With about 900 eucalypts or 'gum trees' in Australia, this genus is very much a part of the Australian psyche. Now, the mystery of the genetic make-up of eucalypts is set to be unearthed by a new project, which aims to map their DNA sequences.

A glimpse into nature's mystery

by Margitta Docters van Leeuwen

The term 'eucalypt' conjures images of tall, imposing trees with branches waving countless leaves with woody fruits and attractive blossoms. Some may even think of the economic value of these trees, particularly in plantations for fibre or eucalyptus oil production. But eucalypts aren't as tough as we would like to believe, and are certainly not immune to the effects of disease, drought and salinity, all of which occur in Western Australia.

Fortunately, the conservation and management of the genus is set to get a boost from a new project, the International Eucalyptus Genome Consortium, which aims to map the eucalypt DNA sequence. The consortium was formed in Hobart in July 2004 and is a groundbreaking international agreement on genetic research into eucalypts that involves Australia and four other countries—Brazil, South Africa, France and Portugal. The project will determine the sequence of the eucalypt genome—the term used to describe the genetic information (DNA) of an organism. Unravelling these sequences will hopefully provide information that will assist with eucalypt management and conservation.

Dieback

In WA, dieback—caused by the introduced plant pathogen *Phytophthora cinnamomi*—is the biggest disease threat to eucalypts. It causes the roots of susceptible plants to rot so they're unable to transport water to the leaves. And, unfortunately, the soil-borne water mould occurs throughout the South West. The Department of Conservation and Land Management (CALM) has found that more than half of the native woody species in the State's South West are susceptible to dieback. It only affects woody plants, and close to half of the affected species are eucalypts.

The secondary effect of dieback is the impact on native animals that inhabit woodlands and forests. As the affected plants die, the natural habitat and food for many native species is reduced, making them more susceptible to extremes of weather and predation.

Salinity

Salinity is also a serious threat to native plants and contributes to the loss of eucalypt woodlands. Salinity in WA is mostly caused by the clearing of native vegetation—which maintained the water table and the highly saline soil layers at depth. The replacement of deep-rooted, perennial vegetation by shallow-rooted annual crops and pastures, which use less water, caused the water table to rise, bringing with it high levels of dissolved salts. The affected soils, with their high salt content, are deadly for crops as well as remaining native plants.

One way to lower the water table and relieve salinity is to replant affected areas with deep-rooted native plants that will use the excess water.

Eucalypt genome project

Not all eucalypts are affected by disease or salinity. In some cases, individual trees survive the disease caused by dieback, and thrive in salt-riddled soils, while neighbouring trees of the same species are dying. This could be a genetic effect that

Left Karri forest.
Photo – Marie Lochman

Above right Mottlecah (*Eucalyptus macrocarpa*) blossom.
Photo – Tom Chvojka

Right South West forest affected by dieback.
Photo – Dennis Sarson/Lochman Transparencies

Above Wandoo woodland.
Photo – Marie Lochman

Below Trees that have perished due to salinity.
Photo – Jiri Lochman.

scientists hope they'll be able to identify through the eucalypt genome mapping project.

There are three major stages to the mapping process; making DNA clones, sequencing the clones and annotating the genes in the sequence. The entire project is expected to take up to three years to complete. The main sequencing will be done by the world's major sequencing facilities, including the Australian Genome Research Facility in Brisbane. When the project is finalised, the completed eucalypt sequence will be placed in the public domain and will be available to all.

The project, and the sequences it will unearth, will provide the basis for a better understanding of how different eucalypt trees resist environmental adversity, such as dieback and salinity. This will have a significant impact on WA, because, if we can find the genes that control these traits, we can breed disease-resistant and salt-tolerant trees.

Understanding how disease resistance and salt tolerance occurs may also lead to the identification of treatments that will activate certain gene responses, and make the eucalypts more resistant to these environmental factors. This could lead to our native forests becoming more productive.

The project will provide the tools to investigate the adaptation of different species to the range of habitat and climatic conditions in which they occur. It will also enable us to understand the genetic basis for the diversity in eucalypts and their evolutionary development as different species. The forests and woodlands of WA will emerge a winner from the eucalypt genome project, as it boosts our ability to manage and conserve these beloved Australian icons.

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Margitta wishes to thank CALM Principal Research Scientist Margaret Byrne for her information, time and assistance.

The author recommends the following websites as useful background information:
www.agrf.org.au/future_initiatives.html
www.up.ac.za/academic/fabi/eucgenomics/euc_mapping/

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Phone (08) 9334 0296 *Fax* (08) 9334 0432.
Subscription enquiries
Phone (08) 9334 0481 or (08) 9334 0437.
Prepress and printing Advance Press, Western Australia.
© ISSN 0815-4465

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Published by the Department of Conservation and Land Management, 17 Dick Perry Avenue, Kensington, Western Australia.