

## Understanding climate change impacts on cloud forests in the Gondwana Rainforests of Australia



Photo: Melinda Laidlaw

The Gondwana Rainforests of Australia World Heritage Area is one of 20 listed World Heritage properties in Australia.

There are gaps in the scientific understanding of the impact of climate change on the Gondwana Rainforests, particularly changes to cloud cover. This is an important environmental variable for the property because of the high amount of water the high elevation forests receive directly from clouds rather than rain.

The Earth Systems and Climate Change Hub worked with property managers to develop and analyse information about changes to the cloud base. This information will inform climate change adaptation planning for the Gondwana Rainforests.

### **Gondwana Rainforests of Australia World Heritage Area**

The Gondwana Rainforests of Australia is a serial World Heritage property that includes parts of 28 rainforest reserves in north-eastern New South Wales, five national parks in south-east Queensland and several smaller parcels of land. The mosaic of rainforest and associated vegetation communities within these reserves contains a range of plant and animal lineages and communities with ancient origins in Gondwana. The Gondwana Rainforests also provides the principal habitat for many endemic and threatened species of plants and animals.

### **Cloud forests and climate change**

The high-elevation rainforests in the Gondwana Rainforests property receive up to 40% of their annual water requirement from clouds and fog. Movement of the cloud base up or down the mountains due to climate change will have important conservation and management implications for rainforest species and communities.

Climate change is the primary threat to the Gondwana Rainforests, with many of its rainforest communities already restricted to climate refugia on the escarpment and east coast. Research into the potential impacts of climate change on these biotic communities is hampered by a lack of data about the current and projected rainfall and cloud variables.

### **Filling knowledge gaps**

Working with Gondwana Rainforests managers, the Earth Systems and Climate Change Hub undertook an assessment to examine the effect of changes in temperature, rainfall and relative humidity on both the high-elevation forests in the Gondwana Rainforests and the key species that live there. Given the reliance of forest species on precipitation received directly from clouds, the study focussed on understanding changes in cloud base height – knowledge that was missing from our understanding of how climate change would impact on the Gondwana Rainforests.

## The changing climate of the Gondwana Rainforests

The Gondwana Rainforests reserves sit across multiple climatic zones, where their climate is shaped by geography, topography, seasonality and climate variability, which all occur against a backdrop of climate change.

The eastern coast of Australia has clearly experienced a warming trend over the past century, although changes in rainfall and humidity are less clear. The impacts of the combination of these changes are likely to be exacerbated under future climate change.

By 2030, this assessment indicates the Gondwana Rainforests can expect an increase in temperature and a slight decrease or little change in relative humidity. Rainfall changes are unclear. Lifting condensation level (LCL, a proxy for cloud base height) shows increases or little change.

By 2050, projections indicate an increase in temperature and slight decrease or little change in relative humidity. Rainfall changes are unclear. LCL projections show increases or little change.

By 2070, temperatures will continue to increase. Relative humidity is expected to decrease overall and rainfall projections are unclear. A range of LCL change is projected, with the assessment of this report being that moderate increases can be expected.

## Detecting biodiversity changes along climatic gradients

The LCL projections developed in this case study were used to analyse potential climate impacts on the biodiversity of the Gondwana Rainforests.

Initial findings suggest that even moderate increases in LCL may have significant implications for cloud-water dependent species, especially those located at elevations adjacent to the current cloud base. Reduced cloud water inputs, especially during the dry season, may increase moisture stress beyond the tolerance of some species, resulting in community change. Observed patterns in canopy species recruitment may already be an indicator of this change.

## How this information will be used

This information will be used to inform risk assessments for the conservation management of the World Heritage values for the property. The development of downscaled climate projections and their analysis in combination with ecological and other data can support improved risk assessment, climate adaptation planning and management of the Gondwana Rainforests of Australia World Heritage Area.

The projections resulting from this study can inform future risk assessments for the Gondwana Rainforests, complementing other spatial tools used by land management agencies to assess and mitigate risk.

## Bushfire risk

While rainforests can endure seasonal moisture stress and periodic drought, long-term drying trends may result in gradual changes to the distribution of plant and animal communities and the potential for species loss. The threat of fire incursion is a more acute risk.

The humid microclimate maintained beneath rainforests generally provide some protection from fire, but this defence is greatly compromised during times of drought, high temperatures and low humidity.

The 2019/20 fire season saw unprecedented bushfire conditions across much of the Gondwana Rainforests, and between September 2019 and January 2020 fire impacted more than 50% of the land area of the property, including extensive areas of rainforest.

While bushfires had previously been identified as a future risk to rainforests, the 2019/20 fire season has demonstrated that the Gondwana Rainforests are flammable under the current climate and should now be managed as such.

The full report from this assessment is available on the Earth Systems and Climate Change Hub website at [www.nespclimate.com.au](http://www.nespclimate.com.au).

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