Case study 1

Biodiversity

Collaborative research on climate change and biodiversity in megadiverse ecosystems

South-west Western Australia and the Cape Province in South Africa are recognised as global biodiversity hotspots; those places on Earth richest in endemic species but most under threat by global change.

The two regions share many characteristics. They have ancient evolutionary links in their floras, (e.g. *Protea* and *Banksia*), similar Mediterranean type climates, very old nutrient impoverished soils, fire-prone ecosystems and plants which share many ecological traits. The regions have also exchanged plant species which have become weeds in their new environments, and both suffer from invasions from other parts of the world.

Increases in atmospheric CO_2 concentrations, projected increases in temperature, declines in rainfall, increases in the frequency of extreme climate events, changes to fire regimes and extensive land transformation will affect biodiversity in both regions and create new opportunities for introduced species to become invasive.

Planning for, and adapting to, the impacts of climate change will require sound scientific advice. Both regions have strong biological science capacity with complementary expertise and because of the ecological similarities are suitable for analytical comparisons and exchange of information.

In recognition of this, the Western Australian Department of Environment and Conservation (DEC) and South African National Biodiversity Institute (SANBI) have teamed up in a project supported by the Australian Government Bilateral Climate Change Partnerships Program.

The project is developing methods and tools to forecast and monitor climate change impacts on biodiversity as a basis for informing adaptive management decisions. Exchange of information and skills is increasing the capacity of both DEC and SANBI to plan for and adapt to climate change.

Research priorities include identifying the most vulnerable species, climate thresholds, improved bioclimatic modeling of species and biomes, interactions with existing stresses, developing management options to reduce vulnerability and the data management systems needed to support these activities.

Comparative modelling and experimental studies of keystone species in *Protea* and *Banksia*, mammal and bird species with contrasting dispersal abilities and mutually exchanged weeds in both regions will provide vital information on the interactive impacts of climate change and other threatening processes on biodiversity in both regions.

For more information contact Dr Colin Yates (colin.yates@dec.wa.gov.au) or Dr Guy Midgley (midgley@sanbi.org).

Case study 2

Biodiversity

Predicting the impacts of climate change on biodiversity and ecosystem function in biodiverse shrublands

The Eneabba sandplain, located 300 kilometres north of Perth, Western Australia, is a world-renowned biodiversity hotspot, and supports native vegetation known as Kwongan — the Aboriginal word for low hard scrub and heathland. Kwongan of the Eneabba region is extremely diverse and contains many species, a large percentage of which are endemic to the region. As well as being biologically important, the area is popular among tourists and botanists who visit Eneabba during the wildflower season.

The sandplain soils have very low water holding capacity, and during the hot summer months dry out to considerable depth, rewetting in winter when rain falls. Many species survive the summer drought with deep root systems capable of accessing water held deep in the soil profile in unconsolidated aquifers, which recharge when winter rain falls. Other species are less reliant on groundwater and have alternative mechanisms for surviving Eneabba's hot and dry summers.

Since the mid 1970s, rainfall in south-west WA has declined, with less rain falling at the beginning of winter. The Indian Ocean Climate Initiative has attributed this in part to anthropogenic climate change, with further drying predicted to continue as greenhouse gases accumulate in the atmosphere. What impact will climate change have on the extraordinarily diverse plant species and communities that make up the Kwongan at Eneabba?

To answer this question scientists from the Department of Environment and Conservation, Murdoch and Edith Cowan universities, and The University of Western Australia have teamed up in a new project to investigate the relationship between climate, groundwater dynamics, plant ecophysiology and population dynamics (demography).

Specifically, the project will:

- quantify diurnal and seasonal patterns of water storage and distribution in the soil profile together with plant water use for a range of species in the Kwongan;
- quantify experimentally the effects of decreased winter rainfall and increased daytime temperatures on plant species' ecophysiology and demography to identify critical climate thresholds;
- analyse the evidence for climate-driven range contraction during the past 30 years among plant species of the Kwongan;
- develop and calibrate models linking climate soil water dynamics, plant water use and demographic response to predict future climate change impacts.

For more information contact Professor Neal Enright (n.enright@murdoch.edu.au) or Dr Colin Yates (colin.yates@dec.wa.gov.au).

Case study 3

Biodiversity

Millennium Seed Bank Project

In 2000, the United Kingdom's Seed Conservation Department at the Royal Botanic Gardens, Kew, opened the Millennium Seed Bank. This is the world's largest native seed bank and seed bank research facility, designed specifically for the conservation of wild species.

The Millennium Seed Bank Project aims to store seeds from 10 per cent of the world's arid and semi arid regions (about 24,000 species) by the year 2010. The project is a global undertaking with numerous partners from around the world, including the Western Australian Government.

In 2001, DEC's Threatened Flora Seed Centre began a nine-year partnership with the Millennium Seed Bank Project which:

- provides duplicate storage for seed collections from the Threatened Flora Seed Centre. Storing seed at two locations ensures double protection for collected seed;
- provides additional resources which have enabled the Threatened Flora Seed Centre to expand its capacity to collect, store and study seed by supporting post-graduate students, employing additional staff and purchasing specialised equipment;
- provides technical and research training for Threatened Flora Seed Centre staff;
- internationally raises the profile of Western Australian seed conservation activities.

Since 2001, Western Australia has contributed more than one million seeds. This project is safeguarding some of the State's most threatened and precious plant species against a range of threats, including the impact of changing climates in areas such as the Stirling Range National Park, where climate change may have a significant impact on the many rare and endemic species found there.

For more information contact Anne Cochrane (anne.cochrane@dec.wa.gov.au).

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