How Australia's animals and plants are changing to keep up with the climate

March 28 2017, by Ary Hoffmann

Credit: José Carlos Alexandre from Pexels

Climate change is one of the greatest threats facing Australia's wildlife, plants and ecosystems, a point driven home by two consecutive years of mass coral bleaching on the Great Barrier Reef.

Yet among this growing destruction there is a degree of resilience to climate change, as Australian animals and plants evolve and adapt.

Some of this resilience is genetic, at the DNA level. Natural selection favours forms of genes that help organisms withstand hotter and drier conditions more effectively.

Over time, the environmental selection for certain forms of genes over others leads to genetic changes. These genetic changes can be complex, involving many genes interacting together, but they are sufficient to make organisms highly tolerant to extreme conditions.

Some of this resilience is unrelated to DNA. These are "plastic" changes – temporary changes in organisms' physical and biochemical functions that help them deal with adverse conditions or shifts in the timing of environmental events.

Plastic changes occur more quickly than genetic changes but are not permanent – the organisms return to their previous state once the environment shifts back. These changes also may not be enough to protect organisms from even more extreme climates.

What about Australia?

In Australia there is evidence of both genetic and plastic adaptation.

Some of the first evidence of genetic adaptation under climate change have been in vinegar flies on the east coast of Australia. These flies have a gene that encodes the enzyme alcohol dehydrogenase. This gene has two major forms: the tropical form and the temperate form. Over the past 30 years, the tropical form of the gene has become more common at the expense of the temperate one.

Plastic adaptation due to climate change has been demonstrated in common brown butterflies in southern Australia. Female butterflies are emerging from their cocoons earlier as higher temperatures have been speeding up their growth and development by 1.6 days every decade. According to overseas research, this faster development allows butterfly caterpillars to take advantage of earlier plant growth.

In many cases, it is not clear if the adaptation is genetic or plastic.

The average body size of Australian birds has changed over the the past 100 years. Usually, when comparing birds of the same species, birds from the tropics are smaller than those from temperate areas. In several widespread species, however, the birds from temperate areas have recently become smaller. This might be the direct result of environmental changes or a consequence of natural selection on the genes that affect size.

Higher temperatures are causing the common brown butterflies in southern Australia to come out of their cocoons earlier. Credit: John Tann/Wikimedia Commons, CC BY-SA

In the case of long-lived species like eucalypts, it is hard to see any adaptive changes. However, there is evidence from experimental plots that eucalypts have the potential to adapt.

Different eucalypt species from across Australia were planted together in experimental forestry plots located in various environments. These plots have unwittingly become climate change adaptation experiments. By monitoring the plots, we can identify species that are better at growing and surviving in extreme climatic conditions.

Plot results together with other forms of DNA-based evidence indicate that some trees unexpectedly grow and survive much better, and are therefore likely to survive into the future.

What's next?

We still have much to learn about the resilience of our flora and fauna.

There will always be species with low resilience or slow adaptive ability. Nevertheless, plastic and genetic changes can provide some resilience, which will change the predictions of likely losses in biodiversity.

Much like how our worst weeds and pests adapted to local climate conditions, as demonstrated many years ago, our local plants and animals will also adapt.

Species with short generation times – a short time between one generation (the parent) and the next (the offspring) – are able to adapt more quickly than species with longer lifespans and generation times.

For species with short generation times, recent models suggest that the ability to adapt may help reduce the impacts of climate change and decrease local extinction rates.

However, species with long generation times and species that cannot easily move to more habitable environments continue to have a high risk of extinction under climate change.

In those cases, management strategies, such as increasing the prevalence of gene forms helpful for surviving extreme conditions and moving species to locations to which they are better adapted, can help species survive.

Unfortunately, this means doing more than simply protecting nature, the hallmark of our biodiversity strategy to date. We need to act quickly to help our animals and plants adapt and survive.

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