Ecosystem
Science Council

Long-term research needs long-term funding

Overview

Our natural and managed ecosystems form the world in which we live, work and play. They are fundamental to our current and future prosperity, and to our national wellbeing. Our unique landscapes, waterways, plants and animals are a vital part of the Earth's natural heritage, and we have many international obligations to look after them. Healthy ecosystems sustain agricultural production, forestry, fisheries and community well-being. They support nature-based tourism worth nearly $25 billion a year, mostly through international visitors. However, growing human populations, increasing demands for resources, continuing habitat loss, and a changing climate are applying unprecedented pressures to Australian ecosystems. Australian governments over the past two decades have recognised ecosystems and their sustainability as high research priorities.

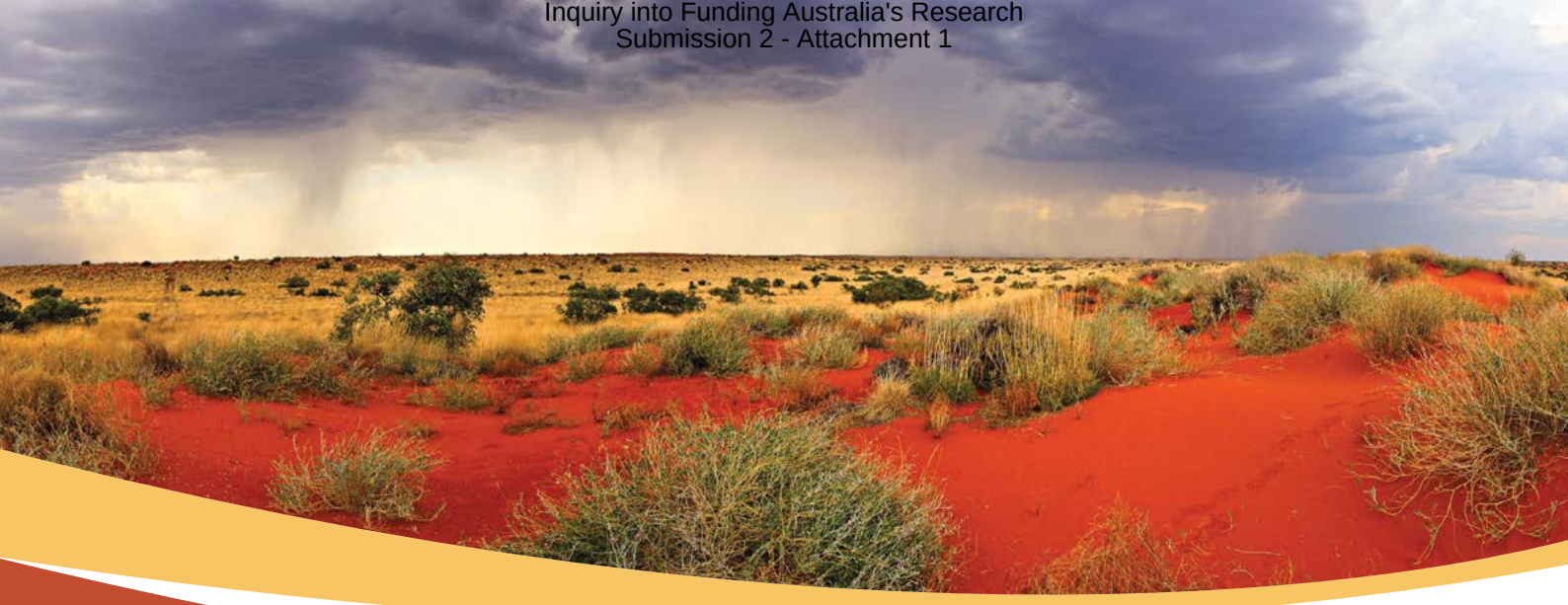
Australia has a proud history in ecosystem science. We punch well about our weight for scientific impact; for example, eight Australian universities are rated 'well above world standard' in ecology and environmental science. However, unlike many other developed countries we lack a nationally coordinated system of long-term research to guide wise decision making. Long-term ecological research is needed because many ecosystem processes operate over decadal timescales. This is especially the case for our land of droughts, fire and floods, where extreme events are a dominant factor in ecosystem dynamics. Long-term research not only describes ecosystem change, but identifies the drivers of change. It therefore provides the basis for forecasting ecosystem change and for guiding management action.

As the following case studies explain, Australia has some excellent examples of how long-term ecological research has led to fundamental insights into the nature of Australian ecosystems, and how this underpins their effective management for the nation's benefit. However, these examples are unrepresentative of the diversity of our ecosystems, and lack funding security. There is an urgent need to establish a nationally-coordinated program of long-term research that has sustainable funding.

Case study 1

The Simpson Desert: understanding the nature of Australia

Australia is indeed a sunburnt country, and the arid outback is ingrained in our national psyche. Australia has the most biodiverse of all arid zones, but a significant component of this diversity has been lost since European settlement through predation by introduced foxes and cats, and over-grazing by rabbits and livestock. Rainfall in inland Australia is not just low but is extremely variable, and ecosystem dynamics are driven by irregular and unpredictable rainfall and associated pulses of resources. This leads to boom-bust population cycles in many plant and animal species. Such variable ecosystems that are prone to extreme events require long-term research for understanding how they function and therefore how they need to be managed.



Storm in the Simpson desert, in our land of drought, floods and fire. Photo: Aaron Greenville

The University of Sydney has been conducting intensive research in an 8,000 km^2 area of the north-eastern Simpson Desert in western Queensland for more than 25 years. The research has documented how heavy rainfall causes a profuse flush of herbs and grasses, leading to population booms of invertebrate species and consequently insectivorous animals. Prolific flowering leads to bumper crops of seeds, which drive population irruptions of resident rodents and attract huge flocks of nomadic birds such as Budgerigars.

However, these rains are not all good news, as they also trigger large increases in established pests such as rabbits, foxes and cats, as well as expansions of new pests and weeds such as cane toads and buffel grass. The profuse ephemeral vegetation also provides fuel for extensive wildfires over the following year. Heavy rainfall is therefore a cue for intensive management of feral animals, weeds and fire. Prolonged droughts are times of severe stress, and researchers have identified critical refuge areas for sustaining native animals during these times. These refuges are priority areas for conservation management, including targeted control of feral animals, weeds and livestock.

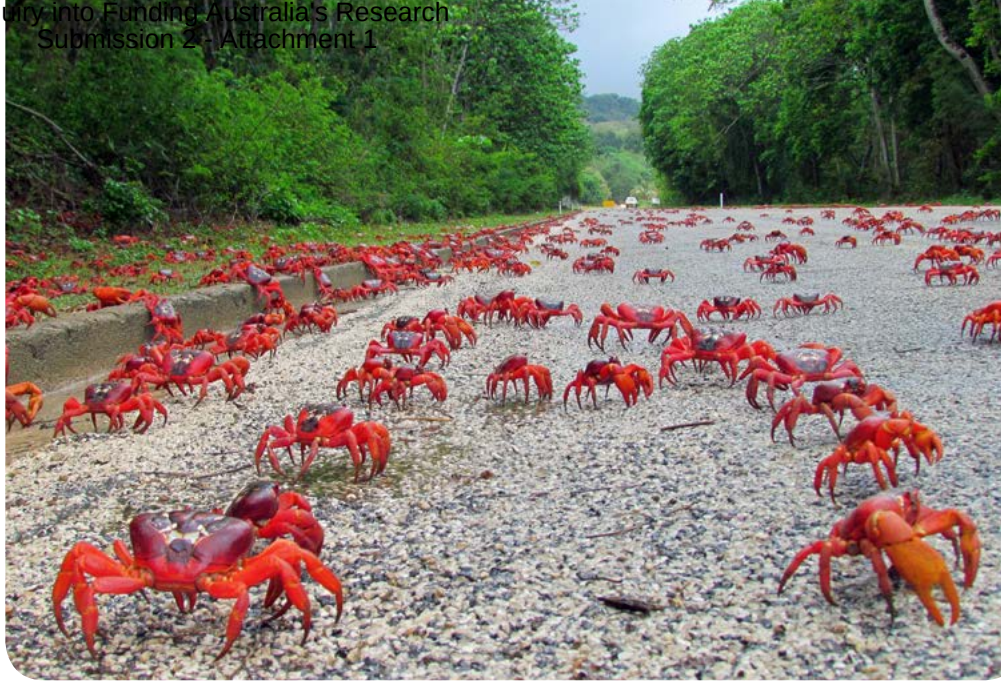
Long-term research in the Simpson Desert has provided fundamental insights into the ecology of outback Australia. These insights underpin effective ecosystem management, ensuring that our iconic plant and animal species continue to boom during the good times, and survive the bad.

Case study 2 ***Species extinctions on Christmas Island***

Australia's Christmas Island in the Indian Ocean is internationally famous for its millions of endemic red land crabs that undergo spectacular annual migrations from the rainforest to the sea for breeding. Christmas Island has extremely high levels of endemism more generally: for example, all five of its native mammal species, five of its six native reptile species and seven bird species occur nowhere else. However, the distinctive biota of Christmas Island is severely threatened, especially due to the introduction of pest animals and weeds. One notable introduction is the yellow crazy ant, whose 'super-colonies' have eliminated land crabs and other species from extensive areas, with cascading effects on rainforest vegetation.

Christmas Island's unique biodiversity is now in a state of crisis. Since the 1990s, most of the island's native reptile fauna has disappeared, and in 2009 the endemic Christmas Island pipistrelle bat also became extinct. For some of these species, information on population trends were sketchy at best, and the problem was not appreciated until populations had already crashed. The specific factors causing declines among the range of potential threats remain poorly

understood, which severely hindered effective management responses. A lack of long-term ecological monitoring and research therefore played a significant role in the loss of an important part of Australia's natural heritage. This is now being addressed. For example, following more than ten years of research and monitoring, a biological control program has been implemented for yellow crazy ants, and this promises to put Christmas Island at the international forefront of pest ant management.

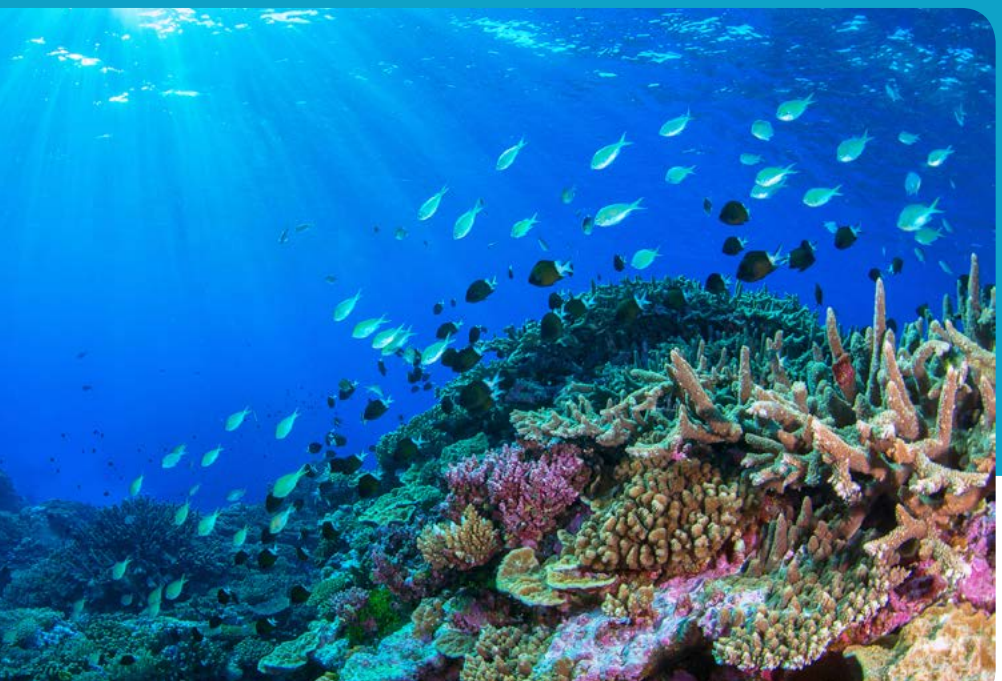


Annual migration of Christmas Island's endemic red land crabs. Photo: John Woinarski

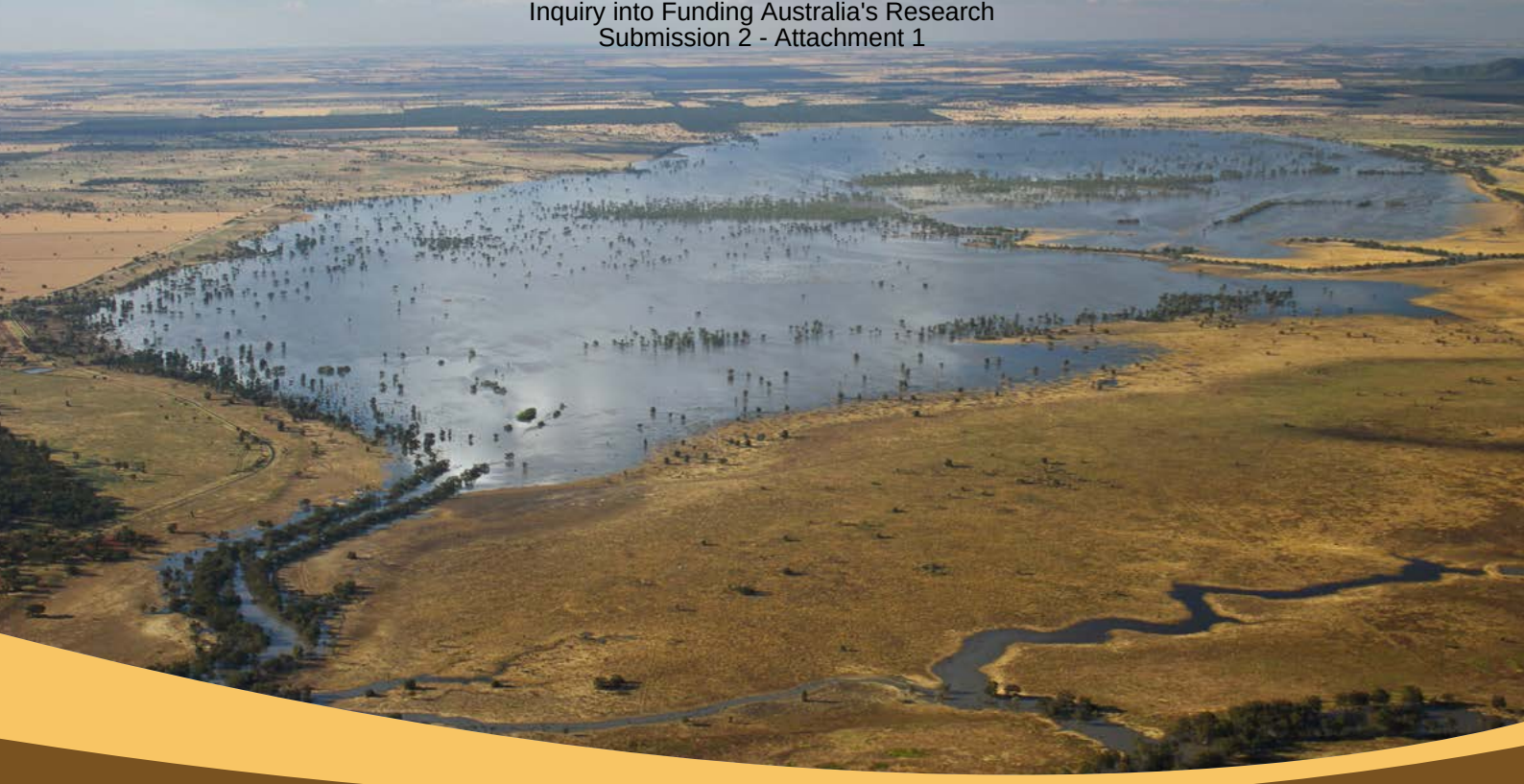
Case study 3 ***Great Barrier Reef***

The Great Barrier Reef (GBR) is an iconic national treasure. As one of the natural wonders of the world, it directly contributes an estimated $7 billion each year to the national economy, primarily through tourism and other recreational activities. At 2,300 km in length, it is the largest living structure on the planet. The GBR supports an incredible diversity of marine plants and animals, including more than 600 species of corals, 3000 species of molluscs, 1625 species of fish, and more than 30 species of whales and dolphins. Although it is protected within the Great Barrier Reef Marine Park, and has World Heritage Area status, the condition of the GBR is in serious decline due to a range of impacts, especially inputs from land-based erosion, outbreaks of crown of thorns starfish, and coral bleaching. There was an alarming 50% decline in coral cover within the GBR between 1995 and 2012, and 2016 witnessed the most severe coral bleaching on record.

In response, the Australian Government has developed the Reef 2050 Long-term Sustainability Plan. This Plan has been critically informed by an integrated program of long-term research that has identified the nature and inter-relationships of the key threatening processes. Findings from this research are underpinning a $2 billion-dollar investment by the Federal and Queensland governments in reef restoration projects over the next decade, aimed at improving water quality through reductions in nutrient inputs from sugar-cane farms and sediment runoff from grazed land. The effectiveness of these programs will be evaluated through ongoing long-term research facilitated through the Reef 2050 Integrated Monitoring and Reporting Program, which is recognised as an essential component of adaptive management of the GBR.



The Great Barrier Reef is one of the natural wonders of the world, but is under serious threat. Photo: Rick Stuart-Smith, Reef Life Survey



Natural wetlands with high biodiversity are interspersed within the agricultural landscapes of the Murray-Darling Basin where there is dryland and irrigation cropping and grazing of livestock. Photo: Richard Kingsford

Case study 4 ***Murray-Darling Basin***

The Murray-Darling Basin (MDB) is Australia's most important agricultural region, supporting half of the nation's total food production at an annual value of >$7 billion. However, the diversion of most of its surface water for agricultural production has come at a severe ecological cost. Water quality for downstream cities and towns is poor, and many of the Basin's iconic wetlands, including those listed under the international Ramsar convention, are highly degraded. During the recent Millennium Drought, inappropriate water resource development had a catastrophic impact on water supply to Adelaide, costing governments more than $2 billion in mitigation.

The Australian Government is now implementing the $12 billion Murray-Darling Basin Plan to restore ecological health to the MDB. This is one of the most ambitious restoration projects in Australian history, and is expected to yield net benefits of up to $5 billion each year. The development and implementation of the Plan has been guided by results from long-term research on rivers, floodplains and water birds that has linked changes in environmental flows to changes in water quality, ecosystem health and biodiversity. Research has needed to be long-term to identify trends in the context of high background variability in rainfall, including periods of drought. The integration of research results into effective management will ensure that additional environmental flows under the Plan deliver maximum overall benefit from the Basin's water for agriculture, for water security for towns and cities, and for biodiversity.

Ecosystem Science Council

The Ecosystem Science Council works with all individuals, groups and organisations within the ecosystem science and management communities to advance the goals of the long-term plan for Australian ecosystem science, **Foundations for the Future.**

For further information see
www.ecosystemscienceplan.org.au

or contact Prof Glenda Wardle
glenda.wardle@sydney.edu.au