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Dear Members,

Well, winter is well and truly upon us. There's no snow here, but there's plenty of frosty mornings with temperatures below minus 3° and days where the mercury can't seem to get past 10. The wind too feels like it's off the South Pole. Brrrr! We've had some rain but not enough to make the Murray or the Darling flow, or to reduce the water restrictions currently in place. I feel for those affected by the flooding in NSW and Victoria, and hope that brighter days are ahead.

Man has well and truly altered the Australian landscape and Nature now is objecting with fury, creating floods where not long ago we had fires, and altering our weather and seasonal climate patterns. As we warm ourselves by donning extra jumpers and jackets, and turning up the heater, we look ahead to the lovely fine days of Spring. How's it been at your end? I hope, wherever you are, that better times are ahead.

I apologise if you have been waiting on a reply from me but I've been a little out of action with a fractured spine. I had a nasty fall which left me bruised and banged up, and with the help of strong pain medication, I'm only just getting back to things. I'll answer as soon as I'm able, and I promise to bank your subs. as soon as possible. In the meantime, thankyou for you patience. *Chris*

MAILBAG

I have received a number of letters and emails on a range of topics and I hope to be able to include some of these in the current and subsequent newsletters. We also welcome several new members to the Study Group, and hope that you find the information enclosed of value. I would encourage you to submit articles on your experiences, or perhaps your concerns on issues which affect our Australian native flora and fauna.

Kath Wray, [Life Member of APS NSW,] wrote to me about Citizens Wildlife Corridors operating in the Northern tablelands of NSW. At altitudes of 1000m. the area is restricted in native species, both flora and fauna, and there has been massive tree loss and over-clearing. She is encouraging the re-planting of native vegetation, but says it's a long difficult process. I'm sure we can all relate to this and other re-greening projects which we have been involved in.

IN THIS EDITION

- # Hints for planting trees in rural areas *Harry Franz, Qld.*
- # The role of small ground foraging mammals... by *Greg Martin, courtesy CWC Newsletter 33, Winter 2006*
- # A small wildlife garden & Wildlife Observations by *Leigh Murray, NSW*
- # Heavy Metal poisoning in birds by *Anita Williamson, SA*
- # Bird Recovery News, Media articles
..... and more

HAPPY READING!

The opinions expressed in this Newsletter are not necessarily those of ASGAP, or state APS groups. No responsibility is taken for any information or advice contained therein.

MAILBAG CONTINUED...

Harry Franz has sent me a very interesting letter on a number of diverse issues, and thoughtfully he has included several articles for the newsletter. I'd like to share some of his letter with you...

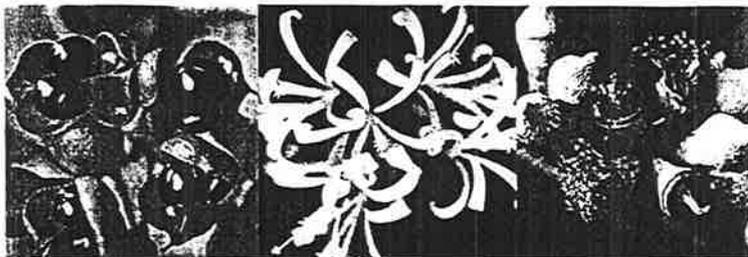
'Among the great articles in Issue 55, the "Mallee to Energise Agriculture" interested me the most. Farming in Australia is always evolving. There are several thousands of hectares of timber eucalypts to be planted near Kingaroy soon by the Queensland Government, on deeper soils, mostly red volcanic loams. Dryland farming in our area has resulted in many years of failed grain crops and poor bank balances. Many farms have been purchased by the Qld. Government at seemingly good prices. Farmers can also arrange to keep their farms and plant trees for the Qld. Forestry Department under several good paying plans. The first plantings of eucalypt plantations in our area were planted from around 2000. The area has been growing since then. Smaller areas of Hoop pine (a native rainforest pine) have been planted as well as several Pawlonia plantations. One pulpwood eucalypt plantation of 36 hectares was planted about 2000 also and is doing well 4kms. from where I live....'

Barbara Melville, has been working in the Kimberley since joining recently. Barbara is the coordinator for a Naturewatch Diary project with the Community Environment Network based on campus at Ourimbah University.

To all our members - I'm sure wherever you are, that you have been doing what you can to advance our native flora and fauna. So keep up the good work!

NEW REFERENCES AVAILABLE

⊕ Electronic References include
Australian Orchid Genera CD-ROM
Grasses of Australia CD-ROM
Euclid - Eucalypts of Australia 3rd ed.
DVD and CD-ROM



Plants of Capricornia

BOOK REVIEW Plants of Capricornia

By Melzer and Plumb, due out Sept.2007

Pre-release information states the book has 'more than 600 native species described and photographed: trees, shrubs, mistletoes, vines, grasses, sedges, orchids and other herbaceous species. Keys to species in each genus. Human usage and ecological notes.' Books may be ordered pre-release at a special rate \$80 hardcover, and \$50 softcover. Apply to Capricorn Conservation Council or SGAP Qld.

Some time ago I was asked for a list of titles and past newsletters that could be purchased. I have now completed that list, (having cleaned out my bookshelves) and it is enclosed with your newsletter. If you are after a specific item, not on the list perhaps you might like to drop me a line, and I'll see what I can do; or you may like to contact your own State branch of APS (SGAP) who generally stock an extensive range of books. Good bookstores also may have them .

Speaking of books, some new titles recently on the shelves. These include:

- ⊕ *David Banks 'Orchids',*
- ⊕ *David Jones 'A Complete Guide to Native Orchids of Australia'*
- ⊕ *Bob Chinnock 'Eremophila and allied genera',*
- ⊕ *Symon & Jussieu 'The Book of the Sturt Pea' (reviewed last issue);*
- ⊕ *Jessop 'Grasses of SA'*
- ⊕ *Cavanagh' & Pieroni 'Dryandas'*
- ⊕ *'Growing Native Plants on the North Coast of NSW' by APS NSW -Coffs Harbour Group*
- ⊕ *Harden, McDonald & Williams 'Rainforest Trees and Shrubs'*
- ⊕ *Zborowski & Edwards 'A Guide to Australian Moths'*
- ⊕ *Peat, McDonald & Talbot Grow What Where 3rd edition+ CD-ROM*
- ⊕ *Aust. Natural History Series, 'Bettongs, Potoroos and the Musky Rat-Kangaroo'*

HINTS FOR PLANTING TREES IN RURAL AREAS

Planting

Planting is best timed when the ground is wet from recent rain. The hottest part of summer is the most difficult time to plant because the ground dries out so quickly. On most soils, it is useful to leave a small depression around the young tree to facilitate watering and to catch rain water. It is important when planting that the soil level at the top of the root ball is the same as it was in the pot. Burying the plant too deeply or shallowly can injure it. Watering at planting time will ensure a good chance of establishment. If necessary, it is important that follow-up watering be done. Therefore, it is best to plant only in numbers that can be managed. If however you plant in dry soil conditions, dig the planting hole and presoak with a minimum of 10 litres of water. Add a minimum of 10 litres after planting and repeat weekly for 4 weeks. Then water 2 weekly, then 3 weekly, then monthly. Continue until a soaking fall of rain between 75 – 100mm. Plant frost hardy species if frost will be a problem or protect frost tender species for a couple of years, during winter, to establish some plants. Wooden stakes and bags can be used to cover frost tender plants. Some organic or artificial fertiliser at planting time can be useful. Use one of the pelleted organic fertilisers, complete with added sulphate of potash and trace elements, at 100 – 200 grams per tree, mixed through the soil at planting time. With other fertilisers, follow directions on the bag, being careful not to exceed recommendations.

Keep grass and weeds away from young trees

Keeping grass and weeds away from young trees will encourage faster growth rates. Chipping or using herbicides such as Glyphosate are two possible methods. Be most careful with herbicides – young trees are easily killed by spray drift.

Animal damage a major threat

Many animals can pose a threat to young trees including cattle, horses, goats, hares, rabbits, and wallabies.

Cattle and horses have long necks and need to be kept well away from plants. They will push through and reach over wire fences and guards to reach trees and grass if the guards are not substantial. When cattle have access to young trees, they will eat, trample, and smash down trees, even up to two metres high. Make fences and guards EXTRA STRONG to keep these animals out.

Many people have trouble with **hares**. They nip off smaller trees of many different species. A variety of guards can be useful. Old car tyres tend to deter them. Netting of metal or plastic can be used and secured with stakes or pegs. Grow tubes or bags can be used, again supported by stakes. Any guard can be removed as trees get bigger and re-used for new plantings.

Goats can be very destructive by browsing small trees and chewing off the bark of bigger trees.

Wallabies can be a problem and need to be fenced out or young trees protected with guards to prevent browsing.

Mulch

Mulch can be useful for suppressing weeds and conserving moisture. Keep mulch away from the stems of young trees to avoid fungal damage. By far the most commonly available mulch in rural areas is low grade hay. Hay usually breaks down quickly, improving the soil. Other useful mulches include pine bark and wood chips. These break down very slowly, but suppress weeds well.

Fire

Fire must be kept away from all young trees as it can destroy years of growth. Species with lignotubers (a large underground storage organ), including eucalypts, can sucker after a fire to produce another tree. It is best to reduce the fuel load near trees by mowing or slashing. Fire breaks will help protect groups of trees.

Planting local varieties

The trees that already occur in any area are always the best to plant – they are well adapted to local conditions such as soil types, rainfall, frost tolerance and pest and disease resistance. It is recommended that trees be propagated from seed collected from those trees occurring locally. This is not always practical, but will be the most successful approach.



Seed technology boosts native plants

MANY Australian plants produce poor quality seeds or seeds that are deeply dormant, making successful plant establishment difficult, even impossible.

Recent research to develop synthetic clonal seeds will potentially make mass plantings more viable and lower the costs of land rehabilitation and commercial wildflower production.

Somatic embryogenesis is a process to create an embryo from somatic (non-sexual) cells, eliminating the need for sexual reproduction.

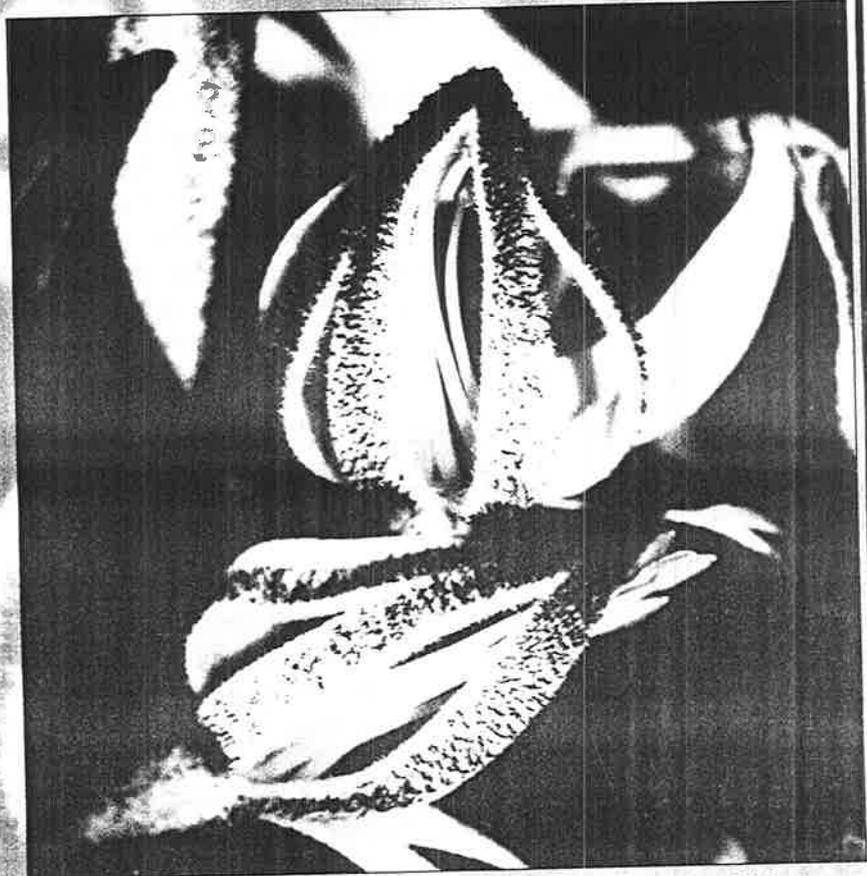
A recent project from the Rural Industries Research and Development Corporation (RIRDC) has investigated using this technology for the mass propagation of Australian plants for both land restoration and for use in horticulture.

The study has built a firm foundation for a superior mass propagation method for native plants that cannot normally be produced by conventional techniques. The study investigated three species that are in demand in the horticultural industry and two for used to rehabilitate disturbed sites including disused mining land.

"The estimated cost of producing a single plant under normal micropropagation methods can vary from less than \$1 to over \$5 depending on the species and how difficult it is to initiate into tissue culture," said researcher Maggie Panaia, of the Botanic Gardens and Parks Authority in Western Australia.

"Somatic embryogenesis (SE) is at least 10 times more efficient with approximately 200 SE per petri dish compared to 15-20 plantlets produced in one tissue culture vessel using normal micropropagation techniques. This means the cost can conservatively be estimated at 10 to 50 cents per plant – a significant saving over current production costs.

"In biodiverse regions or highly diverse floras such as the southern parts of Western Australia, mining often leaves significant components of the biome not



Black Kangaroo Paw is a popular plant but is slow to multiply in sufficient numbers to satisfy demand.

effectively rehabilitated. For example, southern rushes (sedges) and native heaths represent up to 30% of pre-mined diversity and biomass, yet current rehabilitation technology returns barely 1-2 %," Dr Panaia said.

Somatic embryogenesis also has applications for the horticultural potential of unique Australian plants.

"The Black Kangaroo Paw and Koala Fern are in heavy demand in the horticultural industry, but they are slow to multiply in sufficient numbers to satisfy this demand," she said.

"The use of somatic embryogenesis as a technique to deliver a low cost, superior, mass propagation method for these native plant taxa will effectively reduce the cost of production, reduce loss of biodiversity, increase the efficiency of

rehabilitation programs and boost the supply of these species to the horticultural industry."

Roslyn Prinsley, RIRDC general manager for new industries, said that the research has potential for the wildflower industry and the environment.

"This work has laid the foundations for commercial development, and has showed the enormous potential that this technology has for both commercial wildflower production and land rehabilitation," Dr Prinsley said.

"By investing in innovative technologies like this, RIRDC helps the wildflower industry to become more profitable, more sustainable and better equipped to cope with adverse conditions."

Contact: Dr Roslyn Prinsley, RIRDC Canberra phone 02 6272 5227, or visit <www.rirdc.gov.au>.

The Role of small ground-foraging mammals in top-soil health and biodiversity: Implications to management and restoration.

By Greg Martin

(Reprinted from Ecological Management & Restoration Vol 4 No 2 August 2003) from Stipa Newsletter No 33 Pp 43-51.

This article arose from observations made of the habits of bilbies, bettongs and bandicoots while Greg Martin was project manager of Scotia Sanctuary in far western NSW where the animals were free to roam in a large, feral-free environment.

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Summary: Many early Australian records indicate that at the time of European settlement there were extensive tracts of highly productive, and species-rich, grassy communities and chenopod shrublands. Topsoils in many areas were soft and friable. The rapid development of livestock industries led to most changes to the environment being simplistically ascribed to domestic stock grazing, land clearance, introduced pests (such as rabbits) or changed burning practices. It has also commonly been assumed that the hoof action of domestic stock was the principal cause of the compaction and surface sealing of soils in many areas. However, the rapid soil deterioration also coincided with the dramatic decline or complete extinction of many small native ground-foraging mammals and the consequent cessation of the soil disturbances and interactions that they created. This paper reviews the role of small mammals in disturbing soils, and implications for incorporation of organic matter, aeration, improvement in infiltration and the provision of suitable sites for seed germination and seedling establishment. This can aid topsoil formation and health by providing substrate for microorganisms, improved water balance and mineral cycles and enhanced soil structure. Seeds and mycorrhizal fungi, that are integral to the establishment and growth of many plants, are spread. Such intermittent disturbance may be an important driving force in determining the pathway of succession and lead to greater biodiversity. Further ongoing research on Australia's small mammals is needed, especially in areas where they are able to move freely in a natural environment and are protected from introduced predators.

Key words: bandicoots, bettongs, bilbies, ecological disturbance, mimicking nature, mycorrhizal fungi, potoroos, pre-European landscapes, soil formation.

Historical perspective: Impact of European settlement

Extracts from a range of early pioneers' diaries often reflect a substantially different soil and water environment from that seen in Australia more recently. Soils were often described as loose, soft and friable, or becoming hardened and less absorbent (Reid 1876; Bean 1916; Bignell 1982; Sayers 1983; Spence 1997).

Few observers of the time, recognized or recorded the important role that native species played in forming or maintaining the landscape and evidence of the number and density of native animals, many of which were nocturnal, was often scantily recorded. However, in some localized areas, some species were once observed in large numbers. Krefft (1866) an early zoologist, wrote about the Burrowing Bettong (*Bettongia lesueur*):

I have often seen several acres of ground covered by these holes...By far the larger number of animals inhabiting the extensive plains on the Murray Darling are marsupial; and with a few exceptions truly nocturnal in their habits. This accounts for the apparent scarcity of animal life...

Troughton (1946) wrote about the Burrowing Bettong that:

Before the spread of the fox, rat-kangaroos were so numerous that settlers often had to take measures to safeguard their crops and haystacks

And of the Bilby (*Macrotis lagotis*), he wrote:

The largest species once ranged from the Great Dividing Range in New South Wales to the south-western coast of Western Australia, being quite abundant in suitable country, even near such cities as Adelaide, within the last 50 years.

The rapid decline in numbers of these small mammals was, however, noted by Krefft (1866):

This burrowing Bettongia has long retreated before herds of cattle with which the plains bordering on the Murray are now stocked; and it is no longer to be found south of that river...

Noble (1995) investigated relict burrows from the, now locally extinct, Burrowing Bettong in a 5-km² area west of Louth, NSW. An average of seven warrens/km² were recorded. Assuming an average colony size of 10 animals, Noble (1995) conservatively estimated previous populations at around 70/km², although he noted that much higher populations of around 50-60 bettongs per warren had been recorded elsewhere.

Currently, about one-third of all mammal extinctions worldwide are Australian, most were marsupials. At least 10 species and six subspecies of Australian marsupials are extinct with many more threatened with extinction. Increasing numbers of species are under pressure regionally with about one-third of all mammal species having disappeared in the central forests. Over one-quarter of marsupial species are locally extinct in some heavily cleared agricultural areas. The main causes of extinction in some heavily cleared agricultural areas. The main causes of extinction and decline have been identified as the introduction to Australia of predators, such as the Red Fox (*Vulpes vulpes*) and Feral Cat (*Felis catus*) and of herbivores such as the Rabbit (*Oryctolagus cuniculus*), sheep and cattle, habitat destruction through land clearing and changed fire regimes (Maxwell *et al.* 1996).

Australian soils

Australian soils have been shaped by a number of processes and events that differ in significant ways from those operating processes such as uplift, glaciation or volcanic activities have been minimal in recent geological history and most present-day soils are old and deeply weathered, resulting in low intrinsic soil fertility (White 1994; Murphy 2000).

This coupled with low and sporadic rainfall in some regions, requires that soil fertility in many areas is dependent on the levels of biological activity in the upper layers. The patchy soil disturbances created by small mammals can therefore have profound effects on water harvesting and moisture retention in surface soil (Laundre 1993; Whitford & Kay 1999). This is an important first step for the establishment of functional microbial and plant communities, particularly in arid or otherwise hostile environments (Andersen & MacMahon 1985; Guo 1996; Hawkins 1996; Desmet & Cowling 1999) Small mammal foraging scratchings and pits also trap plant litter and seeds, forming nutrient-rich germination sites that enhance species diversity and can influence ecosystem processes from the microhabitat to the landscape scale. (Heske *et al.* 1993; Alkon 1999; Whitford & Kay 1999) and may play an important role in determining the pathway to succession (Andersen & MacMahon 1985).

In overseas studies, the pivotal roles of nocturnal mammals in ecosystem function have been determined by experimental enclosure (Crawley 1986). In Australia, due to the rapid decline in native animal numbers at the time of European settlement and the ongoing threat of introduced predators, observations of many species in a natural environment has been limited. For the major portion of the continent, the landscape is now devoid of many of the animals that existed pre-1788.

Changes in soil condition

James Cotton, stock inspector for the Cobar Sheep District NSW, in giving evidence to the Commission into the Western Lands (Royal Commission on Western Lands 1901) stated:

In the years 1880 and 1881, before this district was stocked, and when it was being improved, the country was covered with a heavy growth of natural grasses – kangaroo grass, star grass, blue grass, mulga, and other grasses. The western half of the district abounded with salt (bush) and cotton bush together with the grasses mentioned. The ground was soft, spongy and very absorbent. One inch of rain then, in spring or autumn, produced a luxurious growth of fresh green grass... There has been a gradual deterioration of the country caused by stock, which has transformed the land from its original soft, spongy, absorbent nature to a hard clayey, smooth surface (more especially on the ridges), which instead of absorbing the rain runs it off in a sheet as fast as it falls, carrying with it the surface mould, seeds of all kinds of plants, sheep manure, sand, etc., to enrich the lower lying country and plant it with pine, box and other noxious shrubs.

George Riddoch remembered his early years at 'Weinteriga' Station (Royal Commission on Western Lands 1901):

When I got away from the track the horses went up to their fetlocks in loose, friable soil...it was like a well tilled field; and the moisture, as it fell, penetrated the soil and fertilized the plants. Now it is scarcely an exaggeration to say that the very ground I am speaking of rings under the horses hooves...

Shortly after settling in the Wannon country of south-western Victoria, Robertson (1853) recorded the extraordinary and rapid decline on his property:

The long deep-rooted grasses that held our strong clay hill together have died out; the ground is now exposed to the sun, and it has cracked in all directions, and the clay hills are slipping...there have been hundreds [of landslips] within the last three years... Ruts seven, eight and ten feet deep, and as wide, are found for miles, where two years ago it was covered with tussocky grass...I will not be able to keep the number of sheep the run did three years ago...it requires no great prophetic knowledge to see that...every year it will get worse.

It is hypothesized that the almost complete loss of Australian small ground-foraging mammals shortly after European settlement contributed to the rapid deterioration recorded in soil health and significant changes to flora and fauna communities.

Small ground-foraging mammals: Their role in soil health and biodiversity.

Bettongs, potoroos, bilbies and bandicoots use their long claws and strong forefeet to turn plant litter and dig shallow scratchings, pits and/or holes when foraging for a variety of foods that include fruits, seeds, roots, insects, fungi, tubers and invertebrates (Strahan 1995). During the foraging process they mix organic matter into the soil (G. Martin, pers. Obs., 2000), spread mycorrhizal fungi and seeds and improve conditions for water collection, absorption and seed germination (Sampson 1971; Christiansen 1980; Claridge et al. 1992; Noble 1995; Garkaklis et al. 1998).

It has been established that the Brush-tailed Bettong (*Bettongia penicillata*) make between 20 and 100 diggings a night foraging and may churn more than 6 t of soil each year (Garkaklis 1998). I have observed that the number of digs by many other species including Burrowing Bettong, Bilby, Southern Brown Bandicoot (*Isodon obesulus*) and Long-nosed Potoroo (*Potorous tridactylus*) appear to be similar, although the amount of soil turned may vary with the size of the animal and variations in their diet. Clear evidence of the difference these mammals make can be gauged by the degree of soil softness experienced underfoot when walking over areas that are populated by bettongs, bilbies, potoroos and bandicoots (G. Martin, pers. Obs., 2000). These diggings and scratchings therefore represent a substantial, ongoing impact on the soil.

The action of their digging moves the soil under and behind the animal often resulting in the soil being turned over and organic matter broken into smaller particles and mixed into the soil (G. Martin, pers. Obs., 2000). This intermixing of organic matter with the soil is important for nutrient cycling (Faulkner 1945; Soule & Piper 1992) and the mixing effects may be apparent after the animals have disappeared from a locality (Andersen & MacMahon 1985). The breaking up of organic matter and mixing into the soil also has the potential to reduce the mass of readily combustible plant material accumulating on the ground. This can be especially noticeable under some tree species (e.g. mallee eucalypts) where large mounds of litter may form, increasing the likelihood of a potentially more damaging crown fire. Some small mammals may also help maintain the balance of trees, shrubs and grasses in the landscape (Noble 1993) by browsing on seeds and new seedlings that germinate after rain or fire. Consequently burning may be less likely to lead to the predominance of a few fire-tolerant species, closely spaced (encouraging more fires).

The function of small mammals in a wide range of ecological processes including inoculum dispersal, organic matter cycling, soil aggregate formation and stability, microbial diversity, water relations and plant community dynamics has been demonstrated (Claridge et al. 1992; Heske et al. 1993; Laundre 1993; Claridge 1996; Guo 1996; Hawkins 1996; Garkaklis et al. 1998; Whitford & Kay 1999; Zaady & Bouskila 2002). Linking this research with research on rehabilitation of inhospitable environments it has been suggested that bettongs, bilbies, potoroos and bandicoots have the potential to have played a key role in soil and vegetation dynamics and may have been an important agent in determining pathways of succession in the recovery from the inhospitable Pleistocene period (Andersen & MacMahon 1985; Desmet & Cowling 1999).

Interactions with soil biota

Intermixed organic matter provides substrate for a wide range of soil biota, including bacteria, fungi, actinomycetes, nematodes, algae, protozoa and viruses (Killham 1944) and is the first step in soil building. In the absence of this substrate, soil biota are dramatically reduced in number and variety (Donahue et al. 1983; Jordan 1988). This process may be particularly important in drier areas where a soil crust can form

underneath plant litter which could prevent its utilization by soil biota. Soil biota perform a wide range of functions in the soil ecosystem including the acquisition and cycling of carbon, nitrogen, sulphur, phosphorus and other nutrients (Killham 1994; Jordan 1998). In addition to their contribution to plant nutrition, they produce sticky secretions, fungal filaments and humic materials that cement mineral particles together into aggregates. Improved soil structure means more water can be held in the pores, between and within the soil aggregates, prolonging plant growth after rain and less rapid drainage of water to lower parts of the profile (Faulkner 1945; Donahue *et al.* 1983; Killham 1994). The interactions between soil biota, the rhizosphere the soil matrix and the intestinal microbial populations of animals are therefore fundamental to soil health and soil building and are the driving force of most terrestrial ecosystems (Killham 1994).

Under natural conditions, most plant roots form highly evolved symbiotic mycorrhizal associations with soil fungi (Fitter 1986; Soule & Piper 1992). Endomycorrhizal and ectomycorrhizal associations are of particular significance to soil and plant ecology (Killham 1994). Mycorrhizal fungi produce fine hyphal threads that wind between soil particles and grow into decomposing organic matter. When in symbiosis, they obtain nutrients and water from the soil and translocate these to the host plant. In return, the fungi receive energy in the form of carbohydrates (Donahue *et al.* 1983; Fitter 1986; Claridge 1996).

Numerous ectomycorrhizal fungi produce spore-filled underground fruiting bodies (truffles), which are sought by mesomarsupials such as potoroos, bandicoots and bettongs (Claridge *et al.* 1992; Strahan 1995; Claridge 1996; Johnson & McIlwee 1997). Although the bulk of the fungal tissue eaten is digested, the spores pass through the gut of the mammals intact, and are voided back into the soil (Claridge *et al.* 1992), enabling new mycorrhizal associations to form. Benefits to the host plant of mycorrhizal infection may include faster growth, improved nutrition, resistance to high temperatures, greater drought tolerance and protection from pathogens (Donahue *et al.* 1983; Fitter 1986; Killham 1994). Indirect benefits to nature plant communities include enhanced soil structure, higher species diversity and greater competitive ability against weeds.

The Long-footed Potoroo (*Potorous longipes*) is a specialist mycophagist and is probably the key vector for mycorrhizal fungi in habitats where it forages and as a result plays a vital role in both regenerating (disturbed) and mature (undisturbed) eucalypt forests (Claridge *et al.* 1992). The conservation of this and other fungus feeding fauna may therefore help maintain critical ecosystem processes (NSW National Parks & Wildlife Service 2001).

Water repellent and hardened soils

The foraging action of small native mammals provides a site for water to infiltrate. In tests undertaken in Western Australia on the effects of the Brush-tailed Bettong foraging on soil water repellence and water infiltration, water repellency was apparent over the entire sampling area, with most soils highly water repellent. At the edge of the digging spoil, water repellency fell sharply from severe to low and was low throughout the entire disturbed region (Garkaklis *et al.* 1998).

After heavy rainfall, distinct colour differences were clearly visible in the soil profiles near diggings, indicating preferential water infiltration. Subsoil water content was also significantly greater in the darker soils below each digging, compared with the paler soils in the undisturbed zones (Garkaklis *et al.* 1998).

With more effective infiltration comes a more effective nutrient cycle, as nutrients are only available in solution to plants. Water trapped in the foraging pits also reduces runoff velocity and the tendency for erosion. Non-wetting or water repellent soils are common to many areas in southern Australia (Garkaklis *et al.* 1998). A crust-like surface feature is usually apparent which acts as a barrier to an underlying wettable soil (DeBano & Rice 1973). These biological crusts are a major component in undisturbed dryland ecological systems (Elridge *et al.* 1995). In the successional pathway of the crust communities, the pioneer colonizers of the soil surface after disturbance are the cyanobacteria, followed by green algae, mosses and lichens (Eldridge *et al.* 1995; Zaady *et al.* 2000).

Small mammal scratchings and diggings may have significant benefits to the biodiversity of such areas. In a study conducted in the Arava Valley, Negev Desert (Zaady & Bouskila 2002) into the relationship between the successional stages of biological soil crusts and the distribution of lizards, it observed four stages of the biological soil crust succession (loose sand, fragile crust, medium crust, hard crust) were characterized by the degree of soil surface compaction. Gekos and diurnal lizards strongly preferred the fragile crust, where they dug 80% and 94% of their burrows, respectively, and the distributions of burrows of these species are affected

by soil surface characteristics. Soil crusts may thus play an important role in determining burrow location. Lizards mostly used young crusts to support the entrance of their burrow. If left untouched for several years these fragile crusts converted into harder and thicker crusts due to successional processes. When fully developed the hard crusts are avoided by the lizards as they are probably too hard to dig into. Likewise, the crustless loose sands are avoided, as the lizards need surface stability to provide support for the entrance of the burrows. The results of this study indicated that at the extreme levels of disturbance (either high or low) the establishment of shelters essential for the survival of the lizards may be prevented. This finding was consistent with the intermediate disturbance hypothesis which predicts that the highest species diversity will be at intermediate levels of disturbance. In extreme cases (too harsh/common or too mild/rare disturbances) few species are predicted to persist. The reason is that under a regime of harsh or common disturbances, only few species can withstand the deteriorated conditions, and under mild or rare disturbances, a few species will dominate the system and prevent the establishment of others (Connell 1978; Petraitis et al. 1989; Zaady & Bouskila 2002).

It was noted by Zaady & Bouskila (2002) that because the maturation of soil crusts with time is a general phenomenon the findings are probably relevant to other organisms and other areas. **They recommended that land conservationists and managers should take these findings into consideration when planning the management of natural habitats and nature reserves where lizards are an important part of the ecosystem.**

In pre-European Australia, not all areas would have been equally affected by small mammal soil interactions. Animal impacts change as density changes due to predation pressure and availability of food, and in arid and semi-arid areas, episodic rainfall that may result in localized [areas] increases in some species such as Brush-tailed Bettong that exhibit embryonic diapause (Strahan 1995). The resulting intermittent patch dynamics would have had important consequences for the health and preservation of other species and the maintenance of biodiversity. This fits with the intermediate disturbance hypothesis (Connell 1978; Petraitis *et al.* 1989).

Mimicking nature to rebuild environments

A challenge that faces Australia today is to halt the decline of soil health and biodiversity and restore existing degraded lands. One solution may be to replicate the rebuilding processes implicit in the recovery to the environment from the inhospitable dry Pleistocene period through to the onset of European settlement by mimicking or using native species as catalysts.

Recent evidence of the significance of small mammals in the rehabilitation of inhospitable environments include: (i) the role of pocket gophers in plant colonization following the Mount St. Helens volcanic eruption in the USA (Andersen & MacMahon 1985), and (ii) the creation of 'islands of fertility' exhibiting improved levels of organic matter, microbial activity, soil structure, soil water relations and plant cover, where fossorial rodents have colonized spoil in South Africa (Desmet & Cowling 1999).

Soil is a dynamic medium and requires periodic localized disturbances in the top layer, where most biological activity takes place (Soule & Piper 1992). Some small mammal soil disturbance actions that aerate the soil, improve water infiltration and provide optimal sites for seed germination and seedling establishment may be mimicked with machinery such as pitter seeders and imprinters that create shallow pits. These may collect plant litter and retain water, improving soil micro-climate and germination outcomes in dry environments (Scholtz 1996), although they often lack the important and varied synergistic effects of native animal interactions.

In areas needing revegetation such as mine site spoils, forestry or agroforestry, soils are sometimes infertile and lacking in sufficient mycorrhizal fungi. The absence of microbes (e.g. mycorrhizae) can severely limit seedling establishment, plant growth, and plant survival (Jasper 1994). As a result the success of revegetation efforts may be significantly influenced by the extent to which microbial activity in soils has been affected and by the extent to which it can be subsequently restored (Archer & Pyke 1991; Rao & Tak 2002). Nutrients taken up by the mycorrhizal fungi in infertile soils may lead to improved plant growth and reproduction and are often considered biofertilizers; that is, while they do not add inorganic nutrients to the soil, they may improve the exploitation of soil resources for poorly mobile nutrients (Sylvia 1999). **Research has also shown that selected fungi may also increase Eucalyptus spp. growth in saline soil (Jasper 1944).** Inoculating seeds or seedlings before planting is one method of utilizing the benefits of mycorrhizal fungi (Jasper 1994; Sylvia 1999; Rao & Tak 2002), but is only practical in intensive plant production. Future research may find that in some situations such as new, regenerating, mature forests, and mine spoils,

protecting existing populations of native mammals or reintroducing new ones who are vectors for the fungi (Claridge *et al.* 1992) may be an alternative approach that also has other significant benefits to biodiversity. Grazing effects by domestic stock can cause considerable impact with declines in native perennial cover, increase in exotic annual cover, reduced litter cover, reduced soil cryptogam cover, loss of surface soil microtopography, increased erosion, changes in the concentration of soil nutrients, degradation of surface soil structure, reduced soil water infiltration rates and changes in near ground and soil microclimate (Yates *et al.* 2000). New techniques of grazing where the simulation of natural movements and grazing patterns, based on early predator prey relationships, which result in short pulses of animal impact followed by adequate periods of rest, are lately being used by some pastoralists to improve soil surface conditions and increases in native groundcover (Earl & Jones 1996; Jones 1999; Jones 2000).

The degradation of soil structure and loss of ecosystem functions after severe grazing can be difficult to reverse (Yates *et al.* 2000). Soil compaction impedes root growth and therefore reduces the ability of the roots to provide the plant with water and nutrients. Soil compaction also reduces water infiltration rates and therefore reduces soil water recharge. Soil water availability may be far more limiting in heavily grazed areas with implications for plant growth reproduction and seedling establishment (Yates *et al.* 2000).

Long-term effects of degraded areas are unlikely to be restored by simply removing livestock but will require strategies that capture resources, increase their retention and improve the microclimate (Yates *et al.* 2000). One of those strategies could be the reintroduction of native mammals such as bettongs, bilbies, bandicoots and potoroos, whose intermittent soil disturbance activities incorporate organic matter into the soil, aerate the soil, improve the infiltration of water and spread mycorrhizal fungi and seeds. The return of these species to many areas would, of course, be dependent on the successful and continuous control of introduced predators (which is an areas of current research and development by many land managers); the re-establishment and maintenance of suitable habitat; research on reintroduction techniques and a review of the current regulations relating to their reintroduction on private land.

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References

If references to this article are required, please email Greg Martin at scotiagmart@bigpond.com



Blair Parsons (CSIRO Sustainable Ecosystems) releasing a burrowing bettong during a monitoring session in October 2003 as part of a Round 6 JSN Community Grant Project.
Credit: Useless Loop Community Biosphere Project Group Inc.
From: *The Web*, Threatened Species Newsletter, Spring 2004.

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Aerial photograph showing the importance of remnants and corridors within a largely cleared landscape.
Photo: Geoff Biddle
From: *Wildlife Corridors*, Dept. Environment and Conservation (NSW).
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Wildlife Observations

by Leigh Murray

We have two gardens, both aimed squarely at attracting wildlife. One garden is on a few hilly acres of bushland at Queanbeyan near Canberra. We've planted additional natives amongst the large indigenous trees (mainly *Eucalyptus goniocalyx*, *E. polyanthemos*, *Exocarpos cupressiformis* and *Callitris endlicheri*) and shrubs (*Acacia rubida* and *Bursaria spinosa*). The other garden is on a 900sq.m block close to the ocean at Tuross Head on the NSW South Coast. Initially bare except for two large Norfolk Island Pines, it's now heavily planted with native shrubs, climbers and trees. We often see wildlife in and about our gardens. Here are some observations.

- **Noisy Friarbirds** were scarce this year, and the numbers of these marvellous characters have steadily decreased over the past few years. Like most other honeyeaters, they migrate each spring to our areas, stay for summer and early autumn, then head north again around Anzac Day. They're fond of toothbrush-flowered grevilleas (eg, *Grevillea* 'Coastal Glow', *G.* 'Poorinda Peter').
- **Yellow-tailed Black-Cockatoos** were unusually plentiful around Canberra for two years after the 2003 bushfires, but they've been few and far between for the past 6 months. There have been fewer at the Coast, too. They enjoy the seeds of *Banksia integrifolia*, *B. spinulosa*, *B. marginata* and *Hakea eriantha*.
- Small numbers of **Rainbow Lorikeets** visit Tuross Head where they fancy the flowers of *Eucalyptus leucoxydon*, *Hakea multilineata*, *Grevillea* 'Coastal Glow', *G. arenaria* and *Melaleuca fulgens*.
- A few **Red Wattlebirds** are resident year-round in both gardens. They're our dominant honeyeater at Queanbeyan. Not only do they love the nectar-rich flowers of grevilleas, callistemons and banksias but they also like *Eremophila denticulata*, *Correa glabra* and *C. reflexa* 'Clearview Giant'. Last summer their toddlers were parked each day in a flowering *Callistemon* 'Harkness'.
- **Little Wattlebirds** are the dominant bird in our Tuross garden, and they're very bossy indeed. To our dismay they chase spinebills fiercely. They also tag along behind lorikeets while they're feeding on grevillea flowers, biting their tails. The lorikeets just ignore them.
- The delightful **Eastern Spinebills** sip nectar from *Epacris longiflora*, *Correa glabra*, *C. baeuerlenii*, *Grevillea victoriae* and other spider-flowered grevilleas and *Banksia ericifolia*. Some of our spinebills let rip with amazingly loud, long trills.
- For many years **Crested Pigeons** were found only further along our ridge at Queanbeyan. They finally made it to our place last spring – and promptly nested in a largish (4m tall x 3m wide), dense *Leptospermum* 'Copper Glow'. They built an untidy cup nest about 2 metres above ground level, and there they raised three clutches of babies. The fledglings spent the daytime hidden in a large *Exocarpos cupressiformis*.
- **Common Bronzings** have nested in our large trees at Queanbeyan for years. They have a wonderful deep 'oom oom' call in the breeding season – it sounds just like a mechanical pump. They sometimes raise one wing, flashing a pinkish armpit (usually males do this).
- For seed-eaters, **Crimson Rosellas** are surprisingly fond of *Darwinia citriodora* and *Grevillea jephcottii* flowers. They also chew on the foliage and flowers of *Westringia* 'Wynabbie Gem'.
- **Gang-gang Cockatoos** weren't sighted at Queanbeyan until the 2003 bushfires. They turned up soon afterwards to dine on *Eucalyptus goniocalyx* seeds, and they've dropped in each winter since.
- A newly built **Magpie** nest was blown off its perch near the top of a Norfolk Island Pine during a windstorm at Tuross. The intact nest landed right way up eight metres away. I propped it up in a small, dead acacia. The magpie built a new nest in another Norfolk, plundering the first nest (she'd lined it beautifully with grasses and dog fur).
- A real treat for me this year was our first 'jewel' spider for many years. That is my name for tiny **hexagonal spiders** (six-spined spiders) that build webs in the garden. They are absolutely gorgeous.
- A mature male **Satin Bowerbird**, resplendent in navy blue plumage, popped in to Tuross this autumn. We think Bowerbirds breed on the golf course nearby because for the past two summers, a Mum and Bub turned up each morning to feed at our place.

- Some years ago, **Crimson Rosellas** twice attempted to nest in a downpipe (6 metres above ground). One rosella was found dead at the stormwater exit, and one was heard trapped at the bottom of the pipe (we managed to rescue it).
- Almost as soon as our house at Tuross was built, **Welcome Swallows** nested on the carport beam. But that area was very open, and a magpie killed a barely fledged baby as it fluttered nearby. The next year the swallows set up shop on the beam in the adjacent garage, flying in and out via a narrow slit above the door. This worked so well that they return each year to breed. (We cover the car with a tarpaulin as poo-protection.)
- It's taken seven years for our garden at Tuross to be put 'on the map'. We've only recently had visits from a pair of **White-headed Pigeons** and a mob of **Thornbills, Fantails** and **Fairy-Wrens** (their massed twittering is charming). The mixed mob that is a regular feature at Queanbeyan also has **Pardalotes** and the odd **Treecreeper**.
- Another recent first time sighting at Tuross was a **Microbat** wheeling around at dusk. For years, we've seen a group of microbats regularly at Queanbeyan.
- From time to time, usually after rain, **Eastern Whipbirds** circumnavigate our garden at Tuross, foraging for insects along narrow tracks amongst shrubs. The whipbirds shun the exotic gardens of our neighbours.
- **Common Koels** breed each year in the Tuross area. **Channel-billed Cuckoos** bred there last year, and the previous summer they bred in our garden at Queanbeyan for the first time (using, I think, **Pied Currawongs** as hosts).
- **Tawny Frogmouths** used to sit on the same branch several days a week at Queanbeyan until I accidentally misted one ever so slightly while hosing foliage nearby. I haven't sighted them since. The moral: don't water your Tawnies!
- After reading that **Peron's Tree Frogs** like to sit on the large leaves of *Hakea petiolaris*, I planted one at Tuross in the area where a Peron's lives (I know he's there because he lets out a triumphant trill occasionally when I least expect it).
- **Whistling Tree Frogs** seem the most cold tolerant of the frogs at Tuross. They call on winter nights, as does the odd

Eastern Froglet. The **Striped Marsh Frogs** 'toc' a lot in the warmer months.

- **Jacky Lizards** are a common sight in our Tuross garden, where they sunbathe not only on rocks but also perched one metre up on the stiff foliage of *Rhagodia spinescens* and even on the soft foliage of a *Prostanthera incisa*. We've also been delighted to have the company in both gardens of **Blue-tongue Lizards**. They stay for months and soon clear the garden of any snails.
- I've found **small nests** (cup-shaped, unoccupied, well hidden) amongst the dense foliage of *Kennedia nigricans* and *Rhagodia spinescens*, 1 to 2 metres above ground level.
- **Wedge-tailed Eagles** soar overhead at Queanbeyan, and **White-bellied Sea-Eagles** at Tuross. We haven't noticed a **Little Eagle** at Queanbeyan for some years, but two flew overhead cheeping (as they do) at Tuross recently.
- We used to have visits from a **Swamp Wallaby** at Queanbeyan, but it hasn't been spotted this year. A small family of **Eastern Grey Kangaroos** often lolls around at Queanbeyan, where we also see and hear **Brushtail Possums**. But we haven't seen a **Ringtail Possum** or **Sugar Glider** there for years.
- **Galahs** at Tuross play slippery dips on the light pole. Two or three galahs line up on the flat part, then take turns to slide down the curved bit, shrieking.

Well, that's some of the wildlife events we've noticed recently. If you have any similar observations, please write a snippet or two about them. I'd love to hear of others' experiences with wildlife and native plants.

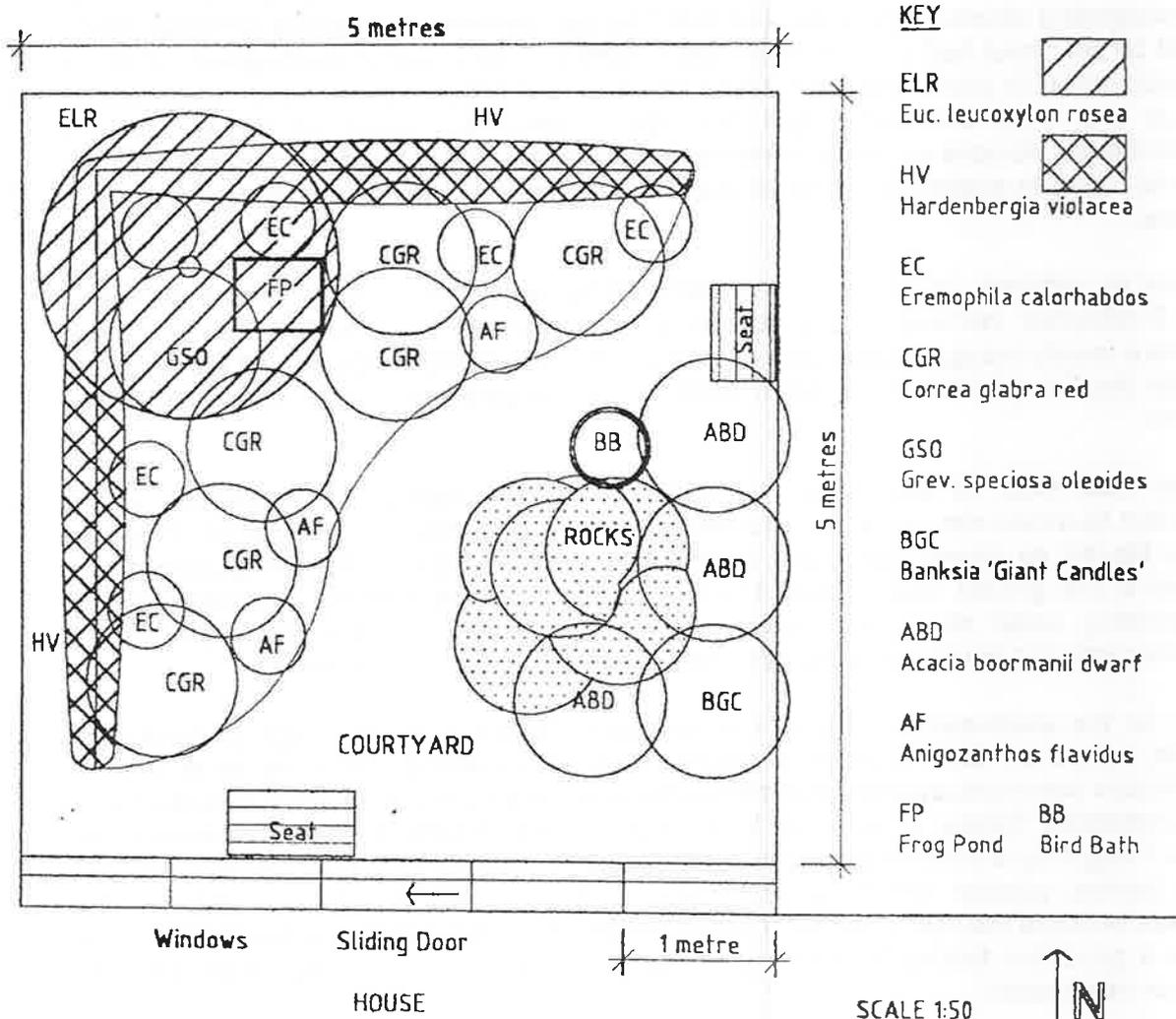


RING-TAILED POSSUM x 1/5

A Small Wildlife Garden

by Leigh Murray

Note: this article was written for the Garden Design Study Group, in response to a request for designs for small gardens of about 5 metres by 5 metres. I have no training in design and I'm certainly not expert – I just love wildlife and native plants, and thought it would be an interesting exercise to try to design a small garden specifically to attract as much wildlife as possible.



Despite being a rank amateur with no formal training in design, I found the idea of designing a small 5m x 5m garden such an appealing challenge that I decided to have a go. What would I do if the only garden I had were just such a small space? As someone who often has to stay indoors for long periods, my primary aim would be to attract wildlife, to have movement and sound that could be appreciated from indoors. I've imagined a heavily planted courtyard garden surrounded by a wall or brush fence, in front of north-facing windows.

The crucial element for this garden would be a slender tree with sturdy branches to act as a landing pad for passing birds. I'd sacrifice a little northerly winter sun for the benefit of having a bird-attracting tree, keeping it well pruned to maximize sun penetration in winter. Birds can enjoy quite a skimpy tree (our spindly *Eucalyptus caesia* of less than a metre spread is a big hit with birds – they love to perch in it). My first choice would be a nectar-rich, long-flowering eucalypt, probably a dwarf form of *E. leucoxylon rosea* (eg, 'Euky Dwarf') or perhaps *E. caesia*. Other possibilities are *E. curtisii*, *E. lansdowneana*, *E. mannifera* 'Little Spotty', *Acacia rubida*, *A. spectabilis* and *Banksia marginata*. All of these should suit training as a slender tree.

Climbers provide excellent habitat for small birds. So the second main element would be climbers trained on to an L-shaped structure on the north and west sides of the courtyard. The supporting structure, probably wire trellis spread between star pickets or timber posts, would be set about half a metre inside the fenceline. This is just enough space for me to squeeze along to prune and train the climbers, to keep them where I want them: out of shrubs and trees and neighbours. My colour preference would be purple or white *Hardenbergia violacea* or, more rampant, the gorgeous bright white flowers and feathery fruits of *Clematis aristata*. A lighter climber I'd consider is *C. microphylla*, which has cream flowers.

As well as climbers, I'd include several scrambling twiners, such as *Billardiera scandens* and *Eustrephus latifolius*, and that very scrambly shrub, *Epacris longiflora*. Because climbers usually leave an untidy gap at the bottom of the trellis, I'd grow a tall carpet of low shrubs (kept to about a metre high) such as *Correa glabra red* or *C. baeuerlenii* or *C. reflexa*.

In the main bed, I'd add tall skinny shrubs (several *Eremophila calorhabdos* and a *Grevillea speciosa* ssp. *oleoides*), clumps of *Anigozanthos flavidus*, a *Grevillea* 'Poorinda Royal Mantle' as ground cover, and a small frog pond based on a 60 litre recycling crate placed in the ground beside logs. The frog pond would be outfitted with rocks, lots of oxygenating water plants (eg. *Vallisneria spiralis*, *Marsilea mutica* and *Myriophyllum verrucosum*), and small fish (preferably indigenous, definitely not goldfish).

Then on the south-eastern side of the courtyard, I'd put rocks and logs as habitat for lizards, a *Banksia* 'Giant Candles' pruned to a tall skinny shape, and a few small acacias (eg, *Acacia boormanii* dwarf). I'd add *Xerochrysum viscosum* daisies, small strappy plants (eg, *Lomandra* 'Tanika' or *Dianella* 'Little Jess'), and a shallow bird bath. Amongst the rocks, I might try a *Kunzea pomifera*, *Enchylaena tomentosa* or *Einadia nutans* (all have tasty berries, popular with birds and lizards). I'd mulch the whole courtyard with tiny pebbles because they allow excellent water penetration, don't become water repellent, and make a good firm footing for paths. And I'd have a bench seat or two for sunning and outdoor observation.

The plants mentioned are top-class plants for wildlife. Most are long-flowering and nectar-rich, with small tubular or spider flowers that don't favour the large honeyeaters at the expense of little birds. All of them do well for us and none are weedy in our conditions. In other areas, different species might suit better. However, the basics for a small wildlife garden remain: a tree, climbers, a large bed of shrubs, a frog pond, rocks and logs, a bird bath, and easy access for pruning so that plants can be kept within bounds and performing at their peak. Although I might modify the plantings after some years of observation, this is how I would set about creating a small garden for wildlife.

Warming to the Ice Plants

Introducing the Ice Plants

Phil Watson

The challenges of Global Warming are yet to be fully appreciated in relation to their potential impacts on our vulnerable indigenous vegetation communities and the habitat they support for our threatened flora and fauna. One predicted response to the gradual global warming will be a relentless search for tolerant species, suitable for our future landscape and revegetation sites which will be able to adapt to the harsher environmental realities. Fortunately members of the Ice Plant family have a series of rare attributes which will enable them to flourish in these predicted climatic extremes. This article seeks to explore these attributes further as well as highlight some of the fascinating cultural, historic and bush tucker values ascribed to its members.

Known botanically as the *Aizoaceae*, (Latin for 'evergreen' or 'ever living'), the name reflects the ability of members to maintain green coverage of fleshy foliage whilst existing in the harshest and driest environments. There are over 2300 succulent, herbs and shrubs in the family from South Africa, Asia, North and South America with only 60 indigenous Australian species (four Tasmanian species). Disturbingly already over 20 naturalised South African invaders thrive in Australia's harsher locations suggesting Climate Change may exacerbate their invasive potential.

The family is composed of two groups, based on the presence or absence of petal-like staminoides (large sterile stamen). The sub family *Mesembryanthemoides* has showy daisy-like flowers made of these brightly coloured staminoides typically seen in Pig Face *Carpobrotus rossii*, whilst the other sub family *Ruschioideis* has small insignificant flowers which are brightly coloured on the inside as seen in *Tetragonia implexicoma*.

Like many of the Australian species the Tasmanian representatives act as key framework species in saline wetlands and dry coastal communities. Local examples include the Pitt water and Lauderdale salt marshes as well as the remaining 100 kilometres of undisturbed Tasmanian sandy beaches exclusively vegetated by indigenous flora.

From an historic perspective immense significance can be directly attributed to two of the family's indigenous species *Tetragonia implexicoma* and *T. tetragonoides* (many common names apply such as Ice Plant, NZ Spinach, Botany Bay Spinach, Warrigal Greens and Cook's Cabbage). It could be considered that these species are held directly responsible for the choice of establishing Australia instead of colonial African nations, as the preferred Penal colony. Undeniably many Tasmanian ancestries would link to this. Decision.

Adaptive responses to the Global warming challenge

Climate Change's predicted warming, reduction of overland flows and reduced soil moisture will impose severe habitat limitations on our indigenous plants and animals. However certain plants within families such as the Ice Plants, Native Grasses (*Poaceae*) and the Cactuses (*Cactaceae*) will be competitively advantaged and potentially increase their natural ranges. Consequently they will attract attention due to their tolerance and adaptability. An obvious example will be Kangaroo Grass, (*Themeda triandra*) which benefits from a more efficient photosynthetic process (known as a C4 pathway) enabling it to flourish in the dry summer periods when most other competitive grasses withdraw into dormancy. Interestingly, recent observations suggest an increased richness of native grasses on disturbed dark-soil grassy woodland due to their exotic competitor grasses, such as Yorkshire Fog Grass, *Holcus lanatus*, and Quaking Grass, *Brija maxima* etc. withering and dying under drought stress.

Remarkably, Ice Plants have evolved a separate mechanism to be known as 'Night-time breathers'¹ or technically Crassulacean Acid Metabolism (CAM) that will increase the plants adaptive capacity to Climate Change. By storing Carbon, in the form of organic

acids produced during night time respiration they do not need to absorb Carbon Dioxide, by opening their stomatal pores. Hence CAM plants stop moisture losses through their pores during the heat of the day. This endows them with added xerophytic abilities that enhance their succulency mechanism to accumulate moisture and halophytic characteristics to survive in highly saline areas.

A Family with many appealing Common Names

The family members are suitably bestowed with intriguing common names, most relating to their striking attributes which enable them to survive low moisture or high salinity conditions. The name of 'Ice Plant' is linked with many family members mostly as a consequence of their leaves being surfaced with salt accumulating bladder-like cells that often sparkle like ice granules to reflect sunlight and reduce transpiration. This name is applied to the fleshy leaved South African Ice Plants (*Mesembryanthemum* sp. and *Lampranthus* sp.) as well as previously mentioned *T. implexicoma*.

The aptly named 'Livingstones' or 'Pebbles' (*Lithops* sp.) and Livingstone Daisy (*Doroanthemum bellidiformis*) are robustly designed to mimic both the colour patterns and tough surface textures of surrounding stones and pebbles. This ensures survival during arid periods by imparting drought resistance and camouflage from foraging herbivores. During the rainy season when the desert is alive with edible vegetation they transform from their chameleon-like behaviour, into large perfumed boldly coloured daisy-like flowers in an attempt to gain the pollination services of passing insects or butterflies.

The term 'Noon flower' is another popular descriptive name applied to family members such as the Australian Coastal Noon flower *Carpobrotus glaucescens*, the Tasmanian salt marsh, Round Leaf Noon flower *Disphyma crassifolium*, as well as the many South African species such as Wiry Noonflower, *Psilocalon tenue*, due to their habit of opening attractive blooms around noon and closing later in the afternoon.

The resulting pink, yellow etc carpets are irresistible to their insect pollinators which are at their busiest from noon to the mid afternoon.

The less than attractive common name 'Snot wort' (*Conicosa pugioniformis*) relates to this succulent's slimy roots which surprisingly are valued as a South African bush tucker delicacy.

The tasty 'Greens' were highly valued by early Explorers

As mentioned in the introduction, Ice Plants form an important historic connection with our Tasmanian convict ancestry. This arose as a consequence of Captain Cook's 1768 voyage to observe the transit of Venus. He satisfied his scurvy-stricken crew's desperate need to savour fresh greens by harvesting the pot herb NZ Spinach, *T. tetragonoides*, from the NZ's shoreline. Following discovery along the Australia coast by Cook and other explorers, of large swards of both *T. tetragonoides* and Botany Bay Greens, *T. implexicoma*, they soon came to rely on these greens as dietary necessities, to enhance their Spartan rations. It is interesting to note, if the early explorers and colonists had shown a little appreciation for the Aboriginal way of life, they would soon have selected today's popular bush tucker treats but instead limited their choice to only those indigenous plants that reflected the image of English vegetables. Besides the Ice Plants these included Sea Celery *Apium prostratum* and Botany Bay Greens *Atriplex cinerea*.

So impressed was Sir Joseph Banks with these Ice Plants, he sent their seeds to Kew Gardens from where it rapidly gained favour in high society cuisine as a summer spinach. In 1779 Banks' fondness for this plant's ability to provide reliable quantities of nutritious greens, was portrayed exuberantly in the House of Common's inquiry delving into the relative suitability of Australia compared to West Africa as a convict-based colony². He obviously left a strong impression and the rest is now history.

(Continued on page 6)

WARMING TO THE ICE PLANTS (Continued from page 5)

'Pigface' was Tasmania's first Bush Tucker

Tasman's voyage of 1642 was not only historically significant as the arrival of the first explorers in Tasmania, but also the collection of 'Greens' (recorded as a *Mesembryanthemum* sp.) by his crew's shore detachment from the banks of the Boomer Creek flowing into Marion Bay. This collection heralded the start of the current bush tucker bonanza. The collection of what is considered to be *Carprobrotus rossii* was reported to be 'not unlike a certain plant growing at Cabode Bona Esperance [Cape Town]'.

Many diaries of early explorers and settlers not only record positive entries on the edibility of these 'Greens' but also draw attention to the unique strawberry-fig-like flavour of the Native Pigface's fruits. During the late 18th century a number of explorers referred to the harvesting of Ice Plants for pot herbage or edible fruits. These included Bligh's 1788 voyage on the Bounty in Adventure Bay, Bruny Island and D'Entrecasteaux's 1793 voyage on the Esperance in Recherche Bay. During this voyage he noted that 'the fruit proved a delicacy with the New Hollanders (Aborigines) and resembled the Hottentot's Fig of South Africa (*Mesembryanthemum edule*) except that the flowers were not yellow but reddish purple'. Settlers at Collin's first settlement at the 'Camp' (Risdon Cove) collected Ice Plants for nutritious 'Greens' whilst inland explorer Edward John Eyre partook of Pigface fruits freely noting the ripe fruit was rich, sweet and refreshing in hot weather

Robust landscape plants with weed potential.

Australia has about 25 exotic species recognised as environmental weeds, a number of which derived from naturalising around old settlements, especially near the coast.

The Tasmanian weed representatives including Noon Flower *Lampranthus glaucus*, Heart Leafed Ice Plant, *Aptenia cordifolia*, Common Ice Plant *Mesembryanthemum crystallinum*, and the South African Hottentot Fig or Sour Fig, *Carprobrotus edulis*, and the Chilean Pig Face, *C. aequilaterus*. Of these, the later two present major concerns as they are either out-competing the native species or are being inadvertently planted by unaware, enthusiastic bush regenerators. Their ability to release 100's of seeds from the fleshy fruit when triggered by rainy spells or establish from fresh or even significantly dehydrated cuttings ensures they will remain a persistent threat. Given the recent enthusiasm for planting indigenous Pig Faces, it is important to positively identify the Pig face before planting. Remember, if it has a yellow flower err on the side of caution and check it is not a weedy Sour Fig!

Valuable 'People's Plants' supplying food and medicine

It was apparent that explorers and colonists developed a strong desire for the tasty and nutritious green foliage of *Tetragonia* species. This attraction continued to gain momentum over the next two centuries with these pot herbs being cultivated in European gardens. They have now become an heirloom vegetable, worthy of any menu especially being suited to stir fries, spinach dishes and quiches. Of course, they also prove just as attractive to wildlife; hence protection from browsing is required, during their establishment. Once growing vigorously the wild life grazing can be used to advantage by acting as marsupial pruning shears to limit their rampant growth!

It is important to be aware that, like rhubarb and silver beet, it is best not to over indulge in them due to the low levels of oxalates and saponins existing in the succulent leaves and stems.

In relation to the luscious fruits of *Carprobrotus rossii*, local Aborigines eagerly awaited their summertime ripening. Aboriginal family bands would often establish camp next to broad expanses of fruiting pigface in order to supplement their fish and seafood diets with otherwise distinctly difficult to find harvestable offerings of summer-ripening bush tucker. They not only enjoyed the fruits but also cooked leaves of this native Pig Face or

at times the Round Leaf Noon flower *Disphyma crassifolium* to accompany their fire-pit-roasted possum, roo or echidnas etc.

Beyond their bush tucker attributes, the finger-like leaves and stems when squeezed ooze a gel-like sap which acted as a soothing lotion in much the same way as Aloe vera does today. As an aside these bulky, sappy leaves have proven problematical for all those plant collectors and students who have attempted to use plant presses to dry and press specimens. They are a botanist's nightmare!

When exploring the world wide range of extraordinary plant uses attributed to Ice Plants, it would be remiss not to mention the captivating mind and mood altering qualities of the South African species known locally as 'Kanna' *Sceletium tortuosum*'.

This mood-altering plant (attributed to the alkaloid 'mesembrine') has been used by hunter-gatherers and pastoralists from prehistoric times, to elevate mood and decrease anxiety, stress and tension. Amazingly larger doses have no severe adverse affects, as it induces a euphoric state enabling pastoralists to decrease thirst and hunger or for its application as a local anaesthetic and analgesic for tooth extraction. Traditionally prepared by crushing the succulent plant before sun drying prior to chewing, smoking, inhaling as snuff or brewing as a tea, it is an important children's sedative and has been effectively used by indigenous healers to withdraw alcoholics from their addiction. Even now the plant may be called *onse droe drank*—'our dry liquor'. Although once widely traded in the South African Cape provenance and stocked in trading stores, inventories of wild plants have dwindled due to over-harvesting and habitat destruction. This has sadly resulted in its replacement by alcohol, tobacco and cannabis. It is pleasing to note that, using only cultivated rather than wild harvested materials, currently phyto-pharmaceuticals from *Sceletium* are being extracted for clinical trials in readiness for the international market.

Finally it is worth reflecting on another South African Pig Face look alike known as 'Khadi Root', *Khadia acutipetala*. Its fleshy rootstock provides an alternative yeast source to act as the key fermentation agent in brewing a distinctively flavoured, yet extremely prized beer known as Khadi.

Conclusion

As alluded to earlier, the Ice Plant family primarily consists of hardy and environmentally resilient plants. Their tolerance is a consequence of their efficient methods of seed dispersal, ease of propagation from cuttings or off sets, their succulence, pest and disease resistance, fire resistance, xerophytic and halophytic abilities all supported by their CAM metabolism. In light of the global warming impacts, it is predicted that their recent popularity as landscape, erosion control, bush tucker and revegetation species will increase.

Disappointingly these competitive advantages also result in the prevalence of many more exotic members menacing indigenous vegetation communities as invasive weeds.

To offset this dilemma, many exotics and native members add a rare three dimensional element to landscapes. This is a consequence of their thick, succulent leaves symbolising shapes of limbs and fingers. They can provide an inspiring contrast with the two-dimensional, flat leaves of most other plants in the landscape⁵.

1. The term 'night time breathers' was referenced from the Royal Tasmanian Botanical Gardens information sheet 'The Century Plant'.
2. Low, T., *Bush Tucker—Australia's Wild Food Harvest*, Angus & Robertson, Sydney, 1992; pp. 134-135
3. Potts, B. et al, (ed.) *Janet Somerville's Botanical History of Tasmania*, 2006.
4. Ben-Erik van Wyk & Nigel Gericke, *People's Plants—A Guide to Useful Plants of Southern Africa*, Briza Publications 2003.
5. Low, T., *Bush Tucker Australia's Wild Food Harvest* Angus & Robertson, Sydney, 1992. ©

Australasian and Little Bittern

'Very little is known about the population of the Australasian Bittern in Australia, though it is thought to be decreasing. They occur in freshwater wetlands in south-west Western Australia and south-east Australia. The Action Plan for Australian Birds (2000) by Garnett & Crowley estimates the population at 2500 mature individuals, with fewer than 100 pairs in WA. Birdlife International has recently upgraded their conservation status to Endangered.'

'Even less is known about the Little Bittern population, though recent estimates put the population at around 5000 individuals. The species is extremely secretive and seldom ventures far from thick wetland vegetation.' During breeding season they can be detected by their low grunting calls.

'With most of southern Australia in a long lasting drought, suitable habitat for bitterns is very limited', and birds will be concentrated into a small number of wetlands.

Bush Stone-curlew

'The only known Bush Stone-curlew population in the South Australian Riverland region exists on the Ramsar-listed floodplain of the Chowilla and Ral Ral anabranches, upstream of Renmark.'

Coxen's Fig-Parrot

'Recent reports have come from the Sunshine Coast lowlands and hinterland, Pine Rivers hinterland and Gold Coast lowlands and hinterland in SE Qld., and the Tweed and Lower Richmond Valleys in NE NSW.' Habitats of Coxen's Fig-Parrot include various types of rainforest, as well as eucalypt forests and riparian corridors in woodlands.

Declining woodland birds in the Northern and Yorke Region, SA.

A range of declining woodland species including the Australian Owlet-nightjar, Eastern (crested) Shrike-tit, Diamond Firetail, Grey Fantail and White-winged Chough has been recorded.

Glossy Black-Cockatoo

This South Australian subspecies 'disappeared from the Mount Lofty Ranges between 50 and 100 years ago as a result of large-scale land clearance.' Surveys on Kangaroo Island in the 1980s revealed fewer than 200 GBC remaining. The long-term survival of these birds is uncertain. Poor nesting success was the principal cause of their demise, 'through predators entering nest hollows and destroying eggs, and a shortage of large old eucalypts with suitable nest hollows.'

Helmeted Honeyeater

Monitoring of wild populations at Yellingbo Nature Conservation Reserve and Tonimbuk (Bunyip State Park) has uncovered the culprit responsible for taking nestlings. Nests are being raided by Tiger Snakes. The adult birds become quite flustered and start flying around and calling. A snake then appears below the nest, before climbing its way through the low vegetation and taking the chick.

Mallee Emu-wren

'The Mallee Emu-wren population in South Australia has suffered large losses in the past two years from fires in Ngarkat CP. In 2007 studies will continue to determine the current population size and distribution, habitat requirements of this species, and ...fire planning for habitat protection.'

Orange-bellied Parrot

'Close to 50 birds (about a third of the known total population) were accounted for on the mainland last winter.' Nine birds were recorded in SA (the most seen in that state for some time) and a relatively healthy number were recorded at the known key Victorian sites. A site near Warrnambool appears to be supporting up to 19 birds for several weeks. A recent recording was made 'at Shallow Inlet, north of Wilson's promontory in Victoria. A single adult was sighted in saltmarsh near a small group of Blue-winged Parrots' in January- the earliest mainland record of the species!

Osprey

Nesting numbers in the Tweed, Clarence, Nambucca and Manning valley catchments seem to be on the increase. Some nest losses have occurred due to aging nest trees shedding limbs or falling over. Reports include a nest perched in a dead shrub on a cliff with a 75 degree slope, and another nest site on the ground, while ospreys have returned to Tuggerah Lakes on the Central Coast of NSW.

Painted Snipe

The spring-summer period has been an interesting one as birds were reported along 'the east coast during October and November. There have been sightings in Qld. at Hasties Swamp and Hervey Bay, in NSW at Fivebough Swamp and around the Newcastle region, and in Victoria at Hird Swamp and in Gippsland.' Two separate sightings were made in the NT, 'with one bird seen at Yellow Water in Kakadu and a male seen by a number of birdwatchers at McMinn's Lagoon.'

Red-tailed Black Cockatoo

'There are 5 subspecies of Red-tailed Black Cockatoo across Australia, with the southeastern subspecies confined to a relatively small area' covering stringybark forest areas 'in south-west Victoria and south-east SA. This subspecies is listed as endangered under both national and State (SA and Victorian) legislation.' Volunteers in 2006 counted 1078 birds across its range.

Superb Parrot

These birds are found in southern NSW and Victoria. Previous surveys observed 79 birds in seven NSW sites and 248 birds recorded in 14 sites. The dry conditions and lack of food availability has resulted in lower numbers of juveniles.

Western Whipbird (Eastern subspecies)

'Much of the habitat of this declining mallee species has been lost to fire in the last three years.'

Yellow-tailed Black Cockatoo (Eyre Peninsula)

The drought year has not disrupted the summer migration of Eyre Peninsula YTBC as a small flock were observed on lower Eyre Peninsula in mid-October. They were re-sighted in the summer. 'The cumulative effect of the January 2005 Black Tuesday fire and the drought continue to hamper the birds' recovery.' There have been no additional records of the birds. Numbers may be as low as 10-14 individuals. Regeneration of flora within the Koppio Hills breeding area, and the loss of Aleppo Pines has meant reduced cone production availability for the birds. 'The drought has also caused the failure of *Xanthorrhoea* flowering and consequently, a lack of nutritious *Meyriccia latro* moth larvae.'

END

Australia is often referred to as the home of a rich and colourful collection of cockatoos, ranging from cockatiels to Sulphur crested. Two of the most striking are the Major Mitchell Pink Cockatoo and the Gang-gang.

THE PINK COCKATOO

Regarded as one of the most beautiful of all has softened pink feathers crowned by brilliant crimson, yellow and white crest. The explorer after whom the cockatoo is named wrote of the transformation by the pink cockatoo in 'the monotonous hues of the Australian forest'. Major Mitchell cockatoos are found in inland areas of the mainland, with a stronghold in South Australia. Seldom seen in large flocks the rare pink cockatoo flies leisurely over its vast range of dry country, never straying far from the gum trees whose hollow limbs provide it a home. Seeds form the basic food, but special treats are a batch of grasshoppers' eggs, or beetle larvae.

THE GANG-GANG COCKATOO

The Gang-gang cockatoo lives in heavily timbered mountain ranges in NSW, Victoria and Tasmania. It usually feeds on the green seeds of Eucalypts, and has a peculiar wheezy call when feeding. The gang-gang normally nests in a hollow limb high above the ground. It is a small black cockatoo with a bright red forehead and crest.



Gang-Gang Cockatoo



Heavy Metal Poisoning

**Other Names: "New Wire Disease",
Lead or Zinc Toxicosis**

The ingestion (eating of) lead or zinc can be life-threatening to birds, as they are very sensitive to even low levels of lead.

But how can this occur?

- Waterbirds/bottom feeders may ingest lead pellets from the bottoms of dams, lakes and estuaries.
- Raptors may consume lead shot which is embedded in the flesh of their prey.
- Parrots may chew lead-based glazes on ceramic bowls, or the new wire of their cage.
- Parrots tend to chew anything they can get their beaks around, and many household objects contain lead and zinc.
- Parrots may also chew lead-based paint.

SYMPTOMS

Waterfowl (lead)

**lead shot lodged in the tissues of birds does not cause poisoning, it needs to be ingested.*

- general signs of being unwell, unable to fly, etc.
- unsteady walking
- drooping wing/s
- not eating, weak, weight loss
- green liquid faeces
- vomiting

Parrots and other species (lead or zinc)

- brown urine/urates (indicates blood)
- lethargic, depressed
- stargazing
- seizures
- greenish diarrhoea
- increased drinking and high urine content in droppings
- vomiting

DIAGNOSIS

Blood levels for heavy metals can be checked, however the tests may be costly. If this problem is suspected then treatment should start immediately and will not hurt a normal bird if the diagnosis is incorrect. It just means that the bird will not improve on the treatment if the wrong diagnosis is made. Once treatment is started, improvement can be seen within 24hrs.

Low grade, long-term exposure to toxic materials such as lead can result in the development of chronic kidney failure.

TREATMENT

Treatment depends on how sick the bird is. Calcium EDTA is given in all cases, however severely sick patients may also require fluid therapy, anticonvulsants, etc. This will all depend on the symptoms that the bird is showing. Your vet will need to be consulted for all of the above. Bulk laxatives are useful to help excrete the metals as the treatment is continuing. Such products as "Metamucil" are recommended.

PREVENTION

- Galvanised wire mesh needs to be out in the weather for several months (up to 12mths) before placing any birds in newly built aviaries. Alternatively it can be thoroughly scrubbed with vinegar and rinsed with water before the birds are placed in it. This will reduce the chances of zinc poisoning. This type of poisoning is extremely common and an antidote is available from your vet should it occur.
- Be aware of the paints used in aviaries.
- Avoid using galvanised metal drink containers - the water can contain high levels of zinc if left to sit for any length of time.

Anita Williamson

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Flower Power

from *Wildlife Australia* Winter 2006

'Celebrations are in order for the discovery of a healthy population -246 plants - of the rare and endangered grand spider orchid (*Caladenia huegelii*) in a nature reserve near Pinjarra. Searches of the area in previous years had found only single plants. This year's discovery - including plants standing 70cm. high some with two flowers on each stem - occurred during a biodiversity survey of the east side of the Harvey Estuary.'

Notorious hitchhiker gets the flick

from *Wildlife Australia* Winter 2006

'A single cane toad arrived in Western Australia by banana truck in March.(2006). Staff at a Kewdale freight distribution centre spotted the creature and alerted quarantine who sealed off the truck and inspected the surrounding area. Department of Conservation and Land Management staff caught the toad and disposed of it. As a precaution the truck was sealed and the load re-exported out of WA.

Environment Minister Mark McGowan has praised the quick actions of the distribution centre staff.

'Cane toads are notorious hitchhikers and it is a timely warning for anyone travelling from areas where cane toads are found to remain vigilant,' he says. Last year, three cane toads two live and one dead, were found in two separate incidents in Kewdale and Canning Vale. The Minister...said the Federal Government should do more to help counteract the threat.....*'We need to work together with the Commonwealth to stop this menace getting a foothold in the Kimberley, one of Australia's most beautiful, biologically diverse and fascinating regions.'*



Galah

Follow that woylie

from *Wildlife Australia* Summer 2006

'What's happening to the woylies of Western Australia? Otherwise known as brush-tailed bettongs, the small marsupials have experienced dramatic declines in parts of the state's south-west.

Following an injection of state funds, up to 60 woylies have been radio-collared as part of a comprehensive investigation into the decline. Of 36 woylies collared in six weeks of the program, three died after attacks by predators.'

Too many 'roos

from *Wildlife Australia* Summer 2006

'When humans alter an environment, we destroy wildlife habitat. At the same time we create prime habitat for a few species. In parts of the ACT, eastern grey kangaroo populations are among the highest reported for any kangaroo species anywhere in Australia, generating some interesting management challenges.

One response to an over-abundance of suburban kangaroos is oral contraceptives.' While research has shown that injections of a fertility control agent could successfully prevent pregnancy in female eastern grey kangaroos, a move to oral delivery is considered essential for wild kangaroo populations. This may be one method at non-lethal kangaroo control methods.

Boolcoomatta Reserve, SA

From *Bush Heritage News* Autumn 2007

A number of research groups are providing baseline data and information on plants, animals and archaeological sites at Boolcoomatta Reserve. A survey to establish benchmark biodiversity data was completed. A total 27 species of reptile and one frog species were recorded as well as two dunnart species, Bolom's mouse and five bat species, along with an increased range for the Eastern Grey Kangaroo. Archaeologists discovered skeletal remains of the yellow-footed rock wallaby, golden bandicoot, Gould's mouse and stick-nest rat, telling us about the wildlife and habitat of the past. Research continues.....