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LAND FOR WILDLIFE

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THE NOISY SCRUB-BIRD IN THE DARLING RANGE

by Alan Danks

THE NOISY SCRUB-BIRD is one of the most intriguing birds you are likely to come across in Western Australia. It isn't large or spectacular and it doesn't dominate the skies in large raucous flocks. But this small, semi-flightless inhabitant of dense scrub draws attention with its loud song and tantalises with its easy command of a tangled and impenetrable habitat. Those with the patience to wait quietly may be rewarded with a few glimpses of a bright-eyed, cocky bird dressed in subtle colours but with a voice that makes your ears ring. After a Cheshire Cat history of discovery, disappearance and rediscovery, the successful management of this threatened species in recent decades has ensured that the bird is well established in coastal areas east of Albany. One of Western Australia's conservation icons, the Noisy Scrub-bird has recently been reintroduced to its old haunts in the Darling Range.

John Gilbert discovered the Noisy Scrub-bird in November 1842 while exploring and collecting in Western Australia for John Gould. With the botanist James Drummond he travelled from Perth to Augusta along the coastal plain. From Pinjarra they made a detour to explore Mt William in the Darling Range. They made their way from the Murray River rapids up into the hills, crossing several westward flowing streams before reaching their goal.

This was Gilbert's second trip to WA and he was reasonably familiar with the bird life of the colony. But at the Murray he was tantalised by a bird whose resonant song told him it was something new. Gilbert wrote to Gould in England: "... its loud but pleasing note fairly made my ears ring, and yet I could not see the creature". At the first stream past the Murray (now known as Drakesbrook) after "waiting around in the rain for days" he at last got a glimpse of it and was able to shoot one. Gilbert sent several specimens to Gould who officially described the new species. Gould was also intrigued by the bird and wrote: "Few of the novelties received from Australia are more interesting than (this) species". He also predicted gloomily that it was "destined to rarely meet the gaze of civilised man".

Gilbert considered scrub-birds were locally common but after his report, no other naturalist reported them in the Darling Range. But Gould's publication and interest aroused curiosity and ornithologists were keen to find out more about the life history and breeding biology of the Noisy Scrub-bird. They were intrigued by its anatomical peculiarities - it has no wishbone for instance - and puzzled about its relationships to other birds. The bird's elusive habits and impenetrable habitat however, made it extremely difficult to study in the wild or even to obtain specimens. Frustratingly, as scientific curiosity about the scrub-bird grew stronger in Australia and Europe, the scrub-bird was dwindling as its habitat was ravaged by wildfire and clearing for agriculture. By the end of the nineteenth century the Noisy Scrub-bird was referred to as "rara avis", by the 1920s it was widely considered to be extinct. In 1948, a memorial to the "sweet-voiced bird of the bush" was placed at Drakesbrook, near the site of John Gilbert's discovery.

Fortunately however, the Noisy Scrub-bird was not actually extinct. One tiny population remained, hidden in the deep gullies of the Mt Gardner peninsula at Two Peoples Bay. Here, less than 50 individuals clung precariously to existence and, in 1961, after more than 70 years without an official record, the Noisy Scrub-bird made a dramatic reappearance. This "rediscovery" brought international conservation attention to Albany and Two Peoples Bay in the early 1960s. The Noisy Scrub-bird was literally on the brink,

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EDITORIAL

Greetings everyone!

In March this year the State Government released an update of the Salinity Strategy. This is a very important document for everyone whose property could be affected by salinity – indeed for all Western Australians. You can obtain a copy of the information package from AgWEST. It comes with a booklet which summarises the resources available to landholders: "Salinity: a guide for land managers". I would urge every interested person – especially anyone on an LCDC or CG Committee – to read these, note the current state of play and what has – and has not - been suggested for the future. Reports on native vegetation management and drainage are also available from AgWEST.

There is some great information in this issue of 'Western Wildlife'! Among others, Steve Hopper takes up the issue of the effect of climate change on dryandras (raised by Odile Pouliquen-Young last issue) to explain just why WA plants are unlikely to 'move to track the climate'. John Pate gives some interesting detail about nitrogen-fixing plants in the bush, Alan Danks talks about translocating noisy scrub-birds, while Ian Common introduces us to a little known group of moths.

Personally, I was fascinated by the 'scat moths' who undergo their entire larval development within the droppings of marsupials. Dr Common is interested in looking for more of these moths from WA, especially from possums, quendas or tammars, but to do that he needs poo samples. If you can locate some scats which you can confidently attribute to a particular native mammal (NOT roos) you might like to contact Dr Common and ask if he would like you to send him some samples. The droppings must not be too fresh, since adult moths have to have time to find them and lay an egg. Well – it's a different sort of quest!

Penny Hussey

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Review of "Managing Your Bushland"

As part of the *Land for Wildlife* package, many members will have received a copy of the book "Managing Your Bushland". This was published in 1993 as a text outlining the principles on which bushland management and revegetation for nature conservation are based. Its now out of print, and the authors, Ken Wallace and Penny Hussey, are interested in whether you have found it useful, as a guide to whether it should be reprinted.

Sometime before the end of the year, a researcher will telephone a random sample of *LFWers* to ask about your reaction to "Managing Your Bushland". If you get such a call, we would be grateful if you would take time to answer the questions as fully as you can.

Many thanks in advance!

Did you know .....??

.....why spiders don't get stuck to their own webs?

They walk between the sticky bits! When spiders construct the web, they lay down sticky patches and bare patches at just the right interval for their stride. As the spider grows, so the spacing changes. Small spiders with small webs use very small sticky patches to avoid catching large insects that would either damage their web or even injure the spider.

From Peter Mawson, CALM

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however, and strong measures were needed if it were to be saved from extinction.

Conservation

The first priority was to protect the bird's habitat. This was begun by the creation of Two Peoples Bay Nature Reserve. On-site management made it possible to exclude fire within the reserve and this seems to have been particularly important. Scrub-bird numbers began to increase from 1972. Such a small population however, is at risk from many factors – fire, habitat disturbance, predation. The solution is to build the numbers quickly and spread the population out in the landscape. But the bird needed access to more habitat if the population was to grow enough to provide security from wildfires in the longer term. For a bird with very limited powers of dispersal, this meant that new populations would have to be created by translocation from the rediscovered population. Fortunately, by the early 1980s scrub-bird numbers had grown enough to allow some removals and a translocation program began to be developed.

Once the essential methods of capture, transport and monitoring were developed, the birds were taken to new homes in a number of places along the south coast between 1983 and 1995. Populations developed successfully in the area east of Albany but, interestingly, not to the west where there were several failures. Overall however, the program was successful and resulted in a five-fold increase in numbers in the Albany area.

By 1995, however, scrub-birds in the Albany area were already occupying most of the suitable habitat. Numbers would continue to rise as these populations developed, but it was clear that there were no other areas suitable for establishing large populations. There was a need to look further afield. To the east and north, lower rainfall meant little suitable habitat. To the west of Albany, the unsuccessful attempts at settling Noisy scrub-birds and the lack of any historic evidence that they had occurred there, indicated little likelihood of success in that direction.

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On the other hand, it was known from John Gilbert's records that scrub-birds had definitely existed in parts of the Darling Range last century. Perhaps some habitat still existed which would allow the reintroduction of the Noisy Scrub-bird to these former haunts?

During 1996 extensive surveys were carried out from the Murray River, where it flows out of the hills to the coastal plain, south to the Wellington Dam. It soon became clear that the riparian vegetation along the streams originating in the uplands around Mt William contained habitat which looked suitable for Noisy Scrub-birds. This was precisely the area where John Gilbert had recorded the scrub-bird in 1842. The habitat in this area - a distinct association within the surrounding jarrah/marri forest - is characterised by a fringing forest of Bullich (*Eucalyptus megacarpa*) and Blackbutt (*E. patens*) with *Agonis linearifolia* in the stream zone. Dense tangles of *Gahnia* and *Hypocalymma* along the swampy banks provide an equivalent for the low scrub and sedges at Two Peoples Bay.

First releases in the Darling Range

Department of Conservation and Land Management staff, with the support of Alcoa Australia, released the first batch of Noisy Scrub-birds from Two Peoples Bay in two sites in this area during June and July in 1997. The initial pioneer group consisted of males only. This was a deliberate strategy developed during the previous ten years of translocation work on the south coast. Males, although difficult to capture, are more easily caught than females and are usually in surplus. Importantly, because they sing when they establish territories, they allow survival in the new area to be monitored. This provides a way of confirming the new habitat without the possibility of wasting precious females in unsuitable areas.

In one of the release areas, the males were fitted with tiny radio-transmitters before release allowing their movements in the thick vegetation to be followed without needing to see the birds themselves. For the few weeks in which the transmitters remained attached, the scrub-birds led the scientists up and down the stream system as they foraged and explored their new home. Many "song battles" between competing males were witnessed and it was clear that territory ownership changed hands, often several times. Territory ownership was seen to be more dynamic than previously thought. This was a new observation about scrub-bird behaviour, only detectable by the use of radio-transmitters with individually identifiable signals.

But most importantly, the birds continued to sing in the release area indicating the habitat could support them. A year later, at the beginning of the next breeding season, some scrub-birds were still singing. If they had survived through the summer, and it was a particularly dry one, then the chances of longer-term survival were reasonably good. It was time to introduce the surviving males to some females. In 1998, the first females and some more males were added to the initial release areas and a third site was used as well. More males and females were released in 1999.

A small number of male Noisy Scrub-birds can now be heard singing regularly in the Darling Range for the first time in over 150 years and only a few kilometres from where John Gilbert heard them in 1842. If the scrub-birds now present and surviving can be nurtured into establishing a breeding population, their off-spring may be better able to colonise the available habitat. Indeed, for the reintroduction to be considered a success, we need to be able to demonstrate that breeding is occurring and young are being recruited into the adult population. This will take several years yet. But, the success so far is encouraging and, with luck the Darling Range could become a permanent home for a new population of Noisy Scrub-birds.

Alan Danks is Regional Leader Nature Conservation at CALM, Albany. He can be contacted on 9842 4514.

FLORA

CLIMATE CHANGE, DISPERSAL MECHANISMS AND REVEGETATION WITH WA PLANTS

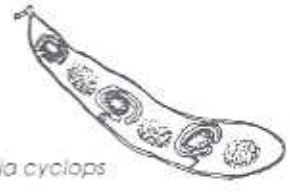
by Stephen Hopper

ODILE Pouliquen-Young's recent article (Western Wildlife 4/2 pp 8-9) highlighted the vulnerability of species of *Dryandra* in south-western Australia to minor climate change of up to 2°C. I would like to expand on two aspects of this important issue – is it likely that south-western plants might disperse across the landscape to track the climate? And, secondly, what does the answer mean in terms of best practice approaches to natural revegetation and restoration in the south-west?

Dispersal capabilities

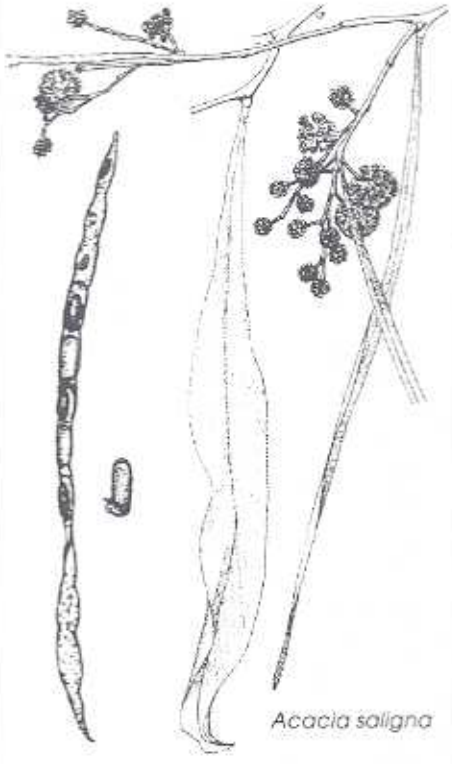
Effective dispersal involves transport of seeds or vegetation propagules some distance from the mother plant, followed by germination and successful establishment to form a breeding population at a new site.

One striking aspect of the majority of the south-west's 8000 native plant species is the absence of obvious means of seed dispersal. Very few species have large wings or light-weight seeds for wind dispersal – orchids, daisies, some native grasses and sheoaks come immediately to mind as exceptions. But look at the seeds of eucalypts, kangaroo paws or most shrubs and perennial herbs that dominate south-western plant communities and you will see that they are unlikely to move away from the maternal plant more than a few metres unless picked up by cyclonic winds, firestorms, sheet flooding or animals.



Acacia cyclops

Another significant deficiency in the flora are berries, drupes and other fleshy fruits encasing seeds as an enticement for birds and mammals to consume and disperse seeds in their droppings. Exceptions are quandongs, mistletoes and many southern heaths (Epacridaceae). Legumes, including wattles, may carry a fleshy structure attached to



Acacia saligna

individual seeds called an aril or elaiosome. These seeds are usually gathered by ants and dispersed short distances, often to underground caches. In a few species, such as the coastal wattle *Acacia cyclops*, the aril is big and bright red, attracting mobile birds as dispersal agents. But, again, the vast majority of south-western plants lack such enticements.

Indeed, it is predominantly in relatively new or open habitats that obvious adaptations for seed dispersal are found – aquatic environments, coastal dunes, margins of rivers and salt lakes, recent dunes or granite outcrops are places to look. The habitats that dominate the south-west display the converse – plants of woodlands, forests, kwongan heaths and mallee country for example usually lack any obvious means of dispersal other then gravity.

This situation contrasts strikingly with that seen in most places elsewhere. Rainforests, for example, are replete with fleshy-fruited species that attract animals as dispersers. The woodlands and forests of eastern Australia have far more such species than do those of the south-west. The vast conifer forests of the northern hemisphere are dominated by widespread fast-growing species with seeds readily dispersed by the wind or by fruit-eating animals. Even the fynbos heathland vegetation of South Africa, so similar to the south-west kwongan in many ways, has a predominance of berry fruits and seeds adapted for wind dispersal.

Why is the dominant south-western flora so different? The explanation is likely to be found in the great antiquity and continuous presence of land in the south-west above sea level and without major disturbance from mountain-building or massive glaciers for more than 200 million years. Such conditions are almost unique on earth. They explain why so much of the south-west is so flat, why soils are so highly leached of nutrients, why such a complicated mosaic of different soil types sits on the gently undulating terrain of the wheatbelt, and why so much salt sits in the landscape.

The native flora, during its evolution over vast periods, has faced quite different selection pressures to that of places where massive glaciers covered vast areas during the ice ages of the past two million years, or where mountain building has rejuvenated soils through accelerated erosional processes (e.g. eastern Australia down the Great Dividing Range). In the south-west, staying close to the maternal plant has been the safest bet for seeds and propagules for tens of millions of years. In many landscape positions, moving even tens of metres away increases the likelihood of striking a different

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soil type and therefore being at a competitive disadvantage to species of the alternative soil preference.

Contrast this with being a plant in a coniferous forest on the edge of a retreating ice-age glacier in North America or Eurasia. Vast areas of rejuvenated bare fertile soil beckoned to those species able to disperse their seeds long distances. Little wonder that adaptations such as prominent wings on seeds or berry fruits are so prevalent in these habitats.

Implications for climate change

An appreciation of the limited seed dispersal capabilities of most south-western plants suggest that tracking climate change is an unlikely option. Perhaps along coastal dunes, riverlines and salt lake systems some movement might occur. For plants of most other habitats, however, much more likely under a drying climate scenario is that populations would die out in marginal habitat and persist in the landscape only in refugial wetter habitat.

Evidence for this is all around us in the south-west. Many rare relictual species are found in locally wet habitat such as on granite outcrops, on the southern slopes of breakaways, on seeps and in ephemeral swamps. This becomes clear in a cursory read of habitats covered in CALM's book on WA's threatened flora (see ref.). Conservation of such seasonally wet habitats will be a key strategy as the climate warms.

I would venture to suggest that Dr. Pouliquen-Young's conservative models for species of *Dryandra* are overly optimistic as they assume that species are capable of colonising most patches of preferred soil within a given climatic envelope. Years of searching for

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rare and poorly known plant species in the south-west has impressed upon me that occupation of all or even half the available preferred soil patches occurs rarely indeed. It is far more common for species to occur sporadically in localised patches even if their preferred soil is quite abundant and continuous over many kilometres.

One only has to reflect upon the recent death of many plants on shallow soils adjacent to granite outcrops in the jarrah forest, wheatbelt and goldfields during summer heatwaves of the 1990s to appreciate that persistent global warming will have immediate and dramatic impact locally. Moreover, given the severe limitations on seed dispersal of most native plants, and relatively high proportion of weeds now in the south-western flora, such deaths associated with global warming may well exacerbate weed invasion.

Implications for revegetation

The extraordinary limitations on seed dispersal for most south-western plant species indicate that using local seed and planting to soil type for revegetation are critical – far more so than anywhere else on earth. This will ensure the conservation of the full range of biodiversity, including all the local animals that track differences over short distances in the flora.

Naturally, there will be differences in what constitutes local seed depending upon the species of concern. Research is currently under way to help put some figures for local gene pools on a range of plant species of different biology and life-form. Already we know that forest and major woodland trees in the south-west having continuous large populations are more genetically uniform across their geographical range than understorey plants such as triggerplants, lilies or kangaroo paws, or mallee species distributed on isolated granite outcrops. Until such research is well advanced, however, the precautionary approach is to stay as local as possible in seed collecting within the soil type being revegetated.

Ref: Western Australia's Threatened Flora 1998. Ed: A. Brown, C. Thompson-Dans & N. Marchant. CALM

Dr Steve Hopper is Director of the Botanic Gardens and Parks Authority (formerly Kings Park and Botanic Gardens). He is a botanist and ecologist with special interest in specific plant groups, such as eucalypts and kangaroo paws, and in granite rock habitats. He can be contacted on 9480 3600.

BUSH DETECTIVE

Where do the prickles come from?

This thong has picked up a load of hard, sharp, prickly fruits. What plant do they come from? (Hint: It's not native to WA!)

Answer - page 19

FAUNA

MALLEE MOTHS

by Ian Common

MOTHS and butterflies constitute the large insect order Lepidoptera (insects with scaled wings) which, next to the beetles (Coleoptera), is the largest order in Australia. With about 400 species Australia has a poor butterfly fauna, whereas the moth fauna is richly diverse, with more than 10,000 named species and an estimated fauna of some 22,000 species. As in other insects adult moths have a tough external frame or exoskeleton enclosing the softer internal organs of the body, which are bathed in haemolymph (blood). They have six jointed legs and two pairs of wings. The body, wings and legs are covered with minute overlapping scales, which contain the pigments responsible for their patterns and colours. The head is equipped with two antennae and compound eyes, paired mouthparts bearing complex sensory organs and, usually, a coiled proboscis for sucking up water or other fluids.

The mallee moths of the family Oecophoridae number more than 3000 known species and represent about a quarter of the Australian moth fauna; a total of some 5000 species is estimated. Most are fairly small, with cryptic colours and markings, but many are among the most beautiful moths. Their larvae have very diverse, often complex behaviour patterns, but for food most depend on the live or dead foliage of the hard-fruit genera of Myrtaceae. Nearly all of the known species feed on dead *Eucalyptus* leaves, which are tough and leathery and very resistant to breakdown, especially in a dry climate. They are rich in phenolic compounds and tannins that normally act as feeding deterrents for most organisms. Thus mallee moths have a significant role in breaking down dead eucalypt leaves to humus, thus returning nitrogen and other nutrients to the poor soils characteristic of Australian forests. Except for clear-felling or large-scale wild fire, I believe that extensive control burning at short intervals poses the greatest threat to the survival of these insects and the long-term health of our native forests. The relationship between control burning and mallee moth diversity deserves scientific study.

It is thought that the Australian mallee moths evolved from Gondwanan stock and, after the Australian continent split off from Antarctica, their extensive radiation probably parallelled that of the large

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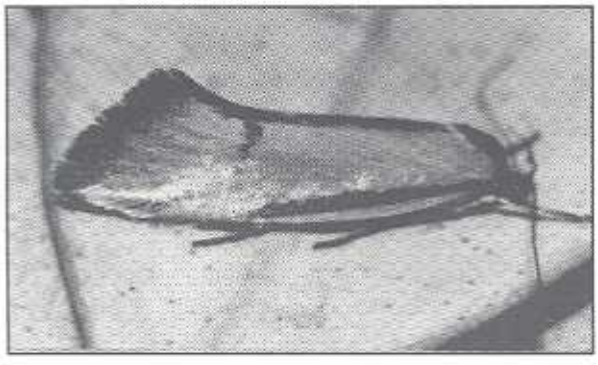

Fig. 1. Philobota *sp., wingspan 20 mm, forewings orange, outer one-third and leading edge dark brown, hindwings dark brown.*

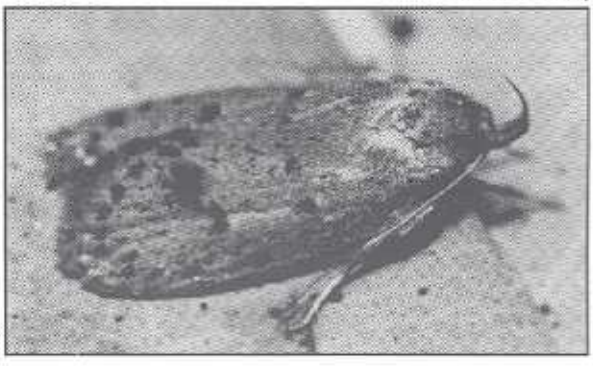

Fig. 2. Eulechria atmospila *(Turner), wingspan 18 mm, forewings light grey, spots blackish, hindwings light grey.*

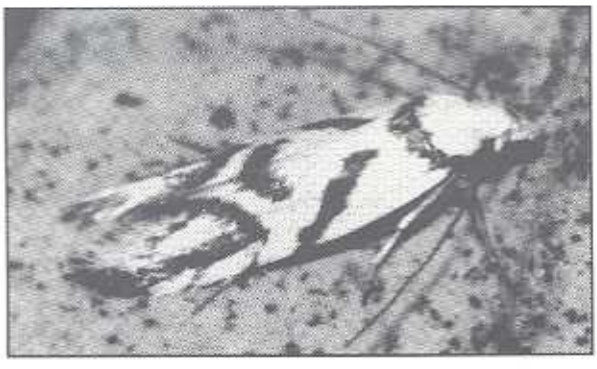

Fig. 3. Oxythecta acceptella *(Walker), wingspan 15 mm, forewings white, markings orange, hindwings grey, fringe yellowish.*

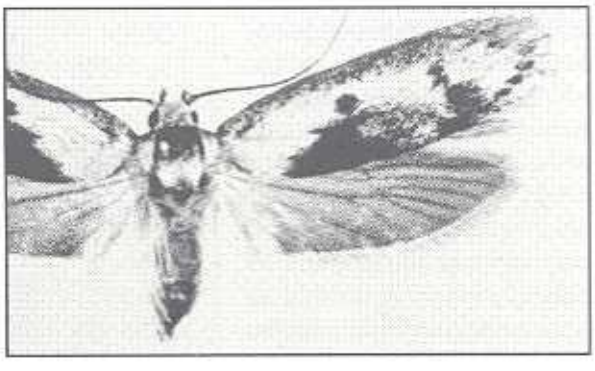

Fig. 4. Conobrosis acervata *(Meyrick), wingspan 18 mm, forewings whitish, leading edge grey, markings dark brown, hindwings grey-brown, fringe pale yellow.*

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genus *Eucalyptus* and other hard-fruited Myrtaceae. Nearly all of the 271 named genera are endemic to Australia, and several are endemic to the south-west. The greatest concentration of both genera and species occurs in New South Wales and south-east Queensland, where more than 1000 species are known in nearly 200 genera. Only 356 named species in 98 genera are known from southern Western Australia. However, the relatively low number of species recorded from the south-west may simply reflect the absence of resident collectors with an interest in small moths.

Myrascia larvae feed on live foliage of *Melaleuca*, *Leptospermum* and *Kunzea*. *Myrascia megalocentra* larvae, from the Geraldton area, live in portable cases on *Melaleuca uncinata*. The larvae are unique in having a diverticular sac of the foregut in which they secrete pure pungent oil from the foliage, gaining protection by regurging it on to any potential predator. The secreted oil is discarded when moulting occurs but, at pupation in the larval case, the whole sac is shed along with the lining of the foregut and other larval cuticle. The sac of oil thus provides a deterrent should a bird or other predator attempt to open the case.

Wingia has larvae using live eucalypt leaves as food, and includes some of the larger and most beautiful mallee moths. *W. lambertella*, which has a wingspan of about 4 cm, has rich pink fore wings and hind wings which are light yellow in Western Australia, but pink in south Queensland. The slightly smaller *W. aurata* has hook-tipped fore wings which vary in shade from yellow to orange-red.

It seems likely that the dead-leaf feeding behaviour of Australian mallee moths is more specialised than live-leaf feeding. This suggestion is based on the behaviour patterns of several unrelated genera of larvae that use live eucalypt foliage when young, but complete their development using dead eucalypt leaves. In *Heliocausta*, for example, the eggs are apparently laid in the eucalypt tree canopy and

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the young larvae feed on the live leaves. When about 1 cm in length they shelter between two undamaged leaves, join them lightly with silk and sever the two petioles. Having dropped to the ground the larva attaches the two leaves with silk to a stone or other object and feeds on the two wilting and finally dead leaves for the remainder of its development, leaving only an irregular oval shelter formed from the leaf remnants. This it attaches with silk to a tree or stone and pupates in a dense cocoon it spins within the shelter. At least ten species are known, two of which, *H. oecophorella* and *H. floridula* occur in the south-west.

Dead eucalypt leaves are used by most mallee moth larvae throughout their development. Most of the 200 named species in each of two genera *Philobota* (Fig. 1) and *Eulechria* (Fig. 2) are good examples. Each includes only about 20 named species in the south-west, but most of them, as well as several other genera, would have larvae using dead eucalypt leaves as food.

We have recently discovered that as many as 50 species in three genera of mallee moths, *Telanepsia*, *Oxythecta* (Fig. 3) and *Scatochresis*, have larvae which depend for the whole of their development on the faecal droppings (scats) of marsupials, including koalas, brushtail possums, wombats and rock and other wallabies. As the first of these were reared from koala scats, which consist of finely divided fragments of their eucalypt-leaf food, we suspected that the larvae were thus using eucalypt leaves indirectly. However, wombats and wallabies do not eat eucalypt leaves. Nearly all of our records come from eastern Australia, but one unnamed species of *Telanepsia*, two unnamed species of *Oxythecta* and one species, *Scatochresis perigrapta*, are from the south-west. Only one adult (?*Oxythecta* sp) has been reared so far from scats (rock wallaby) collected in Western Australia.

Dung-feeding (coprophagy) also occurs in the two large species of *Trisyntopa*. The larvae of *T. scatophaga*, from Cape York Peninsula, live in the nest hollows of the golden-shouldered parrot that are excavated in termite mounds. The larvae feed on the droppings produced by the nestlings and probably help to maintain a hygenic nest environment. Those of *T. euryspoda* have a similar role in the nests of the eastern rosella and mulga parrot farther south.

Although the larvae of most mallee moths depend on the foliage of Myrtaceae as food, there are some exceptions. Two species of *Conobrosis* utilise the dead male cones of *Macrozamia* cycads, apparently feeding on the pollen, sporangia and microsporophylls. Infested cones are covered by a dense webbing of silk, faecal pellets and sporangia. *C. acervata* (Fig. 4) is found on *M. riedlei* in south-west Western Australia.

Ian Common is an Honorary Research Fellow of CSIRO Entomology, having retired in 1982 after 34 years research, mainly on Microlepidoptera, especially mallee moths. He can be contacted on (07) 4638 4203.

Further Reading

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RESEARCH

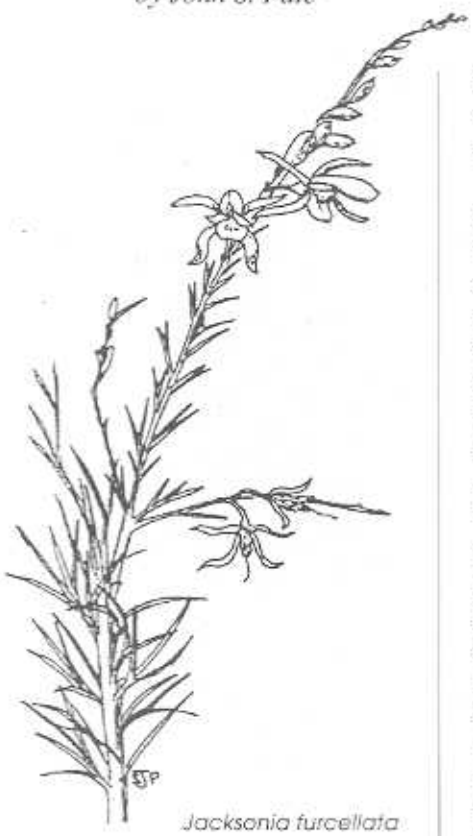
LEGUMES IN NATIVE BUSH AND AGRICULTURE: POTENTIAL ROLES IN FIXATION AND CYCLING OF NITROGEN?

by John S. Pate

WHENEVER one sees a prolific crop of lupins, peas, faba beans or chickpeas, or a pasture rich in clover or serradella, one immediately thinks of bacterial-induced root nodules and their capacity to supply legumes with fixed atmospheric nitrogen. Indeed, without inputs from such crop and pasture legumes, broadacre farming in most regions of Australia would be disastrously unprofitable, since it is uneconomical for most farmers to replace the free source of nitrogen from legumes with expensive nitrogen fertilisers.

Nevertheless, it must be remembered that our agricultural systems operate successfully only through continued application of superphosphate and, in certain circumstances, any of a number of other potentially limiting nutrients such as potassium, sulphur, copper, zinc, manganese, molybdenum and cobalt. By correcting such deficiencies, a situation is created in which legumes flourish and compete successfully with non-fixing species in low nitrogen soils. Additionally, where a cereal follows a previous legume crop or pasture, the yield of the cereal is noticeably benefited by nitrogen released in decomposition of residues of the legumes concerned.

But what about nitrogen fixation in the original bushlands from which our artificial agrosystems have been created? In virtually all cases legumes are present in significant amount in terms of numbers of species and the collective biomass which they represent. In fact in some cases, such as mulga and certain heathland systems, legumes such as wattles (*Acacia* spp) may comprise major components of vegetation. Yet, is there evidence



Jacksonia furcellata

that such legumes are nodulated and, if so, do they fix nitrogen as effectively as in our ameliorated agricultural systems?

As a further issue, are there other classes of plant in native vegetation which are able to engage in symbiotic nitrogen fixation in a manner akin to legumes? The remainder of this short article will attempt to answer these and other questions, mostly using information which the author and his colleagues have gathered from a range of ecosystems in south west WA over the past years.

Is it correct to assume that all legumes are capable of forming nodules and therefore fixing nitrogen? Legumes comprise three groups, the pea family (Fabaceae), the acacias and their allies (Mimosaceae) and the cassias and their allies (Caesalpiniaceae). Members of the first two groups can form nodules in the presence of appropriate bacteria, while members of the third group cannot.

Even then, inspection of roots of native members of Fabaceae and Mimosaceae (peas and wattles) will often fail to show presence of nodules, especially when dealing with relatively old plants. However, stands of seedlings of short-lived legumes (eg *Bossiaea, Acacia, Gompholobium, Sesbania*) recruiting after recent fires would be expected to be well nodulated and can be shown by various chemically-based assays to be currently fixing appreciable amounts of nitrogen. However, as these stands age, nodulation becomes much less prolific or even totally absent. Our interpretation of this phenomenon is that the element phosphorous, normally the principal limiting nutrient in our ecosystems, becomes transiently available after a fire in the form of deposited ash or released from plants killed in the fire. On the other hand, most nitrogen of above-ground biomass is lost to the atmosphere as gaseous ammonia and oxides of nitrogen during the fire, and so under the ensuing nitrogen-limited: phosphorous-sufficient conditions well-nodulated legumes will flourish and compete particularly effectively with non-legumes. The predominance of shrub legumes in many post fire understoreys in our forest and woodland ecosystems attest to this.

Eventually, however, once phosphorous availability declines, both legumes and non-legumes have to invest increasingly in specialised feeding roots and symbiotic associations with mycorrhizal fungi to access insoluble forms of phosphorous. Ability to fix nitrogen

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is then no longer an issue. Indeed, legumes might well be disadvantaged if devoting part of their resource of photosynthetic product to formation of nodules while also supporting energy-demanding mechanisms for acquiring phosphate. Nevertheless, despite their declining activity in fixing nitrogen in later years, it is generally agreed that understorey legumes of the above kind play an important role in replenishing nitrogen resources lost in fire. In some cases populations of such shrub legumes die off more or less synchronously, say 6-10 years after the fire event which prompted their establishment. In such cases transfer of nitrogen to non-leguminous sibling species over the following seasons may be very noticeable.

It is well known that cycads such as our zamia (*Macrozamia riedlei*) fix nitrogen through the agency of specialised coralloid roots harbouring nitrogen-fixing blue green algae (*Cyanophyta*), and sheoaks (*Casuarina, Allocasuarina*) behave similarly using root tubercles containing the actinomycete *Frankia*. Studies suggest these long-lived species carry perennial symbiotic organs providing the host plant more or less continuously with nitrogen. However, at least in zamia, nitrogen fixation becomes particularly active after fire, coinciding with the plant producing a flush of new leaves and engaging in fire-induced reproduction. In the case of the above non-legume species and equivalently long-lived legumes one would expect significant and continuous inputs of fixed N to be made, thus contributing towards maintenance of nitrogen capital within the parent ecosystem between successive fires.

One has to be careful before condemning a legume as non-functional in nitrogen-fixation simply on the basis of not finding nodules in its roots. Nodules on most shallow-rooted legumes are typically short lived and, as far as south west WA conditions are concerned, are typically present and active only for a short winter/spring period when soils are moist and temperatures are not excessively high. So excavations in summer would provide misleading information on nodulating capacity. As a general rule of thumb a legume found to be carrying during the growing season a population of nodules collectively amounting to 3-10% of the mass of the plant would be expected to be providing itself with sufficient fixed nitrogen to support growth. But the nodules concerned would have to be healthy and this is best indicated by presence of red or pink pigmentation in their central bacteria-containing tissues. This indicates presence of haemoglobin-type pigment essential to proper functioning of the nodule in nitrogen fixation.

Gastrolobium bilobum

Unfortunately we still know very little regarding the nodulation status and nitrogen fixing capacities of many of our native legumes, nor indeed of the strains of bacteria which they require to nodulate successfully. Research continues to bring up surprises. For instance, we have recently encountered clusters of large elongated and apparently perennial nodules at 1-4m depth encircling the deeply penetrating tap roots of certain native legumes (eg *Acacia saligna, Jacksonia* spp) and the fodder tree legume tagasaste (*Chamaecytisus proliferus*). Being located in deep, continuously moist parts of the soil profile these nodules are protected from the seasonal drought and high temperature stresses experienced by ephemeral counterparts in near surface layers of the soil.

A further example in which unexpected results have been obtained, concerns our recent studies of nitrogen cycling in mulga vegetation of Western and eastern Australia. Here we have failed to find nodules on any of the half dozen or so acacias which dominate this class of vegetation. Using a specialised stable isotope technique to assay the sources of nitrogen which these legumes and cohabiting non-legumes are using, we have confirmed that symbiotic inputs of nitrogen by the acacias are insignificant and that they and other non-fixing species appear to be relying mostly on the large resources of nitrate typically encountered in soil and groundwaters of the ecosystem. It is well known that nodulation and nitrogen fixation of agricultural legumes are strongly inhibited by nitrate and possibly this is what is happening in acacias at our mulga sites. Supporting this contention we have encountered interesting legume populations inhabiting ridges of leached wind-blown sand around a lake in one of the mulga habitats. In this unusual situation the legumes turned out to be well nodulated and were shown by our isotope assay technique to be heavily dependant on fixed nitrogen. Incidentally, despite the general absence of nitrogen fixation by legumes in the major plant components of mulga, fixation inputs were indicated as being made by certain lichen crusts, and possibly more importantly by termite colonies. Worker termites have been shown to have colonies of cellulose-decomposing and nitrogen-fixing bacteria in their guts, with the former micro-organisms providing the latter with energy-yielding sugars to implement nitrogen fixation. Furthermore, one can detect high concentrations of nitrate in the soil below certain termite colonies suggesting that they may have been

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MAKING CONNECTIONS

MOST of us tend to be focused on our own patch of bush and as a consequence manage it as an isolated entity. It may be worthwhile taking a step back and considering the important role 'our patch' plays, or could play, in the broader vegetation landscape.

By connecting bush remnants, we establish a living network, which is more diverse than the individual elements. We then become part of a more robust system, that has the capacity to buffer and protect our patch from permanent loss of biodiversity caused by a localised disturbance or catastrophe. With time and good management wildlife activity in our patch should increase as a result of being part of a larger system.

A project currently underway in Bridgetown is looking to identify opportunities where these broad landscape connections can be made.

The BiG.liNCS Project

In March 1999 the Blackwood Environment Society received funding from the Natural Heritage Trust to undertake the "Bridgetown-Greenbushes Nature Conservation Strategic Plan", now known by its acronym as the **BiG.liNCS** project. The project is using a blend of geographic information systems, on-ground vegetation surveys, ecological expertise and local land manager groups to identify and target priority areas for future conservation management and on-ground works within the Shire of Bridgetown-Greenbushes. Ultimately the implementation of the strategic plan should lead to an effective integrated nature conservation network across the Shire.

Bridgetown's Vegetation Mosaic

The landscape mosaic in the Shire is composed of a series of distinct and typically unconnected elements. The largest of these are the big areas of State Forest to the south, west and north, which extend well out beyond the Shire boundary. These blocks comprise about 75% of the native vegetation cover in the Shire. Nestled inside these large forest areas are 12

LINKING BUSH REMNANTS

By Jenny Dewing & David Singe

unconnected smaller forest blocks, some of which are State Forest and others various categories of reserve, which make up another 18%.

Privately owned bush remnants are then scattered between these other vegetation elements, and account for less than 7% of the vegetation cover in the Shire. Of these 1500 private remnants most are only several hectares, with only around 150 being 20 hectares or greater, and a third of these modified to some extent (heavily grazed, regularly burnt or partially cleared).

The other significant element in the mosaic is the Blackwood River, which splits the Shire roughly in two. The river can be both a connecting element between vegetation remnants for some species and a barrier for others.

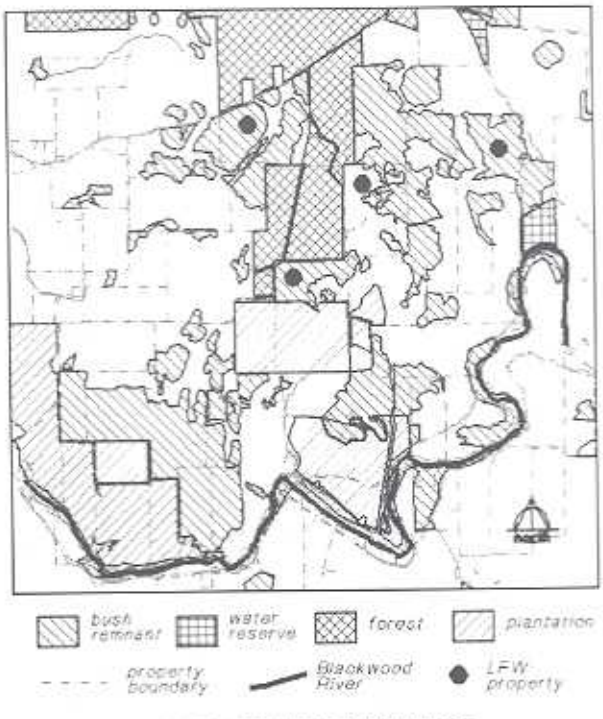
Under the guidance of consultant ecologists, the project team has been able to study the Shire's vegetation mosaic. The most logical routes for connecting all of the forest and reserve blocks and the private remnants greater than 40 hectares have been identified. To avoid dead ends in this proposed network, at least two connections were made to each element. The route of each connection typically optimises the use of smaller remnants along its path to act as stepping-stones. It also takes into account location in the landscape (ridge, creekline), the vegetation types which it moves through, and a social consideration where known (does the affected landmanager have an enlightened attitude to nature conservation).

While the process has focused on the connections between the larger public and private bush remnants at a whole of Shire scale, it can be used at a much smaller scale, right down to individual properties if the base data is accurate enough.

The BiG.liNCS project has also confirmed the importance of several potential connections, which had previously been recognised during *Land for Wildlife* property visits. BiG.liNCS team member and local *Land for Wildlife* Officer Jenny Dewing has been working with landholders along one of these connections for 6 months.

Wheatley to Wheatley Linkage

During a *Land for Wildlife* property visit in December 1998, Jenny Dewing and members of the Wheatley family identified a potential landscape connection through the property. Commencing on the Blackwood River, the connection passes through their remnant bush up to one of the Hester Forest blocks and back down across a number of large private remnants to the Blackwood River, about 10 kilometres downstream. It has become known as the 'Wheatley-to-Wheatley' linkage after the two distantly related families that live at either end of the link. The Blackwood Basin Group's



WHEATLEY TO WHEATLEY LINKAGE

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Biodiversity Program has also recently ranked this chain of remnants as a high priority complex.

Landholders in the linkage reflect the changing demographic and landuse profile of the Shire, where larger farms are being broken up into lifestyle bush blocks, hobby farms or tree farms. The seventeen properties include three large farms, four small farms, two timber plantations, a tourist enterprise, a berry farm, three bush blocks, a property owned by the Shire, a DOLA Reserve and part of the Hester Conservation Zone. Seven of the property owners are absentee owners.

Ten of the "greater than twenty-hectare" remnants in the Shire occur in the Wheatley-to-Wheatley linkage. Vegetation types include jarrah–marri forest, jarrah-wandoo woodlands, banksia–tea tree thicket wetlands, rock outcrops, the flooded gum woodland of the Blackwood River foreshore and "bull and ti tree" gullies. The linkage includes some large wandoo remnants, a less common vegetation type within the Shire.

Landholders have reported sightings of the common western grey kangaroo and small mammals such as chuditch, phascogales, brush-tailed wallabies and possums, bandicoots and water rats. Indeed, Eric and Gillian Wheatley at the downstream end of the linkage have an ongoing encounter with a young male chuditch. Responsible for taking their poultry, the chuditch was trapped on a number of occasions, dutifully taken back to the bush only to have it return for more of the same several days later. The chook pen is now chuditch-proofed. The area also provides nesting sites for red–tailed black cockatoos, wedge–tailed eagles and a number of owl species.

Landholder Groups

In October 1999 landholders with properties in the Wheatley-to-Wheatley linkage were invited to a meeting to learn about the BiG.liNCS project, and to consider opportunities for managing their remnant bush together, with nature conservation as a common goal. An important outcome of the meeting was this new way of seeing the landscape as an integrated system, rather than isolated patches of bush. There was general agreement on the value of working together,

Learning about the forest floor with John Dell.

particularly for weed and feral animal control and when applying for fencing and revegetation grants.

Resources available to the group include fencing subsidies from the Blackwood Biodiversity Program, advice on providing habitats for wildlife for landholders who register with the *Land for Wildlife* scheme, and vegetation surveys and management advice through the BiGliNCS project. From this initial meeting two more landholders within the group joined *Land for Wildlife*, and two other landholders decided to covenant the bush on their property. Covenants are voluntary agreements to provide long-term protection for conservation values on private land.

From October to December 1999 Jenny Dewing (as Shire Landcare Co-ordinator) and Landcare Trainee Anthea Paino carried out vegetation community and condition assessments on most properties within the linkage. Specific management issues were discussed with each landholder on a property- by- property basis.

With landholders keen to learn more about the bush in their linkage, John Dell, Senior Technical Officer for the WA Museum was invited down in March this year. Twenty-five people spent the whole day in the field with John, walking and talking as representative sites on four properties and in the Hester Conservation Zone were explored. Landholders learnt first hand about habitats and how to manage them for wildlife, with particular emphasis upon reducing disturbance and encouraging natural regeneration.

The key lessons from John's visit were the importance of the invertebrate communities that live on the forest floor and the unique management issues for fragmented landscapes. As with all situations where remnant bush and farmland adjoin, the balance between fire prevention and wildlife habitat maintenance was raised as a major concern. The day was capped off by evening spotlighting in the Hester Conservation Zone which revealed a pair of brush-tailed possums, a barn owl, and many spiders. Following this a fourth property registered for *Land for Wildlife* and two others are considering covenants.

Landholders followed up the March activity with a group fox baiting effort in April. Twelve dozen 1080 baited eggs were laid across the linkage during the same week.

Future Directions

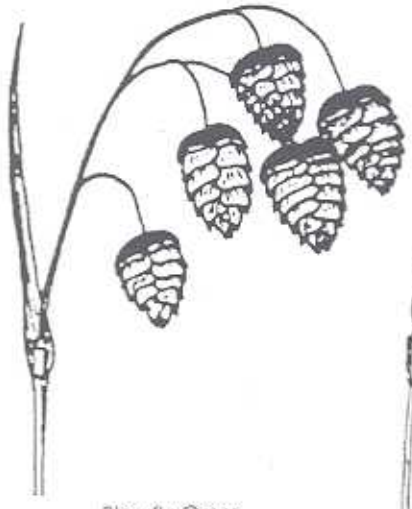
At the big end of the scale the process developing through the BiG.liNCS project may be extended beyond its current Shire limits, or could be taken elsewhere and adapted to a quite different vegetation landscape. At the other end of the scale the process has only just begun. Landholders are thinking "whole of landscape" and "long term". **What we do now will have impacts in two to three hundred years and longer**. Learning to work together in a landscape sense takes time and involves negotiation and compromise. There is an opportunity to develop working partnerships with the Bridgetown–Greenbushes Shire and CALM. A workshop on fire management is planned. Several small gaps in the linkage need revegetating, and some remnants still need to be fenced. Importantly a start has been made and this same process will extend to other connections identified by the BiG.liNCS project.

Jenny Dewing is the Land for Wildlife Officer in Bridgetown, and David Singe the Project Manager for the BiG.liNCS Project. They both have properties on the Blackwood River, where they are connecting their remnant vegetation back to the river. Both work out of the Old Railway Station in Bridgetown. David's Boyup Brook property is registered with Land For Wildlife. Jenny can be contacted on 9761 2318, and David on 9761 2450.

PRACTICALITIES

MANAGING WILD OATS AMONG NATIVE GRASSES IN A YORK GUM/JAM WOODLAND

by Kate Brown



Blowfly Grass

Wild Oats

THE Quairading Nature Reserve, 600 hectares of bushland just west of Quairading, contains a diverse range of soils, landforms and associated plant communities. Salmon gum and wandoo woodlands occur on the heavier soils, *Banksia prionotes* woodlands on the yellow sandy rises and heathlands on grey sand plains. York gum/jam woodlands grade into rock oak woodlands around the granites and tamma shrublands cover a range of soils including sandy loams and gravelly sands. Much of the bushland is relatively undisturbed, however a past history of grazing in the York gum/jam woodlands has left a legacy of weed invasion. These woodlands have historically been favoured sites for grazing, and wild oats (*Avena barbata*) and blowfly grass (*Briza maxima*) are now common components of the understorey, smothering and out-competing many of the flowering native herbs and native perennial grasses.

Previous studies both in Western Australia and in native grasslands in eastern Australia have indicated that very low rates of grass selective herbicides sprayed early in the winter season can effectively control annual exotic grasses without seriously impacting on other plants including perennial native grasses. Preliminary results of our work among the native grasses in the York gum/jam woodland at Quairading are supporting these earlier studies

In early August 1999 when the wild oats were around 10cm high, plots of 20m x 20m were sprayed with low rates of grass selective herbicide (for exact prescription, contact author). Within the sprayed plots the wild oats were very much reduced both in abundance and size. The blowfly grass was also much reduced. There was no loss of native grasses within these sprayed plots, however there did appear to be a reduction in flowering particularly in foxtail mulga grass (*Neurachne alopecuroidea).* It will be interesting to see what the next season brings in the way of recruitment of native species. Over the summer months seed from native everlastings including *Rhodanthe manglesii, R. citrina,* and *Waitzia acuminata,* also from perennial grasses such as foxtail mulga grass, *Austrostipa trichophylla* and *A. elegantissima* were collected. Hopefully sowing these into sprayed areas this autumn will encourage natives rather exotic invaders to move into the gaps. Wild oats' seed is short lived (around six months) in the soil and so it was not surprising that few germinants were observed in the sprayed plots following summer rains in January/ February 2000.

The management of wild oats is just one example of the sort of management actions that are required to effectively look after the conservation values of woodlands. In August 2000 the Environmental Weeds Action Network and the Wildflower Society will be holding an on-site workshop at Quairading highlighting looking after the bushland and maintaining the conservation values. Any effective management of bushland requires an understanding and knowledge of plants (both native and introduced) and their patterns of distribution in a particular bushland patch. The workshop will look at how the information gathered from the September 1998 bushland plant survey, carried out by the Wildflower Society with help from members of the Quairading community, can be used to help manage the conservation values of this diverse patch of remnant vegetation. It will include site inspections and a visit to the wild oats trials.

Ref: Hitchmough J.D., Kilgour R.A., Morgan J.W. and Shears I.G. (1994). Efficacy of some grass specific herbicides in controlling exotic grass seedlings in native grassy vegetation. Plant Protection Quarterly, 9: pp 28-34.

Kate Brown is Project Officer for the Environmental Weeds Action Network. She can be contacted at the Swan Catchment Centre on 9220 5300.

DO YOU LIKE TO WATCH BIRDS?

If you like to watch birds, if you can identify the local birds, and if you live in or visit the wheatbelt, then you can enjoy watching birds for a new project. The Wheatbelt Birds Monitoring Project links the New Atlas of Australian Birds and the Biological Resources Survey work being done for the Salinity Action Plan by CALM.

News of a Community Conservation Grant for this project came to hand just before this newsletter went to press, so we can't print more details here.

If you're interested, contact Cheryl Gole, Birds Australia WA, Tel/Fax 9293 4958.

TRIAZINE RESISTANT WILD RADISH

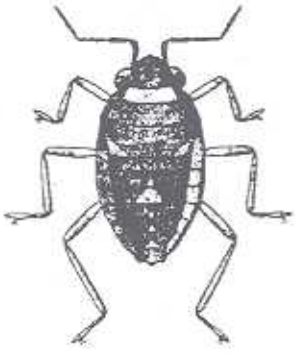
Wild radish in WA has evolved resistance to triazine herbicides such as simazine and atrazine. A patch was first discovered in 1998 in a paddock at Mingenew. When seed was collected and tested in the laboratory, 10-30% of seedlings survived up to 18.0L atrazine (normal paddock dosage is 6.0L – 2.0L pre- and 4.0L post-emergence spray). Evolution of resistance to triazines by wild radish poses a great risk to the oilseed, lupin and pulse industries in WA and has the potential to become very widespread.

Abul Hasheem, the scientist working on this problem, urges all farmers to be aware of the risk triazine resistant wild radish could pose, and to adopt integrated weed management including non-chemical methods to control it. His trials have shown that autumn tickling, crop topping and blanket wiping are effective in depleting the soil seed bank and preventing seed-setting in wild radish.

In bushland, hand pulling or wiping with a knockdown herbicide are the best options.

For more information, contact Dr. Abul Hasheem, AgWEST, 9368 3333.

IN BRIEF



MEET THE MILLENNIUM BUG!

It had to happen, a bug has been discovered which will be named the 'Millennium Bug'! It is a small (2 mm long) water strider, living in mountain streams in Qld and northeast NSW. The bug will be used as a biological indicator to monitor the health of the streams.

For further information, contact: Ebbe Nielson, CSIRO, on (02) 6246 4258.

HITCH-HIKING TIGER SNAKE!

New Zealand is snake-free, and their quarantine authorities keep a close watch on cargoes arriving in the country to try and ensure that it remains so. Recently a tiger snake (*Notechis ater*) was spotted by a crane operator unloading containers from Fremantle. He solved any possible problems by dropping a container on it! But it makes one wonder how such an animal could get on board a ship - presumably in an open-sided machinery-carrying container, or hidden deep within one of the hollow struts that are used when the container is being moved by a fork-lift.

The most interesting question though - is the Fremantle container wharf a haven for tiger snakes??

From Dick Veitch, Papakura, New Zealand.

CARNABY'S COCKATOO DECLINING - AND TOO GOOD TO LOSE!

Carnaby's Cockatoo is a white-tailed black cockatoo living nowhere else but the south-west of WA. This big, visible and wonderfully rowdy cockatoo is specially protected as threatened fauna. Most people know the Carnaby's wailing 'wee-ooo' call. But if we don't do something to save it, people in the future may never hear that wonderful sound.

This great cockatoo needs your help. The first part of the recovery plan for the Carnaby's will identify some of its important breeding areas in the wheatbelt so that they can be protected for the future. Birds Australia WA, CALM and other community organisations and individuals are working together. You too can work with us.

Carnaby's Cockatoo breeds in the wheatbelt between July and December. If you see Carnaby's in this area at this time of the year, we'd like to hear from you. What can you do? Tell us you're interested. We'll add you to our mailing list and send you reply-paid postcards on which to record information on where the birds are, how many there are, and what they are doing.

Carnaby's needs you!

Contact: Cheryl Gole, BA WA, 71 Oceanic Dr, FLOREAT 6014. Tel/fax: 9293 4958. Email: gole@starwon.com.au

MEMBERS PAGE

WHAT KIND OF FROG?

We live on a small bush block, close to Lake Powell on the west side of Albany. The property itself is divided by a drainage channel conveying storm water to the lake. Being close to water, we share the environment with a host of frogs; the quacking frog, moaning frog, banjo frog, slender tree frog, spotted thigh frog, motorbike frog and various froglets that we still have to identify. We have noticed that with this year, being so wet, there are many more adult frogs than there have been over the past four to five years. Our snake numbers also seem to be fewer. The king skinks still seem to be out in force and we have noticed that they hunt frogs, grabbing them by their hind legs and flaying them backwards and forwards as does a crocodile with its prey, then devouring them when they are pacified.

One particular frog has roused our curiosity because of its dramatic defence behaviour, and not being experts we have yet to identify it. Its first reaction to disturbance is a very loud screeching. This is piercing and sustained. If escape seems impossible, its next ploy is to appear aggressive. When approached (by a hand) it raises itself on its toes so that it appears somewhat larger and it jumps straight at its aggressor with its mouth open. It has a large gape, even for a frog, and will actually grab a finger tip (quite painless!!!) Finally, if these two behaviours do not work to its advantage, it enacts the most amazing ploy of all - it feigns dying!! It stretches out its fore and hind limbs stiffly and at the same time pushes itself on to its back. In this position it quivers and jerks spasmodically, gradually becoming rigid and changing colour! The drab grey and white colouration combined with the extended body (which appears dry and shrunken) has the appearance of something dead - long dead - it fooled us! Heart failure maybe? We were sure it had expired. However, after a fairly protracted time the changes reversed and it eventually hopped away. Obviously this last behaviour cost a lot of effort because the frog seemed a bit slower and maybe even exhausted.

Cliff and Margaret White with one of the frogs more commonly found on their property - a motorbike frog (Litoria moorei)

Margaret and I have witnessed this drama on only two occasions, which coincide with the number of times that we have seen this particular type of frog. We hope to see it again, although we may have to wait a while. We will have a camera ready next time.

Cliff and Margaret White, Albany

Dale Roberts, Dept of Zoology, UWA, says: "The behaviour sounds like *Neobatrachus pelobatoides* which screams when agitated, blows itself up and stands on all fours. I haven't seen the next bit where it feigns death but that does not surprise me. Colours could be this species but the grey is more suggestive of *N. albipes*. They may both behave the same way, and both are likely to occur in your area. A good clear photograph would be useful. Incidentally, a lot of frogs scream when threatened. *Helioporus* species as well as *Litoria moorei* and *L. cyclorhynchus* often do so."

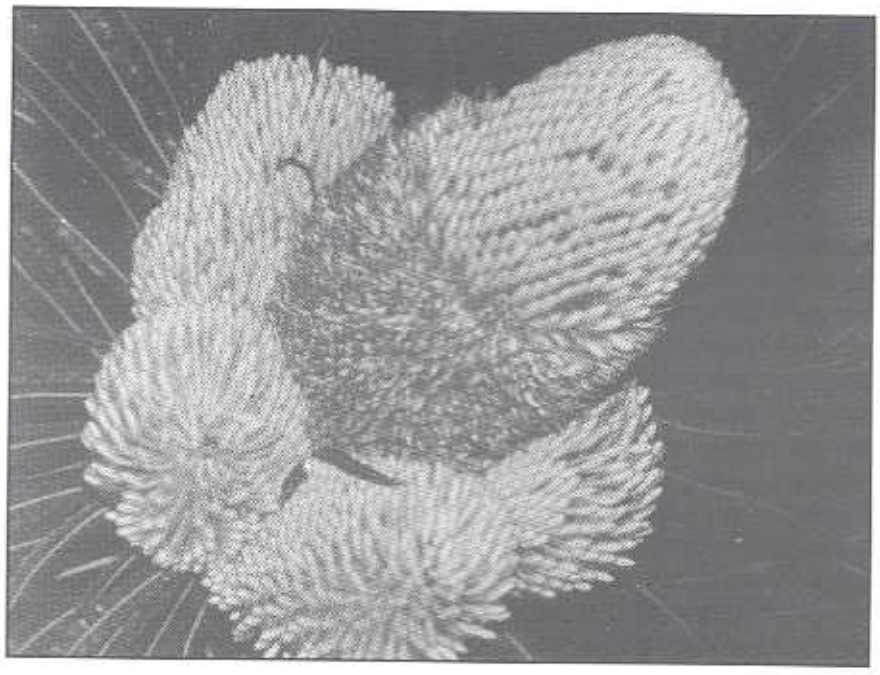
IN BRIEF

WATER UNDER THE DESERT?

Recently there was a story in the media about a 'massive', 'new' find of groundwater from the Officer Basin under the Great Victoria Desert. It was going to supply Perth for 4000 years! Philip Commander, a hydrogeologist with the Water and Rivers Commission, cautions everyone to be very careful about media hype ... The find is not new, the quality is variable and, due to very low rates of recharge, the proposals for use will need extremely careful evaluation if they are to be sustainable.

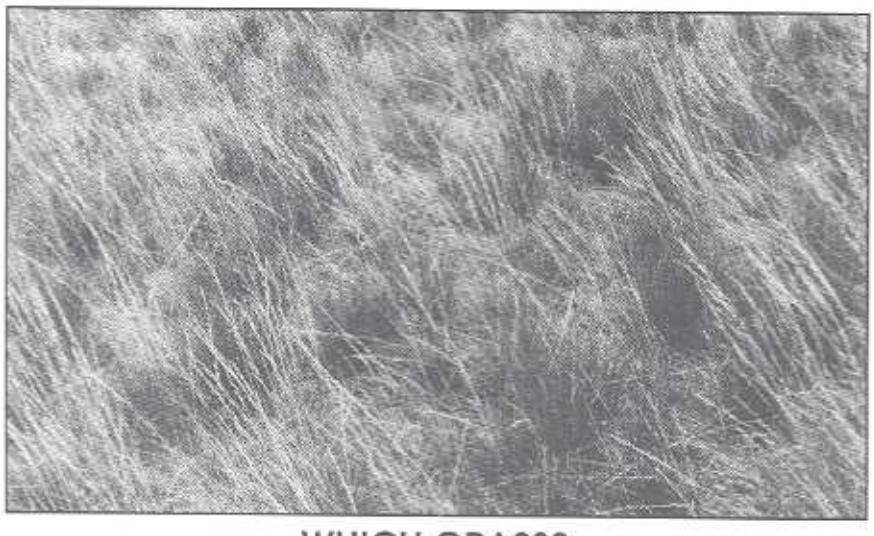
For copies of Dr Commander's two papers relating to this, ring 9334 0530.

MEMBERS PAGE



THIS photo was taken in March, and sent to us by Wally Jones of Mandurah. It shows a *Banksia prionotes* with lots of small flowerheads around the main one. Wally asks if we can explain why this happens.

It's probably caused by insects damaging the growing bud. If the damage is too great, the stem dies and new shoots grow out, but sometimes the effect is merely to segment the flower-producing cells, so that you get multiple heads, like this. The most likely culprit is a shiny green weevil about 1.5cm long which particularly likes eating *B. prionotes*.



WHICH GRASS?

Following the recent interest in native grasses, I observed this native grass in our sandplain paddocks, sometimes sparsely, but after 6.5 inches of rain in January it grew well and supported 14 bulls in one paddock for several months. The photo was taken around the farm yard, where it has grown for 30 years with no super and very light grazing. Can you tell me which grass it is?

Bev Hall, Quairading

Terry McFarlane, CALMScience, Manjimup, says: "It is an *Austrostipa* (spear grass), but you will need to collect the flowering heads next October before it can be identified to species."

MORE CROW TALK – A SHORT STORY

A pair of ravens built a nest in a tall marri tree, just below the canopy. The nest, although distant, is in full view from my kitchen window where I frequently sit for my cup of tea, particularly before breakfast.

I have watched these two bring out young ravens over several years, mostly only one at a time. There is no proof that it was the same birds every year, but I thought so. Last spring I noticed that the tree was looking poorly but the ravens were able to rear their usual nestling. Summer has passed and the tree has died.

The other morning as I sat by the window sipping tea, the ravens arrived one by one. What occurred then was almost beyond belief. They discovered the old nest tree was dead and bare and started to shout and fly into the air, flapping wildly. In and out and up they went, in and around where the nest was, all the time calling continuously in what seemed like grief and fury. Incredibly, this went on for a considerable time, then they flew away one by one. They could not have gone far, because in no time they were back and repeated the performance again and again, until finally they left and have not returned.

I am not one for imputing feelings to birds, but in this case??? I am now watching for which tree they will choose for a new nest this year – if they can find one.

Joanna Seabrook,
Helena Valley.

RUSHES AND SEDGES WORKSHOPS

During March, four very sucessful workshops were held at Ongerup, Mount Barker, Tambellup and Denmark, with the theme of rushes and sedges in rehabilitation work. The presenter was Linda Taman, a consultant with huge experience in growing and using plants from these families and great skill in presenting the topic. All told, 93 people attended the four workshops and were unanimous in their praise for the day, and in calling for more similar events.

The overall programme was organised by Dorothy Redreau of Greenskills, in collaboration with *Land for Wildlife*, Greening Australia and Water and Rivers Commission. Each of the four organisations took responsibility for being host at one of the venues, as well as contributing to the cost, which was also supported by grants from the Gordon Reid Foundation for Conservation and NHT. This wide collaboration worked very well, and led to more being achieved than each group could have managed on its own. This model could well be followed with other topics in future.

Sylvia Leighton

LFW NEWS

Congratulations

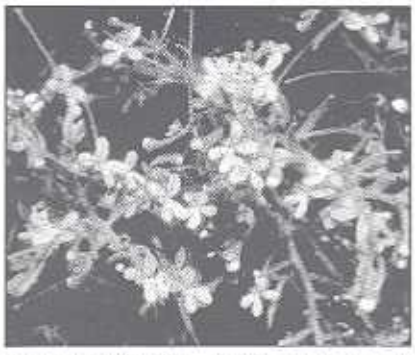
To Avril Baxter (*LFW* Narrogin) for winning "Runner up" in the Indoor Display at Wagin Woolorama. Visitors were enthralled by the fauna!

Photo: D. Lamont

LFW STAFF WORKSHOP - THREE YEARS' ON

On 18th 19th May, LFW staff gathered at CALM, Kensington, for a workshop to consider the operation of *Land for Wildlife*, and what future directions we might take. Shown here are, L-R back row: Penny Hussey, Sylvia Leighton, Bob Huston, Avril Baxter, Fiona Falconer, Claire Hall; front row: Jenny Dewing, Heather Adamson, Cherie Kemp. (Anne Rick had to leave early, her littlies had developed a virus.)

TRIGGERPLANT TREASURES



Stylidium merrallii. *Photo: K. Kenneally*

Once presumed extinct for more than 100 years, *Stylidium merrallii* (Merrall's Triggerplant) was rediscovered in 1976 in the Wongan Hills area but wasn't officially identified until 1992. Early this March a healthy new population was discovered near a granite outcrop on a *LFWer*'s property in the Doodlakine area.

Triggerplants have a sensitive trigger action that is used as a unique method of pollination. Insects sipping nectar from the throats of young flowers disturb a 'trigger' which releases a strap-like column that carries anthers loaded with pollen. Previously hidden beneath the petals, its sudden release causes a swinging blow which showers pollen over the insect's back. It takes about 20 mins for the trigger to reset for the next visitor. Anthers on older flowers develop a hairy cushion or brush between them, this brushes up pollen from any insects that had previously visited younger flowers, thus completing the pollination cycle.

The shape of triggerplant flowers throughout the wheatbelt usually resemble a small butterfly and are of various colours, the most common being bright pink with white throats. Each also has a secretive minute petal called a labellum, which is an added fascination and aid to identification.

To date there are 16 different triggerplants in the Shire of Merredin and it is a great pleasure to add *Stylidium merrallii* (Declared Rare Flora - status: Vulnerable), to that list.

Heather Adamson

FUNGI

The Ghoul Fungus

Fungi are as varied in their requirements as other organisms. One group, called the 'ammonia fungi' require nitrogen in the form of ammonia in order to grow and fruit. An example from the south-west forests and woodlands is *Hebeloma aminophilum*, the Ghoul Fungus.

This is a fairly large toadstool (cap about 14 cm across), all-over beige-brown with rusty spores. It is always found growing alongside the carcasses of kangaroos, sheep, snakes or other sizable animals. It fruits in winter and early spring. Since dead bodies can occur anywhere, it makes one wonder how many million fungal-spores are floating in the atmosphere, just waiting for the appropriate circumstances to occur so that they can develop and grow.

There are no known edible species of hebelomas, they are all more or less poisonous, though proably not deadly.

Illustration by K. Griffiths from "A Field Guide to the Larger Fungi of the Darling Scarp and the South West of Western Australia".

FLORA

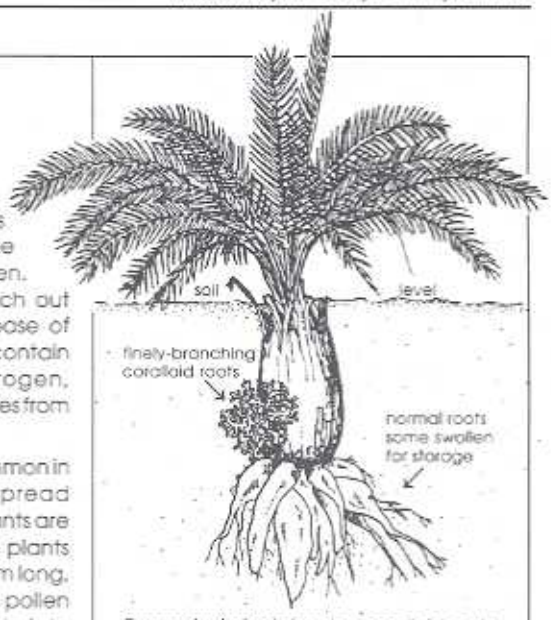
Zamia

Zamias grow well in WA's impoverished soil, as they have the ability to fix atmospheric nitrogen. Masses of "coralloid roots" branch out from the swollen underground base of the stem. These specialised roots contain cyanobacteria which fix nitrogen, themselves receiving carbohydrates from their host.

Zamia (*Macrozamia reidlei*) is common in the Jarrah forest, and widespread throughout the southwest. The plants are either male or female. The male plants develop several cones, up to 30 cm long, which are made up of scales with pollen sacs underneath. Pollen is shed in late spring. Female plants seldom develop more than two cones, and they are very large, weighing up to 14 kg. Each scale in the female cone develops two seeds, originally bright red in colour, which are released when the cone rots away. Emus, and possibly other animals, help to disperse the seed.

These huge cones are an enormous drain on a plant's stored food reserves. A male plant uses 10% of its stored energy in order to produce a cone. It takes 25% of a female plant's store to produce even one cone. If, due to burning off, Zamias are forced to use stored reserves to produce whole sets of new leaves every few years, there will be little energy left for reproduction, so cone production may be reduced. By the time the store has been built up, the fire comes again. This may account for the apparent preponderance of male plants in forest areas.

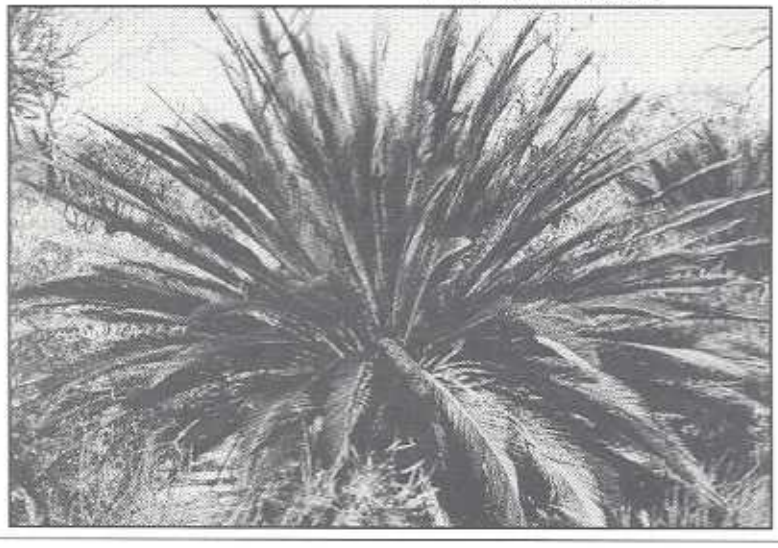
Zamia leaves contain a substance toxic to stock. Grazing of regrowth leaves after fire or partial clearing of the country (ie probably the only time when these leaves are palatable to stock) causes "wobbles" in cattle. Zamia seeds contain a lot of starch, and the Aboriginal people leached out the poison before eating them. When Captain Fremantle explored the Swan River his party roasted and ate the seeds, and were extremely ill afterwards! Incidentally, Charles Fraser, the Colonial Botanist of NSW, explored the Swan with a party from Captain Stirling's H.M.S. *Success* in 1827. Near Claise Brook he reported Zamias 30 feet high! Zamias are slow growing, so these must have been extremely old. Few such large specimens still exist, although there are still some in Stockyard Gully National Park.



Excavated plant showing coralloid roots

Zamia "palm" is not a good name, as the Zamia is a cycad, a much more ancient group of plants than palms.

▲ *Ripe seeds on female cone*



▼ *Plant with male cone*

IN BRIEF

Frog WAtching

By Sue McLaughlin

Listening for banjos, motor bikes and humming - signs of some of the frogs found on site.....Alcoa's Simon Sandover at one of Pinjarra Refinery's permanent water holes.

MOTOR BIKES, banjos, humming and quacking .....what do these noises all have in common? Believe it or not they are all made by local frogs! The Alcoa FrogWAtch program involves collecting information on just such frogs.

Managed by Dr Ken Aplin, from the WA Museum, the Alcoa FrogWAtch program monitors what frogs are where. FrogWAtch members go out and listen to the frog calls to identify the types and numbers of frogs and also send dead frogs found back to the museum where they are checked for a fungal disease called Chytrid Frog Fungus which is killing frogs on a world wide basis.

If going out and listening to frogs in generally cold and wet conditions is not your cup of tea, frog watching team leader Simon Sandover, from Alcoa's Pinjarra Refinery, may have the answer.

Simon is a Senior Environmental Scientist. He has worked with Pinjarra Refinery's Environment and Industrial Hygiene Assistant, John Caldwell, and Lynton Storer of Herring Storer Acoustics, to come up with a system that allows a tape recorder and a computer to do all the hard work. An acoustics graph is produced from the recording, which identifies each frog call.

Since the system has been successfully trialed and tested on the squelching frog, another six species are currently being added, with the final aim to have the sounds of 16 different frog species included.

It is important to remember that this innovation will not replace people listening. We still need as many people as possible out there, listening and counting frogs as well as collecting dead ones for the museum.

Why is this program so important? Simon explains, "Lots of frogs equals a healthy environment. They are extremely sensitive to an environment that is out of balance. When this occurs the frogs will quickly die off".

Alcoa has developed a series of wetlands as part of Pinjarra Refinery's land management plan. These wetlands have involved the use of old 'borrow pits' that surround the Refinery's residue area and are now successful ecosystems and home to many frog species.

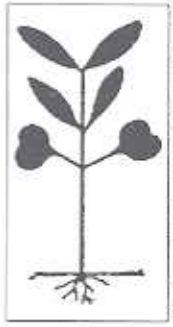
If you are interested in getting involved with the Alcoa FrogWAtch program, contact Dr Ken Aplin at the WA Museum on 94272826.

RECRUITMENT OF RED TINGLE AFTER FIRE

SUSTAINABLE management in tall timber country is just as problematical as in other ecosystems - there are so many unknowns. Red tingle (*Eucalyptus jacksonii*) forests are limited in extent, and so of particular concern. Recently, a team of CALMScience researchers, led by Lachlan McCaw, published data on the survival of red tingle and karri (*E. diversicolor*) seedlings after low-moderate intensity fuel reduction burns at two sites near Walpole. They noted that most seedlings emerged on burnt ground created where litter had been fully consumed, but some also emerged on the charred surface of fallen logs. Although initially seedlings were quite plentiful, they declined rapidly.

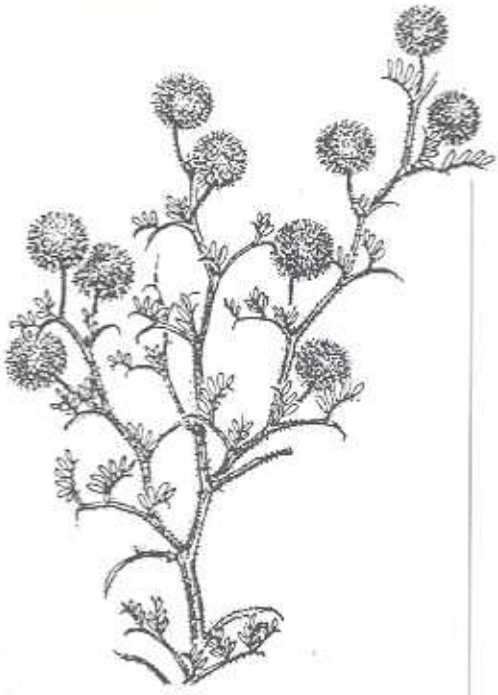
The authors concluded: "Few of the surviving seedlings exhibited dynamic growth or appeared likely to develop into saplings. Small gaps created by natural tree fall were no better stocked than areas beneath an intact forest canopy. The presence of red tingle and karri seedlings following low to moderate intensity fires used for fuel reduction may not therefore lead to even-aged sapling cohorts of these species. The scale and intensity of disturbance required for effective recruitment in red tingle-karri forest is a subject worthy of further investigation."

For the full story, read: McCaw, W.L., Smith, R.H. & Neal, J.E. 2000. Post-fire recruitment of red tingle and karri following low-moderate intensity prescribed fires near Walpole, south-west Western Australia. CALMScience **3**: 87-94.



A seven-month old red tingle seedling.

LEGUMES continued from page 9



Acacia drewiana

in the past and continue to be responsible for generating the large pools of nitrate now evident in the system.

So we still have much to learn about nitrogen fixation and nitrogen cycling in native and agricultural ecosystems. In view of the important role of nitrogen in plant growth and the dangers which can follow when the element pollutes the environment, research conducted in the future on this topic is clearly necessary and rewarding.

John Pate is Emeritus Professor at the University of Western Australia where he continues research on environmentally-related issues in the Botany Dept. and Centre for Legumes in Mediterranean Agriculture. He can be contacted on (08) 9380 1974 or 9380 2206.

Further Reading

Unkovich MJ, Pate JS, & Sanford P. (1997) Nitrogen fixation by annual legumes in Australian Mediterranean agriculture. *Aust J. of Agric. Res.* **48**: 267-293

Pate JS, Unkovich MJ, Erskine PD & Stewart GR. (1998) Australian mulga ecosystems – 13C and 15N natural abundance of biota components and their ecophysiological significance. *Plant, Cell and Environment* **21**, 1231-1242.

Pate JS & Unkovich MJ (1999) Measuring symbiotic nitrogen fixation: case studies of natural and agricultural ecosystems in a Western Australian setting. IN 'Physiological Plant Ecology' (Eds. MC Press, JD Scholes & MG Barker) pp. 153-173. Blackwell Science, Oxford.

Unkovich MJ, Pate JS, Lefroy EC & Arthur DJ. (in press) Inputs of fixed nitrogen by the fodder tree tagasaste at alley and plantation densities on deep sands in southwestern Australia. Aust. J. Plant Physiology.

ABOUT GROUPS

The community group Green Skills has asked that we include information about their employment arm, 'Ecojobs'.

ECOJOBS ENVIRONMENTAL PERSONNEL:
FOR ALL YOUR ENVIRONMENTAL PERSONNEL NEEDS

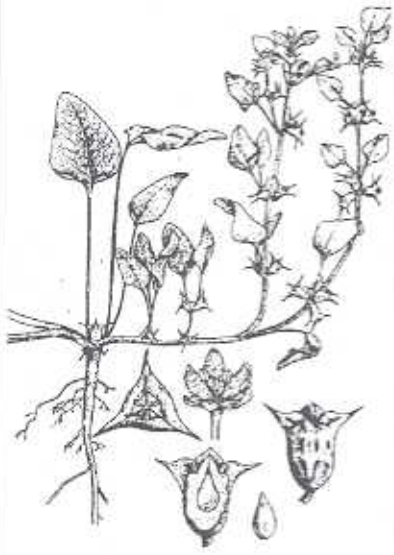
As we are in the middle of the tree planting season, I would like to remind everyone that Ecojobs offers a wide range of skilled environmental personnel at very affordable rates, starting from $17.50/hr (+ GST). Our rates are all inclusive and we can also provide project coordination and supervision of volunteers.

Ecojobs Environmental Personnel is a project of Green Skills Inc. which has been successfully operating since 1995. Our clients include the Botanical Gardens and Parks Authority, the Water and Rivers Commission, various councils, private consultancies, as well as catchment and landcare groups.

We are looking forward to hearing from you soon.

Jean-Paul Orsini, Ecojobs Coordinator
Green Skills-Fremantle
30 Holdsworth Street
Fremantle WA 6160
Ph. (08) 9336 1033, Fax (08) 9336 3301.
email: grskills@upnaway.com
Website:
http://www.greenskills.green.net.au/

BUSH DETECTIVE ANSWER



They are Doublegee (*Emex australis*) fruits. Early settlers brought the plant from South Africa to use as a salad vegetable, and it is now widespread over the State. Red-tailed Black Cockatoos eat the seed, they are able to crack the fruit with their powerful bills. (Try to crack open the fruit yourself, to see how strong they must be.)

✦ ✦ ✦ ✦

A final comment, from a teenage *LFWer.*

Q: What do you get if you collect up a pile of Doublegee seeds, make holes in them, and thread them on twine to make two ropes?

Ans: A double G-string!

OUCH!!!

WEEKEND GETAWAY!

Many LFW members have facilities for visitors - if you are looking for somewhere to go where people care about bushland -you need the WA LFW Ecotourism Contact List! Ring 9334 0427 for your copy.

COMING EVENTS

FUNGIMAP WORKSHOPS

with **Katie Syme**
Learn about the importance of fungi and how to map their distribution
- Merredin Herbarium
- Sat-Sun 8th - 9th July

Contact: Heather Adamson 9041 2488;
email: heathera@calm.wa.gov.au

- Irabina Field Study Centre - Dryandra Woodland
- Friday 21st July 2000
- 9.00 am - 3.30 pm

cost $10.00
Contact Avril Baxter 9881 9218 oe
email: avrilb@calm.wa.gov.au

Organised by Land for Wildlife and Fungimap

YORK GUM AND ASSOCIATED UNDERSTOREY

With Malcolm French
- Sat 29th July
- 10.00am - 3.30 pm

Meet: Sandalwood yard, Avon Terrace, York
Organised by River Conservation Society

LOOKING AFTER OUR BUSHLAND: FIELD DAY IN THE QUAIRADING COMMUNITY NATURE RESERVE

- Quairading Community Centre
- Tuesday 15th August 2000
- 9.30 am – 4 pm

Cost: not yet decided
Maintaining the conservation values of bushland and management of weeds.
To register, ring Barbara Jones: 9220 5300.
Organised by Environmental Weeds Action Network and Wildflower Society of Western Australia.

GRASSTREES AND KINGIA

With Bill Loneragan
- Sat 26th Aug
- 10.00 am - 3.30 pm

Meet: Sandalwood yard, Avon Terrace, York
Organised by River Conservation Society

WEEDS IN BUSHLAND

With Neville Marchant
- Sat 3rd Sept
- 10.00 am 0 3.30 pm

Meet: Sandalwood yard, Avon Terrace, York
Organised by River Conservation Society

STOPPING TREE DECLINE IN THE GREAT SOUTHERN

A seminar and field day on how to stop tree loss

Do your trees look like this wandoo at York? Smallest crown branches dead, clumps of browned leaves show newly dead branches ... ?
And the process continuing remorselessly ...?
Attend the workshop:
- Thursday Sept 14th 2000
- 8.15 am - 4.30 pm
- Kojonup Memorial Hall

Contact: Avril Baxter: 9881 9218.
Organised by Land for Wildlife and Greening Western Australia

NEW BOOKS

HAKEAS OF WESTERN AUSTRALIA: BOTANICAL DISTRICTS OF IRWIN AND DARLING

By Jennifer Young
$20.00 + $5.00 postage

The second in a series of illustrated guides to hakeas, this one covers the northern sandplains and the southern forests, essentially from Shark Bay to Albany, including the Darling Range. As with the previous book (covering the wheatbelt), this has been written to assist with the identification of hakeas for revegetation projects and it details the use and provenance to which each plant belongs. Each species is illustrated with clear line drawings which will enable identification, and there are also many colour photographs.

Anyone interested in wildflowers, especially if your property is in the area covered, will find this an interesting and useful book.

To obtain a copy, contact: J. Young, PO Box 576, WEST PERTH, WA 6872. Ph: 9242 2207.

This Newsletter is a compendium of articles written by many different people. The views expressed are those of the authors, not necessarily those of the Department of Conservation and Land Management.
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