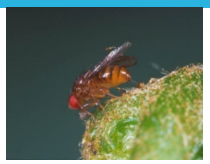
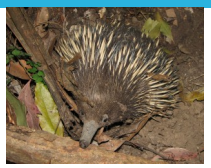
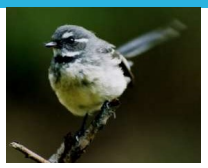
NCCARF
National Climate Change Adaptation Research Facility
Adaptation Research Network
TERRESTRIAL BIODIVERSITY

INFORMATION SHEET ONE

Climate Change Impacts and Species Response in Terrestrial Systems

Climate change threatens ecosystems worldwide. The Inter-governmental Panel on Climate Change (IPCC) reports that recent warming has been greater over land than over the oceans, with considerable implications for terrestrial biodiversity.

Average surface air temperature has risen 0.9°C in Australia over the past 100 years, accompanied by changes in rainfall across most of the continent. Scientists expect these trends to continue and be associated with increases in extremely hot days, a southerly expansion in the tracks of tropical cyclones and changes to seasonal patterns of rainfall.

This Information Sheet outlines some of the observed and predicted impacts on, and responses of, Australia's terrestrial biodiversity to climate change.

Species Distributions

Some of the first reported impacts of climate change were altered species distributions. A number of species have shifted to higher elevations or latitudes to track their preferred climate.

Similar changes in geographic range have been predicted for Australian species such as kangaroos, butterflies and some native trees, and many others could be affected. The ranges of some species could decrease or become more fragmented.

Conversely, climate change might favour some introduced species. If these species expand their range there will be implications for native species.


Climate change could result in a decline in distribution for some native animals and plants, including butterflies, but an expansion in the range of exotic species such as the red fox.

If plants start flowering earlier, but insect emergence doesn't advance at the same rate, it could create mismatch between plants and pollinators.

Phenological Changes

Phenology refers to the timing and duration of biological events such as migration, breeding and flowering.

Climate change has been linked to changes in migration patterns, with many birds (including Australian species) migrating earlier in spring and later in autumn. Breeding patterns and seasonality have also altered in a variety of species, from plants and insects to mammals.

Changes in phenology may have a minor impact on some species or could even be favourable. For instance, an advancing spring has resulted in extended breeding seasons and increased reproductive success of some species.

However, interactions between many species could be affected if one species responds differently to climate change compared to another interacting species. For example if the breeding season of a predatory bird advances faster than the peak abundance of its main prey, caterpillars.

Mismatches have already been identified in predator-prey interactions and plant-herbivore systems. They are also predicted for some plant-pollinator relationships in Australia.

Impacts on Physiology

Most animals and plants are adapted to a small range of environmental conditions that vary depending on their evolutionary history and geographic range. For example, desert species can tolerate high temperatures and periods of drought and may breed opportunistically following occasional rainfall. In contrast, tropical species often have narrow thermal tolerances and favour a more stable environment, and so may be particularly at risk.

The predicted increase in temperature extremes could see some individuals experience extreme heat stress and possibly death. In 2002, more than 3000 flying foxes died in New South Wales when temperatures rose above 42°C. Some marsupials, such as the rainforest green ringtail possum, become heat stressed at temperatures as low as 30°C.

Other species rely on seasonal rainfall and temperature cues to initiate successful breeding; females of the western swamp tortoise, Australia's most endangered reptile, are unable to produce eggs in years of poor rainfall. This species is restricted to south-west Western Australia, where rainfall declines are expected to be severe.

Long-lived habitat specialists such as the southern cassowary, could be vulnerable to climate change.

Species Vulnerability

A species' vulnerability will depend on its degree of exposure to climate change, microhabitat use and behavior, and a combination of biological traits. Factors expected to increase vulnerability include:

- Narrow geographic range.
- Specialised and/or inflexible ecology, including diet, habitat, microhabitat and behaviour.
- Narrow environmental tolerance that may be exceeded by future climate change.
- Already living close to the limit of environmental tolerance.
- Dependence on environmental triggers or cues that may be disrupted by climate change.
- Poor dispersal ability and/or presence of dispersal barriers that hinder ability to move to more suitable habitat.
- Late age at maturity and low reproductive output, such as long-lived mammals and birds.
- Susceptibility to disease or pathogens that may interact with climate change, such as the amphibian chytrid fungus.

Implications for Managers and Decision-makers

Climate change will challenge biodiversity managers and policy makers. As species shift their range, we will see novel ecosystems and new species interactions. Managers will need a flexible approach, integrating new species into faunal assemblages while still protecting vulnerable species in their current range. Active adaptive management should be a priority.

Management initiatives should increase ecosystem resilience by minimising the impact of other stressors including introduced species and habitat loss. Plans to strengthen and integrate the natural reserve system will improve habitat connectivity and provide corridors for species migration. Priority areas should be identified that provide refugia, protection from other stressors such as invasive species, migration routes and microhabitats which buffer individuals from the impacts of extreme weather such as tree hollows or rock crevices.

Natural refuges, such as tree hollows, could be critical for some species.

About the Adaptation Research Network for Terrestrial Biodiversity

The Adaptation Research Network for Terrestrial Biodiversity is one of eight research networks administered by the National Climate Change Adaptation Research Facility. It is hosted by James Cook University in Townsville, north Queensland.

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For more information on the Climate Change Adaptation Research Facility and other Research Networks, please visit www.nccarf.edu.au

JAMES COOK UNIVERSITY AUSTRALIA

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