Acacia Symposium 13-14th July 2001

Dalwallinu Western Australia

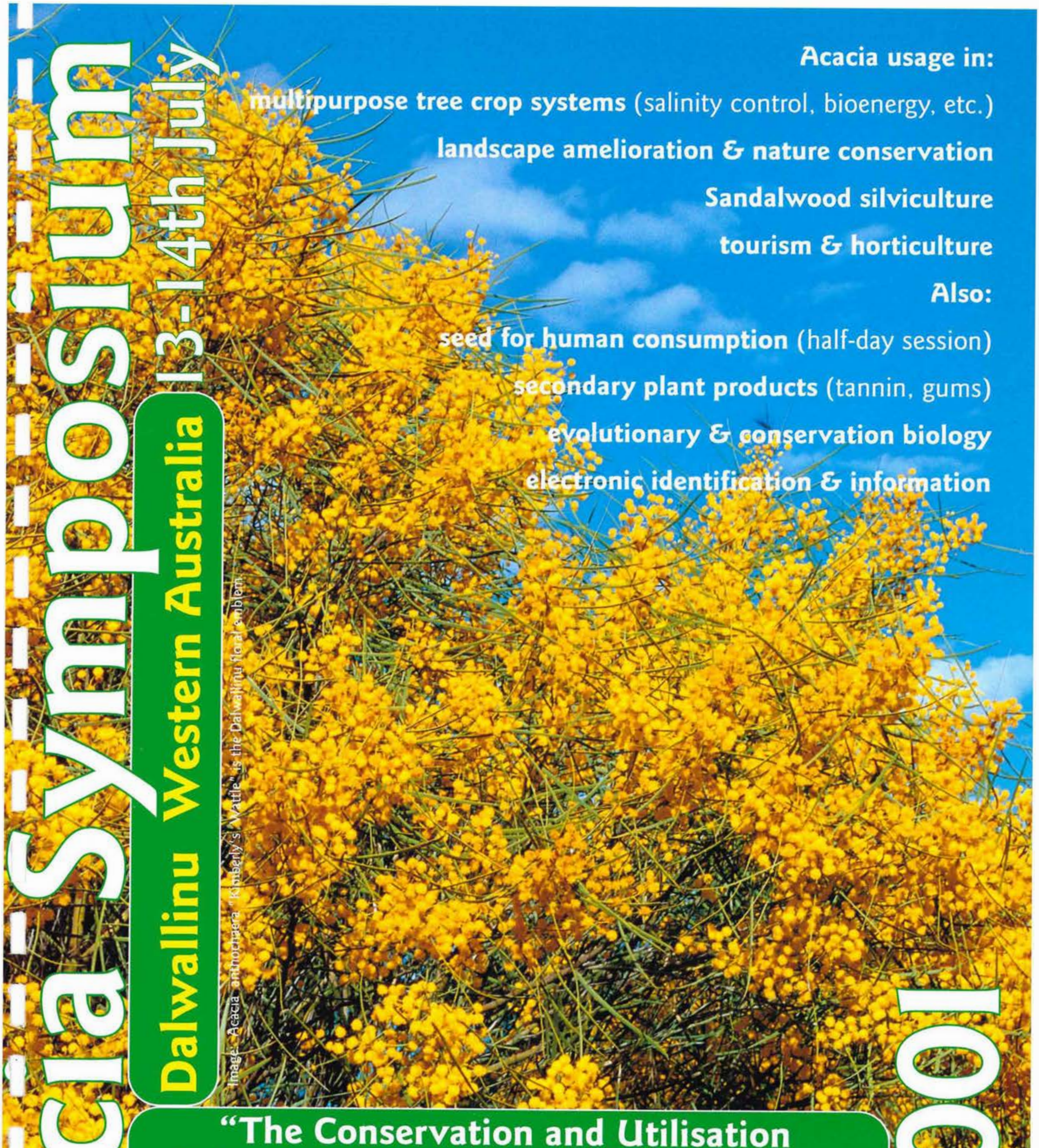

Image: Acacia anthochaera "Kimberly's Wattle" is the Dalwallinu floral emblem

Acacia usage in:

multipurpose tree crop systems (salinity control, bioenergy, etc.)

landscape amelioration & nature conservation

Sandalwood silviculture

tourism & horticulture

Also:

seed for human consumption (half-day session)

secondary plant products (tannin, gums)

evolutionary & conservation biology

electronic identification & information

"The Conservation and Utilisation Potential of Australian Dryland Acacias"

This Symposium is the winner of the inaugural BankWest Conference Development Regional Award.

To register your interest for future information contact:
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GOLDEN HEARTLANDS

DEPARTMENT OF Conservation AND LAND MANAGEMENT
Conserving the nature of WA

Contents

Acknowledgement of Support

The organisers of the Dalwallinu Acacia Symposium would like to thank the following organisations for their monetary and other support:

- BankWest
- Department of Conservation and Land Management
- Shire of Dalwallinu
- Wheatbelt Development Commission
- Boekeman Toyota
- Department of Primary Industries and Fisheries
- Heartlands Tourism Association
- Dalwallinu District Tourism Inc.
- Advanced Visual Design

- The businesses and people of the Shire of Dalwallinu.

ACACIA PROGRAM
OVAL ROOM, RECREATION CENTRE, MYERS STREET

13 JULY 2001

7.30 – 9.00	**SYMPOSIUM REGISTRATION**
9.00 – 9.15	**OFFICIAL OPENING** *Dr. W. Cox, Executive Director, CALM*
	SESSION 1 *Systematics and Conservation: Convenor Dr Stephen Hopper CEO Botanic Gardens and Parks Authority Kings Park*
9.15 – 9.45	**B. Maslin** - Is systematics critical for effective utilisation and conservation of *Acacia*?
9.45 – 10.15	**M. Byrne** - The role of genetics in the conservation and utilisation of *Acacia*.
10.15 – 10.45	**J. Miller, B.R. Maslin, R. Andrew and R. Bayer** - Towards an understanding of variation within the Mulga complex (*Acacia aneura* and relatives) using nuclear DNA techniques.
10.45 – 11.15	**MORNING TEA**
11.15 – 11.45	**M. Buist, D. Coates and C. Yates** - Rarity and threat in relation to the conservation of *Acacia* in Western Australia.
11.45 – 12.15	**P. Hussey** - Wattle I plant for wildlife
12.15 – 12.30	**QUESTION TIME**
12.30 – 1.30	**LUNCH**
	SESSION 2 *Commercial and other applications: Convenor – Mr R. Edmondson, Chairman, Soil and Land Conservation Council of WA*
1.30 – 2.00	**J. Bartle, G. Olsen, J. Carslake and D. Cooper** *Acacia* species as large scale crop plants in the Australian wheatbelt.
2.00 – 2.30	**D. Seigler** - Potential of secondary plant products in *Acacia*.
2.30 – 3.00	**A.C. Schlink, and R.A. Dynes** Livestock potential of Australian Acacia species.
3.00 – 3.30	**J.E. Brand** - Review of the influence of *Acacia* species on Sandalwood (*Santalum spicatum*) establishment in Western Australia.
3.30 – 3.45	**QUESTION TIME**
3.45 – 4.15	**AFTERNOON TEA**
4.15 – 4.45	**K. Wickens and M Pennacchio** - Biological activity of traditional medicinal *Acacia* species used by indigenous Australians.
4.45 – 5.15	**G. Brand and L. Sweedman** - Horticultural potential of *Acacia*.
5.15 – 5.45	**C. Tate** - Tourism potential of *Acacia*, with particular reference to Dalwallinu.
5.45 – 6.00	**QUESTION TIME**
6.00 – 7.00	**HAPPY HOUR** – Oval Room Bar open at Conference
7.30	**SYMPOSIUM DINNER** – Wheatlands Motel – Corner Johnston St & Clinch Rd *Special guest* – The Hon. Kim Chance Minister for Agriculture, Forestry & Fisheries

ACACIA PROGRAM
OVAL ROOM, RECREATION CENTRE, MYERS STREET

14 JULY 2001

7.00 – 9.00	**BUSH BREAKFAST**– Ground adjacent to Recreation Centre (Symposium Site)
	SESSION 3 *Seed for human food: Convenor - Mr Stephen Midgley, Portfolio Manager, Tree Improvement and Genetic Resources, CSIRO Forestry and Forest Products, Canberra*
9.00 – 9.30	**Wattle Seed Dreaming** - Video presentation.
9.30 – 10.00	**P. Latz** - Traditional use of *Acacia* by indigenous Australians.
10.00 – 10.30	**T. Rinaudot and L. Thomson** - Potential of Australian acacias in combating hunger in semi-arid lands.
10.30 – 11.00	**MORNING TEA**
11.00 – 11.30	**B.R. Maslin and M. McDonald** – Australian dryland Acacias with edible seeds..
11.30 – 12.00	**A. Hele** - Issues in the commercialisation of wattle seed for food.
12.00 – 12.30	**S. Davis, R.T. Prinsley, S. Simpson and P. Chudleigh** Developing agroforestry systems for medium to low rainfall areas – the role of dryland acacias.
12.30 – 12.45	**QUESTION TIME**
12.45 – 1.00	**WINDUP**

Underline *= Presenter*

POSTERS will be on display in foyer outside the lecture hall and can be viewed during breaks.

- **L. Monks and D. Coates** - The translocation of two critically endangered *Acacia* species.
- **D. Howard, Gaye Krebs and Maarten Van Houtert** - The value of *Acacia saligna* as a source of feed for sheep.
- **M. Lumban Gaol and J.E.D. Fox** - Reproduction of *Acacia* species at Sanford Rock Nature Reserve (SRNR): variation between years.
- **S. Patrick** - Botanical survey with the aid of volunteers. A study of the vegetation on a Murchison Station.
- **Centre for Plant Biodiversity Research** - The Australian Plant Name Index
- **CSIRO Publishing/B.R. Maslin** - *WATTLE Acacias of Australia* (Electronic interactive key to the identification of Acacias on CD).
- **G.S. Woodall and C.J. Robinson** – Direct Seeding Acacias of different form and function as hosts for Sandalwood (*Santalum Spicatum*).

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ACACIA SYMPOSIUM

13-14 JULY 2001

ABSTRACTS OF ORAL PRESENTATIONS

IS SYSTEMATICS CRITICAL FOR EFFECTIVE UTILISATION AND CONSERVATION OF ACACIA?

Bruce R. Maslin

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"Systematics taxonomy, is the science of delimiting organisms, naming them and determining their relationships."

The Australian Acacia flora represents a vast and as yet largely under-utilised genetic resource. We are only now beginning to properly understand these species, to explore their economic and social potential, and to apply appropriate and effective conservation strategies to ensure their survival.

There are about 960 species of Acacia in Australia making this by far the largest genus of woody plants in the country. Each of these species has a unique scientific name and each name represents a discrete biological unit that has been defined taxonomically. These names are the basic units of communication concerning the species, enabling us to exchange information about them. Without properly circumscribed and named species neither conservation nor utilization has anything to work with, the taxa in effect do not exist. Taxonomy is therefore fundamental to the effective conservation and utilization of biota because it identifies, defines and names taxa, which can then be managed or utilized through the exchange of relevant information. Thus, the first priority for conservation and utilization should be straightforward species circumscription and description (alpha taxonomy).

It is important that the taxonomy be scientifically sound because if the names are wrong then the information that is assembled and disseminated about the species will quite possibly also be erroneous. Wrongly named or poorly defined taxa may have serious and costly implication for users of scientific names. Therein lies the great responsibility for taxonomists, they need to accurately define and name species and to provide reliable means whereby users can gain access to this information.

Although taxonomy is the foundation upon which all biological sciences rely, few people know exactly what taxonomists do. This paper will therefore explore the taxonomic process by examining its role in conservation and utilization research. The five basic taxonomic activities to be discussed will include:

- **Delimitation and nomenclature**. The determination of boundaries between taxa and the application of stable names to the bioligical entities that are recognized.
- **Classification and phylogeny**. The placement of taxa within a hierarchical system and the determination of the historical relationships between them; this provides "value-adding" to the names by giving them predictive value, i.e. they are not merely "tags" or labels.
- **Identification**. Referring individual specimens to previously determined (and usually named) groups, i.e. the provision of tools enabling species to be correctly named.
- **Information**. Assembling and disseminating relevant information about the taxa (the taxon name is the key or conduit to *information*).
- **Vouchering**. The collection and on-going management of specimens that represent a physical manifestation of the taxa under study.

Taxonomy as a scientific discipline has become seriously under-resourced, sometimes to the extent that it is referred to as the "taxonomic impediment". Yet its role in support of conservation and utilisation is fundamental. Recognition of this role is a vital preliminary to addressing what might more properly be called the "taxonomic imperative".

THE ROLE OF GENETICS IN THE CONSERVATION AND UTILIZATION OF *ACACIA*

Margaret Byrne

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Genetic information is important for effective conservation management strategies and is essential for efficient utilization of genetic resources. Genetic analysis covers a broad range of aspects including population genetics and mating systems, phylogeny and systematic relationships at the species level, and phylogeography.

Conservation, not just of rare species, but of all genetic resources is enhanced by knowledge of genetic diversity and structure. Reserve design for in-situ conservation and sampling strategies for ex-situ conservation are both affected by of the level of diversity within populations, and the structuring of this diversity, whether mainly within populations or with significant diversity maintained between populations. Mating system and levels of gene flow affect levels of diversity and population differentiation and are readily influenced by population size and fragmentation. Determination of phylogenetic relationships between related species allows appropriate comparisons between rare and widespread taxa, both in terms of genetic and ecological factors, as well indicating the phylogenetic value of species where priorities for conservation activity may need to be set. Phylogenetic and phylogeographic studies can also define genetic entities for conservation management units.

Commercial utilization of species requires effective selection of superior germplasm, and the development of breeding and improvement programs. Population genetics is valuable for determining the level and structuring of diversity and the identification of provenance effects, which influence sampling strategies to encompass a broad genetic base. The mating system and level of gene flow affects the design and functioning of seed orchards, as well possible introgression from planted stands to natural populations. Phylogeny and the definition of genetic/taxonomic entities are critical in the domestication of species complexes, and phylogeography can identify evolutionary influences that may have effects on traits of interest.

These principals will be illustrated with examples of genetic studies on two rare acacias and their widespread common relatives, and the elucidation of genetic/taxonomic entities and phylogeographic history of the *Acacia acuminata* complex.

TOWARDS AN UNDERSTANDING OF VARIATION WITHIN THE MULGA COMPLEX (ACACIA ANEURA AND RELATIVES) USING NUCLEAR DNA TECHNIQUES

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The *Acacia aneura* or mulga complex is a widespread group of shrubs and trees that is dominant in much of arid zone Australia. The group is taxonomically difficult, due to a complex mix of hybridisation among species, geographic variation within species and sympatric variation within *A. aneura*. Mulga is highly variable in a wide range of vegetative and reproductive characters and it is not unusual to find five or six distinct forms growing side by side.

Current investigations of the complex utilizing field collections, molecular and cytological techniques have help to determine the mechanisms responsible for the variation in the complex which include: hybridisation, polyploidy, polyembrony and apomixis. Diploid, triploid, tetraploid and pentaploid plants have been identified and the cytological and morphological variation is being maintained by asexual seed production. Gene flow among morphotypes within populations and distinctness of morphotypes from different localities will also be addressed. These results will have far reaching repercussions for mulga taxonomy and utilization.

RARITY AND THREAT IN RELATION TO THE CONSERVATION OF *ACACIA* IN WESTERN AUSTRALIA

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Western Australia, particularly the south-west of the State, is recognised for its exceptionally high plant species diversity and endemism. The largest genus in the State, *Acacia*, is represented by 772 taxa of which 211 are recognised as rare and or threatened with two taxa presumed extinct. Currently 28 *Acacia* taxa are listed as threatened taxa (Declared Rare Flora) under the Wildlife Conservation Act and 12 of these are ranked as critically endangered. Another 183 Acacia taxa are considered to be rare and poorly known (Priority Flora) although their conservation status has yet to be accurately determined and many are likely to be under threat of extinction. Most of the rare and threatened taxa occur in the cereal growing areas (Wheatbelt) in the south-west of the State where there has been extensive land clearing and habitat degradation. Within this region threatened *Acacia* taxa are found on various land tenures although the highest numbers of populations occur on private property and Local Shire road reserves.

The list for Declared Rare and Priority Flora are based on rarity, usually defined with reference to distribution and abundance of the taxa, and threat to the populations. The threats identified for *Acacia* taxa include invasive flora and fauna, inappropriate fire regimes, habitat destruction associated with clearing activities, alteration of hydro ecology, and demographic and genetic effects associated with small declining populations. Understanding the ecological and genetic consequences of rarity in terms of low numbers of small, often fragmented populations can provide vital clues to the development of management actions and conservation strategies for rare and threatened species. It is also important to understand whether rarity in plant species is due to historical processes such as past climate change, to habitat specificity or to recent land clearing and habitat destruction. A particularly effective approach to understanding rarity and its implications for conservation is to carry out comparative reproductive, genetic and ecological studies on the rare species and closely related more common species. This approach has been used in studies a number of rare and critically endangered *Acacia* taxa focussing particularly on those factors that may constrain population persistence. The objectives were to determine whether the rare taxa have intrinsic biological characteristics that may account for their rarity and to rank constraints. These comparative studies revealed few differences in reproductive biology, seed predation and regeneration niche. However, they did show that genetic diversity levels were lower and inbreeding higher in the rare critically endangered taxa and that habitat specialisation may be important. Studies of factors constraining population growth in other Critically Endangered *Acacia* taxa have indicated that seed production in small populations is unlikely to limit population growth and that local abundance is perhaps most influenced by fire regimes and competitive interactions with introduced invasive annuals.

WATTLE I PLANT FOR WILDLIFE?

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Wattles (Acacia spp) are an important component of most Australian ecosystems and, as a group, are one of the most widely recognised native plants. However, there is surprisingly little recorded about the relationship between wattles and fauna. This paper looks at the ways in which wattles can provide resources for native fauna and brings together published records relating to Acacias and fauna in the South-west of Western Australia.

Review of the influence of *Acacia* species on sandalwood (*Santalum spicatum*) establishment in Western Australia

ACACIA SPECIES AS LARGE SCALE CROP PLANTS IN THE AUSTRALIAN WHEATBELT

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Revegetation with perennial plants is a well-accepted tool in salinity control across the agricultural regions of southern Australia. However, the scale on which revegetation must be undertaken in order to have significant impact on salinity has only recently become clear. This scale is so large that revegetation for salinity control will only be viable if it is undertaken as a change in the commercial plant base of agriculture. Hence we need an array of profitable perennial plants to complement the traditional annual species.

Apart from their role in salinity control, new perennial plant crops can bring a range of other benefits to agricultural areas, including improved erosion control, protection and enhancement of biodiversity, diversification of farm incomes, and regional development resulting from local processing of perennial plant products.

This paper reviews several desirable attributes for new woody perennial crop plants, including rotation length, scale of markets, whole plant utilisation (multiple products), the desirability of deriving new crops from native species and the concepts and practice of temporal and spatial integration of perennial crops into agriculture. These attributes provide the foundation for objective selection of potential new commercial crop species. From this foundation, a selection and development project called 'Search' has evolved, to systematically assess new large-scale tree crops and processing industries based on native species, select those with high potential for commercial development, and take the first steps towards their development.

The genus *Acacia* provides considerable potential for the development of new commercial perennial plants. It appears to be especially prospective for use as a phase crop in rotation with conventional annual crops. A large number of *Acacia* species occur naturally in the Western Australian Wheatbelt, and several have attributes that may make them suitable for commercial development. Some have useful wood for use in solid wood products, some may be suited to panel board or paper manufacture, others produce gums or tannins, some have foliage that may be suitable as fodder, while several have potential as edible seed crops. Large-scale generic products for which acacias are likely to be suitable include solid fuels for electricity production, liquid transport fuels and charcoal products.

Work on *Acacia* is presented here in the context of a review of progress in the Search Project.

POTENTIAL OF SECONDARY PLANT PRODUCTS IN *ACACIA*.

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Wattles (*Acacia* spp.) produce a number of interesting classes of primary and secondary compounds. Some of these have potential as foods, whereas others may have industrial applications. Triglycerides and fatty acids are common components of the seeds of most plants. Cultivation and harvest of the seeds could provide edible oils and protein rich press cake for both human and domestic animal consumption. Fatty acids have a variety of non-food uses. Tannins are found in many *Acacia* species. These compounds are used for production of leather and a variety of other purposes. They are of intermediate commercial value (about $1US per kilogram), but could prove to be important by-products. In the past, Australia was a major leather producing and exporting country; the ready availability of good quality, inexpensive tannins might put this again within reach. Water soluble polysaccharides known commonly as "gums" also are common constituents of *Acacia* species. There is a significant demand for these products because of long-term shortages - a situation that doesn't appear likely to change in the near future. Gums are important components of food products and are often used to microencapsulate particles of mixes and modify physical properties of the foods. These substances also are used to encapsulate many pharmaceuticals, and also hazardous materials such as insecticides, herbicides, detergents, and dyestuffs. Although gum substitutes are available, none of these gums has the desirable physical properties of gum arabic or gum acacia, primarily derived from one African *Acacia* species. Some Australian wattles appear to produce gum of excellent quality, but new methods of induction of gum formation and of extraction and purification must be perfected before this becomes an economic reality. Plants rich in tannins may not be suitable for gum production, because the presence of tannins in gums decreases the value of the latter, unless innovative separation techniques make it possible to clean up gums more efficiently.

Although many of the compounds found in wattles are beneficial, some species contain harmful substances such as cyanogenic glycosides, β-phenylethylamine, fluoroacetate, and non-protein amino acids. The presence of these compounds is not necessarily limiting, but certainly any plan for using the beneficial compounds must consider them.

Why is utilization of wattles potentially important for Western Australia? The direct value of these products may produce new farm income, but cultivation of the plants that produce them may also contribute to resolution of salinization problems in parts of the Wheat Belt. This would be accomplished with elements of the native flora and contribute to an overall increase in biodiversity. Although intermediate-value products, such as gums and tannins would not be expected to accomplish these goals alone, in combination with bulk products such as wood pulp and fibreboard, gums, tannins, and possibly resins, they have the potential to complement and improve the economic picture in Western Australia.

LIVESTOCK POTENTIAL OF AUSTRALIAN *ACACIA* SPECIES

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In the Australian context there is a potential role for the acacia species to improve animal production by increasing meat, milk or wool production. This can be achieved by the provision of protein or energy via leaf or seedpod production. This paper will discuss the following issues associated with the potential of Acacia's as a source of ruminant feed stock.

1) What is the proximate composition of a range of Acacia leaf and seeds and what are the limitations of the measurements?
2) Is there any improvement in animal production from the inclusion of Acacia products in ruminant diets?
3) Are there potential anti-nutritional problems for ruminants associated with Acacia species?
4) Based on data available what are the predicted outcomes and value of the inclusion of Acacia leaf and seed into ruminant livestock production systems.

REVIEW OF THE INFLUENCE OF *ACACIA* SPECIES ON SANDALWOOD (*SANTALUM SPICATUM*) ESTABLISHMENT IN WESTERN AUSTRALIA

Jonathan E. Brand

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Sandalwood (*Santalum spicatum*) is a root hemi-parasitic tree that produces valuable fragrant oils. Harvesting of *S. spicatum* timber occurs mainly from natural stands in the semi-arid pastoral regions of the Goldfields and Midwest, Western Australia. These natural stands consist mainly of mature trees, with very little successful recruitment. Recruitment failure is most likely due to grazing and poor seed dispersal. On de-stocked pastoral leases, *S. spicatum* seedlings have been successfully established by direct seeding near suitable host plants, including many *Acacia* species.

The opportunity exists to reduce harvesting of natural *S. spicatum* and supplement this with *S. spicatum* grown in tree farm systems. The most suitable areas to grow *S. spicatum* are the 400-600 mm mean annual rainfall areas of the Wheatbelt and Midwest. *S. spicatum* has been successfully established in these regions by direct seeding near 1-2 year old *Acacia acuminata* seedlings. Using this technique, *S. spicatum* growth rates have been relatively fast, with mean stem diameters (at 150 mm) increasing up to 7-9 mm yr^{-1}. Current research is determining methods to further improve *S. spicatum* performance by studying the influence of host species, stocking and provenance.

In a host trial near Katanning, *S. spicatum* stem diameter was higher near *A. acuminata* (47 mm) than near *Allocasuarina huegeliana* (21 mm), at age five years. All *S. spicatum* seedlings died near *Eucalyptus loxophleba* subsp. *loxophleba* within two years.

S. spicatum performance near four separate *Acacia* species is being examined at two sites, near Narrogin and Dandaragan. At age two years, *S. spicatum* mean stem diameter near *A. saligna* (28-33 mm) was 2-4 times greater than those near *A. microbotrya* and *A. hemiteles*.

BIOLOGICAL ACTIVITY OF TRADITIONAL MEDICINAL *ACACIA* SPECIES USED BY INDIGENOUS AUSTRALIANS

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For over 40 000 years, Indigenous Australians have relied on native plants as a source of medicinal agents. Due to their wide distribution and abundance, it comes as no surprise that *Acacia* species were routinely used for this purpose. Preparations from at least 30 species were applied externally for skin sores, cuts, scabies and burns and were taken internally for colds, coughs, sore throats and headaches. Interestingly, the burning of a variety of species was also employed in smoke treatments for mothers and their newborn babies.

As part of a larger study, aimed at identifying novel biologically active compounds from native Australian plants, we have commenced screening a variety of *Acacia* species for bioactivity. Extracts obtained from a number of species routinely used by Indigenous Australians have been tested for antibiotic potential using known skin pathogens as test organisms. The extracts have also been screened for anti-pesticidal, anti-herbicidal and anti-tumour activity. Species, such as *A. pruinocarpa*, *A. aneura, A. bivenosa* and *A. coriacea*, have all revealed interesting biological effects in a number of the tests. We report on these and other species.

HORTICULTURAL POTENTIAL OF *ACACIA*

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The wattle is an acknowledged plant icon of Australia, with Western Australia the hot spot for diversity. Australia has 960 species and Western Australia around 500 species. With familiarity comes complacency and possibly this genus has become a victim of this in the horticultural world. Its potential is vast with the ability to influence all communities within Western Australia. Strategic marketing of Western Australian species that have undergone horticultural development trials, would ensure that the most attractive wattles of Western Australia would be best utilised in the future. Kings Park and Botanic Garden has devoted 0.7 hectare to the cultivation of approx. 70 of the most decorative acacias. This is combined with public artwork, to inspire and focus attention on the more attractive species. I believe there are distinctive locally occurring acacias for each major region throughout Western Australia. These species could be adopted by each community, giving them their own identity and sense of place. These outcomes need to be reinforced with seed being collected from the regions own biosphere. This will create ecologically sound initiatives and will help develop green corridors, linking natural remnant bushland throughout the region. Tabulated presentation indicates the suggested species suitable to create this effect.

THE TOURISM POTENTIAL OF *ACACIA* WITH PARTICULAR REFERENCE TO DALWALLINU

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Tourism is the fastest growing industry in the world and nature-based tourism is the major component. The major factor in the growth of nature-based tourism is the increased awareness of the need to conserve the environment and research has shown that tourists today are more environmentally conscious." (The Australian Bureau of Statistics)

In increasingly competitive national and international marketplaces, destinations need to say what is best or unique about their product. The newness of destinations like WA means that the tourism industry here can capitalise on overseas trends and reinforce those aspects that are being done well. We can find our own niche in an increasingly competitive global marketplace. There is a trend overseas toward smaller scale developments to cater for nature-based tourists, rather than appealing to larger groups. The focus is on providing quality experiences in a natural setting. Authenticity is a major factor in creating a strong sense of place in the development of facilities.

The most popular region in the State is the South West corner due to its close proximity to Perth, the variety of attractions and activities on offer and the high quality of products and services. Developing a tourism attraction in inland Western Australia has proven difficult.

Many rural communities are in decline - currently 60% of our small towns are dying, losing population, business and young people. Broad-acre farming and improved technology has decreased the labour force in rural Australia. Shire Councils and community groups are looking to tourism to create employment and increase economic development. To assist tourism to succeed there needs to be community support and involvement. Local Government will need to provide public facilities and amenities that will benefit the ratepayers and visitors.

Wildflowers are the State's major tourist attraction and there may well be an opportunity for Dalwallinu community to take advantage of this situation to increase visitor numbers to the area.

The Dalwallinu community has attempted in recent years to bring focus to the region through Wattles. They conduct an annual Wattle Festival, have undertaken street plantings of Acacias and have built entry statements to the town, which feature the wattle.

What other initiatives involving this one group of plants can be implemented to increase tourism to the region, and what are the constraints?

These are the issues that will be addressed in this presentation.

"Wattle Seed Dreaming"

A 30 minute documentary shown on French television a couple of years ago.

It focuses on Rosie Nangala, one of two Aboriginal women, who was sponsored to go to Niger in March 1998 by AFFA as part of World Food Day that year.

The visit was a cultural exchange to enable local people in Niger who are eating foods made from *acacia colei* seeds to meet Aboriginal people who use the seeds as traditional food, and to enable the Aboriginal people to see a new use for their food.

The film shows Rosie at her home in Yuendumu and shows her visit to Niger.

Note:
The symposium respects the traditions and views of the Aboriginal people.

One of the two women who appear in this video died last year.

Anyone who feels sensitive about the film can therefore avoid watching it.

TRADITIONAL USE OF ACACIA BY INDIGENOUS AUSTRALIANS

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With my knowledge of Aboriginal plant utilisation I could probably go bush from my home at Alice Springs tomorrow and spend the next year obtaining all I need for survival from the sixty or so Acacia species that occur in Central Australia. Admittedly, to make life more comfortable I would need some bottles of vitamin C pills and some tobacco (because I am a nicotine addict]. I would also need to work like hell during October-November gathering seed to store for use during lean times. Central Australian wattles are generous because they produce edible seed [30+species], grubs [11+], lerps [4], edible galls [1+], honey [2], medicine [13+], wood for implements [18+], excellent firewood, a thermoplastic or glue and material for constructing shelters. Minor products include a detergent, a tea, sharp needles, etc. Central Australian wattles are probably unique in the world in being the dominant organism over most of the deserts' various habitats. They range from being large long-lived trees, which live in undisturbed habitats, to smaller quick-growing shrubs, which thrive in highly disturbed areas. Because wattle seed was such an important part of their diet, central Australian Aborigines had an intimate knowledge of all aspects of their utilization, including use of fire to maximise production.

POTENTIAL OF AUSTRALIAN ACACIAS IN COMBATING HUNGER IN SEMI-ARID LANDS.

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Human populations living in semi-arid regions of the developing, tropical world and relying on annual crops and/or pastures for livestock for food are particularly vulnerable to hunger and periodic famine.

A number of species of edible-seeded Australian acacias, thrive under adverse conditions; conditions under which annual plants barely survive. These acacias include species such as *A. colei*, *A. coriacea/ A. sericophylla*, *A. elachantha*, *A. torulosa*, *A. tumida* and A. *victoriae*. The seeds of these species are tasty, safe and nutritious being high in protein, carbohydrates and fats. In many regions, such as West Africa, the seeds ripen at a time of low labour demand when non-irrigated crops are not being cultivated. Being perennial and thus having an established root system, mature acacias can take advantage of rains that would be ineffective for annual crops (e.g. out of season or poorly distributed rains). Acacia seeds are easily harvested and processed into flour. The flour can be incorporated into local dishes and in "non traditional" foods such as spaghetti, bread and biscuits. The seed also have great potential for feeding to livestock. Alternatively, the hard-coated seeds can be easily stored for many years and act as a famine reserve food.

This paper reviews the current status of knowledge and trials and the use of edible acacias in Africa and India. Particular reference is made to work done in Niger Republic, West Africa, including some of the human dynamics involved in adopting acacias as a food. Attention is drawn to acacias' vast, untapped potential as a new food crop, worthy of larger scale promotion, particularly in semi-arid regions of the world.

AUSTRALIAN DRYLAND ACACIAS WITH EDIBLE SEEDS.

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In 1998 the temperate Australian dryland *Acacia* flora (about 350 species) was assessed for its potential to produce seeds for human food in semi-arid regions of southern Australia[1]. Based on reports of traditional use by indigenous Australians and on a number of other important plant attributes, 47 species were identified as potential candidates. Although these species included representatives from most or the major dryland groups of *Acacia*, the 18 "best prospects" belonged to a single group, namely, tall shrubs or small trees characterised by one-nerved phyllodes and flower heads arranged in racemose inflorescences (section Phyllodineae).

This study was an extension of similar research based on the edible seeds of a number of tropical dry zone Australian acacias, notably *A. colei* and *A. elachantha*, for use in sub-Saharan Africa[2]. The rationale for working on southern Australia species was the need to identify deep-rooted, drought-tolerant perennial plants to complement existing shallow-rooted annual crops and/or pastures in an effort to help reverse land degradation in these regions. The potential to generate a commercial benefit from growing dryland acacias with edible seeds was also seen as an important factor.

Although much of the critical information necessary for the effective utilisation of edible dryland acacias is not yet available, the 18 "best prospect" species possess promising morphological, biological, ecological and silvicultural attributes. This talk will discuss these characteristics.

Acacia victoriae and *A. murrayana* in particular have outstanding attributes for planting as dryland acacias with edible seeds. Their seeds have good nutritional characteristics and were commonly used as food by Aborigines. Wild populations are adapted to a wide range of conditions, grow rapidly and produce moderate to heavy seed crops in most years. Both species are easily propagated from seed and plantations can be established by direct seeding. Over-mature, declining stands may be regenerated by coppicing and/or shallow ripping to induce root-suckering. *Acacia victoriae* is currently considered the most important edible wattle species in the Australian bushfood industry.

[1]Maslin, B.R., Thomson, L.A.J., McDonald, M.W. and Hamilton-Brown, S. (1998). *Edible wattle seeds of southern Australia. A review of species for use in semi-arid regions*. 108 pp. (CSIRO: Australia.)

[2] House, A.P.N. and Harwood, C.E. (eds) (1992). *Australian Dry-Zone Acacias for Human Food*. 151 pp. (ATSC/CSIRO: Melbourne.).

www. anpi. com. au

ISSUES IN THE COMMERCIALISATION OF WATTLE SEED FOR FOOD

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Wattle seeds are a versatile product with a range of potential food industry uses, and small amounts of mostly wild-harvested seed are currently used in baked goods and other products. However, in common with many other Australian native food crops, the expansion of uses and markets is currently constrained by the inconsistent quality and quantity of wild-harvested supplies.

Commercial cultivation of the plant has commenced and further expansion is likely. Beyond normal new crop questions such as suitable production areas, input management, pest and disease control, etc, a fundamental issue in commercialisation is the current lack of tested and proven production system models for the crop. While models have been proposed and several have been implemented in the field, so far none seems to have been comprehensively tested and evaluated over a full plantation lifecycle.

Any model is a jigsaw of interlinking components that need to follow a basic management approach, be internally consistent, mesh with external systems and meet desired production targets.

A basic management approach entails determining whether production is undertaken as a low input larger-scale field crop or as a more intensively managed and smaller-scale horticultural crop, or some combination of the two. It is likely that a range of approaches may prove successful, depending on geographical areas, species, complementary and existing farm management practices and specific viability targets.

Internal consistency is required because individual management factors, particularly species selection, planting layout, canopy management, harvesting and rejuvenation methods are all strongly interrelated, with decisions made in each area impacting upon other management areas. Because the cost of harvesting is likely to have a large impact on the economic viability of wattle seed production and has significant interactions with other management areas, an assessment of likely methods is one of the key decisions for any production model.

The production system needs to mesh with on-farm external systems, such as livestock or other crop systems, and meet the requirements of off-farm systems, such as the marketing chain.

Production targets that have to be addressed may include financial returns, environmental benefits or performance as a companion planting.
While this paper suggests how some of these jigsaw components may fit together, practical research and development efforts and comparative evaluation over a plantation lifecycle are required to test and prove likely production system models.

DEVELOPING AGROFORESTRY SYSTEMS FOR MEDIUM TO LOW RAINFALL AREAS - THE ROLE OF DRYLAND ACACIAS

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Farm forestry is important to Australia's sustainable natural resource management. Tree planting has particular environmental rewards in areas with low to medium rainfall (400-700 mm). Farmers can alleviate dryland salinity, reduce wind and water erosion, provide shade and shelter for animals and contribute to biodiversity preservation, all through planting trees. Trees can also boost farm income, enhancing both farm profitability and natural resource management. There are, therefore, significant environmental drivers for the development of commercially viable agroforestry systems in medium to low rainfall areas.

Improvement of the economic viability of low rainfall agroforestry is a priority area for current and future research and development funding for the JVAP. The program aims to develop farm forestry systems and products suited to these regions - where trees can be hard to establish, growth rates are slow and the distance to markets is often large. Unless trees are profitable for farmers in these areas they will not be planted on a sufficient scale to achieve desired environmental benefits.

The range of emerging products and services being investigated by the JVAP include:

- Timber and wood products such as composites
- Biomass for energy and other industrial products
- Novel products such as pharmaceuticals, wattle seeds, tannin and firewood
- Fodder crops
- Environmental services

Wattle seed (*Acacia* spp.) has been used as a food source by Australian Aboriginal people for thousands of years. More recently, there has been a small but increasing demand for wattle seed as part of the commercial bush food market. This paper focuses particularly on the opportunity for broad scale wattle seed production and use of wattle seed in mainstream food production industries such as bread and biscuit making be investigated as a commercial output of future plantings of perennial species to combat rising water tables and dryland salinity

A recent JVAP study has identified that there is significant potential for wattle seed production in specific food and flour markets. However, further research is required in the following areas:

- Food production and nutritional characteristics
- Market research
- Economic analyses
- Seed production, harvesting and sustainability

ACACIA SYMPOSIUM

13-14 JULY 2001

ABSTRACTS OF POSTER PRESENTATIONS

THE TRANSLOCATION OF TWO CRITICALLY ENDANGERED ACACIA SPECIES

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The successful recovery of critically endangered flora will rely increasingly on the translocation of these flora to secure sites where the amelioration of threats has been successful or where current threats such as weeds are not present. Translocations are both costly and time consuming, and in many cases involve very small numbers of plants from critically endangered populations. It is most important that cost effective and efficient methodologies are developed that ensure translocation establishment and that protocols are developed for determining translocation success.

Of the 28 Acacia taxa listed as threatened (Declared Rare Flora) 12 are critically endangered and all occur in the cereal growing areas (Wheatbelt) where there has been extensive land clearing and habitat degradation. Many populations of these critically endangered Acacia taxa occur on degraded road verges and other small remnants of degraded vegetation.

By the end of 2001 CALM will have carried out 15 translocations of critically endangered taxa as part of approved Interim Recovery Plans of which two are Acacias, *Acacia aprica* and *Acacia cochlocarpa* subsp. *cochlocarpa*. Various translocation methodologies have been experimentally tested and preliminary data indicate different success rates depending upon site and climatic conditions. The development of scientifically based translocations methodologies that offer a reasonable probability of success require detailed monitoring and data analysis of experimental translocations. Equally critical, as part of the same monitoring program, is the need to develop protocols for determining and predicting translocation success. These protocols need to be based on estimates of the viability of the translocated population in terms of reproductive output (seed production, seed viability etc) and the subsequent recruitment of new individuals. Preliminary data is presented on the current status and success of translocations of *A. aprica* and *A. cochlocarpa* subsp. *cochlocarpa*.

THE VALUE OF ACACIA SALIGNA AS A SOURCE OF FEED FOR SHEEP

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Acacia saligna, a native to Western Australia has been widely acknowledged as a useful species for land conservation. More recently, there has been a focus on *A. saligna* as a potential source of fodder for ruminants. A common conclusion of researchers is that the presence of condensed tannins (CT) is the primary factor inhibiting its value as a feed source.

Pen trials, using 6 mature merino wethers fitted with permanent rumen cannulae, were conducted in order to evaluate the value of *A. saligna* as a source of feed for sheep.

TRIAL 1

April - June 1999.

The aims of Trial 1 were:

- To evaluate the value of *A. saligna* as a sole source of nutrients for sheep.
- To evaluate the effect that partial detannification (by dosing sheep with PEG 4000) of *A. saligna* might have on its value as a source of nutrients for sheep.

A. saligna was lopped from a three year old plantation (grown directly from seed, sown in 1996). Only acacia foliage less than 12 months old was used. The plantation was located at Gidgegannup, Western Australia.

The DMI of *A. saligna* (Table 1) was greater ($P < 0.05$) in sheep supplemented with PEG 4000 compared to the control. This was associated with improved ($P < 0.01$) DMD and OMD.

Table 1 Intake and digestibility of *A. saligna* offered to sheep with or without a supplement of PEG 4000.

	Control	Treatment PEG 4000	Significance
DMI (g/d)	187^a (57)	499^b (101)	*
DMD (%)	31.3^a (7.9)	36.8^b (9.1)	**
OMD (%)	30.4^a (7.8)	32.1^b (9.1)	**

*P < 0.05; **P < 0.01.

Values within rows with different superscripts are significantly different.

Values within brackets indicate standard deviations.

Defaunation was evident in the ruminal fluid of sheep consuming *A. saligna* without the PEG supplement. This suggests that the primary cause of defaunation was the presence of CT.

All groups were in negative N balance, in particular the control group. The inclusion of PEG in the diet improved the utilisation of *A. saligna*. However, the animals remained in negative N balance and all the diets were submaintenance. All animals lost weight, however, the loss in the control animals was considerably greater than those in the PEG group.

The results of this trial indicate that in this instance, *A. saligna* could not be used as a sole diet to maintain the weight of sheep even with partial detannification as a result of inclusion of PEG. Perhaps a higher dose rate of PEG or an alternative form of rumen degradable N would have yielded more positive responses.

TRIAL 2

April - June 2000.

The purpose of Trial 2 was again to investigate the use of *A. saligna* as the basal source of nutrients for sheep. However, because of concerns with feeding *A. saligna* alone (based on observations from Trial 1), wheaten straw was included in the basal diet.

Supplementing with urea was used as a means of increasing the availability of N to the rumen and hence the utilization of the *A. saligna*.

The *A. saligna* used was sourced from Bakers Hill, Western Australia. Branches were cut from mature trees (5-6 year old, grown from bare-rooted seedlings) and then manually fed through a mechanical leaf stripper.

Supplementing the sheep with urea had no benefit in the sheep's utilization of *A. saligna* (Table 2) indicating that the *A. saligna* provided adequate ruminal N.

Table 2 Intake and digestibility of *A. saligna* and straw offered to sheep with or without a supplement of 1% urea

	Control	Treatment + urea	Significance
Average LW (kg)	66.6	67.5	NS
	(10.7)	(10.6)	
DMI (g/d)			
Straw	75	82	NS
	(44)	(52)	
A. saligna	1287	1295	NS
	(200)	(238)	
Total	1362	1377	NS
	(175)	(205)	
DMD (%)	48.2	49.0	NS
	(2.6)	(2.8)	
OMD (%)	49.7	50.9	NS
	(2.4)	(2.5)	

NS, not significant.

The results of Trial 2 were in stark contrast to Trial 1.

Although the DMD and OMD were considerably higher in Trial 2 compared to Trial 1, they remained below 50%. Even so, in Trial 2, average daily DMI of *A. saligna* by sheep in both treatment groups exceeded 1280 g i.e. approximately 2.5 times the intake in Trial 1 where animals were supplemented with PEG and almost **7 times** the intake of the control animals from the first trial.

All sheep readily consumed the *A. saligna* in preference to straw with the urea supplement having no influence on this parameter.

No defaunation was evident suggesting a much lower concentration of CT and/or lower protein precipitation capacity of the CT present in the *A. saligna* foliage, compared to the *A. saligna* used in Trial 1.

Animals tended to maintain body weight on the *A. saligna* diet regardless of the urea supplement.

IMPLICATIONS

Analyses of CT within the *A. saligna* of the respective trials have not yet been completed. Differences in the CT concentration and its biological activity may account for the contrasting results. However, even in the absence of CT, it remains difficult to explain why, when digestibility was only around 50%, DMI of *A. saligna* was so high in Trial 2,

There are several factors that may influence the CT contained within the foliage of browse species including season, soil and age of the tree, among other factors. The foliage used in the two trials was harvested from different sites in different years, from differently aged trees. Further research is needed to determine how CT may vary in *A. saligna* foliage in relation to the many factors that may influence it. Greater understanding of such factors might enable its potential as a source of fodder to be realized.

Whereas Trial 1 demonstrated clearly that *A. saligna* was inadequate as a source of nutrients for sheep, Trial 2 indicated that A. *saligna* could in fact play a useful role as a major component of a sheep's diet.

REPRODUCTIVE POTENTIAL OF *ACACIA* SPECIES AT SANDFORD ROCK NATURE RESERVE (SRNR) - VARIATION BETWEEN YEARS

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The concern was to discover how rainfall variation between years affects reproductive potential. As resources needed for reproduction are ultimately derived from phyllodes the effects of phyllode number and branch position in the crown were investigated. Late spring frost occurred in 1998. Pods from 14 species were examined to test seed quality after the frost. Number of seeds, aborted seeds per pod and percentage of seeds that germinated were obtained. In 1999-2000, eight Acacia species were examined. One to three plants and 15 to 25 branches bearing inflorescences per plant were labelled. Numbers of phyllodes and inflorescences per branch were recorded. After all the pods had matured, plants were re-measured and the number of inflorescences that had set pods and the number of pods per inflorescence were recorded. Branch position was scored as in top, middle or lower plant crown.

A severe late spring frost in 1998, limited seed development. All species produced few seed; many pods were empty; many immature and infected seed were found; and there was poor germination. In all species, seed weight was reduced by more than half that in years before or after this frost. Of 14 species, only three had more than 50% germination. In seven species there was no germination, while all others had less than 30 % germination. Generally, more immature seeds were associated with more infected seeds. Damage to seed by frost provided sites for seed infection

High rainfall in 1999 allowed heavier flowering and fruiting. More inflorescences set pods, more pods were produced and there were more pods per inflorescence. In 2000, pod yields were reduced by drought. The extent of flowering depends on good winter rainfall while fruit and seed production depends on moisture availability in spring. Although all species suffered from the drought in 2000, there were differences in their degree of susceptibility. A. neurophylla, A. fauntleroyi and A. steedmanni were the least affected by drought. A. stereophylla failed to develop pods; A. hemiteles did not flower and less than 1% of inflorescences developed a pod in A. saligna and A. lasiocalyx.

Plants bearing more phyllodes had more flowers and fruits; flowering was earlier; and fewer inflorescences dried off. Phyllodes donate nutrients to fruits and nutrient tends to flow into fruit from the nearest phyllodes. Generally, branches in the upper part of the crown initiated more inflorescences. However, the pods that developed in a particular species were present in higher number in central parts. The difference in the form or architecture of branches among species presumably affected resource partitioning and consequently reproductive potential.

BOTANICAL SURVEY WITH THE AID OF VOLUNTEERS
A STUDY OF THE VEGETATION ON A MURCHISON STATION

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Burnerbinmah is a station in the Murchison Region of Western Australia, purchased by the Department of Conservation and Land Management (CALM) in 1995. It lies within the Austin Botanical District of the Eremaean Botanical Province, in which the vegetation is predominantly mulga low woodland (*Acacia aneura*) on plains, with scrub on hills. Twelve land systems are represented on the station, with a wide range of plant communities, including mulga and mallee woodlands, spinifex sandplain, fresh water and saline wetlands. The predominance of the mulga association in the area is reflected in the fact that 26 species of *Acacia* occur on Burnerbinmah

During work on a Wildlife Management Program for Rare and Poorly Known Flora in the CALM Geraldton District in 1966, opportunity arose to survey the flora on Burnerbinmah. The programs provide information for management and protection of declared rare flora (Threatened Flora) and poorly known flora (Priority Flora) in Western Australia. 37 Threatened Flora and 264 Priority Flora are listed for the District. Burnerbinmah lies in the inland pastoral section, which had no conservation reserves until the purchase. It was therefore important to discover Threatened and Priority Taxa occurring there and to learn more about the vegetation.

Landscope Expeditions, offered by the CALM publication Landscope, and the University of Western Australia Extension program, provide paying volunteers with opportunity to work on CALM research projects. Three Landscope Expeditions, over three seasons, and an expedition with the WA Naturalists Club, completed 18 days of survey work, establishing quadrats and making general collections. 535 taxa were recorded and 9 Priority taxa found, with records of range extensions, poorly collected and undescribed taxa. The work also extends other monitoring programs throughout the region, and provides a data set for future assessment of grazing reduction on the vegetation. This would not have been possible without the considerable input of volunteers.

THE AUSTRALIAN PLANT NAME INDEX

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The Australian Plant Name Index (APNI) is a comprehensive database of published names of Australian plants and their bibliographic and typification details. APNI is now available on-line at www.anbg.gov.au/apni and is linked to the *'What's its Name?'* project (www.anbg.gov.au/win), which lists current Australian plant names. APNI is an integral part of the International Plant Name Index (IPNI) which can be seen at www.ipni.org.

WATTLE - ACACIAS OF AUSTRALIA

B.R. Maslin
(Co-ordinator)

WATTLE Acacias of Australia is a CD ROM production which provides an interactive key and information system for 1165 taxa of *Acacia* which occur in Australia. This number includes all formally described species, subspecies and varieties, and several as-yet undescribed and informal taxa.

With WATTLE you will be able to:

- quickly and accurately identify any of the 1165 taxa of *Acacia* in Australia (using fresh or dry specimens, irrespective of whether they are in flower or fruit; even sterile material can often be named);
- easily access comprehensive information for each taxon, including a botanical description, and notes on their distribution, ecology and taxonomy;
- quickly navigate between related taxa using hyperlinks;
- for each taxon view a diagnostic line drawing (annotated to highlight critical features) and a distribution map;
- view supplementary drawings for around half the taxa.

The *Flora of Australia Acacia* volumes (11A and 11B) will contain information similar to that which is in WATTLE. The principal differences are that WATTLE includes a few extra taxa, the diagnostic line drawings are annotated to show critical features, and supplementary line drawings are often provided. An attempt has been made to maintain consistency between the WATTLE and *Flora* data; however, some discrepancies do occur and in these cases the WATTLE information is normally the more current.

WATTLE has been developed through collaborative arrangements between the following agencies:

- Department of Conservation and Land Management, Perth, Western Australia.
- Australian Biological Resources Study, Canberra, Australian Capital Territory.
- National Herbarium of New South Wales, Sydney, New South Wales.
- CSIRO Forestry and Forest Products, Australian Tree Seed Centre, Canberra, Australian Capital Territory.
- Queensland Herbarium, Brisbane, Queensland.
- Plant Biodiversity Centre, Adelaide, South Australia
- National Herbarium of Victoria, Melbourne, Victoria.
- Northern Territory Herbarium, Darwin, Northern Territory.

WATTLE is authored by B.R. Maslin (co-ordinator), T. Tame, H. Coleman, M.W. McDonald, T. Spokes, M. O'Leary, N.G. Walsh, P.G. Kodela and K.Thiele. It is published jointly by the Australian Biological Resources Study, Canberra, and the Department of Conservation and Land Management, Perth, and is produced by CSIRO Publishing, Melbourne.

A formal demonstration of WATTLE will be given by B.R. Maslin during one of the Symposium breaks, and the program will be available for delegates to "play" with throughout the period of the Symposium.

DIRECT SEEDING ACACIAS OF DIFFERENT FORM AND FUNCTION AS HOSTS FOR SANDALWOOD (*SANTALUM SPICATUM*)

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It has long been recognised that Acacia species are the premier hosts upon which to establish the parasitic sandalwood (*Santalum spicatum*). Most host plantations established to date in the wheatbelt have concentrated on planting seedlings of jam wattle (*Acacia acuminata*) at 830 per hectare as the main species of Acacia. Whilst it is apparent that *A. acuminata* is the ideal principal host and should form a significant part of the host mix, the inclusion of other species should also be considered as they can complement the role played by jam. Naturally, sandalwood parasitises a wide range of species.

Acacias are relatively large seeded and direct seeding is cheap and is usually very successful if adequate site preparation is carried out. Seedling densities of over 5,000 per hectare are readily achieved. By using a biodiverse seed mix it is possible to establish a big range of Acacia species (and other genera) as potential hosts.

Direct seeding of a large number of host plants of diverse species can benefit sandalwood plantations in a number of ways:

1) Reduced stress applied to individual hosts and host groups, maximising the potential for long-term survival of sandalwood plantations.
2) Increased nature conservation value from a diverse species mix of hosts.
3) Additional seasonal sources of water and nutrition: Although shallow rooted Acacias such as *A. pulchella* may not be good sole hosts during the dry summer period, they may however be important nutrient and water sources during autumn, winter and spring.
4) Protection from herbivores: Sandalwood shoots are palatable to most herbivores. Host plants that have thorns like *A. pulchella* and *A. lasiocarpa,* or form dense, low laterally spreading bushes (*A. redolens* and *A. auratiflora*) provide protection to young sandalwood trees until they are above grazing height. When sandalwood is grown in amongst a hedgerow of direct seeded hosts the hedgerow itself tends to reduce herbivory on the young sandalwood seedlings.
5) Access to sunlight: The use of low thorny or laterally spreading Acacia species also allows access by the hemi parasite to full sunlight when it grows beyond the protective canopy in subsequent years.
6) Protection from monoculture diseases: Native mistletoe (also a parasite) can weaken and kill jam trees and when jam is grown as a sole host the consequences of mistletoe outbreak can be severe. Mistletoe attack will have less impact in a mixed host plantation because mistletoes are unlikely to grow on all the host species.
7) Sustained host vigour: It is also important to include long and short lived Acacias in the host mix. Fast growing hosts (*Acacia saligna* and *A. pulchella*) offer initial vigour to the plantation but longer lived hosts such as *Acacia acuminata* and *A. redolens* are required for long term sandalwood growth and survival.