# Making connections

**How can conservationists maintain genetic diversity among plants in fragmented habitats? Research into bromeliads in the forests of Brazil and at Kew is helping to provide answers, reports Christian Lexer**

The Atlantic Forest of Brazil is one of the world's 25 biodiversity hotspots – one of those special regions containing an enormous diversity of animals and plants. Twenty thousand vascular plant species live there, 40 per cent of which occur nowhere else, while up to 450 tree species have been recorded in a single hectare.

However, the Atlantic Forest is not only an extremely biodiverse place, it's also an immensely vulnerable one. The forest has been reduced over the centuries to make room for sugar-cane and coffee plantations, and as a result less than 10 per cent of the original forest cover survives. Today, the fast-growing cities of São Paulo and Rio de Janeiro are exerting immense pressure on habitats, wildlife and plants. How can the remaining species diversity be saved from extinction?

Fortunately, south-east Brazil is promising ground for nature conservation – a large number of local environmental NGOs (non-governmental organisations) are active in the region, reflecting growing public awareness of the importance of protecting biodiversity. New conservation initiatives are emerging, promoted by the Brazilian government, and a growing network of national parks, nature reserves and conservation areas is being developed. As a result, about 24,000 square kilometres of the Brazilian Atlantic Forest are now under strict protection.

Biologists working for Conservation International, a Washington-based NGO, have developed a strategy for the area that involves creating conservation corridors to link the patchwork of protected areas. This series of interconnected corridors will connect forest fragments and protected areas that are too small and isolated to maintain populations of species in the long term.

From a genetic viewpoint, wild animals and plants require a certain minimum area to live in to support local populations of a minimum genetic size. This is simply the number of individuals of a species that actually have the chance to meet and mate, and thus contribute offspring to the next generation. An important aspect is that local populations of wild species, in an undisturbed setting, are connected to form something larger, known as the species gene pool (all the genetic diversity held by a species).

A particular plant or animal population in a particular place, such as an isolated patch of rainforest, holds only a small portion of the genetic diversity present in the entire species gene pool. It needs connections with other 'islands' to keep the genetic population healthy. In the case of wild plants, for example, animal pollinators such as insects, birds or mammals may move pollen between populations, and other animals may move seeds to different places. This helps connect local plant populations and keep genetic

**Top: *Alcantarea glaziouana* lives on coastal inselbergs in south-eastern Brazil**

**Above: Thelma Barbará records the location of bromeliad species using a GPS device**

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**In Brazil, plant life on inselberg rock outcrops is under pressure from fast-growing cities**

CONSERVATION

PHOTOGRAPHS: CHRISTIAN LEXER, RICARDO AZOURY, CLARISSE PALMA DA SILVA, THELMA BARBARÁ, GÉCELE PAGGI

**Above: *Alcantarea glaziouana* is pollinated by bats that fly between the isolated populations**

**Below: the colourful flowers of *Quesnelia arvensis*, another coastal inselberg dweller**

**Above: *Vriesea gigantea* prefers to live on tree bark, but can also be found attached to rocks**

**Right: Clarisse Palma da Silva collects the epiphytic bromeliad *Vriesea gigantea***

**Right: bromeliads such as *Neoregelia* hold a store of water that is used by various animals**

**Right: among the many pollinators of bromeliads are nectar-loving hummingbirds**

**Right: a population of *Alcantarea imperialis* growing on a rocky outcrop**

population sizes up. When the connection is lost, genetic erosion occurs – local populations become too small, resulting in inbreeding and the random loss of genetic diversity. A plant species is then on the path to extinction.

In the laboratory, conservation geneticists at Kew can measure the genetic size of populations and the degree of connectedness between them – known as gene flow – using DNA-based genetic markers. Thelma Barbará and Clarisse Palma da Silva, two Brazilian PhD students at Kew, used this technique to work on an investigation of bromeliads, the Atlantic Forest, and opportunities for conservation genetics research in the Jodrell Laboratory at Kew. Their results not only provide some of the first available data on patterns of genetic diversity and gene flow in plants of the Atlantic Forest, they also create the opportunity to monitor diversity and gene flow during the implementation of conservation corridors.

Thelma's PhD project investigated bromeliads of the genus *Alcantarea*, which are adapted to living on inselbergs (rock outcrops) in the Atlantic Forest. Sugarloaf Mountain in Rio de Janeiro is an inselberg. These outcrops form habitat islands for rock-adapted species within a 'sea' of tropical rainforest. Thelma's work, published this year in *Molecular Ecology*, shows that these bromeliads have lived on the rocks for thousands of years. *Alcantarea* species are widely scattered by nature, but occasional gene exchange between populations has so far been possible because they are pollinated by bats, which can move from one isolated population to another, and because their seeds are carried on the wind.

In contrast to inselberg species, the closely related bromeliad *Vriesea gigantea* (the subject of Clarisse's studies) prefers to live on trees within the forest. Clarisse's work in Kew's Jodrell Laboratory shows that this species experiences ten times more gene flow than its rock-adapted relatives. However, the gene flow is now decreasing because of the continued fragmentation of the forest habitat, due to human activity.

Genetic data such as this is a vital source of information for conservation efforts. It tells us how bromeliads' gene pools have reacted to fragmentation in the past. We can now see what happened over timescales of hundreds to thousands of years, and this gives us a baseline against which contemporary man-made fragmentation can be compared.

Conservation geneticists can now work on the next phase – measuring present-day gene flow in plants of the Atlantic Forest corridor. This will reveal how well forest fragments are connected genetically and where additional efforts are needed to close the gaps. Forest-dwelling bromeliads can play an important role, because their generation times are shorter than those of trees, so the effects of fragmentation and isolation become apparent more quickly.

And, all scientific considerations aside, we conservation scientists are driven by the beauty of the plants we work with and a keen desire to protect them and their habitats. Bromeliads are cherished by plant lovers the world over, and because of the interest in them they are ambassadors for a larger cause – the protection of one of the most diverse and threatened ecosystems on earth.

*Christian Lexer is a population geneticist at Kew*