



**Big Scrub Landcare**  
The Voice of the Rainforest

## **SCIENCE SAVING RAINFORESTS**

### **APPLYING GENOME SCIENCE TO SAVE AUSTRALIA'S ENDANGERED SUBTROPICAL RAINFOREST FROM EXTINCTION**

This innovative project demonstrates how the latest genome science can be applied to save degraded rainforests throughout the world.

#### **The problem**

Australia's critically endangered lowland subtropical rainforest faces extinction because many of its key species are trapped in isolated remnants and lack the genetic diversity needed to adapt and survive in the long term. These rainforests are descended from the great Gondwana rainforests that largely covered Australia 40 million years ago. They are internationally significant and an important component of Australia's unique biodiversity heritage. All but 7% of this magnificent, richly biodiverse forest was cleared following European settlement. The patches that remain are mostly isolated remnants of the 'original' forest and re-growth scattered across 200,000 ha of coastal hinterland in NE NSW and SE QLD. The largest contiguous forest was, and the largest area of remaining remnants is, the Big Scrub region in NE NSW.

#### **Internationally innovative cutting-edge genetic research to the rescue**

Big Scrub Landcare, the Royal Botanic Gardens Sydney and their partners are applying the latest DNA sequencing and genome science in this long-term project to overcome the species and community level problems associated with extreme area reduction, fragmentation, and isolation. This internationally innovative approach is transferrable and can be applied to the ecological restoration of other highly degraded forest ecosystems.

#### **Genetic diversity the key to survival**

Genetic diversity is a key indicator of species fitness and includes a species capacity to survive and reproduce in the short term, and adapt to changing conditions (such as climate change and pathogens) in the long term.

#### **Solution - A living seed bank incorporating optimal genetic diversity**

The project will develop a living seed bank in the form of plantations that will produce seed from the key species of the 'original' forest with optimal genetic diversity for use in restoration plantings. As the individual trees in the restoration plantings reproduce, seed with genetic diversity and fitness that maximises species-level capacity to reproduce and adapt to climate and other changes will be distributed across the landscape. This will facilitate the survival of the most important structural components of the forest (the tall trees) and thus Australia's critically endangered lowland subtropical rainforest.

#### **Project overview**

DNA sequencing will be carried out on leaf cuttings being collected from an average of 180 trees of each species from 30 locations across its range. The species chosen include key canopy and sub-canopy trees that create the closed canopy and other key structural features that

characterise and enable the functioning of the rainforest ecosystem. These species represent some of the most frequently naturally occurring and planted 'late secondary and mature stage' species used in the restoration of lowland subtropical rainforest.

Innovative genomic analysis technologies (similar to the approaches used in the 'Human Genome Project') will capture detailed genetic, climatic and ecological information of each species. This analysis will enable the identification of 10 to 30 individual trees of each species that collectively have the genetic diversity required to maximise each species capacity to reproduce successfully and be as resilient as possible to climate and other changes in the long term.

Cuttings from each of the individual trees will be collected and grown on in a nursery to produce the planting stock for the seed plantations. As each species starts reproducing, their seeds will be harvested and provided to nurseries to produce genetically diverse planting stock for rainforest restoration plantings. The plantations will continue to produce genetically diverse seeds for many decades into the future.

### **International application**

The innovative, genome-science based approach of this project can be applied both internationally and within Australia to the restoration and survival of degraded rainforests and other forest ecosystems, and more generally in reforestation projects. Two informal international expressions of interest have already been received.

### **The first plantation**

The first plantation located near Bangalow in the Byron Bay hinterland in northeastern NSW will comprise 23 key canopy and structural species. Collection of cuttings for DNA sequencing has commenced.

### **Our vision**

Our vision is to expand genome analysis and plantation development to the 100 most important species that hold the key to the survival of critically endangered lowland subtropical rainforest.

### **Experience counts**

The founding partners in this project are:

**Royal Botanic Gardens Sydney** - A world leader in research on rainforest genomics. The project will be part of its acclaimed, internationally innovative Restore and Renew Program funded in part by the NSW Government.

**Dr Robert Kooyman** – The leading Australian and international rainforest ecologist and researcher.

**Big Scrub Landcare** - A multi award-winning community not-for-profit organisation with an outstanding 20-year track record in achieving best-practice, cost effective outcomes in the ecological restoration of critically endangered lowland subtropical rainforest. It received the Society for Ecological Restoration Australasia's 2016 Award for Restoration Excellence, the major scientific award in this field.

**The Big Scrub Foundation** – Sister organisation whose role is to raise funding for this project and other projects run by Big Scrub Landcare's to help save critically endangered lowland subtropical rainforest.

**Firewheel Rainforest Nursery** – Australia's leading rainforest nursery that has pioneered the large-scale production of high quality planting stock for rainforest restoration projects and is currently producing a book on techniques for the propagation of rainforest seeds.

## **Piccadilly Park Macadamias, Brookfarm Ltd and Cape Byron Distillery Ltd**

Leading innovators in the design, development and operation of sustainable plantations for the production of macadamia nuts and rainforest botanicals. Brookfarm is also an award-winning developer, manufacturer and marketer of internationally acclaimed, premium food products that value-add to macadamias and other high quality Australian farm produce. Cape Byron Distillery is a new sister company that is leading the world in using rainforest botanicals in its products.

### **Leading the way**

The project is led by:

**Dr Maurizio Rossetto and Dr Robert Kooyman**, respectively Australia's leading rainforest geneticist and research ecologist.

**Dr Tony Parkes**, President of Big Scrub Landcare since its establishment in 1993. Has a background in science, business and investment banking. Raised the funding for and directed more than 40 rainforest restoration projects with a total value of more than \$5 million. Restored rainforest on a third of his family farm near Bangalow in northeast NSW.

**Mark Dunphy**, a leading rainforest regenerator and rainforest nurseryman who is the proprietor of Firewheel Nursery, Australia's largest rainforest nursery.

**Martin Brook**, Chairman of Brookfarm Ltd, Vice-president of Big Scrub Landcare, and an innovative business leader in the region.

**Rex and Dan Harris**, the principals of Piccadilly Park Macadamias

### **Funding**

The total budgeted cash cost of the first plantation is \$0.5 m, which is supplemented by in-kind contributions of the same amount from the Royal Botanic Gardens Sydney and other partners. DNA sequencing and genome analysis account for two thirds of the costs. Big Scrub Foundation, the sister organisation of Big Scrub Landcare, is funding the initial work, which is the collection of leaf samples for DNA sequencing from 3400 trees of 19 species, at a budgeted cost of \$70,000 and will contribute a further \$30,000 cash to the project. Funding for the balance of \$400,000 is being sought from philanthropic organisations. Please contact us at [info@bigscrubrainforest.org](mailto:info@bigscrubrainforest.org) for further information.