DEPARTMENT OF Conservation AND LAND MANAGEMENT
Conserving the nature of WA

Western Wildlife

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ROOT CLUSTERS OF WESTERN AUSTRALIAN PLANTS: A CURIOSITY IN CONTEXT

Hans Lambers, Michael W. Shane and Erik. J. Veneklaas

Western Australia was a part of Gondwanaland, and some of the most ancient parts of the Earth's crust can be found here. The rocks are up to 3.6 billion years old, with some of the sediments being as old as 4.3 billion years. Other parts of the Western Australian landscape originated more recently from calcareous marine deposits. This explains why our soils are amongst the most heavily leached and nutrient-impoverished in the world. Phosphorus is one of the least available nutrients, at least for plants that are not adapted to the Western Australian soils. It is an essential nutrient for all living organisms, including our native plants. Micronutrients (e.g., copper, manganese, zinc) are also scarcely available on ancient weathered soils; micronutrients are also essential for life.

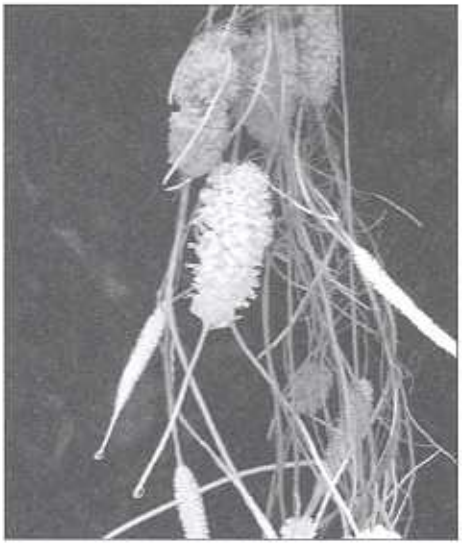

Fig. 1: Simple cluster roots of *Hakea prostrata*, grown in nutrient solution in the glasshouse at UWA.

The nutrient-impoverished soils of the southwest of Western Australia harbour one of the world's 25 hotspots of biodiversity. The Proteaceae (e.g. *Banksia*, *Grevillea*, *Hakea*) represents the top most species-rich plant family in Australia, and has a very long geological association with the continent, beginning 65 million years ago. Cyperaceae (sedges) are also an important component of the Western Australian flora. Therefore, both the Proteaceae and the Cyperaceae offer a unique opportunity to study plant adaptations to nutrient-poor soil conditions. We have grabbed that opportunity, to learn more about our highly biodiverse flora and to search for traits that would be desirable for crop plants grown in Western Australian soils.

A relatively large proportion of the species from the nutrient-poor soils in Western Australia, including almost all Proteaceae and Cyperaceae, cannot produce a symbiotic association with a mycorrhizal fungus. That is paradoxical, because mycorrhizas are widely considered an adaptation to phosphorus-impoverished soils. Moreover, it is widely accepted that all ancestors of the Proteaceae and Cyperaceae were once mycorrhizal. Therefore, during the course of millions of years of evolution, most of the species belonging to the Proteaceae and Cyperaceae must have lost their ability to be colonised by symbiotic mycorrhizal fungi. Instead, many species belonging to these plant families in Western Australia produce **root clusters**. In the Proteaceae we find 'proteoid' or 'cluster' roots (Figures 1 and 2). In Cyperaceae 'dauciform' or 'carrot-shaped' roots are common. Root clusters also occur in several other species belonging to different families that are common in Western Australia, e.g., in *Viminaria juncea* (native broom), *Casuarina* (sheoak), *Jacksonia* and *Kennedia* species. Other forms of root clusters can be found in Restionaceae (rushes), another non-mycorrhizal family.

The functioning of the root clusters of Proteaceae and Cyperaceae is a major component of our current investigations in the School of Plant Biology at the University of Western Australia. Once it was believed that their adaptive significance was to enhance the roots' surface area, and hence allowed the roots to 'scavenge' for nutrients. However, the individual rootlets and root

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EDITORIAL

Greetings all!

Well, my first few months with *Land for Wildlife* have flown by. Organising the *LFW* annual staff workshop, collating the data from the questionnaires that you have returned and preparing for this edition of Western Wildlife has kept me very busy indeed. I would like to thank Penny Hussey for her assistance with this; hers are big shoes to fill!

I'd like to thank you all for your enthusiastic response to our questionnaire. There are still some coming in, and all the information will be analysed and used to direct the program and its publications for the future. Based on the 215 questionnaires received at the time of writing this editorial, we have some preliminary feedback. A more detailed analysis will be available upon request as soon as all the questionnaires have been received.

It is interesting to note, 60 % of respondents indicated that their *LFW* property was a 'lifestyle' block and 36 % indicated that their property was 'commercial farming or horticulture'. Although these were the dominant responses, many *LFW* members consider their properties to have multiple uses, for example 'commercial farming or horticulture / conservation' or 'lifestyle / tourism'. The number of 'lifestyle' blocks is probably not surprising given that 64 % of the properties were in the Swan and South West regions. Only one lonely response was received to represent Rangelands! Given this, it is also not surprising that the majority of properties were small scale, with 40% of the properties being less than 10 ha in size and a further 30% of properties between 10 and 99 ha.

Only 16% of respondents have conservation covenants over their properties, and of those who have such covenants, 52% are with the Department of Agriculture. In general, respondents indicated that *LFW* membership did not help them decide to register a covenant (75%). However, when we consider only those who entered into specific nature conservation covenants with National Trust of Australia (WA) or CALM, then those figures change, with 64% of respondents indicating that *LFW* membership did help them decide to register a covenant. It is also interesting to note that only 3% of respondents are receiving rate relief as a result of being registered with a Local Government scheme and that only 15% of respondents have listed their property with other biodiversity programs. The majority of these are listed with Birds on Farms or Bird Atlas. Only 14% have received a grant for conservation works on their property where *LFW* supported their application. So, it appears that we have some work to do in promoting the biodiversity conservation benefits of these other programs and funding schemes and enabling our members to tap into these resources.

The results for our staff were very positive, with 97% of respondents agreeing that they found *LFW* staff knowledgeable and helpful and 83% using the information gained from *LFW* to help them manage their bushland. Since joining *LFW* 81% of respondents feel that they have a greater appreciation of their bushland. With 93% of respondents agreeing that they could contact

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EDITORIAL

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their *LFW* Officer directly to discuss specific issues and 92% agreeing that this advice was specific to their needs, it was surprising that only 44% of respondents contact our staff at least once a year for information or advice. It might be inferred that the initial information that was provided was sufficient, and that members would only need to consult with their *LFW* Officer if a new management issue arises.

As many of our new members would be aware, there is often a considerable wait between registering for *LFW* and receiving a property visit, particularly in the Swan region. We are working on resolving this and hope to be able to take on new staff in this area to reduce the backlog. Surprisingly though, only 34% of respondents indicated that the time between applying for registration and the property visit was too long. Of those who had a property visit and received a report, 85% felt that the report was not too detailed nor too long and 86% felt that the written material received answered most of their queries. We will continue to endeavour to provide a high level of land management information, while retaining a reader friendly format.

Only 25% of respondents have attended a workshop, field day or other event organised by *LFW*, however, 39% have visited a display at a local Show (e.g. Woolarama). Almost all of those who attended such events felt that they were useful and interesting. Given the overwhelmingly positive response from those attending workshops and field days, it may be that we need to hold more such events and advertise them more widely to increase member participation and ensure more members are receiving the benefits.

The response to our publications, in particular to Western Wildlife, was wonderfully positive. Ninety-nine percent of respondents agreed that Western Wildlife was interesting and informative, 97% agreed that the articles cover topics relevant to land managers and 95% of respondents keep copies for future reference! Also, 96% of respondents liked the style of design and layout. With comments like 'keep up the good work', we are overwhelmed by the positive responses to Western Wildlife. The responses to other *LFW* publications were also positive, with 81% of respondents agreeing that 'Managing Your Bushland' is a useful text reference, an average of 59% agreeing that 'How to .....' texts were useful references and 82% agreeing that they have used information from 'Wildlife Notes' in their bushland management.

We received an excellent response to the question of 'how should we celebrate *Land for Wildlife's* 10th anniversary?' The majority of respondents indicated that they would like to see 'open days' held on *LFW* properties (88%) and a special edition of Western Wildlife (81%). There was lesser enthusiasm for the ideas of holding a celebratory weekend (59%) or sponsoring a keynote speaker (58%). Based on many of the comments, location was a big concern, with many respondents suggesting that a series of local events may be preferable.

With regard to what you would like to see *LFW* do in the next ten years, respondents indicated that they would like *LFW* to continue property visits as at present (95%), actively approach landholders who have good bushland to ask if they would like to join the scheme (89%) and work more with Shire Councils (85%). It was also clear that respondents did not want us to charge for *LFW* services (72%) or decrease the frequency of the publication program (71%). Organising more field days and workshops also rated highly (74%), as did providing more detailed revegetation assistance (72%).

LFW staff, March 2004
Back row, L-R: Claire, Anthea, Avril, Julia, Rosemary, Fiona
Front row L-R: Zara, Cherie, Heather, Sylvia

We have received lots of other helpful suggestions beyond these statistics, and I would like to thank those that went to the effort of writing to us with additional feedback. It is much appreciated and will be used to guide the program into the future. Please do not hesitate to give me a call if you would like copies of the full detailed analysis.

The winners of the five prizes of CALM publications are:

Mary Bremner, Wembley
Catherine Fowler, Walpole
Peter Guazzelli, Broomehill
Nina Pratt, Yallingup,
Anne Smith, Busselton.

Anthea Jones

FLORA

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hairs of the root cluster would all be competing with each other for the same molecules in the soil, and hence do not make this a very effective scavenging structure.

We have recently discovered that these root clusters release vast amounts of organic acids, especially citric acid, during just a couple of days in their very short existence. Cluster roots live for about 3 weeks only; dauciform roots live for less than 2 weeks. Citric acid effectively mobilises phosphorus and micronutrients that are 'locked up' in the soil, pushing these vital nutrients in solution for the roots to take up. Therefore, root clusters actively 'mine' the soil. This is a costly process because of the large quantities of organic acids that have to be produced and released. However, the root clusters are very successful where roots that lack this ability to 'mine' the soil, including mycorrhizal roots, would fail. Ideally, crop plants would have similar adaptations of efficient nutrient acquisition, to perform well on the soils in Western Australia, and this is the subject of our further investigations. Some lupin species, e.g. white lupin and blue lupin, have traits that are very similar to those of the Proteaceae and, consequently, these crop plants do better on phosphorus-impoverished soils, when compared with wheat.

Many Proteaceae, including *Banksia* and *Hakea* species, are readily killed by phosphorus fertilisation; they are highly sensitive at slightly enhanced soil phosphorus levels (Figure 3). Even at slightly elevated levels of phosphorus in soil, many Proteaceae tend to 'hyperaccumulate' phosphorus in their leaves, building up toxic phosphorus concentrations. Other plants rarely achieve such high concentrations in their leaves, even when heavily fertilised with phosphorus. That is because most plants have the capacity to reduce the rate at which phosphorus is taken up when the phosphorus supply in the soil exceeds the plant's demand for phosphorus. That is, they "close the doors through which phosphorus enters the roots when a big crowd of phosphorus molecules is waiting to move in". We have recently discovered that the extreme sensitivity of harsh hakea, *H. prostrata*, is due to its severely impaired capacity to reduce its phosphorus-uptake rate at elevated phosphorus levels in the soil. Some time, during the course of millions of years of evolution on severely phosphorus-impoverished soils, this capacity diminished. To conserve our precious biodiverse flora, we have to respect these millions of years of evolution, and ensure that phosphorus-sensitive plants are not exposed to elevated soil phosphorus levels.

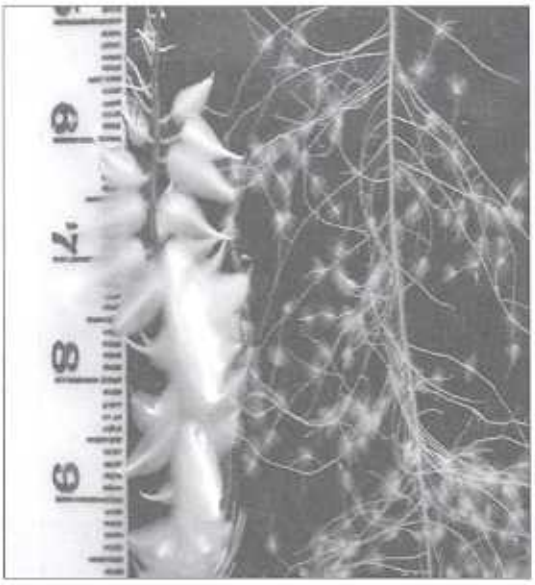

Fig 2: Dauciform roots of two WA sedges grown in the glasshouse at UWA. Grass-like sedges are very common elements in the WA flora, but are often overlooked. Very few ecophysiological studies have been done on this fascinating part of our flora. Many sedges make 'dauciform' or 'carrot-shaped' roots, which live for less than two weeks. As with cluster roots, dauciform roots release large quantities of organic acids (eg citrate) during a brief period (1-2 days only) when mature.

Fig 3: Phosphorous toxicity in *Hakea prostrata*. In the early stages of P-toxicity, affected leaves become 'blotchy', and white crystal-like material can be found on both sides og the leaves. The crystals emerge on the leaf surface through stomatal pores. The exact composition of the crystals is not known, but we do know it is not phosphorous, which hyperaccumulates in cells inside the leaves. Later the leaves turn yellow and die. In the end, the entire plant succumbs to phosphorous poisoning.

Having discovered the physiological cause of the phosphorus sensitivity of harsh hakea, we made a wider survey of related species. Interestingly, the close relative *Grevillea crithmifolia*, also belonging to the Proteaceae, does not suffer from phosphorus toxicity, even when exposed to phosphorus levels that are much higher than those that kill some *Hakea* or some *Banksia* species. We found that roots of this grevillea "close the doors through which phosphorus moves in" when supplied with a lot of phosphorus. These new findings offer enormous potential for breeders who are keen to develop new cultivars in the Proteaceae. It should not be too difficult to cross phosphorus insensitivity into new cultivars, which could then be grown without the risk of phosphorus poisoning in our gardens. One of our colleagues in the School of Plant Biology at UWA, Dr Guijun Yan, is working to achieve that aim.

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REVEGETATION

THE MAGIC OF MOISTURE - HOW CAN WE MAKE THE MOST OF IT?

Rosemary Jasper

If only there was a formula for getting bush to regenerate! Sometimes regeneration will happen magnificently, other times there seems a stoic resistance to any form of renewal. Yet understanding how to achieve good regeneration and successful revegetation is critical if small patches of vegetation are to have a future, and if we are to achieve worthwhile revegetation on farming properties. This is particularly an issue in the drier parts of the agricultural area.

There are various disturbance events which are known to trigger regeneration in natural systems. These include fire, destructive windstorms, drought, soil upheaval and flood. This article is about the significance of flooding as an agent of renewal in the area in which I live and work – the Lake King to Esperance region.

I continue to see regeneration that occurred in low-lying areas right across this region after the floods of January 2000. Now, five years since the flood, the growth is almost always healthy and dense. One of the best examples is on the Salmon Gums golf course where the swamp yates, *Eucalyptus occidentalis*, came up thickly in a big area on one of the fairways: as if there weren't enough hazards in 'the rough'!

I have looked in some detail at the regeneration that occurred as a consequence of the 2000 flood in some swamps which are in an internally-draining catchment between Ravensthorpe and Lake King. In this area, 281 mm of rain were recorded for January 2000, almost certainly the highest January rainfall for 100 years; the average January rainfall being about 23 mm. It was a very significant event and caused massive flooding at the time, with surface water persisting in some wetlands for more than two years.

As a consequence of this flooding there has been large -scale regeneration around the wetlands in the catchment. The species composition of the regeneration reflects the before-flood vegetation. In one wetland the paperbark, *Melaleuca strobophylla*, is dominant in the regeneration, while in another Kondinin blackbutt, *Eucalyptus kondininensis*, and *Melaleuca acuminata* are the dominant species. The photograph shows the density at which the *M. strobophylla* grew. After 3.5 years the melaleucas were between 0.2 and 1.6 m tall, indicating that germination continued well after the initial flood. The typical density was approximately 150 stems/m2, a density that it is assumed will reduce as individual plants become dominant in the stand. It is also noteworthy that there were no weeds in the regeneration despite being in the middle of paddocks.

Given that regeneration is shown to occur in this situation for these species and has also been recorded for swamp yate, swamp mallet, *E. spathulata*, and salmon gum, *E. salmonophloia*: what can we learn from this to assist in large scale regeneration and revegetation?

Firstly, if the task is to revegetate a swampy area, one could wait to commence the revegetation until the site is judged to be as wet as it is going to get in that season. Seed of a species that would have been common at the site, and is expected would still be suited to the site, could then be introduced. Consider ways

Flooding, January 2000. (Photo: Main Roads WA)

Melaleuca regrowth , September 2004. (Photo: R. Jasper)

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that you could imitate the process of seed falling from established plants onto the water surface, and the seed floating to the edge or high watermark. The seed could be introduced on several occasions as the water level drops, aiming for a broad band of regeneration and maximising the possibility of success.

Second, and more challenging, is the possibility of adapting the flood experience to the task of revegetation in the drier parts of the landscape. It is well established that by creating water-holding patches the chance of successful establishment of plants is improved: witness the healthy growth of vegetation often occurring in the table drains of roads.

In western NSW the Soil Conservation Service of NSW have shown that the creation of large-scale, shallow, water-holding ponds on scalded land was an effective land treatment for achieving revegetation. These ponds provided a more lasting effect in relation to water retention and vegetation establishment than ploughing or furrowing. Their work was focussed on the establishment of saltbush species (*Atriplex, Maireana* and *Sclerolaena)* and may have relevance to the reclamation of badly degraded land in WA, if not general revegetation work.

Other research in Texas, USA, (400 mm annual rainfall) has demonstrated the advantage for revegetation of creating small micro-catchments which catch and hold water. The micro-catchments used were 1.5 sqm and 10 cm deep. Not only did the seedlings planted in these micro-catchments survive and grow better, their healthy growth resulted in an increase in soil organic matter and a better recruitment of other plants by natural processes. The concentration of water, organic matter, nutrients and seeds in these micro-catchments resulted in the re-establishment of natural processes in an otherwise degraded environment.

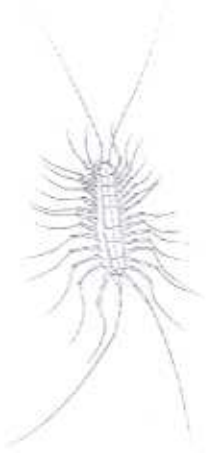
To concentrate available water in some way is logical when working in a low or unpredictable rainfall area and the issue may become critical in a wider area given climate change. To capitalise on the availability of moisture requires anticipation and preparation - to have chosen a strategy of action and done the necessary work (collecting the seed, growing the seedlings, fencing the area, creating some water-holding micro-catchments, or whatever). There is some fine-tuning to be done in the manipulation of water availability, but it seems an aspect that is important to focus on if working in areas where water is not plentiful and arrives unpredictably.

If you are in the south-eastern areas of the wheatbelt and south coast and would like to discuss what you could do to 'prepare' your remnant patch for a possible flood regeneration event, or to create water-holding regeneration areas, contact me on (08) 9838 1890 or rosemaryj@calm.wa.gov.au.

Rosemary Jasper is LFW Officer at Ravensthorpe.

Bush Detective

What's this long-legged animal?



Land for Wildlife member Alison Ashton of Roleystone asked about this animal.

It is a Scutigerid or house centipede. This insect is a predator with long, delicate legs which enable it to move very rapidly up walls and along ceilings and floors. House centipedes are about 15-20 mm long and differ from other centipedes in that they have only 8 body segments and 15 pairs of legs as adults. Many species are attractively coloured and have blue longitudinal stripes.

House centipedes usually live ouside in cool, damp places such as under rocks or wood piles, but they occasionally enter houses. They hunt a wide variety of prey such as spiders, termites, silverfish and other household pests. Prey are ensnared by the terminal sections of their long legs and are then killed by poisonous fangs. They seldom sting humans, the result being no worse than a minor bee sting, and their venom is too weak to seriously harm dogs and cats.

After mating, the female lays her eggs singly in the ground. The newly-born young possess only four pairs of legs and they gain a new pair with each moulting.

Do not kill an unwanted house centipede in your house, simply herd it into a clean container with a lid, take it outside and release it. House centipedes could be providing a free service to you by controlling insect pests.

Claire Hall

LANDCARE

LANDHOLDERS AND RESEARCHERS WORKING TOGETHER

Sommer Jenkins

Soil salinity is a recognised problem in the southwest of Western Australia, threatening to reduce agricultural production and viability in the region. The widespread clearing of deep-rooted native vegetation and its replacement with annual crops and pastures of current agricultural systems has led to the groundwater table rising and mobilizing salt from within the soil profile. There are numerous studies being conducted on the consequences of, and possible solutions to, secondary salinity. These studies can generate information to help farmers make productive use of their saline land.

Ecological zonation of the two grasses
Photo: S. Jenkins

However, many readers can appreciate that research, suggestions and data generated in a university may sometimes be inaccessible, or difficult to put into action by the landholder. It is important therefore, that research reaches the landholder, farmer or individual to whom it is most appropriate. Collaboration between researchers and landholders is a good way to ensure this transfer of information occurs. Collaboration is mutually beneficial, as the research is based on what is happening out in the field, and the information generated in this way is directly accessed by the landholder.

My PhD project at the University of Western Australia, working in conjunction with the Co-operative Research Centre (CRC) for Plant-Based Management of Dryland Salinity, is focused on the perennial pasture grasses puccinellia and tall wheatgrass (cv. Tyrell). Of particular interest to me is the ecological zonation of these two grasses, as caused by salinity and waterlogging gradients. Ecological zonation refers to the distribution of plant species in separate ecological zones because of variations in the environment (e.g. soil salinity and waterlogging).

Pasture grasses are commonly sown on saline land to increase water use, revegetate bare land and for use as fodder for livestock. It is recommended that a combination of grasses with different salt and waterlogging tolerances be sown to ensure good establishment as most saline sites are highly variable. Puccinellia and tall wheatgrass are often sown together as mixtures, with puccinellia colonising the more waterlogged zones of the landscape and tall wheatgrass occupying the less affected zones.

My glasshouse and lab-based project was in need of a field location. Through the assistance of Landcare, I was put in contact with a willing landholder in the southern wheat belt. I was lucky enough to be introduced to Peter Macleay who, for the last two years, has generously allowed me access to his 570 ha farm just out of Kojonup. On this property, there is a small low-lying area affected by secondary salinity, which serves as a very convenient study site. It was convenient in that it showed natural zonation of puccinellia and tall wheatgrass.

About 15 years ago Peter addressed this isolated secondary salinity issue by planting a mix of puccinellia and tall wheatgrass. When I asked Peter if he planted this mix as fodder, he replied, "I planted this mix because it would grow in saline areas where trees would not. It was easier to plant and I thought it would use more water than trees. I did not start to use it until about 5 years later when I had sheep in a feed lot over the break of the season and noticed the wheatgrass, and decided it was worth a graze. I then

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LANDCARE

noticed that the clover and other grasses grew better when there was both wheatgrass and two grazings a year. I then realised the potential of perennial grasses and the grazing systems that they need. There is a synergy with cropping in that the grasses love the areas that crops don't grow well in."

The synergy extends to my project as well. I gain from Peter's enthusiasm and knowledge, as well as access to his pasture. I visit the site regularly and monitor the watertable level, soil and groundwater salinity and pH, plant health and biomass. Peter benefits from ongoing monitoring of his pasture and is recognized for his significant contribution within the CRC. Peter has been involved with research groups in the past. Whilst he has never had a formal connection with Landcare, he has been interested in the debates and research results. Currently he is mainly involved with the Kojonup Crop Research Group. He says, "It was set up to help develop high rainfall cropping. We are still working with CSIRO and Ag WA in this area, mainly looking at fundamental limits to production."

When asked what motivates him to donate his time and pasture to research, he replied "I am interested in the results, and the contact with the ideas and the people who do the research."

The field work aspect of my project has become central to my research, and has provided me with a great deal of valuable information. Thanks to the enthusiastic and successful collaboration between landholder and researcher, my investigation continues to prove very worthwhile.

Sommer Jenkins is undertaking a PhD research project at UWA. Further information on related topics is available at www.agric.uwa.edu.au/soils/nuts/home.html or www1.crcsalinity.com.

(Note: Both puccinellia and tall wheatgrass can become weeds in conservation areas - especially natural salt lake communities - so, if using them, be careful they do not escape - Ed.)

Cooperation pays off!

Working with the community and community based Landcare Officers is a key to achieving many conservation outcomes in the Wheatbelt and this was again the case at this year's Wagin Woolorama.

CALM staff from *LFW* and Roadside Conservation Committee programs combined with Landcare staff from zones within the Blackwood Basin, Birds Australia, Greening Australia, Green Skills and the South West Catchment Council, to develop and staff the Landcare Marquee to great success.

As well as making a lot of useful contacts and passing on valuable messages to the high number of visitors, the group also managed to win the "Best on Ground Exhibitor" award!

The overall theme for the Landcare Marquee was "Cover up for Landcare" with the value of remnant vegetation and revegetation on farms and roadsides as habitat for native flora and fauna.

Some of the Landcare exhibit team at Wagin Woolorama with their trophy for "Best Exhibitor on the Grounds".
Top L-R: Avril Baxter, Sally Thomson, Leonie McMahon and Carl Beck
Bottom L-R: Nicole Davey, Rennie the cockie, Kirsten Martin and Sharon Haeusler

A major attraction for the display was Rennie, a 2 1/2 year old Carnaby's Black-Cockatoo which was hit by a car as a fledgeling and, as she can not be released back in the wild, is now part of CALM's derelict fauna program and used as an educational bird. Rennie, who's distinctive call could be heard across the show ground, was part of a display highlighting the Birds Australia Carnaby's Black-Cockatoo Recovery Project which was coordinated by Leonie McMahon.

LFWO Avril Baxter said "Working closely with the local Landcare Project Officers and the community is very important in the Wheatbelt and other remote areas. Woolorama not only allowed us to get our messages out to the general community but also gave us the opportunity to strengthen our relationships with the other Natural Resource Managers who participated in making the Landcare Marquee a great success."

Avril Baxter & Carl Beck

FAUNA

SECRETS OF KANGAROO HERBIVORY

Micheal Parsons, Carol Lander and Byron Lamont

While working for our industry partners, Alcoa Australia and Worsley Alumina Pty Ltd, our job was to quantify something mine rehabilitation officers had observed for some time. Kangaroos were changing the makeup of restored lands by selectively browsing young nutritious seedlings. They seemed to like some species, while being put off by others. Unfortunately nothing was in print on the topic, so few people outside the profession were aware of what was happening. Our test was simple and fairly common among herbivory studies.

We constructed kangaroo-proof fences (exclosures) and selected 24 common, but contrasting, species and planted 64 replicates of each species inside and outside each fence to compare the effects. We expected plants outside the fences be smaller or die. We were in for some surprises when we learned it isn't that simple. The results were startling. We found that some plants outside the fences were browsed to the ground while other plants showed signs of heavy browsing, but were actually larger in terms of both weight and height. Instead of doing a community-level study we were forced to look at each species individually and determine what factors caused kangaroos to be more selective about certain plants, and consequently why some plants were devastated by the damage while others appeared to thrive on it!

After working for an entire year and monitoring which plants were eaten and which were avoided, we harvested the plants and undertook chemical analyses on each.

What did the eaten plants have in common? It appears that plants were not chosen for protein content as might have been expected, while almost all of the severely damaged plants tended to be grass like in appearance (as seedlings) even if they were not true grasses. The least eaten plants had higher levels of salts and tannins.

We then wanted to know if the factors that contributed to our results were actually due to their chemical content. We did cafeteria trials (taste tests with a range of foods) with kangaroos at a wildlife sanctuary in Boyup Brook to find out.

To our delight, the results were the same as for the studies on the minesites. Pellets with added salts and tannins were avoided just like for the plants, leading us to make some generalizations about which species will be selected. However, the limited knowledge we have is not very helpful in solving the big problem - deterring kangaroos from restored patches entirely. It appears kangaroos are very intelligent, organizing themselves into mobs with elected sentries and scouts and follow a pecking order. The scouts are able to find the preferred food and inform the rest of the mob where it is, while the sentries stay alert for danger, but that's another story altogether.

Cafeteria trials involving kangaroos

Table 1: Plant species most eaten, least eaten and species that over-compensate (benefit from being eaten) by kangaroos

Most eaten plants	Least eaten plants	Over-compensators
Xanthorrhoea spp.	*Acacia alata*	*Acacia alata*
Tetraria capillaris	*Hakea amplexicaulis*	*Acacia urophylla*
Viminaria juncea	*Hakea ruscifolia*	*Viminaria juncea*
Notodanthonia caespitosa	*Eucalyptus marginata*	

Michael Parsons is a PhD student at Curtin University. Carol Lander is the proprietor of Roo Gully Wildlife Sanctuary in Boyup Brook and Byron Lamont is Michael's supervisor. All will appear in the made for ABC series "Tales from Roo Gully" in the first quarter of 2007.

If you would like to share your experiences regarding the feeding behaviour, preferences or deterrence of kangaroos, Michael is keen to hear from you. He can be contacted at Michael.Parsons@student.Curtin.edu.au.

FLORA

NORTHERN WHEATBELT FLORA SURVEY

Stephen Davies

Between 1999 and 2002 I had the pleasure of working with local landowners and Landcare staff in surveying the flora of private remnants in the northern wheatbelt of Western Australia. The Landcare Districts of Latham, Marchagee, Mullewa, Waddy Forest and Wilton Well span a fascinating transition zone of the State's flora, with such south-western plants as kangaroo paws in the south and west and arid zone shrubs, mulga and bowgada, in the north and east.

Remnant vegetation on private land is scattered throughout these areas. Although many of the government reserves have been surveyed, very little systematic work had been done on private land. In all, 170 sites were visited and over 2000 specimens identified. Many of these specimens were the same species collected in different Landcare Districts, so the total number of plant species recorded was about 1000. This still represents significant biodiversity in the region and emphasises the importance of private remnants in preserving that biodiversity. In each of the Landcare Districts at least some of the Declared Rare Flora and Priority 1 species were located, for example *Chamelaucium repens*, creeping darwinia, in Mullewa, *Hensmania chapmanii*, Chapman's hensmania, in Wilton Well, *Eremophila vernicosa* in Marchagee and *Frankenia bracteata* in Waddy Forest. Several of these were known to the landowners but their significance was not. One rare plant, *Chorizema humile*, prostrate flame pea, was the subject of a special survey, because the Waddy Forest area had turned up a very large, unrecorded population. The follow-up survey recorded another nine populations, each small but significant in representing further genetic diversity.

Many of the remnants were unfenced, but the survey, which involved the landowner wherever possible, stimulated further fencing efforts, supported by Natural Heritage Trust grants, once the value of the remnants was documented. It was especially interesting to find that many plants rarely collected and therefore considered rare, grew in the salt creek systems. These areas are regarded as infertile in farming circles, and also perhaps in botanical circles. The situation is reminiscent of the arid zone, where *Acacia pruinocarpa*, gidgee, the largest acacia in the inland, was uncollected and therefore undescribed until 1958 because no good botanist would go to the arid zone in mid-summer! In the same way the salt creek systems are a neglected resource. Because they are little used by farmers, they are less disturbed than fertile areas and will yield many interesting specimens when adequately collected. In another way they are very important because they form long, undisturbed corridors traversing the countryside, enabling animals and to some extent plants, to disperse through otherwise hostile landscapes.

Observation on the survey illustrated time and again destructive effects of high rabbit and kangaroo populations. Even in remnants fenced with ringlock and equivalent netting to exclude stock, there was little regeneration. Most had been eaten by the herbivores that the fencing did not exclude. Farmers are aware of the damage rabbits can do but few seem to appreciate the damage high numbers of kangaroos can cause. Environment Australia surveys the density of kangaroos over the whole of Australia every three years. These surveys show that the density of kangaroos in undisturbed woodland is 0.86 (1) per square kilometre. In the Inering Catchment east of Carnamah, I have measured densities of 62 grey kangaroos per square kilometre of remnant. No regeneration can sustain such densities of grazing animals. The reason I emphasise areas of remnant is that kangaroos feed on clover and other pastures in the winter, the season when, before farming development, they were short of food, but are now well fed. In the summer they feed on the young green plants in the bushland, that is the regenerating seedlings, wiping them out if the kangaroo (or rabbit) density is high. Where plants like *Chorizema humile* are protected by bird netting (12 mm netting), as at Bindi Bindi and "Koobabbie", Coorow, the main stems survive but any shoot beyond the netting is grazed off in the summer. Until the need is recognised to adequately subsidise the fencing of remnants, particularly those containing palatable rare species, with rabbit netting (30 mm), biodiversity will continue to be lost in many remnants, both those publicly and privately owned.

The surveys have provided a baseline against which to follow changes in the vegetation as landcare practices develop. In the Marchagee and Latham Catchments in particular, survey sites have been marked so that return visits can be made in later decades to measure quantitative changes in floral diversity. Reference points along these lines should be established in other catchments.

Finally let me say how much I enjoyed undertaking the work, meeting and getting to know the farmers, and how grateful I am to those who helped me.

Adjunct Professor Stephen Davies can be contacted via Curtin Uni.: S.Davies@exchange.curtin.edu.au

ECONOMIC VALUE OF BIODIVERSITY

NEW BOOKLET ON MANAGING PRIVATE NATIVE FOREST

Peter Beatty

The recent release of a bush management booklet will guide landowners in assessing, protecting and managing their native forest in the south west of WA. The 28 page booklet will also provide the licencing protocols required where landowners seek to remove native vegetation on farmland or sell timber products under the provisions of relevant legislation. The booklet, entitled "Managing private native forests and woodlands in the south west of Western Australia – *combining wood production and conservation*" is aimed at addressing many of the issues involved in the care and use of private native forest where thinning of trees is proposed. It is particularly directed at those landowners who are interested in sustainable timber production as one of their main objectives and will assist them in preparing a management plan for their forest.

Private ownership of woodlands and forest in Western Australia is about 1.6 million ha and more than 300,000 ha of that occurs in the south west. While clearing controls are now in place protecting remnant vegetation from clearing, this is often not enough in itself to ensure its continued survival and health. A proportion of this has had, or will be suitable for, thinning and selective timber removal. The promotion of regeneration and tree growth and an appropriate fire regime, are important management actions to preserve health and sustainability value in most cases.

There is a growing awareness of the importance of maintaining healthy bush, particularly as much of it has been lost or adversely affected by land clearing for agricultural and urban development purposes.

It is vital to preserve the viability and health of these areas of private forests, not only for landscape protection purposes and provision of usable products, but also as conserved examples of the forest and vegetation types that once existed there. Damaging agents such as stock, fire, disease, weeds and inappropriate cutting reduce the future sustainability of these forests and jeopardize healthy canopy development and regeneration. Also, where forests are overstocked with young trees, the effect of moisture stress, especially in times of lower annual rainfall, can limit growth.

The booklet covers silvicultural aspects such as forest density, thinning and regeneration techniques, as well as providing details about applying for a Clearing Permit (Environmental Protection Act) or Commercial Producers License (Wildlife Protection Act).

Two case studies of properties are presented as working examples of how private bush (wandoo and karri forest types) can be managed effectively for timber production and conservation.

A field day involving landowners, industry and agency people as well as bush lovers was conducted in early April to examine a wandoo bush management project at Julyan and Sue Sumner's property (one of those described in the booklet) at North Dinninup. The 250 hectare area had previously been assessed under the *Land for Wildlife* program.

Copies of the booklet will be available from the Department of Environment, CALM, Forest Products Commission and Trees South West.

Peter Beatty is Community Consultation Coordinator, Forest Products Commission. He can be contacted on: peterbe@fpc.wa.gov.au

Julyan and Sue Sumner in their bushland managed jointly for conservation and timber production.

FAUNA

DIY BIRD HIDE

Lesley Brooker

Since purchasing our bush property at Westonia last year, we have known that we shared the bush with Malleefowl, as we often saw their footprints on our dirt tracks. For twelve months we diligently searched for an active mound, and found six inactive ones in the process, but it was not until last November that we finally found what we were looking for – a mound that was being actively worked. Delighted, we set to work erecting a bird hide so that we could watch their daily lives without disturbing them.

A simple, one-person bird hide is easy to assemble. Birds Australia (http://www.birdsaustralia.com.au/infosheets/08_hides.pdf) recommends that they should be light in weight, drab in colour, with a non-shiny texture, easily carried and set up, weather proof but breathable, stable and without loose flaps. I made mine out of a wool pack and four broom handles, giving a cubicle 70 cm wide, 70 cm deep and 140 cm tall, in which I can just fit a camping chair and one person.

1. Turn the wool pack upside down.
2. Undo one of the vertical seams, creating a doorway.
3. Attach a couple of tape ties so that the doorway can be closed from inside.
4. Insert a bullet-head nail into the rounded end of each broom stick to form a spike.
5. Push the spike of each broom stick between the stitching at the top corners of the wool pack.
6. Cut a narrow slit at an appropriate height across the front of the wool pack.

Voilà - Place in situ and secure with guy ropes.

This is the very basic version, which is good if you are in a hurry or need to use the hide for only a short period of time. It does, however, have some drawbacks – it can become very hot and stuffy, especially after sunrise; the roof will become a puddle if it rains; the slit will fray and is not adjustable and the colour is not exactly inconspicuous.

For the deluxe version:-

1. Purchase 2m of camouflage netting and sew into the sides as windows (approx $11 per metre from army disposal stores).

2. Sew a loop into the centre of the roof to allow a tie to an overhanging branch, so that the rain will run off.

3. Cut a rectagular viewing window and bind with bias binding. Cut a larger rectangle from the material cut from the sides and attach this as a flap to the inside of the viewing window. This flap can then be adjusted as required with pegs or safety pins.

4. Spray with a dark coloured paint.

IMPORTANT

The aim of the hide is to allow you to watch birds without disturbing them. If there is any evidence that the birds are disturbed by the hide then it should be removed. Position the hide where you have a good line of sight (with binoculars) without removing any vegetation. In the case of Malleefowl, erect the hide at least 20 m from the mound at a time of least activity (mid afternoon). Resist the urge to sit and watch immediately. Leave the hide

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WEED ALERT

The next big weed?

Montpellier broom (Canary broom or French broom) *Genista monspessulana*, is a native to the Mediterranean region. It is readily available in nurseries and widely grown as a hardy evergreen shrub of up to 3 m tall. It has yellow pea shaped flowers in spring, produces pods containing 5-8 dark brown to black seeds and can set seed after 2 years.

But, Montpellier broom is another GARDEN THUG that now occurs in large areas of the Jarrah-Marri and smaller areas of Karri forest in south west WA.

Anecdotal evidence east of Manjimup suggests that Montpellier broom has increased over the last 20 years. Some areas are so dense that dieback interpretation is impossible to carry out, as native indicator species can't be seen.

No wonder it's a survivor, soil stored seeds are long lived, and plants can tolerate drought and frost. Seeds are ejected out of exploding pods up to 2m away from the parent plant and are often carried long distances on vehicles and by earth-moving equipment. Once established, Montpellier broom can exclude most other vegetation and competitors by forming dense infestations that increase fire fuel-loads and provide safe habitats for rabbits and foxes.

Small plants of Montpellier broom can be hand pulled or slashed. Larger plants can be cut off and their stumps painted with a suitable herbicide. Basal bark treatment is another option. Soil disturbance and fire usually encourage huge germination of soil-stored seed, which may give opportunities for herbicide application before other vegetation sprouts.

Resist buying this GARDEN THUG and encourage others to do the same. And please advise your local weed group or similar organization if you see Montpellier broom occurring where it doesn't belong. The earlier this weed is controlled the better the results!

Contact Lee Fontanini on 9771 7958

Environmental Weeds: Eastern Plains and Hills Region

Pub: Wooroloo Brook LCDC

Cost: FREE (inclusive of postage) to the first 50 Western Wildlife readers! Otherwise distribution is normally restricted to those in the local area.

For a copy please e-mail Janette Huston at peakpot@vianet.net.au

The Wooroloo Brook LCDC has been volunteering in Landcare since 1989 and has coordinated the planting of over 500,000 seedlings in the Wooroloo Brook Catchment area. The Committee is made up of community, volunteers, local government and State government representatives. Their publication is a useful handbook of the major environmental weeds of the Eastern Plains and Hills region.

The introduction provides a definition of environmental weeds and briefly explains some of their detrimental impacts. General weed management practices are outlined in the first section, noting the factors to consider when undertaking weed control, as well as general methods for both physical and chemical control.

The remainder of the publication has been broken into chapters on 'Grasses', 'Bulbs, Corms and Tubers', 'Herbs and Rushes' and 'Shrubs and Trees'. These chapters focus on specific weeds and their origin, habitat, identification, reproduction and management. This information is provided in easy-to-read point form, and photographs of many of the weeds can be found at the end of each chapter.

This publication provides an excellent resource for community groups undertaking weed management within the Hills region and beyond. It is normally available at no cost to those living in the area, and we would like to thank the Wooroloo Brook LCDC for extending this offer to the first 50 Western Wildlife readers who contact the group.

Anthea Jones

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for 24 h. When you are sure that the Malleefowl have accepted the hide (i.e. they have returned and worked the mound during your absence) then it is ready for use. If not, move the hide further back or remove altogether. Always enter and leave the hide from the same direction (away from the mound). After erecting the hide do not approach the mound. When using the hide be as quiet as possible (no talking) and make as little movement as possible. You will need to take a camping chair, binoculars, can of fly spray and a couple of safety pins (for adjusting the viewing slit).

The best time to watch Malleefowl is in the early morning when the male will usually (but not always) open the mound to check the temperature. If you are lucky you may see the female also. You may see the male put his head down between his legs and "boom" from the mound. And if you're very, very patient and very, very quiet, you may even see the female lay.

Dr Lesley Brooker is a (retired) zoologist with CSIRO. She can be contacted on:
LesMikeBrooker@bigpond.com

MEMBERS' PAGE

Should tadpoles be moved when the pond dries up?

Alison Doley

The April 2004 issue of 'Western Wildlife' had an interesting article on the Western Spotted Frog [by Robert Davis – *Ed.*] which occurs in this area. (In September 1990, Stephen Davies collected one in a pit trap on our farm.)

The article mentions the problem of 'early pond drying'. Occasionally I come across tadpoles struggling to survive in the last muddy dregs of a pool. I rescue as many as possible and transfer them to the nearest dam with water, which can be up to 4 km away. The temperature of the dam is lower than that in the drying pool, is this a problem? Is there a risk of transferring disease? Are the tadpoles being transferred to an unsuitable habitat? I cannot identify which species are involved.

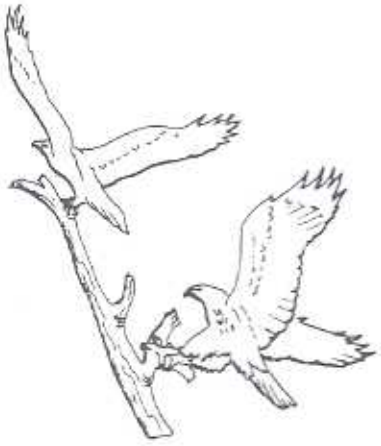
Perhaps Robert Davis could provide some advice on the best way to re-locate tadpoles, or is it a futile exercise carried out by someone who has not completely lost that childhood fascination with tadpoles!

Comment

I was unable to contact Dr Robert Davis, but I spoke with Brad Maryan (Herpetology, Department of Terrestrial Vertebrates, Museum of Natural Science) regarding your queries. Brad noted that there has been little research in Western Australia regarding tadpoles. He was unaware of any evidence of tadpoles being affected by changes in water temperature, but suggested that, like other animals, they may suffer some effects from 'shock'. With regard to diseases, given that you are only moving them within your own property and at the tadpole stage, the risk of transferring disease would be low. Whether the frogs are being transferred to suitable habitat is a difficult question, a large component of which relates to what else is living in the dam in the way of predators and competition. It may also be valuable to consider not only the impacts on the tadpoles being moved, but also on other species living in the dam.

Brad noted that frogs have very rapid life cycles in order to make the most of suitable climatic conditions e.g. there are frogs that live in the desert where they may not get rain for years! In theory, the strongest survive and the species adapt. So, although the negative impacts of you moving frogs between water bodies within your own property may be low, it may not be the best for those frogs in the long-term. - *Ed.*

An eagle yarn



Derek Hare, now retired but formerly farming at Pingaring, writes:

We used to take in and cater for B&B guests through the 'farmstay' scheme. About half of our guests were from overseas, and I used to take them around the farm including the reserve. I must tell you a funny story. Sometimes a violent wind or willy-willy will rip off a branch from a tree and the branch can get caught in the fork of another tree. This, of course, is an ideal platform for wedgetailed eagles to build their nest. When I explained how the eagles built their nests, one of the tourists said "They must be strong to carry that big log!"

"Oh yes," I replied, "I think they must have had an eagle each end to carry that one!"

Anyone else got any tall stories?! – Ed.

Birds in tree belts

Rita Watkins has been studying birds on the family farm "Payneham Vale" at Frankland for many years. She wrote about her work in Western Wildlife 2/2, April 1998, when she emphasised how valuable tree belts were for both foraging and breeding birds.

Rita has updated and expanded on her observations in a recent edition of the "Western Australian Naturalist". She gives details of the birds and their usage of individual tree species, including changes as the trees mature. Anyone interested in the biodiversity value of landcare revegetation will enjoy this article.

Ref: Watkins, R. 2004. *Bird usage of planted treebelts on farmland at Frankland, Western Australia.* Western Australian Naturalist **24**: 179-194

MEMBERS' PAGE

Pesky fox

John Lambie

I saw an amazing thing in January. I was working in my big shed on the back block and at about 4.30 pm a roo came bounding down the firebreak on the adjoining property being pursued by a fox.

It was chased into the corner of two fences and was desperately trying to jump over and escape. The fox savaged the cornered roo until it collapsed and then it sat on its haunches about 3 metres away and watched the roo, which lay motionless in a pitiful heap. I frantically searched for the keys to my gun cabinet and after about 5 minutes unlocking the cabinet and the ammo cabinet I loaded up and took aim with my single shot 22.

The fox heard me and repositioned its body behind a strainer post with its head poking out looking my way. Such a small target!! It was about 170 metres away so my rifle was not up to it but the shot kicked up some dust about a metre in front. It jumped away and sat in the open so that I could get a second shot, then it took off. The fox was a dark red colour (similar to a red cloud kelpie colour). Is it possible that a kelpie may have mated with a fox? I think it may have been the fox we saw fleetingly when walking on the ridge area during the *LFW* revisit. I have also seen it down in the orchard and am concerned as I now have nine Suffolk ewes and five lambs in the front paddocks. What can I do to obtain some bait or have someone bait or trap the errant fox?

The roo was about 3 years old and a doe and as it had no obvious injuries (some blood from the nostrils) I tried to help it stand up. It had no balance and just kept falling over. Later some other roos came close to join it but eventually they moved off and the roo died. Is it common for foxes to bring down middle size roos?

This story has some very interesting observations that made for some fascinating discussion around the office and a couple of different explanatory theories.

From Penny Hussey, currently Coordinator of Bushland Benefits:

"This is a very interesting event that you witnessed, and it does sound surprising. It is much more likely for the fox to take a young joey, which is not uncommon - you are aware that the mothers throw them out of the pouch as they make their own escape?

Another interesting fact is that when roos get stressed, they make an enzyme which digests protein, effectively, they can canabalise their own muscles to get energy (they have almost no fat reserves). The same thing happens to long distance runners - do you remember the person who collapsed as she was entering the stadium at the Montreal Olympics? It is this factor which dictates that roos for meat must be killed instantly, or the meat spoils."

I also asked Christine Freegard, a Technical Officer with Western Shield:

"My first thought is that maybe the kangaroo had been hit by a car and sustained internal injuries, hence the bleeding from the nose, and was therefore less able to escape the fox attack. I think it would be very rare for a fox to successfully bring down even a medium sized healthy kangaroo. A fox of course, wouldn't pass an opportunity if a roo were caught by surprise, injured, caught in a fence etc."

With regard to the question of whether it is possible that a kelpie may have mated with a fox, I spoke with Peter Orell, the Western Shield Zoologist.

Peter indicated that the fox (*Vulpes vulpes*) and the domestic dog (*Canis familiaris*) are different species and have different numbers of chromosomes, and that as such interbreeding between the two is probably not possible.

Seek advice from the Animal Pest Section at the Department of Agriculture ((08) 9366 2301) as to the recommended methods of fox control for your particular location and conditions. An Agriculture Protection Officer may be able to visit your property and provide specific advice. It is possible that baiting may not be considered an appropriate method of control in your area. - Ed.

Did you know?

Why geckos are able to grow new tails without the fluid retention and swelling associated with human surgery? It seems they have a special protein growth factor which enables them to regenerate their lymphatic systems. Medical researchers are hoping to develop a similar product for humans.

NEW BOOKS

Geology of Western Australia's National Parks: geology for everyone

Peter Lane
Pub: Peter Lane
Cost: $29.95

Peter Lane worked as a geologist in the oil exploration industry in Papua New Guinea, Canada and Australia and has lived in Margaret River for the last 18 years. He is heavily committed to environmental issues and has self-published this reference book.

The author describes the work as a 'helicopter' view of the geological setting of our national parks. He aims to explain in plain terms how the geology came about and encourage the reader to ask, "just how did that get there?" The result is a very readable account of the geology of our national parks and their contextual setting.

The preface provides a broad geological background, considering in simple terms the birth of the Universe, the evolution of the Earth and the break-up of Gondwana. The 6 chapters, 'The Darling Fault', 'The South-West', 'The South Coast', 'Perth to Shark Bay', 'The Pilbara and Northern Gascoyne' and 'The Kimberley', provide a brief geological background to each region and consider each National Park in this context. It explores the geology of 60 national parks, including Leeuwin-Naturaliste, D'Entrecasteaux, Lesueur, Karijini and Purnululu. The characteristics of each region are clearly depicted through the combination of hand drawn illustrations, photographs and satellite imagery.

This publication would be a valuable reference for anyone keen to enhance their understanding of our National Parks and the geology in which these ecosystems are founded. Available from select bookshops and CALM.

Anthea Jones

Guide to Native Grasses in the Perth Hills, 2nd Edition

Una Bell
Pub. Una Bell, Mundaring.
Cost: $15 + postage, 53 pages.
Contact Una Bell on Ph/fax (08) 9295 1668

The second edition of this book has been updated to include 36 native grasses that grow in the Perth Hills. It continues the simple format used in the First Edition of recognition of native grasses by the use of life-sized black and white photocopies of specimens. Notes on each species include a full description, area of occurrence and growth habits. This is not a key to identification, but simply aids recognition at a basic level and further assistance should be obtained if you are having difficulty with identification.

Native grasses in the Perth Region

Una Bell
Pub. Una Bell, Mundaring.
Cost: $30 + postage, 198 pages.
Contact Una Bell on Ph/fax (08) 9295 1668

Grasses have been a major part of agriculture since the dawn of civilization, but exotic grasses have had a lot of bad press in recent years due to their invasiveness in bushland and the huge weed problems they can cause. However, there are many native grasses that are useful for stock feed, rehabilitating degraded areas, and landscape gardening. Consequently, it is very important to be able to recognise the difference between a weedy grass and a native grass before undertaking weed control. This book is a comprehensive guide to recognition of the native grasses of the Perth Region.

The area of study is defined as a 100 km radius from Perth and includes off-shore islands, Swan coastal plain, Gingin Scarp, Dandaragan Plateau, Darling Scarp and Darling Plateau. Description starts at the basic level with "What is a Grass?", and details characteristics of the various parts of the leaves and flowers. The book describes annual, perennial, tropical and temperate grasses and the subfamilies, tribes and genera. To identify a grass you need an inflorescence or seed-head, then place it in a genus by looking through the black and white life-sized photocopies of grass specimens in the Guide to Native Grass Genera. When you have placed the grass in a genus, proceed to the specimen section which includes photocopies of specimens and enlarged drawings to aid identification. Some grasses can be difficult to identify so you may need to seek professional help.

This book would be an invaluable resource for community groups or landowners who want to identify and become familiar with the grasses on land in their care. On the surface native grasses could be described as rather bland, but delve into their delicate features and you may find them rather interesting in their own way!

Claire Hall

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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