

# AUSTRALIAN LANDSCAPES FROM EOCENE TO ANTHROPOCENE

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**ABSTRACT:** The 65-million-year journey from the demise of the dinosaurs to the present day is characterised by changing climates, periods of species extinctions and, finally, the appearance of *Homo sapiens*. As an island from the start of this period, Australia's landscapes were isolated from the rest of the world and to this day are characterised by a unique biodiversity. Since their arrival, First Nations peoples have somehow understood this special landscape, living in conformity with it, changing along the way as the climate and landscape changed. That all changed with the arrival of people from Europe, who were more familiar with a weedy landscape recovering from deep glaciation. Over the last 250 years, a lack of understanding of the uniqueness of the Australian landscape, and of First Nations connections with that landscape, has wrought both biological and cultural disruptions. Looking ahead, more conversations between all Australians on how to manage this country into an uncertain future, respecting the range of world views that exist, and rebuilding a viable biocultural diversity, remains a significant but achievable challenge.

**Keywords:** Climate change, biocultural diversity, cultural severance, landscapes, extinction, stewardship, reconciliation

## A JOURNEY THROUGH TIME

This paper deals with the transition from the 'fifth great extinction' (at the boundary between the Cretaceous and Tertiary periods about 65 Ma) to the present day, but beginning at the start of the Eocene Epoch (approximately 55 Ma). The geological timescales used in this paper are those of the International Commission on Stratigraphy — the body established to adjudicate on the geological timescale and names (Cohen et al. 2013). The Commission uses the abbreviations ka for thousand, and Ma for million of years BCE, and those abbreviations are followed in this text. In the approximately 55 Ma period from the start of the Eocene to the (currently debated) period termed the Anthropocene, Australia journeyed northwards from Antarctica after the split-up of Gondwana was complete (about 30 Ma). Australian landscapes from Eocene to Anthropocene are all about context — with the key themes in this geological period being:

- climate change
- extinction
- biocultural diversity
- cultural severance.

The Eocene Epoch includes the warmest climate in the Cenozoic Era but ends in an icehouse climate. Between about 55 Ma and about 49 Ma little to no ice was present on Earth, and there was a smaller difference in temperature from the equator to the poles than at present. Following that maximum temperature (higher than the current global average temperature), an icehouse climate pervaded Earth

from 49–28 Ma. During this icehouse period, ice began to reappear at the poles, and the Antarctic ice sheet began to expand rapidly.

In terms of biodiversity from the onset of the Eocene, following the age of dinosaurs, rapid diversification of mammals and a further expansion and diversification of flowering plants occurred across the globe. For Australia, the main feature of the northwards drift was a change from a continent with significant rainforest cover and flowing rivers to one where the climate became drier with seasonal rainfall — all connected with a general global cooling. Although the fifth great extinction preceded this period of the Earth's history there were several smaller extinction events throughout the whole period. Perhaps the most important (and clearly documented) such extinction for Australia was the demise of the megafauna around 40 ka — an event apparently repeated globally (Turvey et al. 2021). The precise causes of this global demise are uncertain, but both sudden climate shifts and increasingly intense human–wildlife interactions have been implicated.

Although Australia was generally lusher than today, as time went by a drier heart of the continent became evident, increasing as time reached the present and the continent continued its northwards drift. As it took place on an island for 55 million years, mammal evolution favoured marsupials, and the distinctive ex-Gondwanan flora we have today covered the country, while continuing also to evolve in the drying climate. At the dawn of the Pleistocene, around 2.5 Ma, the key feature in Australia

was increasing aridity. Due to strong transcontinental winds about 700 ka the continent experienced expansion of longitudinal dune fields. For much of the Pleistocene, Tasmania was connected to the mainland by the Bassian Plain, as the global glaciations kept the sea level well below its present height. Flinders Island is one of the remnants of mountainous areas in the eastern part of the Bassian Plain.

And then, enter *Homo sapiens*. It is generally agreed *H. sapiens* arose in southern or eastern Africa, around 120 ka. We now know *H. sapiens* co-existed with other species in the genus *Homo*, notably *H. neanderthalis*, “Denisovan man” and *H. erectus*. Interbreeding occurred, which means that although other species are now extinct, modern *H. sapiens* carries genes of its cogeners in its genome. There is some evidence Aboriginal Australian and other indigenous peoples of the southwest Pacific may have a higher proportion of these genes from our now-extinct relatives (Bergström et al. 2021). This genetic ‘bonus’ was likely to have helped survival and the ability of people to thrive during the climatic variation experienced in Australia during the last 60–70 thousand years.

During their time in Australia, Aboriginal people have walked from north to south and from east to west. The majority of the Bassian Plain is now Bass Strait, presently drowning (or immersing) traces of the lakes and rivers that interspersed the dune fields, but in early human exploration of the continent people were able to walk into Tasmania. Trading routes, and routes for meetings and cultural exchanges have meant the ‘wilderness’ seen from the perspective of today’s urban settlements has, in fact, seen both hand and foot of people for millennia. Along the way came a deep understanding by Australia’s First Nations of land and shoreline, a blossoming of complex culture, and exposure to changing climates from tundra to subtropical.

#### THE ANTHROPOCENE

There is broad agreement we are now living in a new and distinct epoch — the Anthropocene — although when it started is subject to much debate among geologists and environmentalists (e.g. Lewis & Maslin 2015; Subramanian 2019). The main characteristics attributed to the Anthropocene are rapid, often unpredictable, but linked, modifications of the landscape. These modifications arise from changes in climate; hydrology (especially groundwaters); genes, species, and ecosystems (biodiversity); and human culture. Increasingly, many use the term Anthropocene in an almost political way to highlight extensive human disruption to the Earth system over the last 50–60 years (see Partzsch et al. 2018). My own view is that the start of the Anthropocene can be traced to the time when *H. sapiens* had deliberately or accidentally extirpated all other species in the genus *Homo* and set out

on an unprecedented colonisation and change management of the whole planet. Such a view does not, of course, yet fit the geologists’ need for a ‘golden spike’ in stratigraphy to denote the start of a new geological period.

#### LANDSCAPES

Looking at landscapes in the twenty-first century, the prevailing popular view of the landscape as permanent and unchanging militates against the basis of ecosystem dynamics. Yet that view predominates because most people live their lives within a timeframe where few changes can be observed, or are easily forgotten. But interactions between people and the rest of nature created a new type of diversity — biocultural diversity (Bridgewater & Rotherham 2019). This is a dynamic, place-based aspect of nature arising from links and feedbacks between human cultural diversity and biological diversity. Biocultural assets and heritage result from these interactions between people and non-human biodiversity at a given time, in a given place. Separation of nature from human culture (cultural severance) has been identified as a serious problem in the conservation of both natural and cultural heritage (Rotherham 2013). Some consequences of cultural severance include dramatic declines in ecosystem and species richness and reduction in landscape quality. While Rotherham (2013) wrote about the UK, the issue has even sharper focus in Australia.

#### THE DREAMING

For Australia, Gammage (2012) wrote: ‘Although comprising many ways of maintaining land, and managers mostly unknown to each other, this vast area was governed by a single religious philosophy, called in English “the Dreaming”. The Dreaming and its practices made the continent a single Estate.’ Following this thinking, we can imagine that in 1788 Australia, plant patterns were unnatural but universal. People (Aboriginal) everywhere made similar templates for similar purposes. Different lives followed the same Law (lore), allied with fire (cultural fire) (Figure 1), and in the great river systems, water (cultural flows). This human activity worked locally across the continent to make biodiversity ‘abundant, convenient, and predictable’ (Gammage 2012). While the 2019–2020 bushfires in Australia have been strongly linked to climate change and poor forestry (Lindenmayer et al. 2020) that is not the whole story; they have also occurred because of an inability by non-Aboriginal Australians to understand, or even converse about, biocultural values involved in proper management of fire in landscape — a classic example of cultural severance. This same story is unfolding in the North American landscapes equally subject to recent intensive fires (e.g. Lake et al. 2017; Buono 2020).



Figure 1: Early dry season burn in Kakadu National Park, showing low-level fire intensity in Melaleuca swamp forest.

People have always had stewardship of landscapes in stability and change, but climate change and biodiversity change are currently an order of magnitude different, and present new challenges. Words like wilderness, pristine and wild lands give Arcadia-like impressions which have no reality in the framework of climate change, and probably never have.

#### THE WAY FORWARD

So, what attitudinal changes are needed to live safely and comfortably in the landscapes of the Anthropocene? A Landscape Stewardship Approach (e.g. Bieling & Plieninger 2017) would seem to provide the ideal solution, which would mean:

- seeking to simultaneously improve food production, heritage and biodiversity conservation, and rural livelihoods, particularly acknowledging the interconnections between social justice and environmental health
- supporting self-organised and highly participatory, adaptive, collaborative management within a social learning framework, and, especially
- valuing a diversity of ‘ways of knowing’, including local and indigenous knowledge, about landscapes and natural resources.

This means rethinking the connection of non-Aboriginal Australians to our landscapes and wildlife, accepting the panoply of worldviews that exist, leading to development of a more sustainable way of living. Hopefully, the webinars by the Royal Societies of Australia will help to promote more community discussion on these issues, in turn assisting with reconciliation efforts between Aboriginal and non-Aboriginal Australians. Finally, we need politicians, at all levels, to think about and discuss these matters intensively — hopefully leading to action from local to national.

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#### Conflict of interest

The author declares no conflicts of interest.

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