Gum bark: *E. pauciflora*, Brindabella Range. Photo: Heather Keith.

INTRODUCTION

Natural forests play a significant role in the global carbon cycle. Biomass and soil store approximately three times the amount of carbon that is currently found in the atmosphere, and the annual exchange of carbon between the atmosphere and natural forests is 10 times more than the annual global carbon emissions from humans burning fossil fuels. Despite natural forests storing such significant amounts of carbon, to date there has been scant consideration given by policymakers to the role of forests in addressing the climate change problem. At the 2007 United Nations Climate Change Conference in Bali (UNFCCC CoP 13), however, the international community recognized the need to reduce emissions from deforestation and forest degradation (REDD) as a vital component of a comprehensive solution to the climate change problem.

The significance to the climate change problem of achieving REDD can be appreciated when we consider that about 35 per cent of greenhouse gases stored in the atmosphere is due to past deforestation, and about 18 per cent of annual global emissions is the result of continuing deforestation (IPCC 2007). Furthermore, even when forest is not cleared to make way for other land uses, there are significant and continuing emissions of carbon dioxide from commercial logging and other land-use activities that reduce the stock of carbon stored in the ecosystem. Consequently, there is now great interest in, and indeed an urgent need to develop and apply, methods that better quantify the carbon stored in natural forests and how these pools change as the result of human land-use activities.

While international attention is now focused on REDD in developing countries, the laws of nature that account for the global carbon cycle operate irrespective of political boundaries. Therefore, a unit of carbon emitted due to deforestation and forest degradation in Australia, the United States, Canada or Russia has exactly the same impact on atmospheric greenhouse gas levels as a unit of carbon emitted from deforestation and degradation of forests in Indonesia, Papua New Guinea, the Congo Basin or Brazil. From a scientific perspective, solving the climate change problem requires, among others things, that REDD be accounted for in all forest biomes, irrespective of the host nation's economic status.

The Intergovernmental Panel on Climate Change (IPCC) has identified the need for forest-based mitigation analyses that account for natural variability, use primary data and provide reliable baseline carbon accounts (Nabuurs et al. 2007). In response, we are conducting a series of investigations into the carbon stocks of intact natural forests over large geographical areas, inclusive of environmental factors operating at landscape and regional scales. We are also considering the carbon impacts of land-use activities, including commercial logging.

In Australia, a number of studies have examined carbon stocks at continental scales (Barrett 2002) and using fine-resolution land-cover data (Brack et al. 2006). There is, however, a lack of baseline

carbon accounts for natural forests undisturbed by intensive human land-use activities. Such baselines are essential if we are to value accurately the carbon stored in natural forests, and in order to account properly for the carbon emissions from land-use activities.

An approach to estimating the carbon stocks of intact natural forests was developed and tested by Roxburgh et al. (2006). Our study extends this approach by applying it over entire regions. The approach is based on estimating what we call the 'natural carbon carrying capacity' of a landscape. The natural carbon carrying capacity is defined as the mass of carbon able to be stored in a forest ecosystem under prevailing environmental conditions and natural disturbance regimes, but excluding disturbance by human activities (Gupta and Rao 1994). This estimate provides an appropriate baseline for estimating the impacts on carbon stocks of intensive human land-use activities. Once the natural carbon carrying capacity is established, it is possible to calculate the potential increase in carbon storage that would occur if land-use management were changed and carbon-emitting land-use ceased. This potential increase in the carbon stored in the forest is called the 'carbon sequestration potential'.

The key question we are asking in our research is 'How much carbon can natural forests store when undisturbed by intensive human land-use activity?' This report presents a summary of results from case studies in the eucalypt forests of south-eastern Australia. We use these results to frame a discussion of REDD and we make policy recommendations to help promote a scientific understanding of the role of natural forests in the global carbon cycle and in solving the climate change problem.

This report was prepared in response to the considerable public interest in the issue of REDD. An earlier version was written as preparatory material for the Bali 2007 Climate Change Conference. A technical paper that details the source data, the methods used and the full results is being prepared for a scientific journal. In the interim, any technical questions regarding data and methods should be directed to the authors.

E. dalrympleana, E. pauciflora, subalpine forest, Kosciuszko National Park, NSW (325 tC ha^{-1} of biomass carbon). Photo: Ian Smith.