

Climate change impacts factsheet:

2. Terrestrial biodiversity

Terrestrial biodiversity can be defined as the variety of life forms on the land surface of the Earth. High biodiversity is often used as an indicator of ecosystem health and has been shown to have direct links to human health.

Climate change will affect terrestrial biodiversity and ecosystems through both gradual and sudden changes in response to the average climate (e.g. increased temperatures, decreased rainfall, changes to seasonality), and extreme events (increased hot days, fire, increased frequency and severity of cyclones, heat waves, intensified wet seasons).

Climate and terrestrial biodiversity

The distribution and life cycle of individual terrestrial species are inherently linked to local climate conditions. All species have an 'optimum climate' in which they survive and thrive and which dictates the timing of life cycle events (e.g. flowering, emergence, mating and migration) and their geographical distribution. At the extremes of a species' climate tolerance, growth and reproduction may be reduced compared to populations growing at optimal conditions. The success of a species may also rely on the climate tolerance of interacting species. For example, a herbivore may be able to tolerate warmer conditions than the plant it feeds on, but the absence of this plant may exclude it from warmer regions. Individuals of a species can sometimes avoid unfavourable

climate conditions through behaviour (e.g. resting in cool rock cracks during hot conditions) and exploitation of micro-climate conditions (e.g. cool, moist gullies).

Future climate trends

Average surface air temperature rose 0.9°C in Australia in the past 100 years, and the distribution, intensity and seasonality of rain across most of the continent has changed. These trends are expected to continue, accompanied by increases in the incidence of hot days, reductions in cold days, frosts and snow cover, and a southerly movement of tropical cyclone tracks. For terrestrial biodiversity, the projected increase in the number of extremely hot days (>35°C) will be significant - in many parts of the continent, the number of days over 35°C could triple by 2070. The predicted increase in extreme fire days is concerning and could have substantial impacts on terrestrial biodiversity. Major biomes and climatic zones may shift and some researchers predict an expansion of the sub-tropical dry zone across Australia, bringing hotter, drier, desert-like conditions.

Climate change impacts and vulnerabilities

The Intergovernmental Panel on Climate Change identified terrestrial systems as among the most vulnerable sectors in Australia and New Zealand. The vulnerability of species and ecosystems depends on factors including the sensitivity of the species or ecosystem, the level of exposure and the intrinsic adaptive potential.

Terrestrial species have already responded to observed climatic changes, globally, and in Australia. The geographic ranges of many species have changed in location and size, and many species are displaying altered timing of life cycle processes such as migration and breeding. Some species also show altered behavioural, genetic, and physiological traits.

Terrestrial species likely to be most vulnerable include many that are already endangered or rare. These species commonly have restricted or fragmented geographic distributions or habitats. They may have specialised ecological requirements and narrow climatic tolerances. Species that are currently common or widespread may also be negatively affected. Extreme events such as heat waves, droughts and wildfires will likely have catastrophic impacts. For example, mass die-offs of possums and grey headed flying foxes have already been observed following prolonged high temperatures.

Fragile ecosystems include:

- Alpine species and communities, which will be particularly at risk from a combination of reduced snow cover and potential increases in wildfire occurrence.



Image: Andrew Kenworthy

- The biodiversity hotspot of south-west Western Australia, where a variety of systems and species will be severely affected by increased frequency or severity of drought.
- Mangroves and coastal wetlands, which will be affected by rising sea levels, storm surges, and more cyclones.
- Rainforests of north Queensland, which support a large number of endemic terrestrial species. The lifting of the cloud cap, the increasing length of dry seasons, increasing temperature and more severe cyclones could have very severe impacts.

Research suggests that climate change will interact with, and exacerbate, many other processes that threaten terrestrial systems. Many of these are of human origin, including introduced species and land-use change.

Social and economic impacts

The effects of climate change on terrestrial biodiversity will have cultural, social, and economic impacts including loss of ecosystem services such as clean water, pollinators and amenity. For Indigenous people, biodiversity loss could mean the loss of culturally significant species including important bush tucker, medicinal plants and art and craft resources, and of important ancestral connections. Tourism in Australia contributed \$33 billion to the 2010 Gross Domestic Product and nature-based tourism contributes significant revenue in all Australian states and territories. Key tourism regions likely to be affected include Kakadu National Park (wetlands affected by salt intrusion linked to sea-level rise), Victorian alpine regions, the Great Barrier Reef and the Wet Tropics rainforest.

Adaptation: practices, options and barriers

Most adaptation actions will be highly specific to particular ecological communities or ecosystems. For example, suppressing fire in sensitive vegetation types in the alpine zone will require different management strategies from those facilitating landward migration of endangered salt marsh communities in the coastal fringe.

Central to adaptation in terrestrial systems is the concept of Ecosystem based Adaptation (EbA). Defined as *'the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change'*, EbA promotes the value of maintaining intact and functional ecosystems as a cost-effective strategy for protecting human health, settlements and livelihoods from extreme weather events. EbA activities could include restoration of wetlands and riparian areas, which benefits wetland-associated species, reduces flooding potential and maintains water quality.

Other key areas for adaptation in terrestrial systems include conserving and regenerating climate refugia. Climate change will increasingly be a consideration in the selection, design and management of protected areas. Many species currently protected in national parks, for example, will no longer be in climatically suitable areas as the climate changes; strategies to facilitate autonomous adaptation (e.g. movement corridors) will need to be considered.

More interventionist strategies include managed relocation, genetic translocation (i.e. moving individuals with different genetic make-up into new populations) and ex-situ conservation, which may be the final option for critically endangered species. Biodiversity will also be affected by adaptation strategies in other sectors, such as bushfire control

Research priorities

Nationally, we need to know how climate change will affect existing conservation goals and how best to implement new conservation strategies to minimise negative impacts. Regionally, we need to understand how climate change will interact with other key stressors such as fire, invasive species, salinity and habitat loss, the impact of which will differ among states and regions. Locally, we need to understand how particular species and ecological communities can be managed to maintain viable populations.

Other uncertainties include the extent and speed at which climate change will affect biodiversity and ecosystem services, and the thresholds of climate change above which ecosystems might be irreversibly changed and no longer function in their current form. There is considerable uncertainty about the effectiveness of direct interventions such as managed relocation or habitat corridors, and experience shows that they may come with significant risk of unintended consequences.

around human settlements, and changes to agricultural locations and methods, including abandonment of marginal agricultural land and increased demand for irrigation water.

Costs

Undoubtedly, the natural world provides many services that are undervalued. The reduction or loss of these services would greatly affect human health, infrastructure and livelihoods, and the capacity of human society to adapt to climate change. There is currently limited information on the costs of impacts and adaptation to climate change for terrestrial biodiversity. The cost of what we will lose if we fail to adapt to or mitigate climate change will be immense. A recent report on *The Economics of Ecosystems and Biodiversity* (TEEB, 2010) looked at the value of some ecosystem services, and estimated that:

- halving deforestation to reduce greenhouse gas emissions by 2030 is worth US\$3.7 trillion; and
- the economic value of insect pollination for agriculture worldwide in 2005 is US\$153 billion.

About the Network

The Terrestrial Biodiversity Network aims to collate knowledge, co-ordinate expertise and synthesise these inputs into recommendations and frameworks to guide the way for Australia to adapt to global climate change. The Network has a national focus, and distributes activities and funding opportunities across all states and territories. Membership includes researchers, institutions and stakeholder organisations, government agencies, conservation groups, and a variety of non-government organisations.

A major focus is to communicate research to end-users through quarterly newsletters and information sheets, stakeholder roadshows, workshops and seminars. The Network also builds research capacity by funding student projects and collaborative travel grants.

For more information visit:

<http://nccarf.jcu.edu.au/terrestrialbiodiversity>