

A lush tropical rainforest scene featuring a stream flowing through large, moss-covered rocks. The forest is dense with tall trees and various tropical plants, including palm trees and ferns. The lighting is soft, highlighting the vibrant green colors of the vegetation.

SCIENCE SAVING RAINFORESTS

Iain Stych

photo: Iain Stych

This innovative project applies the latest genome science to the development of a living seed bank to produce seed with optimal genetic diversity for use in the restoration of Australia's critically endangered lowland subtropical rainforest. The approach used in this unique project has a worldwide application.

The problem

Early European settlers cleared 93% of Australia's richly biodiverse, internationally significant lowland subtropical rainforest that is that descended from the great Gondwana rainforests that largely covered Australia 40 million years ago. What remains of this, the now critically endangered lowland subtropical rainforest, faces extinction because many of its key species are trapped in isolated remnants and lack the evolutionary potential needed to adapt to climate change, new diseases and new pests.

The 2 million trees planted over the past 25 years in the process of restoring 550 ha of rainforest, are also likely to lack sufficient genetic diversity to ensure self-sustainability.

Internationally innovative cutting edge genetic research to the rescue

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 in the long term.

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 problems of poor genetic diversity associated with extreme area reduction, fragmentation, and isolation resulting from clearing of most of the forest. This internationally innovative approach is transferrable and can be applied to the ecological restoration of other highly degraded forest ecosystems.

Big Scrub Landcare is a multi-award-winning community not-for-profit organisation with an outstanding 25 year track record in achieving best-practice, cost effective outcomes in restoring of critically endangered lowland subtropical rainforest. It has completed more than fifty projects and received the Society for Ecological Restoration Australasia's 2016 Award for Restoration Excellence, the major scientific award in this field.

For more information visit www.bigscrubrainforest.org

Royal Botanic Gardens, Sydney is 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, as well as a range of sponsors and donors.

For more information visit www.rbgsyd.nsw.gov.au





photo: Iain Stych

Solution. A living Seed Bank incorporating optimal genetic diversity

The project will develop a living seed bank in the form of a plantation of multiple, carefully selected individuals from 23 structurally important species. The individuals chosen based on genome analysis will produce seed with optimal genetic diversity for restoration plantings.

As the trees in the restoration plantings derived from growing stock from the living seed bank reach maturity, their genetically diverse seed will be spread across the landscape, enhancing the reproductive capacity and resilience of the target species to climate change and in turn helping to ensure the long term survival of the rainforest community.

Project overview

DNA sequencing will be carried out on leaf samples collected from an average of 180 trees of each species from over 30 locations across its range. The species chosen include trees that are key components of the closed canopy that characterises rainforest ecosystems. 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 analytical techniques will capture detailed genetic, climatic and ecological information of each species to identify approximately 20 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.

Cuttings from each of the individual trees will be collected and grown in a nursery to produce the planting stock for the seed plantation.

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 plantation will continue to produce genetically diverse seeds for many decades into the future. It will provide a living seed bank.





photos: Hugh Nicholson

Experience counts

The founding partners have outstanding experience that will ensure the success of this project.

Royal Botanic Gardens Sydney

As well as its leading genome research program, the Royal Botanic Gardens and Domain Trust carries out research in a number of fields and operates Plant Bank and the National Herbarium of NSW.

Dr Robert Kooyman

A leading Australian and international rainforest evolutionary ecologist and researcher. For further information visit www.researchgate.net/profile/Robert_Kooyman

Big Scrub Landcare (BSL)

A multi award-winning community not-for-profit organisation that catalysed and has led the ecological restoration of critically endangered lowland subtropical rainforest over the past 25 years. For more information visit www.bigscrubrainforest.org

The Big Scrub Foundation (BSF)

BSF, BSL's sister organisation, is a charity whose role is to raise funding for this project and other projects run by BSL to help save critically endangered lowland subtropical rainforest. For more information visit www.bigscrubfoundation.org

Firewheel Rainforest Nursery

Australia's leading rainforest nursery that has pioneered the large-scale production of high-quality planting stock for rainforest restoration projects. For more information visit www.firewheelnursery.com.au

Supporters and Collaborators

NSW Government Department of Primary Industry: providing land and support services for the initial seed plantation.

NSW Government Environmental Trust: providing approximately 50% of the funding for DNA sequencing and genome analyses.

SoilCare Inc and Piccadilly Park Macadamias: providing advice and assistance is applying regenerative agriculture practices to the development and operation of the plantation.

Brookfarm Ltd and Cape Byron Distillery Ltd: providing assistance in promoting and funding of the project. These local companies are leading innovators in the production of premium food and liquor incorporating rainforest ingredients. They are experienced in the design, development and operation of sustainable plantations for the production of macadamia nuts and rainforest botanicals.





International application

Rainforests and other forests around the world are suffering from the ravages of continued clearing, logging, fire and indiscriminate clearing for small scale agriculture. 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 seed production plantation located near Wollongbar in the Byron Bay hinterland in north eastern NSW will comprise 23 key canopy and other structural species. Collection of leaf cuttings for DNA sequencing is well-advanced.

Our Vision

Our vision is to expand on this project and develop plantations comprising at least 50 of the most important species that hold the key to the survival of critically endangered lowland subtropical rainforest and also threatened and rare Gondwana species.





Leading the way

The project is led by:

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

Dr Tony Parkes AO, co-founder and President of BSL since its establishment in 1993 and Founder and Executive Chair of BSF. He 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, Vice-president of BSL, a leading rainforest regenerator and rainforest nurseryman who is the proprietor of Firewheel Nursery, Australia's largest rainforest nursery. He is the lead author of a recently published book Australian Rainforest Seeds.

Martin Brook, Chairman and Co-founder of Brookfarm Ltd and Cape Byron Distillery, an innovative business leader and promoter of rainforest restoration in the region.

Kieran Livermore, Chairman of SoilCare Inc, leading innovators in the application of regenerative agriculture in the region and **Rex Harris**, principal of Piccadilly Park Macadamias.

Funding

The total budgeted cash cost of the first plantation is \$0.55m, which is supplemented by larger cash and in-kind contributions from the Royal Botanic Gardens Sydney, BSF and other partners.

BSF 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. It will contribute a further \$30,000 cash to the project.

DNA sequencing and genome analysis requires cash funding of \$400,000, of which half is being provided by the NSW Environmental Trust. Funding for the balance of \$200,000 for DNA sequencing and genome analysis plus \$50,000 for plantation site preparation and development, is being sought from philanthropic organisations.







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Big Scrub Landcare

The Voice of the Rainforest