TROPICAL tree FARMING

The mystique of sandalwood, the elegance of teak, the warmth of carved rosewood, and the dense darkness of ebony: these have long been part of human history. Once abundant, these tropical timbers are becoming increasingly precious as world supplies dwindle. But research in the Ord River Irrigation Area, in Western Australia's far north, is breaking new ground in the science of tropical plantation forestry—blending and irrigating species to produce crops of some of the most valuable wood and wood products in the world.

by Andrew Radomiljac and Mandy Clews

Centuries of over-exploitation of tropical timbers are taking their toll. The 'endangered species' status we associate with animals applies increasingly to a number of plant species, among them the trees that have given us a long tradition of fine furniture and architectural decoration.

Our need for those trees continues, despite their decline. To the musician, there may be no more enjoyable sound than the mellow tones of a well-played clarinet, or no more satisfying feeling to the touch than the silky firmness of the black keys on a fine old piano. These are two specialised, traditional areas of demand for East African ebony, a species that is now on the Convention of International Trade of Endangered Species (CITES) list. It is simply no longer available for commercial exploitation. Likewise, other tropical timber species are shrinking in the face of vanishing habitat and unsustainable forestry practices overseas.

But such deficiencies can be transformed into opportunities. Western Australia has the necessary tropical climate zones, fully developed economy and a culture of internationally recognised forestry expertise. At the Department of Conservation and Land Management (CALM), a patchwork history of tropical timber trials has evolved into a structured program of research and development. The research carries the promise of adding the viable production of sandalwood, ebony, rosewood and teak to the growing agricultural cornucopia of the Ord.

THE ORD'S SUCCESS STORY

The Ord River's vast water supplies—so immense as to be measured in Sydney Harbours—were secured by building two major dams in the 1960s and 1970s. The radical visionaries who brought the original Ord River Irrigation Area (ORIA) project into being had quite different ideas about how the region would develop; they saw a vision of broadacre tropical crops such as cotton. The failure of these early attempts, in the face of insecticide-resistant pests, led to a period of disillusionment with the ORIA project and to the notorious 'white elephant' tag that persisted to the early 1980s.

Nowadays, however, the Ord is enjoying newfound success in horticultural industries. Progressive growers have been pioneering new ideas—allotting smaller areas to an array of common and unusual tropical fruits and vegetables—and are amassing an impressive and growing account of successes with export and domestic markets. In partnership with government agencies, Ord farmers have found innovation and diversity to be the key to commercial confidence and promise.

One of the most dramatic examples of the turnaround in the Ord River Irrigation Areas fortunes is the rapidly developing sugar industry. With 2 800 hectares of land now under canefields and CSR's new high-tech sugar mill now operating, Kununurra is set to give the Burdekin River Irrigation Area in Queensland a run for its money as the sugar capital of Australia. The Ord's hotter climate is better suited than Queensland's to sugar growing, and the state-of-the-art technology of the mill at Kununurra allows for greater efficiency than the industry has ever seen before. These are sweet rewards for the growers

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The Diversion Dam on Lake Kununurra. Some of the plantation areas can be seen beneath the hills in the background.
Photo – Col Roberts/Lochman Transparencies

Above: Indian sandalwood (*Santalum album*) seedling.
Photo – Andrew Radomiljac

Far left: A flood-irrigated Indian sandalwood plantation soon after establishment.
Photo – Allan Thomson

Left: Craig Palmer inspecting a teak (*Tectona grandis*) seedling at CALM's Kununurra nursery.
Photo – Andrew Radomiljac

who have stayed with, or become part of, the region's dream.

CALM's tropical silviculture program in the Ord is now poised to add another dimension to this picture of productivity. Species selection experiments in the area have had encouraging results for teak and rosewood, while sandalwood and ebony are performing soundly under controlled conditions. As these trials progress, Ord growers will be able to enlist the expertise of CALM foresters to develop their own competitive and profitable plantations. To their long and growing list of adventurous niche enterprises, they will be able to add a sustainable, lucrative supply of valuable timbers, which have been all but disappearing from the world marketplace.

Limited supplies of these timbers are available from plantations in other countries. However, the Ord project is unique in using irrigation. Forestry plantations of any description are rarely artificially watered. They tend to rely on seasonal rainfall, particularly in developing countries where irrigation technology is reserved for food crops. The use of irrigation, together with the sciences of species selection and tree-breeding, adds a critical element to CALM's program. Quite apart from the timber product, the technology itself from these plantations will have export potential.

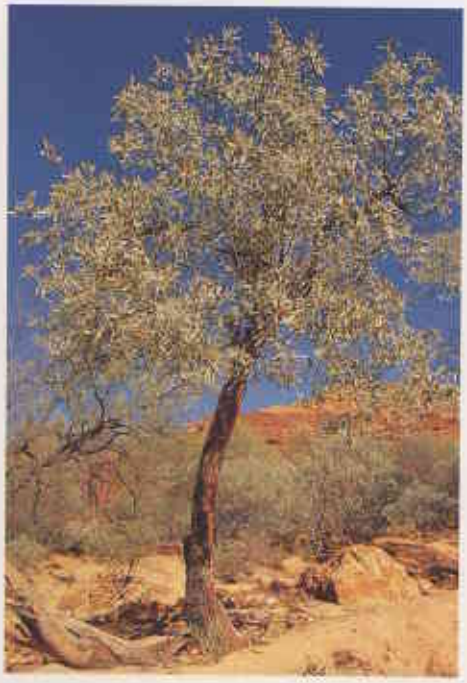
THINKING LOCAL: SANDALWOOD

For thousands of years, Indian sandalwood (*Santalum album*) has been highly prized in the Middle East and Asia as a main ingredient in incense and perfumes. In times when sandalwood was more plentiful, the timber was used to make coffins, producing a sweetly scented smoke during cremation that was believed to carry the departed's spirit away. Prayer poles were also carved from the wood and placed in Middle Eastern mosques and churches for people to pray against. Nowadays, a shortage of sandalwood prohibits these uses. Western culture's interest in sandalwood oil is more recent but no less enthusiastic. The product is much sought-after for perfume, cosmetics and aromatherapy, with such well-known names as Chanel accounting for steady demand. This is a lucrative boutique market.

Perhaps it was the presence of Australian native sandalwood species in the arid interior that first gave hopeful foresters the idea of growing plantations of Indian sandalwood on Australian soil. In the early 1980s, a small number of Indian sandalwood seedlings were planted in the ORIA by the then WA Forests Department. Because understanding of the complexities of sandalwood silviculture was so poor,

Above: The Ord River Dam on Lake Argyle.
Photo – Michael James

Right: Indian sandalwood canopy with *Cassia siamea* and *Acacia gracillima* hosts. Showing the bio-diverse aspect of sandalwood plantations.
Photo – Andrew Radomiljac



preliminary results were disappointing. But the seed, so to speak, was sown.

Sandalwood silviculture is enormously complex. Among the complications a prospective grower faces is the selection of plants to accompany the sandalwood, which cannot thrive on its own. Like the WA Christmas tree (*Nuytsia floribunda*) in the State's south-west, sandalwood is a parasite. Adjunct structures on the sandalwood's root system, called haustoria, latch onto a host plant's roots, penetrating the host's xylem tissue and extracting moisture and nutrients to supplement its own self-nourishing capacity (see 'Urban Antics', *LANDSCOPE*, Spring 1994).

After the failure of earlier attempts, experiments with sandalwood continued with the formation of CALM. In 1985, 180 seedlings were planted at CALM's Kununurra arboretum using a number of acacia species as hosts. By the late 1980s, experiments had established Cununurra clay—one of three main soil types in the ORIA—as the best suited to sandalwood plantations. In 1992, a research program dedicated to sandalwood development was established by CALM in conjunction with a number of other agencies, including the Australian Centre for International Agricultural Research (ACIAR), the Sandalwood Research Institute (SRI) and CALM's own Sandalwood Conservation and Regeneration Program (SCARP), to refine nursery propagation and field establishment techniques.

But in an interesting twist, the parasitic nature of sandalwood has recently come to be understood as an advantage rather than an impediment to plantation viability. One species that has trialed well as a host is East African ebony (*Dalbergia melanoxylon*). Itself a highly marketable product, ebony is a leguminous species, giving it the added benefit of increasing nitrogen availability to the parasite. CALM's innovation in this plantation research is now twofold: in the first place, full irrigation, and in the second, biodiversity, which gives nutrient enrichment and offers two marketable products from a single plantation area.

A TREE WITH A HEART

Another complication of commercial sandalwood production is that the sapwood itself is of little value. Ironically, the real worth of this timber is in its waste products, the alpha and beta santalol compounds that are deposited in the centre of the stem—the heartwood—as the plant matures. These somewhat mundane-sounding chemical components, which are dumped into the non-living part of the tree, are what give the wood its sweet aroma. In order for a sandalwood tree to have market value, it has to have formed a critical volume of heartwood.

What decides the stage at which sandalwood heartwood is formed is not fully understood. Maturity is a factor, as substantial sapwood is necessary to form heartwood—although trees in Timor as old as 25 years have been found to contain none. In an interesting and exciting contrast, trees planted only five years ago in the ORIA have been discovered to have already

Top left: The Australian native sandalwood compared with a three-year-old Indian sandalwood tree (*centre*), seen here with *Cassia siamea* and *Acacia trachycarpa* hosts.
Photos – Jiri Lochman (*top*) and Andrew Radomiljac (*centre*)

Left: Broadacre sugarcane farming within the Ord River Irrigation Area.
Photo – Andrew Radomiljac

developed distinctive heartwood. Until the heartwood factor is better understood and more controllable, plantation yield will be difficult to measure and even harder to predict.

More research is being directed toward the mysteries of heartwood formation. Seedlings raised from the ORIA's young scented trees, together with seedlings raised from seed collected in India, are being planted this winter in CALM's first venture into Indian sandalwood tree-breeding research. The research will help determine to what extent early heartwood formation is a genetically manageable trait.

Once the question of heartwood heritability is better understood, tree-breeding will play an important role in increasing plantation heartwood yield. A vital tool in tree-breeding will be vegetative propagation, or cloning. CALM has supported research by Murdoch University's Professor Jen McComb to develop a micro-propagation technique, which will eventually enable high-performing trees to be cloned, thereby helping to ensure a viable industry.

OTHER IRONS IN THE FIRE

Because of its many silvicultural twists and turns, sandalwood and its marketable companion ebony are receiving the most intensive research attention in the ORIA project. However, teak (*Tectonia grandis*) and rosewood (*Pterocarpus* spp.), perhaps more straightforward plantation species, are also being put to methodical trials by CALM, with encouraging results.

The main issue associated with rosewood and teak is soil type. While sandalwood has been found to grow best in the Cununurra clay soil, teak and rosewood prefer the Ord's sandy soils—the Levee soil and Cockatoo sands—which are the home of the voracious giant termite (*Mastotermes darwinensis*). The fact that this species, unlike other termites, attacks timber within the living tree, might start silvicultural alarm bells ringing. However, test plots established in the 1970s have proved both teak and rosewood to have a high resistance to the termites, giving them great promise as crop timbers.

Local landowners in the Ord are showing a keen interest in CALM's tropical timber trials. This winter will see the establishment of the first CALM-assisted private plantation of Indian sandalwood and East African ebony in the ORIA. Farmers will be able to integrate small tropical woodlots into their existing systems, establishing small areas that are at present largely unused, such as along irrigation channels and drains, beside farm roads and around farm infrastructure. It is expected that this scheme will develop into a tropical sharefarming complement to CALM's existing radiata pine, maritime pine and bluegum sharefarming programs in the south-west. In so doing, it will be re-establishing a sustainable supply of precious timbers that had been taken to the edge of extinction.

Twenty years ago, the notion of monoculture nearly killed the Ord. Now, a new era of diversity, that of farming smaller areas to fill speciality niches, is leading the ORIA into a new world of productivity and prosperity. CALM's research is offering small, intensive, biodiverse tropical timber plantations as another option to these innovative farmers. It is becoming part of the legend of the Ord, success born of vision, cooperation, innovation and a persistent belief in possibility.

Right: Six-month-old Indian sandalwood parasitised to *Sesbania formosa,* a leguminous host.
Photo – Andrew Radomiljac

Below right: Large leaves of a teak seedling.
Photo – Andrew Radomiljac

Bottom right: An established twenty-year-old teak tree.
Photo – Andrew Radomiljac

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The Perth Observatory celebrates its centenary this year, and during its 100 years' life it has played some major roles in the world of astronomy. Find out more on page 10.

John Forrest National Park has long been a popular picnicking spot for Perth residents, but this place of beauty has much more to offer. See page 16.

The Cape Range, in north-west WA, is known for its harsh environment. But if you look a little closer you'll discover the vast 'Range of Flowers' that live there. See page 28.

In 1961, the noisy scrub-bird was rediscovered at Two Peoples Bay. In 1994, the Gilbert's potoroo turned up unexpectedly. Find out more about this haven for the lost and found on page 35.

If all goes to plan, the Ord River area, will soon be known as a prime farming area for rare tropical timbers. Find out why on page 23.

FEATURES

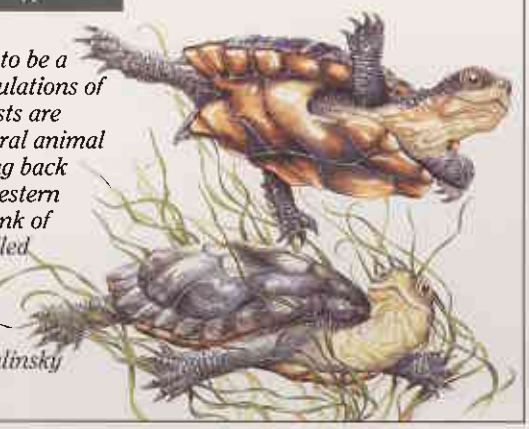
REGULARS

COVER

Fox-baiting has been shown to be a major tool in rebuilding populations of native animals. Now, scientists are embarking on a Statewide feral animal control program to help bring back native species, such as the western swamp tortoise, from the brink of extinction. The project is called 'Western Shield'.

The story is on page 41.

Illustration by Philippa Nikulinsky



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