropics, and the database accumulated by Westcott and his colleagues offers a powerful tool to identify plant species that will require assistance by man to maintain the movement of genetic material among fragmented populations and to colonize newly opened habitats. Their knowledge base for the management and conservation of tropical forest plants is unrivalled anywhere else in the world.

Cunningham and Blanche (Chapter 18, this volume) take a remarkably different approach in the fourth chapter of this part. Earlier studies of the benefits human societies reap from the natural world have ignored the potential costs associated with close proximity to the natural world (Costanza *et al.* 1997). Following this tradition, Cunningham and Blanche document benefits that accrue from pollination services and from pest control by predatory insects when crops are located near forest fragments where native pollinators and predatory insects live. Cunningham and Blanche also depart from tradition, however, and examine the potential costs associated with insect pests that might move to crops from the same nearby forest fragments. Their approach heralds a new type of analysis where both the benefits and costs of proximity to wild nature are tallied to determine the net impact of wild nature on our lives. The Wet Tropics offers an ideal setting for these studies. The results of

Cunningham and Blanche indicate that the net benefits of proximity to forest vary among the most important crops grown in the region. Their approach has the potential to increase crop yields through matching crops to the mosaic landscape of forest fragments interspersed among human land uses.

In the final chapter of this part, Curtis (Chapter 19, this volume) provides an overview of the economist's approach to the valuation of goods and services received from wild nature and then summarizes recent work, much of it his own, on the development of a globally accepted set of standards for such valuations. This is crucially important work because the conservation of rainforest will only be able to compete with agriculture and other human land uses after the commercial market recognizes the value of the goods and services provided by the original rainforest. Natural ecosystems provide 20 widely recognized goods and services ranging from a clean water supply to the opportunity for recreation and tourism, to aesthetic and spiritual values. The problem is how to place a dollar value on these goods and services so that society will recognize the contribution of natural ecosystems and so that the loss of the goods and services provided by natural ecosystems is included when calculating the net benefit of conversion of land to alternative human uses. As an example, Curtis calculated the value of ecosystem goods and services provided by rainforest on private land in the Wet Tropics to be in the range of Au\$370–446 ha<sup>-1</sup> yr<sup>-1</sup> in June 2005. This is sharply lower than the value of US\$2007 ha<sup>-1</sup> yr<sup>-1</sup> for tropical forests globally (Costanza *et al.* 1997). This large discrepancy points towards the need for a set of standards for such valuations. Again, the work of Curtis is an important step forward towards these standards, and his valuations for the Wet Tropics represent an important tool to be incorporated into regional development schemes.

To summarize, the five chapters in this part represent five significant advances towards the realization that the human occupants of the Wet Tropics benefit in diverse ways from their proximity to tropical rainforests. Several of the chapters provide concrete tools for the management and conservation of those rainforests or for the management of regional resources. All five chapters point towards the true net benefits realized by society through the preservation of the Wet Tropics of Queensland World Heritage Area.

This realization will place conservation on a firm financial footing, and the example provided by the Wet Tropics has the potential to lead the way for less studied tropical forests located in developing countries around the world.

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## Reference

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Costanza, R., d'Arge, R., de Groot, R. *et al.* (1997). The value of the world's ecosystem services and natural capital. *Nature* 387: 253–60.

