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LANDSCOPE

W.A.'s Conservation, Forests and Wildlife Magazine



Termites!

Montebellos - After the Bomb

Shark Bay - What's Next?

Perth's Hidden Water

LANDSCOPE

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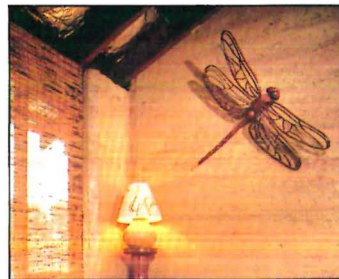
EDITORIAL

Anybody who reads tourist brochures in this State will appreciate that the tourist industry is, to a large extent, dependent on natural features and wildlife for its 'product'. Many people who are concerned with the natural environment are antagonistic to tourism, and it is certainly true that in the past there have been some insensitive tourist developments in the State. But, just as the farming community over the past ten years has become one of the greatest allies of conservation, so, increasingly, is the tourist industry. For example, in a recently published tourist industry report on tourism in the Kimberley, the need to preserve this environment was given top priority.



Shark Bay, p.8

This report is indicative of the growing awareness in that industry of the symbiotic relationship between tourism and the protection and maintenance of our unique flora, fauna and landscapes. Rather than being despoilers, the tourist industry has the potential to become one of the strongest advocates for conservation in the broadest sense.



Carving the Future, p.33

There is a great potential for synergism between those interested in the science of conservation and the tourist industry. One of the ways by which the tourist potential of any natural area can be enhanced without any cost to the environment is by providing information to the visitors on the natural science that makes that area special.



Garden Escapes, p.44

Landscape is one avenue by which we are attempting to provide an added dimension to the 'look it's lovely' tourist experience. Interestingly, while *Landscape* receives almost universal acclaim from the general public, there is ongoing, often vigorous, internal debate about how technical we should make the magazine. We would appreciate your views.

Cover Photo

'Now, just how do I find my way out of this Renoir landscape?'
Photographer **Richard Woldendorp**
captured this lizard taking a sighting.

BEYOND THE BOMB



Montebellos in 1988

The Montebellos are a group of more than 100 islands off the north-west coast of W.A. They achieved international notoriety in 1952 when the British, in an operation code-named Hurricane, detonated an atomic weapon in a bay off one of the major islands. Two further atomic tests were carried out in May and June of 1956. The nuclear cloud tends to overshadow less dramatic aspects of the islands' history, but there are many colourful twists to the tale. Thirty-two years after the British departed, it's time to review the Montebellos: past, present, and future.



Ground zero, Trimouille Island (above).

The Montebello Islands are located 20 km north of Barrow Island and 120 km north, north-west of Dampier, and were named by the French navigator Nicolas Baudin in 1801. According to P.D. Montague, writing in the *Geographical Journal* in 1913, Baudin was 'discouraged by the seeming barrenness of the country, the scarcity of fresh water, and the hostility of the blacks, he kept to the sea, and did little else than survey the coast-line and islands'. Before he left, however, he named the islands after the battle of Montebello, where the victorious French general Lannes (later the Duke of Montebello) defeated the Austrians in 1800.

The flat, limestone islands range in size from Hermite, the largest, at about 1 000 ha, to several small islets and rocks of less than one hectare. They are the remnants of an old coastal landform, and have been separated from the mainland for more than 8 000 years.

No evidence has been found of Aboriginal occupation of the islands since that separation, although they probably lived there before.

The earliest known European use of the islands was in 1622, when one of Australia's first recorded shipwrecks, that of the *Tryal*, took place just west of the Montebellos. The survivors of the wreck spent seven days on the northern islands before setting forth for the East Indies. What a godforsaken place it must have seemed to them. There was nothing like the macabre massacres that took place at the more southerly Abrolhos Islands after the shipwreck of the *Batavia*, nonetheless, only 30 people could set sail with the Captain in the lifeboat, the rest were left to their fate on the wrecked ship. Other early navigators, Baudin in 1801, King in 1818, and Stokes in 1840, had less eventful voyages.

The development of the pearling industry along the north-west coast in the late 19th Century formed the next exciting chapter in the history of the Montebellos. The pearlers who fished the waters and camped on the islands are probably responsible for the introduction of the cat (*Felis catus*) and the black rat (*Rattus rattus*) which persist on the islands today. Possibly the cats were deliberately introduced to catch the rats. After all, plaguing rats have an ability to make camping an unpleasant experience.

Montague noted 'the cats which have been introduced into Hermite Island appear to be breeding rapidly; wherever introduced they soon become exceedingly shy and wary and grow to a very large size. They will, no doubt, in a few years time have accounted for the wallabies, as they have for the bandicoots. If they cannot kill a full-grown wallaby - though I'm inclined to believe they do - they make short

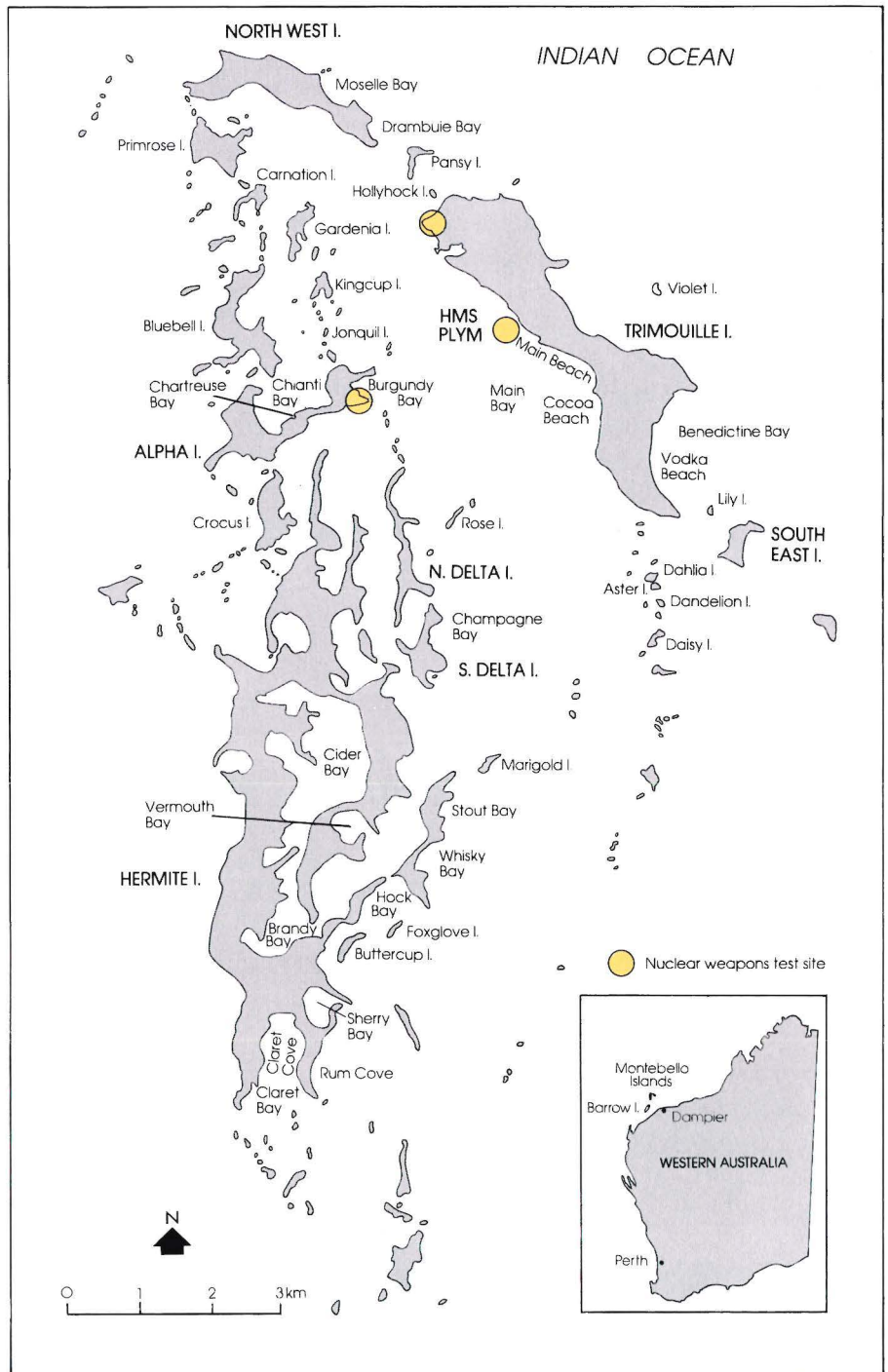
The survivors of the Tryal spent seven days on the islands before setting forth for the West Indies. What a godforsaken place it must have seemed to them.



work among the young ones.' His prophecy was depressingly accurate.

One of the most notable characters among the pearlers was Thomas Haynes, who held a pearling licence for the Montebellos from 1902-1913. Evidence of his pioneering experiments in raising pearl oysters can still be found on Hermite Island. There is an inscription in cement 'The Montebello Experimental Shell Pool, Constructed 1906. Continued 20 Sept. 1981 by R.P. Morgan and Crew.' Haynes also left other evidence of his presence, which the W.A. Museum picked up on a recent survey. These include bottles of tonic (apparently a necessity because of the poor diet imposed by the remoteness) and a bottle bearing the proud legend *Swan Brewing Co.* Some things don't change much with time! Haynes left Hermite in 1909, after a willie-willie completely destroyed his house and damaged his oyster enclosure.

An even less successful enterprise was described by Montague: 'When Hawksbill Turtles were abundant on the islands in the north of the group, Malays were stationed on the various islands to watch the sandy shores during breeding season, and an attempt was made by a storekeeper at Onslow to ship green turtle, alive or canned, and a small canning factory was established. This, however, came to nothing, and the project proved a financial failure.' Turtles continued to be taken commercially until 1973, when concern at the decline of the green turtle led to the licences being cancelled.



The Montebello Islands, showing the nuclear test sites (top right).

North-west Island (left).

The wall of Thomas Haynes' shell pool (right).



K. Morris

A dramatic attempt at feral animal control was made in 1952, when the British joined the exclusive nuclear club by detonating the first atomic weapon on H.M.S. Plym, moored in Main Bay, close to Trimouille Island. Further atomic bombs were exploded on Trimouille and Alpha Islands. Many relics remain. No doubt the British were satisfied that they achieved the real objectives of their experiments. As a means of controlling feral animals, however, it proved a dismal failure, demonstrating merely the resilience of the cat and the black rat. And, for that matter, most of the other flora and fauna.

Regular monitoring of radiation levels shows that, with the exception of ground zero sites (the exact places the bombs were detonated), radiation has dropped below levels considered dangerous to public health. A good thing, seeing the increasing population of the Pilbara has taken the place to heart as a recreation site. Recently, cruising

yachts and commercial charter vessels have begun to visit the islands. Public access is controlled by the Navy, and approval must be gained prior to visiting the islands. Public access is still prohibited to some areas near the atomic test sites.

The Montebellos are among the State's most distant continental islands, and, despite the introduction of exotic mammals and disturbance from atomic weapons testing, the islands and their surrounding waters still support a diverse and interesting array of terrestrial and marine fauna. Fortunately, there were biological surveys of land fauna made prior to the introduction of the cat and the black rat, and both before and after the atomic explosions. The Golden Bandicoot disappeared from Hermite Island prior to 1912, and the Spectacled Hare-wallaby disappeared between 1912 and 1950. Both of these marsupials are still common on nearby Barrow Island, and their extinction

on Hermite is probably due to the feral cat. Some bird species, such as the Crimson Chat and Rufous Whistler also disappeared prior to the atomic explosions, and again the cat and rat are likely culprits. These species are nomadic, however, and their sighting in 1912, and subsequent disappearance, may only reflect their natural patterns. The Spinifex Bird and the Black and White Wren were last recorded on the Montebellos in 1950, and it is likely that the extensive fire that followed the atomic explosions, together with predators, rendered the area unsuitable for these predominantly grassland birds. Burrowing fauna, such as the reptiles (and rats!) that were underground at the time of the testing were able to avoid its effects, and these species persist on the islands today. Many of the bird species would have been able to recolonise from undisturbed areas of the Montebellos and Barrow Island. When Serventy and Marshall visited Trimouille Island in 1958, two years

The islands and their surrounding waters still support a diverse and interesting array of terrestrial and marine fauna.



N. Wehleck/Lochman Transparencies

N. Wehleck/Lochman Transparencies

J. Lochman

after the last test, they commented that many plants had recolonised the burnt area, lizards were near the test sites, and turtles were on nearby beaches: 'Apart from the damaged blockhouses or pillboxes on the site, it would be difficult to imagine that an atomic explosion had taken place in the vicinity'. The islands now support over 100 species of plants, including one of the State's most distant mangrove stands. Several species of seabird, and at least two species of marine turtle nest on the islands, and one species of legless lizard, *Aprasia rostrata*, is known only from Hermite Island.

The marine environment also appears to have fully recovered from any damage it may have sustained. One of the major attractions of the Montebellos is their diverse marine life. At least 200 species of inshore mollusc are known and the waters provide habitat for relatively protected breeding populations, which act as reservoirs for the

Pilbara coast. A range of undisturbed coral groups, and a vast array of reef fish and crustaceans also call the Montebellos home.

Since the atomic testing, the Montebellos have been controlled by the Commonwealth Government, and public access has been restricted. Because of the increasing appeal of marine recreation, and the decrease in radiation levels, the State is seeking to regain control of the islands.

The Department of Conservation and Land Management has prepared guidelines for managing the islands and surrounding waters as a marine park. These highlight the islands' conservation, recreation and historical values. Once the State has resumed control, a detailed management plan will be prepared identifying zonings based on a detailed knowledge of both the marine and terrestrial environments, and an understanding of the land-use capability.

Day trips and camping on some beaches for short periods will probably be allowed. Obviously, there would be no public access to ground zero sites, where the radiation is still relatively high. Seabird and turtle nesting sites will also have to be protected. There may be some zones for recreational fishing, but commercial fishing will be controlled in any marine park. Shelling would probably also be prohibited because the islands are an important haven for mollusc breeding populations.

Other potential actions include the eradication of the feral cat and black rat, and the re-introduction of the Golden Bandicoot and the Spectacled Hare-wallaby to Hermite Island from Barrow Island. There may also be some work on the historic pearling sites. Relics from the atomic testing period will be left as they are: there are some parts of the past which cannot be undone.

Keith Morris/Liana Christensen/Tony Start

Relics from the atomic testing period will be left as they are: there are some parts of the past which cannot be undone.

Green Turtle (far left).
 Olive sea snake (left).
 Osprey (below left).
 Spectacled Hare-wallaby on Barrow Island. This species may be re-introduced to the Montebellos (below).
 Concrete bunker on Trimouille Island (right).



R. Lagdon/WAPEI



A. Start

Shark Bay



Shark Bay no doubt deserves its fearsome name, but it is home to many creatures besides sharks. Dr Barry Wilson, Director of Nature Conservation with CALM, looks at Shark Bay from several perspectives, and at the Region Plan which will guide future development in the Bay and ensure the preservation of its very special features.



G. Freudenthaler

There are many ways to look at Shark Bay. Perhaps that is part of the magic of the place. The early Aboriginal inhabitants would have found easy pickings there as far as food is concerned. The lack of potable surface water must have caused constant hardship, yet no doubt they loved the place as home.

When in 1712 the survivors of the Dutch shipwreck *Zuytdorp* scrambled up the mighty cliffs of Edel Land which now bear the name of their stricken ship, they must have gazed at the waterless dunes of the hinterland in utter despair. Yet Francois Peron, naturalist with the French scientific Baudin Expedition which spent some months

in these waters in 1801, found the arid and sparsely vegetated landscapes abounding with strange animals unknown to European science at the time. We can picture him delighting in his release from tedious months below deck as he roamed these red dunes, collecting specimens to take back to the natural history museum in Paris.

What privations the European graziers must have faced when they settled in these bleak lands in the late 19th century, but what joy when the sparse vegetation turned out to produce fine wool. Their vision of Shark Bay would have been of hardship and opportunity.

At Monkey Mia wild dolphins make friends with people - but are free meals the real motive? (left).

Local fishermen spot for schools of whiting and mullet in the shallows of the bay (right).

Red dunes of Peron Peninsula contrast vividly with the blue and green shallows of Big Lagoon (below).



B. Wilson



B. Wilson



B. Wilson

Can you imagine what the young Malay pearl divers made of this place, so different from their native land, when they were brought down in the late 1800s to help fish the little pearls which are so abundant on the bay's shallow banks.

In modern times the high-flying jet passenger looks down on Shark Bay and sees one of Earth's most breathtaking land-seascapes, a complex jigsaw pattern of ochre red land rimmed with stark white beaches, patched with round silver salt lakes and interfingered with brilliant green and blue-black sea inlets.

On the ground the modern-day traveller may not be impressed with the low relief, scrubby red landscapes - until a corner of the road is turned and there is a vista of long curving beaches, red cliffs and sparkling green bays. This vision of Shark Bay is of distance, spaciousness, symmetry, bright light and vivid colour-contrasts.

But it is in the mind's eye that the diversity of perceptions of Shark Bay is most manifest. After more than a century of non-Aboriginal settlement some see the place in terms of home and personal heritage, or a source of natural produce and income, others as a refuge from the fast-lane, and others as a place on the brink of development and commercial opportunity. Many outsiders see it as a place for a very different kind of holiday, a wilderness where the

Bleak but magnificent, the barren slopes of Eagle Bluff overlook the protected waters of Freycinet Inlet (top left)).

The formidable Zuytdorp Cliffs south of Steep Point were the site of the wreck of the Dutch vessel *Zuytdorp* in 1712 (left).

Big Lagoon on Peron Peninsula is a complex system of hyper-saline embayments which, besides their visual attractions, serve as nursery areas for fish (right).



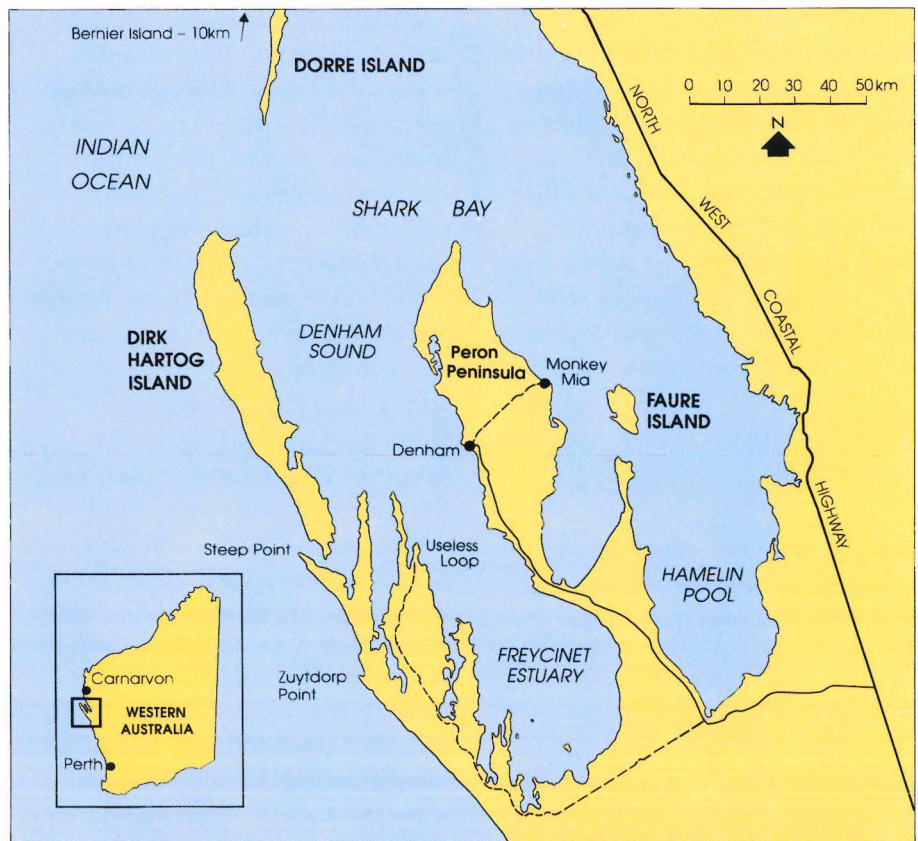
G. Freudenthaler

fishing is fantastic and there is space to be self-reliant and free. Some, looking into the smiling eye of a dolphin at Monkey Mia, see something intangible which, though not understood, pulls at the heartstrings and leaves indelible memories. And some see Shark Bay's wildlife, wilderness, unique scenery and environmental features in terms of national heritage. Practically everybody sees Shark Bay as a special place.

In 1898 a tiny settlement, now known as Denham, was established on Peron Peninsula, as a base for the lucrative pearl fishery. It was one of the world's most remote villages, accessible only by sea, about 700 km from the small English colony on the Swan River. Getting to Denham was an adventure in those days. The small multi-racial community there lived in isolation from the world.

After World War II, rough and ready airstrips were constructed near Denham (the two existing strips may be described in those terms still) and a formed road was built. Although the pearl-fishing industry collapsed, a new scale fishery was established with several small processing factories in Denham. And a saltworks was constructed at Useless Loop, with its own small town and ship-loading facility, taking advantage of the high natural salinity in one of the shallow inlets and the extremely high evaporation rate.

Then in 1985 an event of immeasurable significance occurred. A sealed highway was constructed linking Denham to the NW Coastal Highway. Although it is a long way to go, access in and out of the town is now safe, easy and quick. The Shark Bay community remains remote, but no longer isolated. Fishing, grazing and mining continue as before, but tourism now looms as a new and flourishing industry in the district and the life-style of



the local people can never be quite the same.

A community's response to rapid change of this magnitude is inevitably nervous and mixed. While welcoming the new job opportunities for young people and new community facilities provided by increasing local revenue, many people find their familiar daily routines disturbed and there are differing views about the directions and pace of change. The key to resolution of these issues is planning and, most essentially, involve-



ment of the local people in the planning process.

It was for these reasons that the State Government set up a land-use planning project in Shark Bay in 1986. A technical working group was established under the wing of the State Planning Commission and the Department of Conservation and Land Management, in consultation with the Shark Bay and Car-

narvon Shire Councils. A Consultative Committee of local people was appointed to ensure two-way exchange of information and opinion. The Shark Bay Region Plan is the end result, after two years of office and field studies, discussion papers, workshops and public meetings, and direct discussions with individuals. The plan was adopted by the Government in March 1988 as a guideline for the development of the Shark Bay Region into the 21st century.

The plan has identified in broad terms the environmental, cultural and economic resources of the Shark Bay Region, and proposed a scheme by which they may be protected, conserved and utilised in a balanced way. There are many aspects of the natural environment of Shark Bay which warrant protection in their own right as part of Australia's natural heritage. Some of its renewable natural resources, e.g. its pastures, fisheries and evaporites (salts), are best managed for sustained yield. The Region Plan seeks to determine the best and most equitable use of each area of land and water to meet all these objectives.

Tourism is identified as the industry with most potential for further development. Tourism is based directly on the environment and the natural features of the region. People come to Shark Bay to enjoy the fishing, and the scenery, spaciousness and sunshine, to visit the dolphins, to explore the remote beaches and to experience the pleasure of being human in a friendly wilderness. Like any other industry, tourism carries with it the danger of over-exploitation and destroying the resource upon which it depends. It is necessary to identify the assets and use them carefully.

Most of the land in the region is currently assigned for pastoral use. Pastoralism has served the region

well, but some areas are not well-suited to this use. For example, the coastal lands in the south-west corner of the region are vulnerable to erosion, but they have magnificent scenery and high wildlife conservation values. Similarly, although the northern part of Peron Peninsula is moderately productive pastoral land, it has much greater value to the community for its scenic and recreational potential. Consequently, the Region Plan proposes that significant parts of the pastoral lands revert to public use as national parks. The areas remaining in pastoral leases are to be managed to protect nature conservation values as well as for grazing.

In spite of the aridity of the Shark Bay landscape it has been known since the days of Peron that the terrestrial fauna and flora of this region is diverse and of great scientific interest.

On Bernier and Dorre Islands (both named by the early French explorers) there are five species of mammal, two of which are now extinct on the Australian mainland and survive only on these two islands. Given the small size of the islands, those species must be considered to be on the brink of total extinction. The two islands are already declared nature reserves and their careful management is obviously a critical responsibility for the State. Research may show

how the mainland habitat could be restored to a condition suitable once more for these mammals. Careful translocation programs may then allow re-establishment of populations on the mainland, so giving these species a chance to avoid extinction. Because of their shape, the peninsulas and prongs of mainland Shark Bay, which are proposed as national park or nature reserve, lend themselves to a rescue mission of this kind.

The undulating plains and dune fields of the land south of Shark Bay are of special interest to botanists and biogeographers because they straddle the overlap zone between the Eremean and South West Biogeographical Provinces. The vegetation in the south of the area consists of plants typical of the South-west; its flora is diverse and includes many gloriously flowering shrubs and trees. A portion of this important botanical treasure is already preserved in the Cooloomia Nature Reserve, although its remoteness deters effective protection against fire and feral animals. The Region Plan proposes that the area of the reserve be greatly increased to include parts of adjacent pastoral



B. Wilson

leases which have limited pastoral values.

The mighty Zuytdorp Cliffs of remote Edel Land are the most westerly land of the Australian continent. Behind them are high dunes, some of which are unstable and on the move. This is a striking wilderness. In spite of its aridity, this bleak land is the only habitat of an amazing frog, *Arenophryne rotunda*, which spends most of its life buried in the hot sand and emerges to perform its biological functions only on the rare occasions when it rains. But perhaps the aridity is not as extreme here as one might

suppose. Rainfall is scant, but there is frequently a sea mist along this coast. There is much to learn about the biology of the strange frog and other creatures which inhabit this seemingly inhospitable but wildly beautiful coastline.

It may seem strange that such a bleak arid land can support such an array of plants and animals, but there is no doubting the high nature conservation values of Shark Bay's red dunes. Not so strange is the immensely rich marine flora and fauna of the bay itself.

Shark Bay is the largest enclosed marine embayment in Australia.

Its vast expanses of shallow water are split into narrow inlets in the south by long, finger-like peninsulas and prongs. These warm, shallow and sheltered waters are highly productive in biological terms. Sea-grasses cover almost 4 000 square kilometres of the seabed and provide food and shelter for diverse and distinctive marine fauna. Photosynthetic activity of the sea-grasses in the warm sunlit shallows generates a high level of nutrients. Also, a high rate of deposition of carbonate sediments provides a substrate very conducive to the burrowing lifestyles of invertebrate animals. Extensive

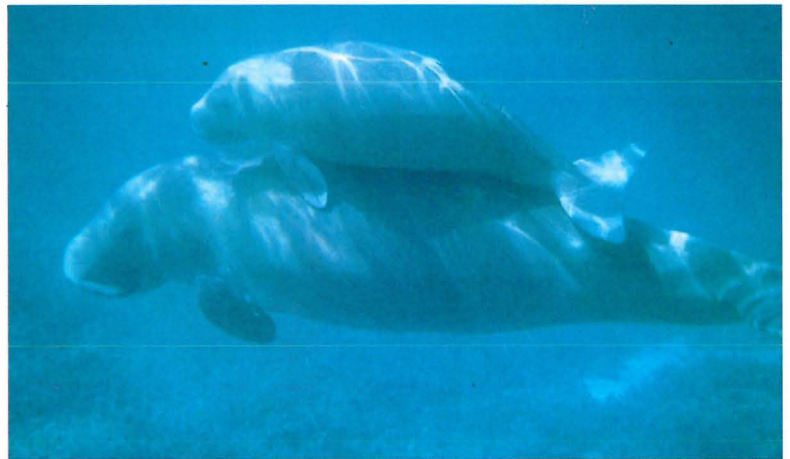
Dorre Island (left) is a nature reserve providing refuge for five kinds of native mammal, several of which are now extinct on the mainland of Australia (see pics. on next page).

In Shark Bay there is a secure population of dugong, a strange marine mammal which has been hunted to extinction in many other areas (right).

Steep Point is a popular site for rock-fishing (below right).

Banksia ashbyi, a common species from Kalbarri to Shark Bay and northwards along the coast, with a Spiny-cheeked Honeyeater, one of the banksias main pollinators (below).

The Shark Bay Volute (*Cymbiolacea nivosa*), an endemic west coast mollusc, is a common predator on the intertidal sand-flats of Shark Bay (bottom).



P. Anderson



S. Hopper



B. Wilson



N. Wehleck/Lochman Transparencies

intertidal sand-flats are a particular feature of Shark Bay shorelines, and these support an unusually rich fauna of burrowing bivalves and other molluscs.

With this high biological productivity it is no surprise that the sea-grass beds and shallow inlets of Shark Bay serve as nursery areas for many fish and crustaceans and, ultimately, support major scale-fish and shell-fish industries. Netting for whiting, mullet, bream and other scale fish, hooking and potting for snapper, and trawling for prawns and scallops provide significant employment and revenue for the region.

It is the same nutrient-richness, high productivity, and wide areas of shallows which produce and support the recreational fishery which is such an important resource for the developing tourist industry of Shark Bay.

Clearly, the shallow nursery areas and the productive sea-grass banks require careful protection.

One very special feature of the Shark Bay marine fauna is a large population (estimated to be about 1 000 animals) of dugong (*Dugong dugong*), probably the strangest of all marine mammals. These quiet, bottom-feeding 'sea cows' have been hunted to extinction in most parts of their tropical Indo-Pacific range, but here in Shark Bay there is a large and apparently healthy family of them. In summer they concentrate on the shallow sea-grass banks along the eastern mainland shore; in winter they migrate to warmer outer areas of the bay. They are not hunted any more in Shark Bay, but there is risk that they may be disturbed by fast power boats as recreational boating increases in the area. The Region Plan proposes declaration of marine reserves to protect the sum-

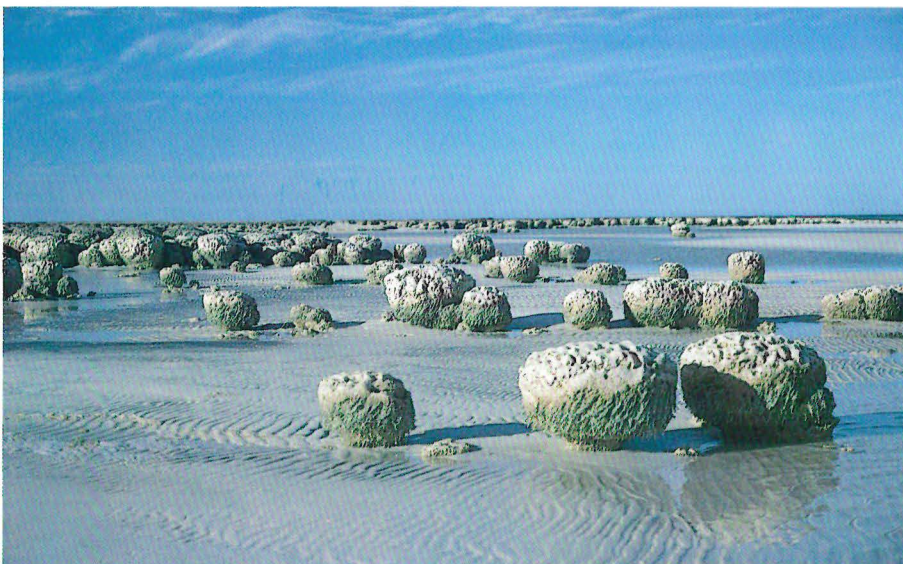
mer and winter feeding habitats of the dugong, and it may be necessary to control boating activities in some areas to prevent disturbance to these gentle creatures.

Certain beaches of Shark Bay are the most southerly nesting areas of the Green Turtle (*Chelonia mydas*) and Loggerhead Turtle (*Caretta caretta*). Like the dugong, these marine vertebrates have been hunted almost to extinction except in northern Australia. Australian wildlife management authorities have a special responsibility to protect their breeding and feeding areas.

Of course, the Monkey Mia dolphins are well known to everyone. What is not so well known is that the dozen or so individuals who turn up so regularly to charm people into giving them free meals are members of a large pod of a hundred or more dolphins which



A.G. Wells



B. Wilson

The Banded Hare-Wallaby (*Lagostrophus fasciatus*) (far left) and the Western Barred Bandicoot (*Perameles bougainville*) (above left). These two marsupials survive now only on Bernier and Dorre Islands.

Low tide in Hamelin Pool exposes stromatolites. These living structures represent a life-form which flourished when life on earth began (left).

inhabit the eastern part of Shark Bay. Why these individuals seek human company is a mystery. Are they the brave, curious or lazy members of their society?

Current studies on the sociology of the pod are revealing many details about the complexities of dolphin life which were hitherto undreamed of. Protecting the phenomenon of the dolphin-human interaction at Monkey Mia is a special objective of the Shark Bay Region Plan. But that depends upon the protection of the social structure, habitat and home range of the entire pod.

Another internationally renowned feature of the Shark Bay marine environment is the occurrence of stromatolites in Hamelin Pool. These peculiar calcareous structures are formed by growth of certain micro-algae and bacteria. Their growth is dependent upon very unusual combinations of environmental conditions in the hyper-saline shallows of Hamelin Pool. It is believed that the same kind of structures, formed by the same biological processes, were characteristic of our world's shallow seas when life on earth began. Hamelin Pool has much to tell us about the early history of our planet. No one would question that the stromatolites must be protected, but it is necessary also to protect the marine environment in which they grow. In particular, maintenance of the sea-grass banks and the Faure Sill at the northern end of Hamelin Pool is essential to maintenance of the stromatolite environment. The Region Plan proposes that the whole of Hamelin Pool and adjacent foreshore lands be protected by reservation and management as a nature reserve.

Thus, for a variety of reasons, the marine environment of Shark Bay has very special features worthy of protection and careful management, especially the inlets and sea-

grass banks which support the important commercial and recreational fisheries. There is particular responsibility for protection of stromatolites, dolphins, dugong and turtles and their habitats, but the entire marine fauna and supporting habitats of Shark Bay are unique, and there are strong reasons for the Region Plan proposals for marine parks and reserves.

There is much scope in Shark Bay for development of out-of-doors recreational facilities. At present, access is lacking, or at best difficult, to many points of interest.

There are many quiet, scenic bays and inlets which cannot be reached except by boat, and boat-launching facilities are rare. Declaration and development of the proposed national parks on Peron Peninsula and at Steep Point and the construction of access roads will greatly enhance public recreational opportunities in the region. Development of observation facilities at places of special interest, for example at the best stromatolite localities and at Monkey Mia, together with provision of natural history and human history information, will greatly enhance public enjoyment and interest.

Fishing for snapper off Peron Peninsula in the quiet of an evening.



One of the attractive features of Shark Bay is its remoteness, however, and the sense of wilderness which it offers. Care must be taken to preserve that atmosphere.

Thus, Shark Bay is a large area of land and sea containing an exceptional number of outstanding natural heritage values set in a matrix of unique scenery and wilderness. Each special feature must be managed and protected not only in its own right, but in the context of the Shark Bay environment as a whole. The Region Plan strategy is to protect special features in reserves but at the same time to provide a means of overall, integrated management which will protect the integrity of the whole.

A plan is merely a framework which provides guidelines for action. Implementation is the next step and, in the case of the Shark Bay Region Plan, this will require time, attention to detail, and a great deal more interaction between management authorities, the regional community, and the public at large.

There is no doubt that Shark Bay is a special place worthy of special attention. Our tasks are to protect, manage and care for all those outstanding natural features which give it its special character, while enhancing its values as a human environment.

The Unforeseen

The best laid plans of mice and managers cannot always cover all eventualities. Cyclone Herbie made its presence felt at dawn on May 21st 1988. A little reminder that nature still rules supreme on the Peron Peninsula. Photographer Jiri Lochman had the (mis)fortune to be there at the time.



The Last Lake



R. Joensch

by Stuart Halse

Toolibin has become the focus of a massive effort to prevent yet another wetland from succumbing to salination. Prior to the 1930s and 1940s the northern Arthur River wetlands, east of Narrogin, were swampy freshwater lagoons, which contained extensive thickets of trees and frequently dried out. Now most of them are saline, they fill more frequently, and the trees they contain are long dead. Only Lakes Toolibin, Dulbinning and Walbyring still have living trees. These are healthiest and most dense in Toolibin, which contains thickets of swamp sheoak (*Casuarina obesa*), paperbarks (*Melaleuca strobophylla*) and occasional flooded gums (*Eucalyptus rudis*).

The thickets of trees in Lake Toolibin provide nesting sites for a very large number of waterbirds, including ducks, herons and related species, and cormorants.

Because of the extensive area of thickets, more species have been recorded breeding at Toolibin than in any other wetland in south-western Australia.

Historically, Lake Toolibin was a very popular venue for duck shooting because it contained large numbers of ducks and a good mixture of timbered areas and open pools. Shooters were able to get an unimpeded shot across the open pools, where dead birds were easily located after they fell into the water, while surrounding trees provided cover until the birds were within range. However, because of the importance of the lake to the Freckled Duck and other protected species such as the Great Egret (*Egretta alba*), Yellow-billed Spoonbill (*Platalea flavipes*) and Rufous Night Heron (*Nycticorax caledonicus*), it was closed to shooting in December 1974.

Public meeting

In the early 1970s it became apparent that, like other northern Arthur River wetlands, Toolibin was being affected by salt. Trees began dying along the western shore and showed a loss of vigour in some other parts of the lake. The process was occurring 30-40 years later in Toolibin than in some of the other Arthur River wetlands, like Taarblin, suggesting that the hydrology of the lake must have some features which make it comparatively resistant to salination. The same applies to Dulbinning and Walbyring, although they are not surviving as well as Toolibin.

The West Australian Field & Game Association and local citizens were very concerned about the decline of Toolibin and organised a public meeting at Narrogin on 25 August, 1976, which was attended by Jim Goodsell and Peter Lambert of the former Department of Fisheries & Wildlife. As a result of the meeting, the Northern Arthur River Wetlands Rehabilitation Committee (NARWRC) was formed to examine ways of reducing the salinity of the lake and to ensure it remained an important breeding area for waterbirds.



R. Gosston.

Freckled Duck

The NARWRC, which consisted of representatives from relevant Government Departments, finished its study in 1986 and its conclusions are summarised in a recently released report. Various members

Even if the water table does not rise, there is a grave danger that Toolibin will become more saline than it is currently because of an increased amount of salt-affected farmland in the catchment

and associates of the committee produced detailed reports on the hydrology, hydrogeology, vegetation and waterbirds of the lake.

The problem

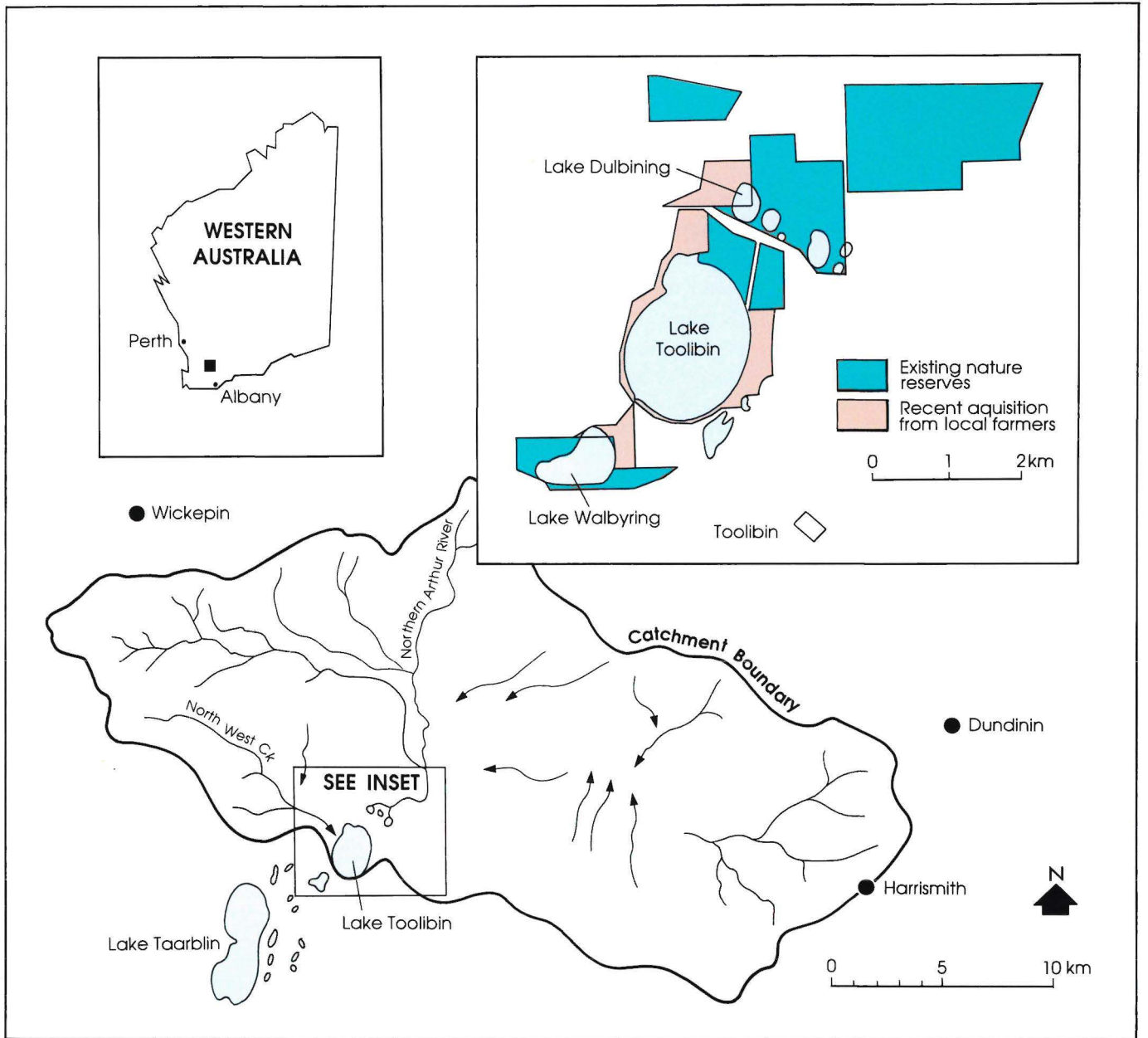
If nothing active is done to control salinity in the Toolibin catchment area, the saline water table will eventually rise above the floor of the lake. This may even happen in spite of remedial action. If it does, and even if it just happens for a brief period, there will be dramatic changes in the ecology of the lake. The reasons for this are explained in the box on p.20. All the trees will

die, because of the salinity of the groundwater and also waterlogging.

It is always difficult to make predictions about the exact effects of environmental changes on animals but it can be said with absolute certainty that if the water table rises above the lake bed, fewer than half the 22 species of waterbird that currently breed at Toolibin will continue to do so. Freckled Ducks, Great Egrets, Yellow-billed Spoonbills, Rufous Night Herons, Great Cormorants (*Phalacrocorax carbo*), Great Crested Grebes (*Podiceps cristatus*) and several other species will abandon the lake as a breeding site. There are two reasons for this.

Firstly, the foliage of live trees provides cover to help conceal the nest from predators and protect it from the elements: some of the species require this. Secondly, young ducks, grebes and coots, which leave the nest immediately after hatching and accompany their parents about the lake, must have access to fresh or only slightly brackish water (<5ppt) for drinking. Older birds can be found in very saline water because they can drink it and excrete the salt it contains via their nasal salt glands as well as their kidneys. They also have the ability to fly to fresh water. For the first week or so after young birds hatch, their salt glands are not functional. This, combined with their lack of mobility, means that successful breeding can only occur in wetlands that are either comparatively fresh **at the time of breeding** or have pockets of fresh water, as a result of seepages or some other phenomenon, where the young can drink.

Even if the water table does not rise, there is a grave danger that Toolibin will become more saline than it is currently because of an increased amount of salt-affected farmland in the catchment and, therefore, more saline run-off.



Juvenile Rufous Night Heron



J. Lochman

Causes of salinity in the Wheatbelt

What are the causes of salination in wheatbelt wetlands? Firstly, all rain contains a very small amount of salt. Over geological time this adds up, so that actually very large quantities of salt have been deposited on the wheatbelt landscape. Because rainfall is too low in the wheatbelt (it is 420 mm a year in the Toolibin area) to leach the salt into the underlying water table, it has accumulated in the soil profile.

Secondly, native vegetation transpires far more water during the course of a year than pastures and crops do. This is chiefly because pastures and crops die off in summer, whereas native vegetation continues to grow. Deep-rooted native trees remove moisture from the soil to a considerable depth as they provide themselves with water for transpiration. When native vegetation is cleared, less soil water is used. As a result more water moves down into the water table and groundwater levels rise.

It can take more than 30 years for groundwater levels to stop rising after a catchment area has been cleared. About one-third of the catchment area of Lake Toolibin was cleared by the 1930s, the remainder was cleared in the 1940s and 1950s. The water table has risen 12-15 metres as a result and is now within 1-2 metres of the lake bed. Salt that was stored quite deep in the soil profile is now dissolved in the groundwater, which is almost as salty as seawater. It is quite probable that the water table in the Toolibin catchment will continue to rise for several more years. A rising water table can cause salination in two ways. Firstly, since wetlands usually occur in the lower parts of the landscape, if the water table rises far enough it will come through the floor of the wetland, which will then become what is called 'a surface expression of groundwater level'. In other words, the water in the wetland will be groundwater rather than surface run-off, and will be saline. This dramatically changes the ecological character of the wetland.

The second way in which salination can occur, as has been happening at Lake Toolibin, is that the surface run-off into a wetland from agricultural areas becomes saline. This happens as low-lying farmland becomes salt-affected because of the water table rising close to the surface. In summer, salty water percolates through to the surface, where the water evaporates and salt is deposited. The salt is washed into the wetlands as surface run-

off after rain. In this situation salinities are lower than when groundwater rises above the floor of the wetland; surface run-off wetlands usually remain brackish rather than becoming saline.

Clearing of native vegetation has also increased the quantity of surface run-off flowing into wetlands in the wheatbelt. This has led to the wetlands filling more frequently and, in some cases, they may hold water through summer, even when they are situated well above the water table.

A final point is that just like surface run-off lakes, the water table shows seasonal (and annual) fluctuations in level according to the amount of rainfall. For this reason, although lakes with a groundwater connection show less variation in level than surface run-off lakes, their water level does vary and they dry out if the groundwater level drops below the lake floor.

Different plant species can tolerate different levels of salinity and inundation. Many aquatic plants can withstand salinities greater than that of seawater and, of course, permanent immersion in water. However, no tree species can survive permanent flooding and not many can tolerate very salty water (mangroves are the best known exception).

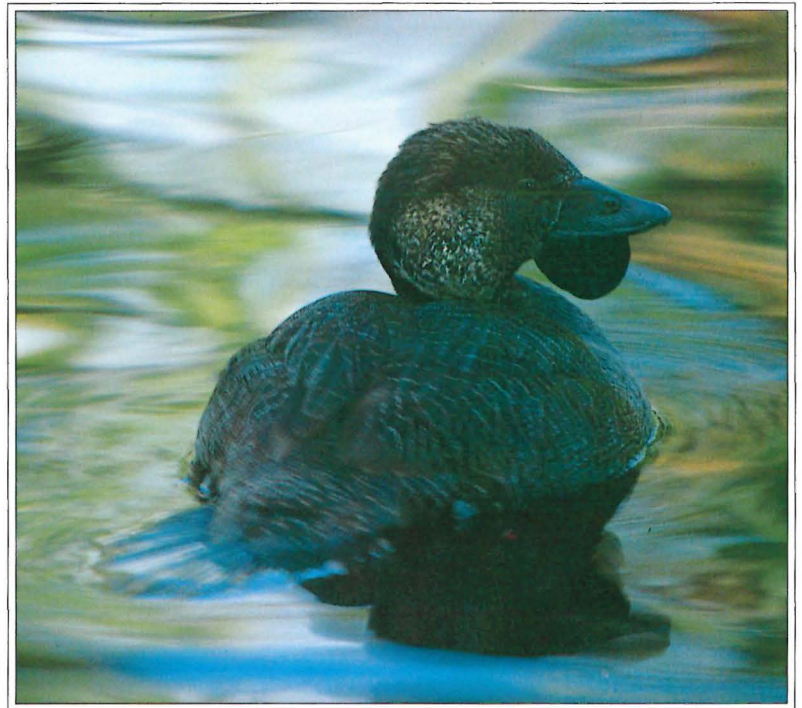
Of the species growing at Toolibin the swamp sheoak is the most tolerant of salinity and inundation but it cannot withstand prolonged exposure to soil or water salinities >10 ppt (parts per thousand). The usual biological classification of water salinity is that <3 ppt is fresh, 3-10 ppt is brackish and >10 ppt is saline. Seawater is about 35 ppt.

Currently the salinity of water in Toolibin varies from <1ppt in winters when there is a lot of run-off and the lake is full to >10 ppt in the shallow pools remaining in the lake just before it dries out in the summers when it does so. Water flowing into the lake in the middle of winter is usually fresh (<1 ppt) but it can be quite saline (>10 ppt) during small flows at the beginning of winter and in spring when there is a lot of salt on the soil surface in the catchment. The salinity of the soil of the lake bed varies from about 1-3 ppt in most of Toolibin to 30 ppt on parts of the western shore where all trees have died.

This would lead to the death of more trees (although perhaps not all the trees) in the lake and would reduce both the number of species breeding and the number of pairs of many of the breeding species. In addition, as cover is lost and water salinity increases, the proportion of young hatched that are actually raised to fledgling stage would probably be reduced quite substantially. Thus, while the effect of an increase in saline surface run-off will not be as dramatic as the effect of a rising saline water table, it would nevertheless substantially reduce total waterbird population and probably prevent breeding by the species with the most salt-sensitive young.

Saving Lake Toolibin

There is no cheap or easy way to prevent the level of salinity in-Toolibin increasing. If the water table continues to rise the only short-term method of saving the lake is pumping groundwater from under it, thus lowering the water table. As a first step, the NARWRC advised installing groundwater pumps along the western side of the lake. Currently, a trial pump is operating, which is discharging into areas that have already been damaged past repair by salt. As a second step, the NARWRC recommended that CALM buy a 200 m wide band of land on the western side of the lake from the adjacent farmer and plant trees. A transaction was recently completed adding 128 ha to the Lake Toolibin Nature Reserve, which now completely surrounds the Lake. Once planted, the trees will increase the transpiration rate locally and, therefore, act as a biological pumping scheme to lower the water table (the trees growing in the lake are one, too). The biological pump has



M. Lochman



W. Hughes/Lochman Transparencies

The Musk Duck is found in Lake Toolibin when it is full (top). Yellow-billed Spoonbill (right).

the advantage that the water is lost to the atmosphere instead of needing to be discharged downstream. The third step was to construct a drain to divert salt flows from the lake to the downstream areas.

In the long-term, good land management by farmers is an essential adjunct to pumping and tree planting around the lake if Toolibin is to remain a viable waterbird habitat. It is important that farmers prevent an increase in the amount of salt-affected land on their properties and re-vegetate areas that are already salt-scalded. This should keep the salinity of surface run-off in the catchment at its present level, or perhaps even reduce it. Unless the salinity of surface run-off is controlled, most vegetation in the lake will die in spite of pumping to drop the level of the water table.

It was farmers' earlier concerns with the problems of soil salinity, waterlogging and flooding on the flat farmland near Lake Toolibin which led to the formation of the Wickepin Soil Conservation District in 1985. What followed was a remarkable community effort: 569 ha of salt-affected land on eight farms was rehabilitated and the ABC National Tree Care Award was won. With the Department of Agriculture, Greening Australia, Alcoa, Wickepin Shire, local schools and farmers cooperating in a Commonwealth Employment Scheme project, 60 000 trees were planted and protected by 34 km of fencing, which was erected by farmers on a cost-share basis. CALM has also planted 9 000 trees on Dulbinning Lake Nature Reserve to complement this work.

The Toolibin flats project has been a valuable lesson for all, emphasising the enormity of the task and pioneering detailed and advanced techniques for salinity rehabilitation. It is now being extended to the whole catchment involving all 50

It is important that farmers prevent an increase in the amount of salt-affected land on their properties and revegetate areas that are already salt-scalded

farmers in the 500 sq km area which drains into Lake Toolibin.

Why Save Lake Toolibin?

Having explained the causes of salinity in Toolibin, its consequences, and how difficult the situation is to remedy, it is necessary to emphasise why it is worth spending so much effort to save the Lake. There are two reasons. The first reason is waterbird conservation. Toolibin is special: it supports the greatest number of breeding species of any surveyed wetland in south-western Australia. Lakes with a large number of breeding species are very rare: of the 251 wetland nature reserves surveyed by the Royal Australasian Ornithologists Union between 1981-85 on which birds

Lake Toolibin seen from the south-west corner.

were found, 44% of them had no breeding species, 35% had from one to four breeding species, 17% from five to ten and only 4% had greater than ten breeding species. Toolibin had 22. The second reason is aesthetic: Toolibin is probably the most attractive lake in the wheat-belt (it is the last viable swamp sheoak wetland) and provides scenic variety in an area that consists mostly of farms and salt lakes.

Without breeding areas, populations of waterbirds in the South-west will rapidly disappear. Toolibin is one of the few areas in the South-west where such attractive species as the Great Egret and Great Crested Grebe nest and is the stronghold of the Freckled Duck. However, its importance is not limited to having several comparatively rare breeding species; it is equally important as a site where large numbers of several common species breed and are able to raise their young with a high success rate.

The existence of such high quality waterbird 'nurseries' is essential to maintaining a profusion of waterbirds in the South-west. Highly productive wetlands, however, are just as rare as wetlands with a high diversity of species. The outstanding value of Toolibin is that it possesses both attributes.



K. Atkins

BUSH TELEGRAPH

Marri Blossom Time



J. Lochman

How blasé West Australians can sometimes be to the beauty that surrounds them! One of the finest blooms of marri ever seen occurred in summer-autumn 1988. Throughout the South-west masses of creamy, blossom-covered trees were bordering road verges, or growing in paddocks, forests and woodlands. Yet hardly a comment

was heard. Certainly no fuss was made in the media, as it is when the cherry trees flower in Japan or Washington, the jacarandas in Grafton, the poincianas in Brisbane, or even the apple trees in Donnybrook.

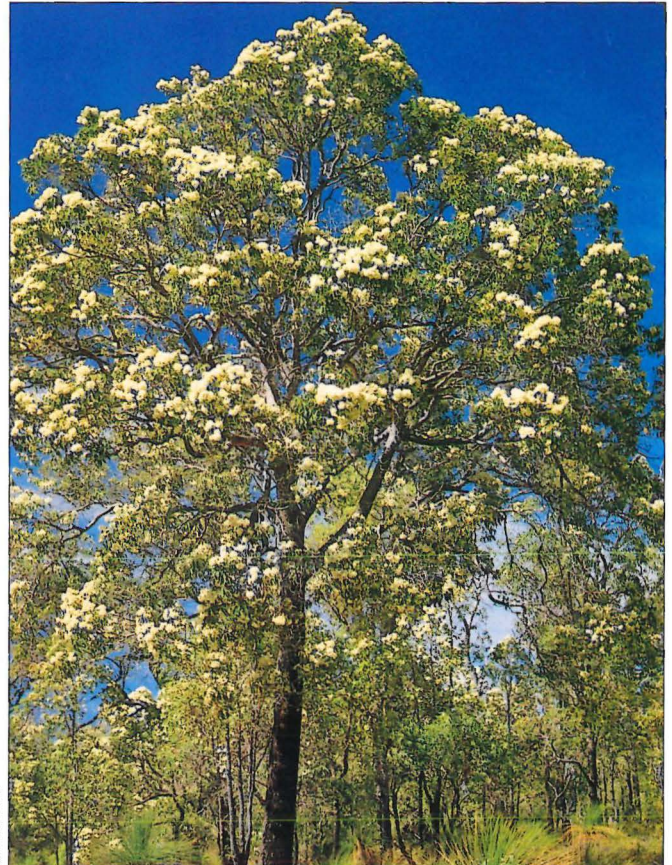
Perhaps the problem is that a mass flowering of marri only occurs infrequently, and cannot reliably be predicted.

In general, marri trees tend to flower about every two years, but there is a four or eight-year cycle between the sort of mass, synchronised flowering which we saw throughout the South-west this year. Another dramatic marri blossom in recent times was in the summer of 1972/3. The flowering that year was so prolific that foresters at Manjimup commissioned a special aerial photography mission to provide the definitive data base on the distribution of the species. Marri grows throughout the South-west, developing into a pure forest in some rare spots like Beedelup National Park, but more often growing in mixture with jarrah, karri or blackbutt.

Although conventional bush wisdom has it that a mass flowering of marri foretells an early, heavy winter, this is not supported by rainfall records. Research into mass eucalypt flowering has yet to provide anything conclusive about either the causes or the effects. Nonetheless, any good bushie can tell you the significance of a heavy marri blossom - plenty of honkey nuts the next year!

Marri is a curiously underrated tree. For most of the years of European settlement West Australians always seemed to have preferred jarrah and karri for timber, wandoo for honey, and red flowering gum as an ornamental tree. Even on farms, where marri grows into such a superb shade tree, it is often cleared if the trees are thought to harbour the *Armillaria* fungus, which destroys fruit trees.

'Marri Blossom Time' may never become a West Australian festival, but should always be a cause for celebration. The blossom provides us with scenes of unsurpassable beauty, with nectar for birds and beekeepers, and eventually a bumper crop of marri seed for regeneration work in the forest and the raising



C. Winfield



J. Lochman

of marri seedlings in nurseries for the replanting of farms, minesites and dieback areas.

It also reminds us of some of the qualities of this species. Marri is a tough survivor in the W.A. environment. It copes with fire, dieback and leaf miner; with sandy, gravelly or clayey soils; it regenerates easily, grows quickly and flowers prolifically at a very young age. Although good sawlogs are rare, the timber is strong and beautiful. Marri is used most often for fine writing paper, nectar, shade and amenity.

So fellow West Australians, let's take stock of and pay tribute to the marri - the South-west's all round beautiful gum tree.

Roger Underwood

Mixed Fortunes at Yanchep

T. Goodrich

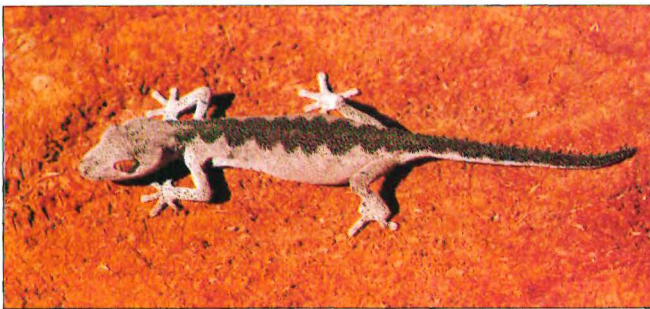


Honey Possum.

A mixture of good news and bad news has been the order of the day during recent biological survey work at Yanchep National Park. Major sampling sessions for the survey, which is being carried out by officers from CALM's Research Division with assistance from local Park staff, began in October

and are being concluded currently. Rangers at Yanchep have assisted with digging holes for the 138 pit traps used in the survey, and have also assisted in the trapping sessions.

T. Goodrich



Western Spiny-tailed Gecko.

The good news is that the reptiles and frogs seem to be doing well and we have been able to add several species to the list of species known for Yanchep. Interesting finds included Turtle Frogs which were caught in pit traps after rain, and the endangered Carpet Python, which Park Rangers occasionally record in the Park. A number of interesting plants have come to light, including the second known population of a declared rare eucalypt which is so 'new' that it hasn't even been named yet - and it is only 50 km from the GPO!

The bad news is that some of the native mammals seem not to be faring very well. The diminutive Honey Possum is still abundant, but we have not yet caught any of several other species of mammals which have previously been recorded in the Park. The only rodents we have found so far are the introduced Black Rat and House Mouse. During extensive trapping in both spring and autumn, we failed to trap the native Bush

Rat, which was once common in the Park, but is now obviously quite rare. The Brush-tailed Possum has also declined in numbers, and is possibly no longer resident in the Park. Three other mammals known to have occurred in Yanchep and not recorded in recent years are the Chuditch, Ash-grey Mouse and Western Pygmy-possum.

Unfortunately, it is not known what has caused the decline of these species but it is likely that introduced animals (cats, foxes) are implicated. Further understanding will only come about through studies of the biology of individual species.

Allan Burbidge.

Peel Inlet ERMP Released

The Environmental Review and Management Program for the Peel Inlet and Harvey Estuary was released by the Government on May 23rd. It is the result of ten years of investigation into the causes of noxious algal growth in this major coastal lagoon, and possible ways of controlling it.

Written comments on the ERMP proposals are sought, and will be received by the Environmental Protection Authority up to the deadline of August 1st, 1988.

The proposed management strategy has six elements:

- construction of a new channel to the ocean at Dawesville to allow flushing of the Harvey Estuary
- modification of farm fertiliser practices to reduce the amount of phosphorous leaching into the system
- moratorium on further clearing and drainage in the catchment until suitable policies are developed
- expansion of intensive agricultural activities in the catchment will only be permitted subject to stringent restrictions on nutrient loss to ground water and drains
- investigation of the potential for farm forestry with a view to the afforestation of up to half the sandy soils to reduce phosphorous leaching
- continuation of weed harvesting operations

The ERMP can be obtained from: The Department of Agriculture, the Department of Marine and Harbours, or Local Government Authorities in the region.

Banksia Atlas Published

The Banksia Atlas, a three year volunteer participant mapping project involving all 75 Australian species, has been published by the Australian Government Printing Service. The project was run by CALM research staff with major funding provided by the Australian Biological Resources Study.

More than 400 enthusiastic contributors and their friends from throughout Australia participated. About 23 000 records of banksias at particular locations were reported and mapped. New species

were identified. Information on flowering, habitat, new shoot growth, habit and pollination was collected in comprehensive detail. Many conservation problems and potential research projects were elucidated.

The Banksia Atlas retails for \$39.95, and is available from the Australian Government Publications Office in each capital city, or the CALM office at 50 Hayman Road, Como.



J. Lochman

Quiet Achievers

by Tess Williams

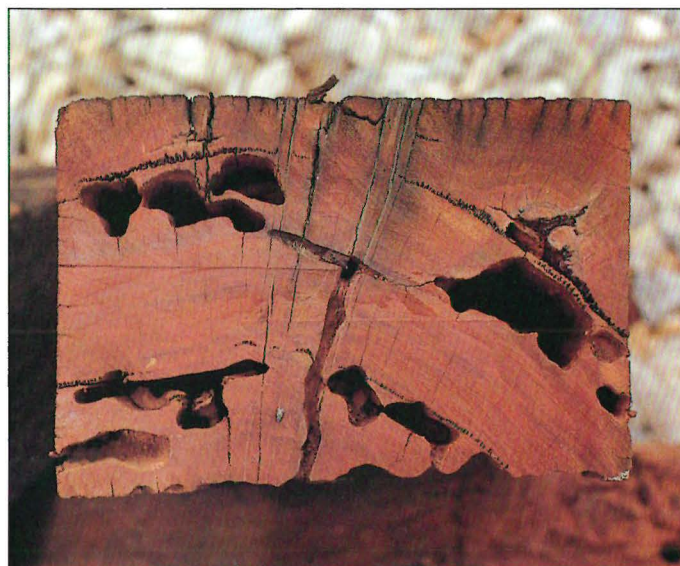
Humans, dependent on 'society', and seemingly unable to define and defend the term, should have great admiration for any population in which each creature finds constructive occupation, each creature lives in harmony with its many brethren and the good of the many is the ruling political principle. Unfortunately, most people do not feel such a sentiment for the humble termite. They are more likely to view it as yet another pesky infestation of suburban Eden.

There may be some basis for the latter reaction if we examine the pedigree of the termite. Termites are, in fact, a close relative of that insect that tends to send all but the most ardent insectophile looking for a shoe - the cockroach. While this may not win them a place on the domestic popularity poll, it does give us further grounds for respect. While termites share few physical characteristics with their relative, they certainly have the same hardiness and adaptability that guarantee them a place on this planet as long as it sustains life.

Ancient termite fossils have been found which date back as far as 200 million years, and fossils dating from between 70-75 million years are common. The continued existence of similar species tells scientists of the insect's capacity to survive enormous climactic change and of a common ancestry with some African and South American species before the continents separated. Definitely one of nature's success stories.

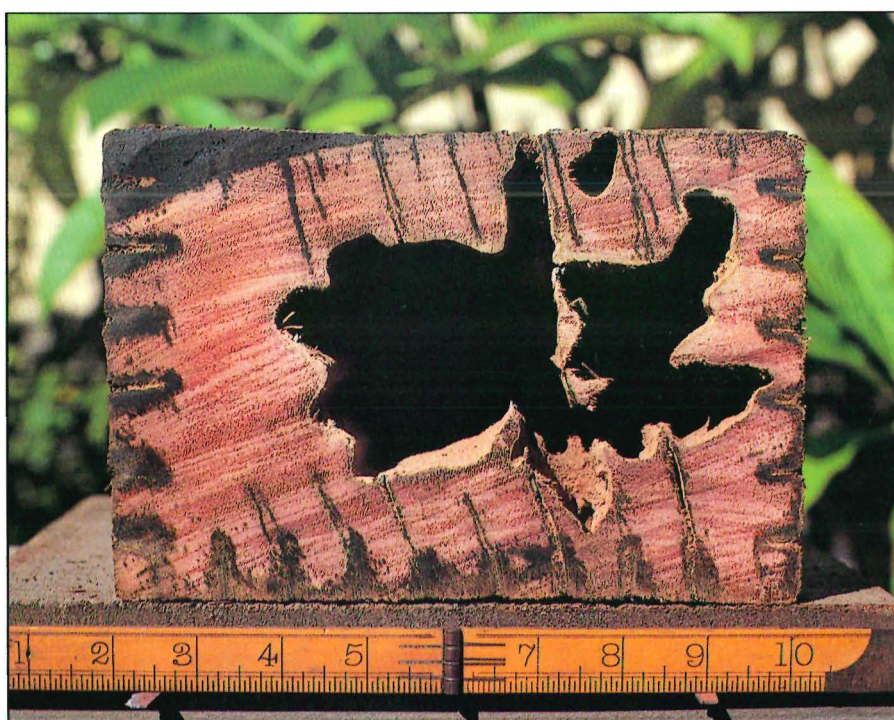
In the Pilbara region of W.A. there is a species of termite, *Mastotermes darwiniensis*, which still closely resembles the fossilised remains of 70 million years ago. This particular species is the SAS contingent of termites in W.A. They are the only true solid wood eaters in the State, and they have provided some expensive headaches for our more recent northern pioneers.

Mining companies laying extensive railway lines to transport iron ore have fallen foul of *Mastotermes*, which will eat wood even when there is no sign of fungal decay. Not only will they eat wood which is whole and healthy, they will eat treated wood. Companies in the North West have even treated railway sleepers with poisons to discourage the infiltration of *Mastotermes*, only to find that a proportion of the termites will man the front trenches, and the rest will



D. Perry

Mastotermes are virtually unstoppable. An attack on a jarrah sleeper (above) and on a karri sleeper which had been treated with dieldrin and creosote (below).



D. Perry

persuade over the bodies of fallen comrades until a depth of wood is reached where poison has not penetrated. Concrete and steel sleepers are gaining in popularity above the Tropic of Capricorn!

Although not generally as aggressive as *Mastotermes*, most termite species still seem to prefer a hardy existence in arid or semi-arid regions. Of approximately 130 documented species, only 15-20 species are regularly found in the wetter, colder South-west corner of

W.A., and an increase in termite activity and occurrence is clear beyond the 500 mm Isohyet in the wheatbelt. Termites do have distinct and complex social structures, similar to the more familiar ants, and a fascinating life cycle which is the basis for their colonies. Although varying in size, from a few hundred individuals to many thousand, the termite nest is always started by two enterprising individuals, known as the king and queen.



Courtesy S. Eyres, Department of Agriculture

A soldier ant (brown) and a worker ant (white) on a twig (right).

The king and queen fly from their original home as alates, and are known, at this stage, as perfect insects. They are winged, sighted and sexed. On finding a suitable site for a nest, the alates land, they snap their wings off, and the queen releases pheromones into the air which indicates the acquisition of crown land and attracts a male if she does not already have a consort nearby. The king and queen then set about excavating a vertical tunnel and a chamber 15-20 cm beneath the soil surface.

It is in this humble bedsitter that the first family is raised, and it is here that the queen will be required to perform manual labour for the first and last time. In addition to excavating their new home, she raises the initial batch of workers and then assumes the sole function of mother to the future colony, while the workers turn to the business of nest building. The king will periodically fertilise the queen and all eggs in the colony will come from her body. The breeding life of the king and queen can be a long one, even by human standards, with the royal pair of some species staying productive for up to 70 years.

With continued egg production, the queen's body becomes quite distorted. Her abdomen will often enlarge and she will be unable to move. And, of course, being the sole egg dispenser the queen is a very valuable member of the community. In a situation where the queen suffers an unplanned demise, the results can be disastrous for the entire colony. Some of the more hardy species, like *Mastotermes*, have a neat evolutionary trick which can be performed in such an eventuality. A worker termite, by means unknown, can be promoted to heir apparent, and can eventually take over the queen's role.

As long as eggs are produced, the workers are kept busy extending the nest and caring for the eggs. Caring for the eggs and the immature insects is a time consuming process as unhatched termites and the young need a constant environment with high humidity and warmth. The search for water to maintain humidity can entail workers burrowing up to 18 m beneath the soil in drier areas and the occupants of the nurseries are continually relocated to ensure the safety of the new population.

Workers, then, are vital to the founding of the colony and form an entire caste in the mature social system of the termite colony. They are responsible not only for building the structures of the expanding nest, but also for maintaining those structures throughout the life of the colony. They provide all care for the king and queen and any dependants, and collect all food needed by the whole population. In human terms, a rather thankless task, as this industrious group are blind, wingless and unsexed.

Another caste in a termite colony is the soldier caste. In practical terms, their individual lives are as joyless as the workers. They are also blind, wingless and unsexed and they devote their lives to protecting the colony and the future generation that will come from the nest. They are, however, well armed, some with large mandibles, some with chemical deterrents which they fire at offenders, and some with both.

The nobility of the termite mound is found in the alates, the last of the three castes. These individuals are the potential founders of new colonies and the reason for the vast

support system of the other castes in the nest. They are the silver spoon faction, winged, sighted and sexed, 'perfect' insects. When breeding season comes, they will have a brief burst of glory as they leave the nest in massive numbers. The release of alates in such quantities is nature's guarantee that some will establish themselves, because most of the pretenders to a throne will actually end their shining careers in the gullet of a frog, bird or lizard.

This flight of the alates often takes place after a cyclone in the Pilbara. They are obviously a vital element of the local ecology. Loaded with fat and protein, they provide a feast for local wildlife, probably influencing the breeding capacities of many other creatures in the drier areas of the State.

The composition of the nest is regulated by two factors. Firstly, royal decree controls caste production, with the queen maintaining the balance of workers, soldiers and the future reproductive caste. The critical factor in the determination of caste is as yet unknown. It is possible that each insect is fed an appropriate diet, or is introduced to certain chemicals, to ensure development into a soldier, worker or alate.

The second factor, which will dictate the size of the nest, is food availability. In times of shortage, the termite family will be considerably reduced, in times of plenty they will thrive in accordance with nature's rules. In Australia, famine for termites is rare. From the scrubby, dry areas of the Pilbara to the wetter southern forest floors, there is usually plenty to eat, from twig and leaf debris to fungus or fungus-affected wood, and even humus.

Very few termites, even though they sport the title of sound wood eaters, drill through healthy wood

or bark. They will search out decaying or damaged wood because termites, like all animals, cannot digest cellulose, it is the micro-organisms which inhabit their gut which do the job. Termites were probably one of very few species in Australia to actually benefit from the advent of Europeans. If trees are bruised or damaged by fire it leaves them vulnerable to decay and future termite attack.

Europeans also provided another source of food for the voracious timber eater - his dwellings and other structures! It is this unfortunate dietary habit, despite the value of the insect in undisturbed ecosystems, which tends to provide the focus of most urban perceptions of the termite. Railway sleepers, house stumps, wood piles, furniture and even books and documents are prey to termite appetite if untreated. And, once infested Prevention is certainly better than cure in this case.

The main culprit was well established in Perth when the first settlers arrived, and has never left, waxing fat on the provisions of white civilisation. This species is called *Coptotermes acinaciformes raffrayi*. All species of the sub-family *Coptotermes* form large colonies in a variety of habitats. The species can live in stumps, in dead or living trees, in subterranean nests or in the distinctive mounds that can be seen in various parts of W.A. It is commonly called the white ant and the mode of operation with domestic timber is to burrow through at a point of weakness and to honeycomb the timber with a series of chambers and galleries which become more extensive as the resident numbers increase.

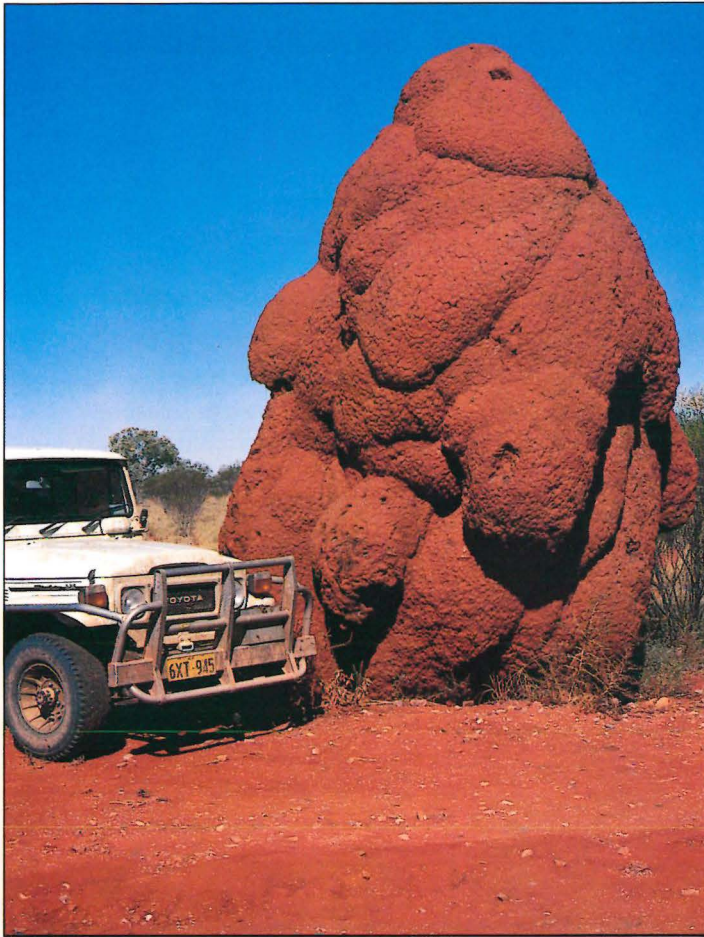
Old wooden homes built on untreated ground are not the only prey for this determined insect. Where houses are built on stumps

with metal protectors, or have impenetrable concrete piers as support, *Coptotermes* will build 'shelter tubes' which will allow them to bypass obstacles and reach timber. They can infest any timber structures in new houses, panelling, architraves, fire surrounds and even furniture. To prevent the original royal pair from settling in like unwanted relatives, it is necessary to take some basic precautions.

Home owners should inspect their properties at least once a year. Areas underneath the house and roof timbers should be checked with a torch, and a sharp instrument should be used to probe wood to ensure there is no infestation. Wooden fences and out buildings should be checked and organic yard litter should be shifted as piles of leaves and woody debris are an invitation to a royal garden party of the worst kind!

If annual inspections are too difficult for the house owner, most pest control firms perform inspections and will provide written reports on any termite activity. They also serve tenants of nests with eviction notices. To dispose of active insects, arsenic dust is used directly in the nests, and chemical barriers can be placed on the soil around and under the house to discourage the termites from entering any neighboring timber. This protective treatment is used regularly on suburban buildings whether they have ever had problems with termites or not.

A lack of local information tends to suggest that, even though damage to man-made structures does occur in and around Perth, the termite is not as prevalent here as in the Eastern States. To corroborate this, and to obtain a clearer portrait of the occurrence of the termite in Perth, CALM is trying to identify the species most common in the metropolitan area, the timber most prone to attack and the specific



J. Lochman

Termite mounds

A large number of harvester termites, termites which harvest grass and small pieces of organic debris, build mounds. They are usually created from a mixture of clay in areas where clay is available. Where it is not, the mounds will be formed of sand and chewed food matter, giving the mound a woody structure.

Mounds can be three to four metres high and be composed of tons of material. Inside a large mound the galleries will often end high above ground level with a pool of water, which assists in keeping the humidity of the nest constant. Because of the enclosed nature of the mound and the enormous amount of activity carried on in galleries and chambers, a large amount of methane gas is generated within termite nests. No mean contribution to the Greenhouse Effect!

Giant mound near Harts Range (left).



R. Karri-Davies

Mound on Bungle Bungle Road.

trouble spots. Local pesticide firms, armed with specimen vials, are helping to collect the necessary information.

Termites in the natural bush surroundings are not so easily studied. Estimates indicate that there are probably 80 species of termites as yet undocumented in W.A., the majority of these are in the semi-arid and arid parts of the State and in the Kimberley.

No doubt the discovery of these unknowns will be the province of the methodical and dedicated bush loving scientist or keen naturalist, as consideration of termites in undeveloped areas is as important as their being studied in the urban landscape, and is a little more difficult. We certainly need to know much more about their impact on

undisturbed environments, their beneficial roles in the ecosystem. Apart from anything else, many a numbat would go hungry without them.

It is vital that we appreciate and respect these creatures rather than being preoccupied with their destruction and potential destruction of property. They have their part to play on the stage that is the world, as we have ours, and they certainly seem to have the market cornered on viable, long lasting social organisation - even if the republican in some people rebels!

Termite poisons

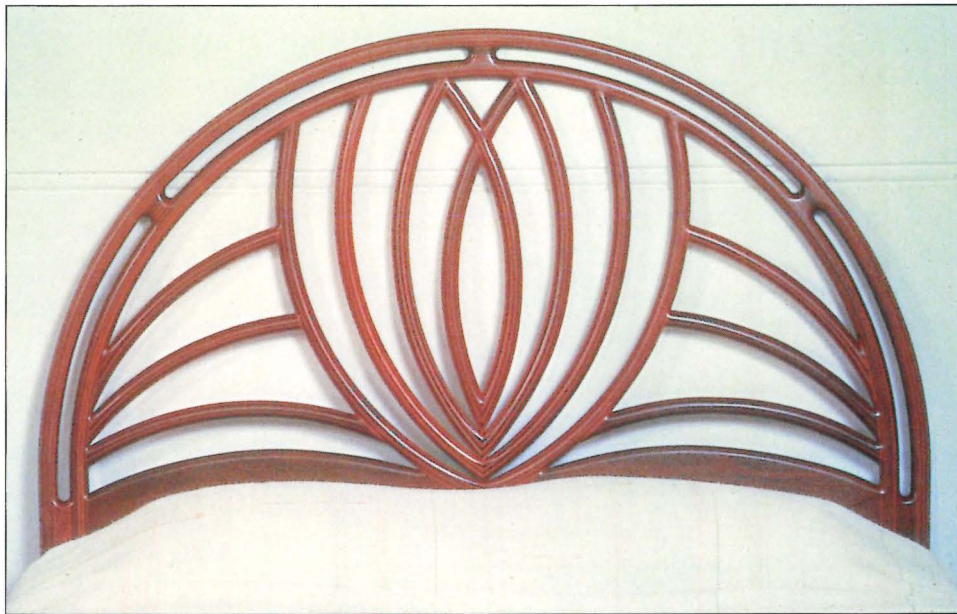
Recent concern about Organochlorines has led to a ban on the general sale of some of the pesticides most commonly used in the control of termites. Licensed pest control firms still use these chemicals, Heptachlor, Dieldrin, Aldrin and Chlordane, and Organochlorines must be used to prepare the ground underneath house slabs.

An alternative in termite treatment is available now for householders concerned about the health risks involved in using long-term residual chemicals. Chlorpyrifos, an Organophosphate, is highly toxic but does not have the residual problems of the other group and is safer to use around livestock and poultry. Its major disadvantage is that it is effective for only three years as opposed to the ten year protection offered by undisturbed Organochlorines.

Termites are the mainstay of a numbat's diet.

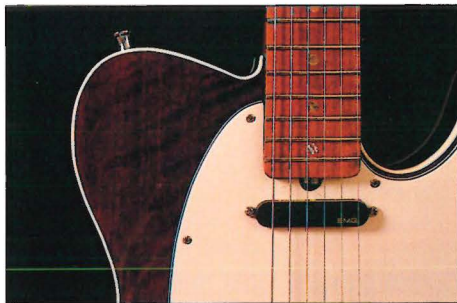


J. Lochman

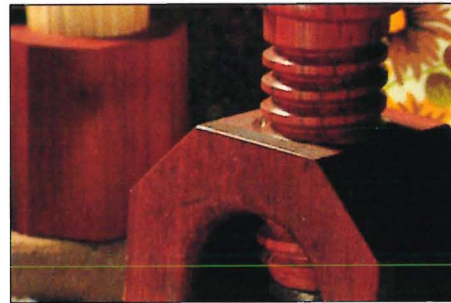


Greg Collins

CARVING THE FUTURE



Scott Wise



John Gordon



Robin and Helen McArthur



Leslie John Wright

By Colleen Henry-Hall

The fine hardwoods of our native forests - jarrah, marri, blackbutt, sheoak and others - in the hands of our local craftspeople and furniture makers are the raw materials

for beautiful and functional works of art. Chairs, tables, cabinets, mirrors, musical instruments, kitchenware: the list continues. The one constant factor throughout is the use of

these beautiful timbers that occur nowhere else but the south-west corner of W.A. We've gathered some samples of work from the portfolios of only a few craftspeople at work in W.A.

Scott Wise

The electric guitar could have been chiselled out of a jarrah tree. Lying on the counter in Scott Wise's darkened shop in Fremantle, it picks up the feeble light coming from outside and throws it back, warm and tingling and alive.

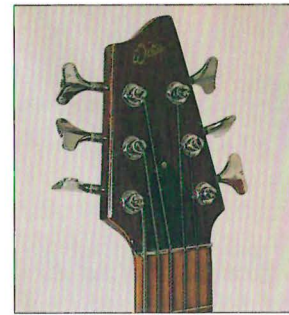
The instrument (pictured) is actually made of separate pieces of wandoo, jarrah, red tingle, and Brazillian ebony, stained one colour. It is the first time that Scott, instrument maker and musician, has used red tingle for an instrument.

He said, 'What we lack in W.A. is a timber that is light, which is important in constructing instruments.'

'I've found that red tingle has a unique combination of the springy strength that karri has, but is lighter.'



D. Valentine



D. Valentine

Scott said, 'I really like to work entirely in Australian woods. They're available locally; I can control the way the wood is cut. It's the idea of using these woods that's important.'

'Working in this wood is a matter of technical evolution. It took traditional instrument makers hundreds of years to arrive at the optimum sizes and sounds for their instruments.'

'That same challenge is here, working with the woods of Australia.'

John Gordon

Henry the cat lies in the doorway of John Gordon's showroom-workshop-living quarters at Bannister Street Craftworks in Fremantle.

'Henry is my PR man, from the laid back school of public relations,' John says.

It's not hard to understand why: pause to pat Henry's sleek fur and you're drawn into the bright showroom to look at the softly gleaming jarrah pieces.

John is a businessman, a designer, a manufacturer. He decides what will sell, he designs it, and then he makes it.

His range includes kitchenware, desktop items, toys. Every one is

functional: nutcracker, toast rack, napkin ring, spinning top, egg cup, paperweight, cutting board.

He says, 'I use jarrah most often because it has a certain mystique among local people, which is passed on to tourists.'

He gets his timber from commercial outlets because they are the most convenient sources.



A. Borthwick



A. Borthwick

From a workshop made of laterite rock, perched on the edge of the Darling Scarp near Byford, Mac and Helen McArthur create original pieces of furniture using native timbers and radiata pine.

The clean, modern contemporary lines of Mac's free-standing pieces are often complemented by the intricate designs of Helen's carving.

Mac, who describes himself and Helen as design craftspeople, was trained in London before coming to W.A., where he and Helen met.

Mac says, 'It's important that what you make is aesthetically good as well as functional. A lot of would-be woodworkers don't have formal training, so they don't have the design skills they need.'



A. Borhwick

Most of their work recently has been for churches: altars, tables, chairs.

Mac designed and built from radiata pine the furniture used by the Pope on his recent visit to Australia.

They do most of their work in jarrah, but Mac says, 'In years to come, we'll see more and more other native woods used, such as marri, blackbutt and karri.'

'The CALM project that enables craftsmen to go into the bush to gather wood for their own purposes is a good idea, because timber that is now going to waste will get used.'

Robin (Mac) and Helen McArthur



A. Borhwick

Leslie John Wright

Semi-precious stone and native timber come together to evoke images of the Australian landscape in Leslie John Wright's designs.

He looks over the Swan River from his workshop and studio at East Fremantle, and, not surprisingly, water seems to figure largely in his designs.

He recently completed a presentation box for the Queen, made of sheoak, inlaid with pieces of blue-green and red stone and mother of pearl. The box represented the red Australian earth, the stone and mother of pearl the sea.

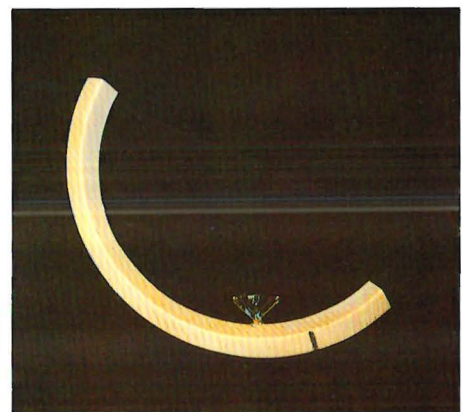
Until recently, Leslie worked almost solely in light coloured woods, of which W.A. has few. But he is turning more and more toward the warm, dark woods of our native bush.

'I'm looking hard at what I can find in my own lifestyle and in the country's topography.

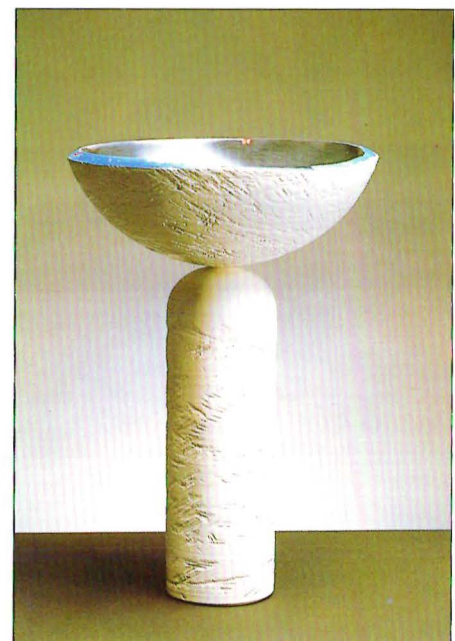
'These creative elements will help me find a design that is Australian by nature and one I can use to develop a collection of furniture that is unique to this country.



L. Wright



L. Wright



L. Wright



L. Wright

'Crest' conversation chairs.

Secretaire, sheoak stained charcoal grey. Design: L.J.Wright/R.Bell, Made by L.Wright. (top).
'Horizon' brooch. Carved huon with sapphire and 18ct gold (middle).
'Hemisphere' bowl, made of sheoak painted, stained and lacquered (bottom).

Greg Collins

A third-generation wood craftsman, Greg Collins works from his base in the South-west, close to the materials he uses in his work: jarrah, sheoak, blackbutt, blackboy, banksia.

His furniture and ornamental pieces are largely commissioned work, and he'll visit clients' homes, talking over ideas and getting a clear picture of where his work will eventually end up.

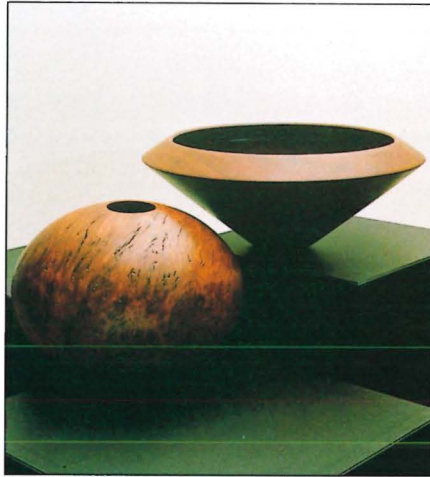
Greg works only in timbers he finds in the South-west, timbers rich in grain pattern, with a wide range of subtle colourings.

He gathers his material from the forests, often salvaged pieces of timber no one else will use.

He will take varying sizes of wood, using them as a segment of a large

dining table or cabinet, or whole for smaller, woodturned pieces.

Greg has had 40 exhibitions around Australia; his work was shown in Tokyo last year and Hong Kong this year, and drew a very favourable response.



Jarrah (top) and jarrah burl bowls.

G. Collins



G. Collins

The coffee table is jarrah - and so is the dragonfly: 350 laminated pieces to be exact.

Fine Wood Project

A new Government initiative based at Manjimup Timber Park aims to foster the fine wood industry in the South-west. Coordinated by Karen Keely and funded by the Department of Employment and Training, the project team will assist with enterprise development, productivity improvements and marketing strategies for fine wood products.

These products can range from sculptured pieces to finished furniture. There is a preference for the unique timber of the South-west, such as jarrah, marri, sheoak, blackbutt and banksia. Individual design and high quality finish are a feature of this work.

It has been the nature of this industry that the crafts people have worked by themselves and in relative geographic isolation. The project team will develop a register of makers, designers and galleries. This will help streamline both supply of timber and marketing of products.

The project will also set up training programs for the fine wood industry, and administer a number of small grants to foster productivity improvement.

Already a craftwood licence has been established by CALM. For \$10.00 the craft person can take up to three cubic metres (three trailer loads) of any material on the forest floor, regardless of length, in a one-month period.

While most people in this emerging industry prefer to fossick for their own material in the forest, CALM has also conducted auctions of small lots of logs and burls at Manjimup, and a recent one at Harvey which found great demand for sawn speciality timbers.

For further information on the Fine Wood Project you can contact:

Dr Karen Keely
Coordinator, Fine Wood Project
'Old Police Station'
Timber Park
Manjimup WA 6258
Phone (097) 71 2641

Perth's Hidden Water Supply

by Trevor Butcher

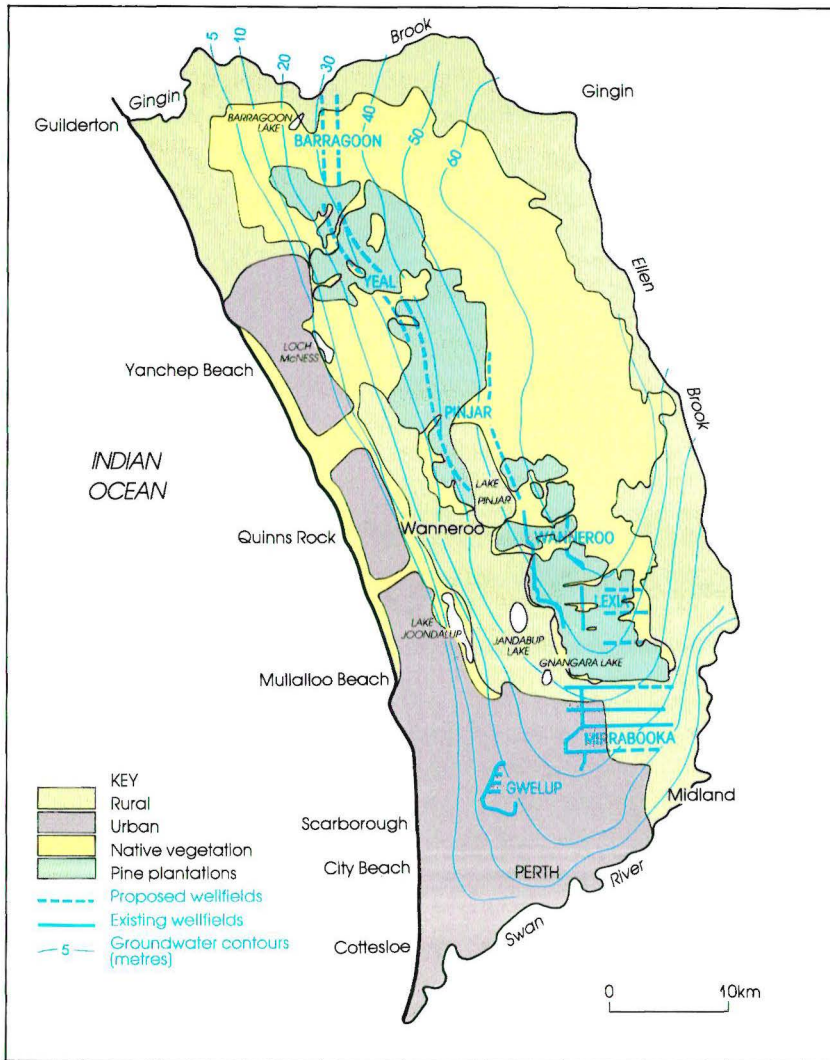
Water in Perth is a valuable commodity. With the possibility of water restrictions last summer, people were made very aware of the limited nature of this resource. It was only the successful education and advertising campaign 'Waterwatch' that avoided the necessity for restrictions. Water consumption targets were given each week set against a backdrop showing the depleted water storage in a surface reservoir. How many people realised that this was only one half of the picture and that more than 40% of the metropolitan area's water supply this summer came from beneath their feet? The Gnangara Mound is this hidden resource; the saviour of Perth. While forming an important source of water for human activities, the groundwater is also an integral part of the natural coastal plain environment, supporting vegetation where the water table is shallow and indigenous flora and fauna at the many wetlands. Management of this resource and associated land uses is essential.

Perth's domestic and industrial requirement for water is expected to double from its present use, to over 350 million cubic metres per year by the year 2 000. The contribution of groundwater to Perth's water supply has risen from 11% in 1971, when the first public groundwater scheme was commissioned, to about 42% in recent years. By the year 2 000, it is estimated that 115 million cubic metres of groundwater will be required. As well as the public water requirement, there are considerable demands on the groundwater by private bores for irrigating domestic, agricultural and horticultural crops; parklands and ovals; and for industrial purposes.

The extensive shallow groundwater resources near Perth have several advantages over surface water storage. Engineering costs for development and distribution are lower, the water supply is more reliable and less affected by prolonged periods of drought, and the evaporative loss of water is less. Against this, the poorer quality

groundwater requires treatment, and there is the need for careful management to avoid any detrimental environmental effects in wetlands as a result of lowering the water table through pumping.

The water resources of the coastal plain are almost entirely below the surface, ranging from relatively shallow unconfined aquifers to deep artesian aquifers. The shallow unconfined aquifers are of sand overlying clays, in between rivers originating on the Darling Plateau. There is no surface runoff because of the very porous sands. Instead, there is a sub-surface flow from the highest parts of the dune system towards the rivers and the coast. Within the dune system, the underground water forms a mildly sloping mound reaching an elevation of about 70 m above sea level at the centre of the coastal plain. This is referred to as the Gnangara Mound. This shallow water resource north of Perth covers an area of 2 200 sq km.

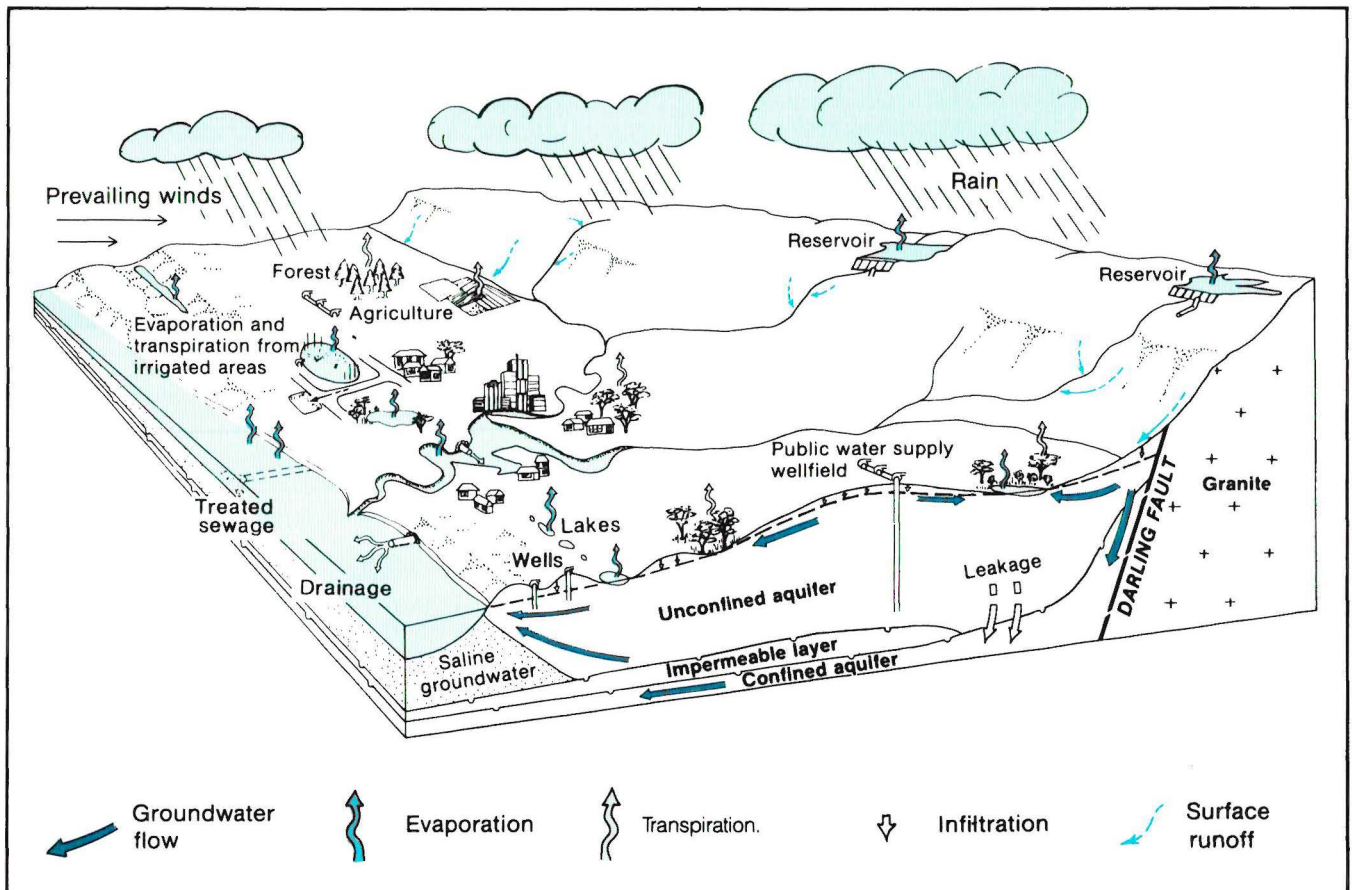


The extent of the shallow water resources within unconfined sandy deposits of the coastal plain north of Perth have been intensively studied since 1961, and this is continuing. Groundwater resources beneath the Swan coastal plain have been well defined and clearly illustrate the magnitude of the hidden supply.

Underground water originates as rainfall. Rain falling on the land

A cross-section of the coastal plain, showing the water cycle (below).

Gnangara Mound water resource and selected land use zones (left).



surface infiltrates the soil and when attractive forces of the soil are exceeded, water moves under gravity through the partially saturated soil to a saturated zone in the formation underlying the soil. This saturated formation is known as an unconfined aquifer and consists mainly of coarse sands which may contain up to 30% by volume of groundwater. The upper surface of the saturated formation is the water table.

Most of the annual rainfall is received in the five months from May to September. This is important hydrologically, as evaporation is low and most of the rainfall is potentially available for recharging the aquifers. Groundwater tables rise rapidly after the start of the winter rains, attaining a maximum level in September-October. The water table falls over the summer due to evaporation and seepage, and reaches its lowest level in March-April. Seasonal changes of 0.5 to 1.5 m are common. The amount of recharge is dependent on the amount of rainfall, interception by vegetation and depth to the water table.

Although dominated by climate, groundwater levels have also been

affected by human activity. There are few areas on the coastal plain which will not ultimately experience some land use change. Planning and management of groundwater resources is desirable to minimise these conflicts. The major forms of land use on the Mound are the natural environment, urban development, rural activities, water supply and forestry.

The wetlands of the coastal plain are simply intersections of the ground surface and regional water table. Many of the coastal lakes are shallow, a depth of more than 3 m being exceptional. Their levels fluctuate with the seasonal rise and fall of the water table and it has been estimated that more than two-thirds of the winter wetlands are lost by the end of summer due to evaporation. The flora and fauna associated with wetlands are adapted to seasonal flooding and drying. The wetlands are probably more resilient to water level changes than is generally known. Present levels are somewhat artificial in that clearing of bushland for urban development has reduced evapotranspiration, with a consequent rise in water tables. Fence lines across some lakes indicate that

water tables in these areas were lower in earlier times. Retention of wetlands is the major restraint in managing the groundwater resources of the Mound. Defining the acceptable change remains somewhat arbitrary; a 0.5 m decline in water level has been adopted by the Water Authority as the criterion for the most environmentally sensitive areas.

Much of the native vegetation remaining on the Mound occurs in State Forest 65 and on Crown land to the north and east. The wetland vegetation is sensitive to changes in water table levels, while upland vegetation is largely independent of this. The recent extended series of below average rainfall years has created extreme drought stress conditions and has led to the decline of the larger overstory and its replacement with seedling and smaller vegetation. The water table declines, forecast for the expanded use of groundwater for public water supply, should have little effect on the extensive areas of upland vegetation on the Mound.

State Forest 65 covers some 500 sq km or nearly one-quarter of the

Fence lines across some lakes indicate that water tables in these areas were lower in earlier times.





C. Sanders

Pine management is critical for the Mound (left).

All vegetation competes for water with pumps. Pines, however, can be thinned to maintain water yield (below left).

Wetland wildlife: Oblong Tortoise (below).

Flower farming in Wanneroo (bottom).



C. Sanders



M. Lochman



J. Lochman



J. Lochman

Joondalup Lake, Wanneroo

Mound area. About half of State Forest 65 is native woodland. The remainder has been converted to pine forest. *Pinus pinaster* trees were first planted at Gnangara in 1926 to provide a softwood timber supply close to the Perth market. Planting increased from around 500 ha per year in the 1950s to about 1 000 ha per year in the 1960s. The final planting of first rotation forests on the Gnangara Mound was completed in 1987. It was not until the 1970s that the potential of the Mound for water supply was realised. Land use objectives have now changed from total wood production to yield maximisation of both pine sawlogs and potable water. This has required changes in management strategies. To reconcile pine silviculture with water catchment, it is necessary to grow pine stands at a relatively low density to ensure replenishment of groundwater. Both forms of land use are compatible, as wood growth on individual trees is maximised in low density stands.

Manipulation of tree numbers by thinning increases throughfall of rainfall and the recharge of the soil moisture system. In an open pine forest, 10% of rainfall is intercepted by tree crowns and this increases to 26% in a dense forest. Rainfall interception in the *Banksia* woodland averages 15%.

Managed pine forests are critical to the development of the Mound. In young pine forests, recharge exceeds the native woodland for the first ten years, and maturing pine trees can be thinned to maintain regional water levels. Thinning can be used as a tool to provide groundwater for extraction and to maintain wetlands and lakes in the immediate proximity.

CALM's management aim is to maintain pine forests at a low density. It is paramount to reduce the interception potential of the pines and allow for the rapid movement of wetting fronts through the sand profile, beyond the concentration of pine roots in the surface soil

horizons. Tree diameter growth is largely dependent on the moisture stored in the unsaturated soil zone. Water use by pine trees in summer is greatly reduced even where water tables are close to the surface. Forestry is a preferred form of alternative land use because the quantity of fertilisers used is markedly below that for agriculture, and there is much less danger of biological pollution.

The Gnangara Mound is a major water resource ideally located to serve the irrigation needs of horticulturists close to markets in Perth. The market garden areas of Wanneroo and the viticulture area of the Swan Valley are two main areas that have been recommended in a Corridor study to be preserved for intensive agriculture. Groundwater has been allocated to meet the projected growth in demand for water for agriculture for the next ten years.

Urbanisation of the North West Corridor will occur gradually in the

coastal strip north of Wanneroo. Much of the Gnangara Mound north of Lake Pinjar is sparsely populated and likely to stay so under the present Corridor plan for metropolitan development. The area of State Forest 65 will make an important contribution to regional open space for recreation, conservation, water and timber production.

Development of public water supply schemes on the Mound commenced in 1971 when the Mirrabooka Groundwater Scheme began production. This was fol-

lowed by the Gwelup Scheme in 1974, and the Wanneroo Scheme in 1976. The Mirrabooka and Wanneroo schemes are the only sources of water supply for the Metropolitan North West Corridor. The Pinjar Scheme, north of Wanneroo, is currently being developed. Water could be flowing from this Scheme by 1989. It is planned to construct future schemes in stages to match the growth in demand while at the same time minimising the impact on the environment. Future wellfields will be located within

State Forest 65 where water quality is protected and water table changes have generally less impact on the natural environment, particularly the wetlands.

For further information:

Gnangara Mound Groundwater Resources Environmental Review and Management Programme

Published by: Water Authority of Western Australia.

What is the Gnangara Mound?

Gnangara Mound reaches from Gingin Brook in the north to the Swan River in the south, and from the Indian Ocean in the West to Ellens Brook in the east. It covers 2 200 sq kilometres, including the North-West Corridor development of Perth and extensive tracts of rural and semi-rural areas.

State forests and natural ecosystems managed by CALM also comprise a significant proportion of the area, as do intensive market gardening and horticultural plots. With such a variety of habitats, natural and urban, it is sometimes difficult to realise that the Mound is one system, or a set of sub-systems that are very closely linked. The Gnangara Mound is formed from ancient coastal dune systems which have compacted against the impermeable fault line of the Darling Scarp, the permanent scenic backdrop for most Perth residents.

The Bassendean Dune System is the oldest of the three major systems which form the Mound, and is closest to the Darling Scarp. It is the largest in area, covering from Bayswater and Maylands on the Swan River to the perimeter of the Moore River and extending inland from Wanneroo to Bullsbrook. The highest point of the Mound is located in this area and reaches up to 70 m above sea level.

Adjacent to the western border of the Bassendean System is the Spearwood System which runs closer to the coast and encompasses a narrow corridor of land reaching from Swanbourne to Yanchep. The development of Perth's northern suburbs follows this line. The newest and most fragmented dune system is the Quindalup Dune System,

which includes some of the more prestigious beach front suburbs from City Beach to Mullaloo.

The compacting of land and the nature of the soils on the Gnangara Mound has led to the formation of an interesting subterranean profile of the coastal plain. On a bedrock layer of older geological formations there is a thin covering of shale. Above that is a variable mantle of sand, limestone, silt and clay, with a predominance of limestone closer to the ocean and more gravelly sand closer to the scarp. This gives the soil of the area a significant water retention capacity, and forms a huge area of groundwater.

Because we are more familiar with surface-level concepts of water storage, we may make the mistake of thinking of groundwater in the shape of an underground river or lake. Most groundwater is actually held in geological formations. Within the compacted sandy soils of the old dunes, usable quantities of water are stored in the tiny spaces between sand, pebbles and in rock fractures. This groundwater-bearing formation is referred to as an aquifer, and there are two types of aquifer.

The first is a confined aquifer where the water is trapped beneath clay, silt or other impervious material and is under pressure. There are two main confined aquifer underlying the area of the Gnangara Mound, the Leederville and the Yarragadee aquifers. Artesian and sub-artesian bores tap this water, relying on storage pressure to force the water to the surface. The water from confined aquifers is used in conjunction with water from unconfined aquifers and other surface water for public water supply. Unconfined aquifers, as the name suggests, don't have an impervious level overlying them.

Urban Antics

We don't eat much.

Bird lovers are a strange breed. Anything from a peacock on the lawn to a canary in a cage might tickle their fancy. The canny ones, however, know how to entice a selection of native birds to grace their garden virtually for free. No cage to clean; no bird seed to buy. You, too, can enjoy birds in your backyard. All you need is an avenue of illyarries, a hedge of *Grevillea* 'Robyn Gordon' and a lawn full of worms. Particularly discriminating aviaphiles will go to the trouble of planting local trees and shrubs to ensure top-class appointments for the local birds. After all, they wouldn't want the neighbourhood going to the dogs (or, worse still, **the cats**).

Speaking of cats, they have to be kept out of the water you supply for potential visitors. Even the smallest bird brain registers the location of a constant supply of water, but, predictably, will not use one frequented by ferocious felines. (Make sure the moggies can't creep up on an unsuspecting bird.) Mind you, other bird species aren't always desirable, either. One unfortunate magpie came down for a drink at his local wateringhole, only to be interrupted by the arrival of a twenty-eight parrot who, oblivious to all propriety, proceeded to take a bath. The magpie won the fight. You may not have to clean cages, but your more fastidious feathered friends will appreciate it if you clean the 'bath', and provide fresh water daily.

Of course, a true bird fancier will find it hard to stop there. A small offering of food wouldn't go astray, but you must be careful to match your morsels to the taste of your guests. Honeyeaters and wattlebirds feed on nectar, and favour a small bowl of honey and water. Place it outside a window, out of reach of the cats, and you will have a 'bird's eye view' of proceedings.

Sophisticates among you will appreciate the odd wattlebird with a flair for cordon bleu dipping its b.y.o. insect into the house sauce. Those with a taste for more homely scenes might be privileged to view fluffy honeyeater offspring brought to dine at your family restaurant.

Twenty-eight parrots appreciate an apple skewered on a broken tree branch. (If you're truly dedicated remove one bite to make it easier for them.) Of course, several apples would satisfy the whole family.



by
Louise Burch

Some might contend that a true friend of feathers can never be friend to fur, but the two can be successfully combined. A case in point: two currawongs set up home in the backyard of a hills house, and duly hatched their baby. Their attention was then turned to gathering food, and plenty of it. They soon spotted that 'Tiddles' was fed twice a day on the back verandah with meals that came in convenient beak-sized chunks. So, with a bit of tricky manoeuvring and considerable bluffing, they managed to persuade the cat to share her dinner. Baby currawong grew sleek and fat, with a taste for food containing 'no preservatives, no added salt, crude protein 7.00%, fat 2.00% and all essential vitamins and minerals needed for the well being of healthy adult cats'.

Of course, sharing your cat's dinner is one thing. Magpies, kookaburras, crows: they can all have a go. But it takes an exceptionally bird-besotted person to contemplate with equilibrium the prospect of sharing their own dinner. If you're like one unlucky diner at Fred Jacoby Park in Mundaring, you won't get a chance to contemplate at all. A kookaburra swooped down on his sausage before it reached his mouth. Knowing very little about processed meats, the kookaburra tried to put the sausage out of its misery by bashing it against a tree a few times before eating it. The mirth this afforded was some recompense for the stolen meal.

Entertainment is one reward for attracting birds to your garden. Magpies, apart from being accomplished choristers, often play chasey around tree trunks. They also indulge in a rudimentary form of soccer played with a leaf or twig carried and thrown by the beak - in any direction, with no particular thought for 'goaling'. The best reward, however, is knowing that the establishment of your habitat doesn't have to mean the displacement of the native species. If you want to know more, have a look at *Garden Birds: Attracting Birds to Australian and New Zealand Gardens*, by Clifford B. Frith.



Garden Escapes

What does garden escape conjure up for you? The vision of a tranquil, leafy nook, where you can escape from the cares of the world? Or perhaps it's the name of a weekender at an enterprising luxury hotel which promises you an escape from the cares of maintaining your garden?

For several years **Greg Keighery**, botanist with CALM, has been involved in documenting a different kind of garden escape - a far more threatening kind, one which has the potential to seriously damage our environment. These garden escapes are plants that have been deliberately cultivated as ornamentals, or occasionally as small-scale crop plants, and have become partly or wholly naturalised.

Garden escapes are often found in cemeteries, rubbish tips, weedy road verges or abandoned town sites. Working in such areas can be construed a strange activity, even for a botanist (and I have been questioned by some subsequently very amused police officers while surveying road verges outside Northam, one evening). It is important,

however, to know your enemy, because if a species can persist and spread, unaided by people, then it can often have the potential to become an environmental weed.

Although in some definitions garden escapes may still be close to the original plantings (in New Zealand all they need to do is spread beyond the garden fence), the

ones we study and are concerned with have severed this link. Unfortunately, too many people still see our bushland as a convenient place to dump garden refuse. The following examples demonstrate that this can be at great cost to conservation, and, indeed, to the taxpayer, who has to bear the cost of removal.

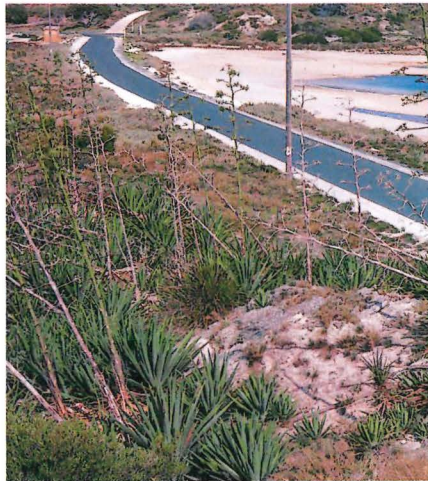
Agave on Rottnest Island

Rottnest has a long history of human settlement, resulting in an island with strong historical and recreational, as well as conservation values. Despite many introductions few species have escaped and flourished outside the settlement because of the island's harsh environment.

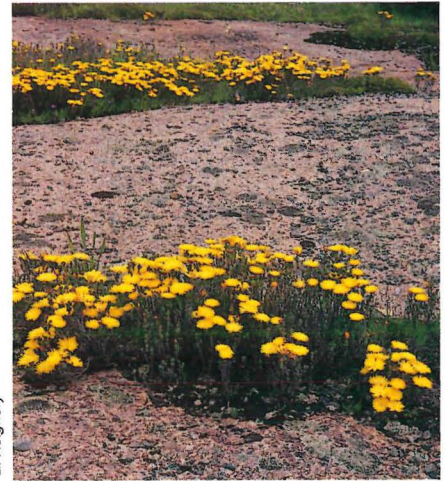
Two successful escapes were *Agave americana* (century plant) and *A. sisalana* (sisal). These were lumped as *Agave americana* in the management plan released by the Rottnest Island Management Planning Group, but Charlie Hansen (Re-afforestation Officer of the Rottnest Island Board) and I were able to work out that two species were present on Rottnest, and have their eradication documented separately.

Agave sisalana was probably imported as a source of sisal (or perhaps a hedge plant), and some were dumped near Garden Lake at least 50 years ago. Since that time the species slowly spread by rhizome and bulbils (it does not produce seed) till it occupied an area of about 0.5 ha, and had completely eliminated all other plants in this area.

During 1987 Charlie Hansen physically removed the infestation (spraying with herbicide had proved ineffective). Even with the aid of school group volunteers and other staff it was a major effort. Some 12 truckloads of *Agave* were removed and buried, each major clump weighing up to one tonne. The area has been fenced, and replanted with native shrubs, but will still need regular inspection to destroy any resprouting from the rhizome. Despite being a small infestation it was very expensive to remove. *Agave sisalana* is not known to have become naturalised elsewhere in W.A., and it will soon become extinct on Rottnest. Details



Agave sisalana infestation on Rottnest.



Lampranthus glaucus.



The problematic cairn at Torndirrup National Park.

of its extent, type of spread and methods of control have been documented and can be used if other populations are found.

South coast succulents

Granite rocks are islands of unique plants scattered throughout southern W.A., and as such they are particularly threatened by garden escapes. Around Albany, the major threat appears to be succulent shrubs, which can tolerate the summer drought and smother out smaller natives. These are usually from southern Africa (*Lampranthus glaucus*) or the Mediterranean region (*Aoenium* species). Perhaps the most unusual series of garden escapes I have encountered were those in Torndirrup National

Park. On the summit of one large granite rock a cairn of stones had been erected and a garden created below it, which was planted with succulents. Unfortunately, two of these species (*Crassula tetragona* and *Aoenium castello-paevoniae*) had become widespread on the rock, at the expense of the other native plants. Most of these escapes have now been removed.

Succulent plants are often encountered as outcasts in refuse tips and apparently rarely become naturalised. Nonetheless, within a specific habitat and perhaps climatic zone, they have the potential to destroy the conservation values of this habitat, and should be destroyed.



Chasmanthe floribunda

G. Keighery

Agricultural Protection Board: Categories of Declared Plants	
P1:	cannot be brought into an area (may be all or part of W.A.), all declared plants
P2:	plants which will be eradicated in W.A., e.g. skeleton weed
P3:	plants which will be controlled (reduced) within the area, e.g. blackberry, saffron thistle
P4:	plants which will be contained within area declared, and prevented from spreading, e.g. Patterson's curse
P5:	plants treated only on road verges or reserves, e.g. watsonia

Bulbs or Corms

Southern W.A. has few native species which possess bulbs or corms, unlike South Africa. Since settlement we have been importing bulbs for our gardens, and unfortunately many of these species shifted into our bushland by dumping over the years.

Probably, our ephemeral wetlands are most at risk from bulbous invaders, they contain a rich herb flora, which is overrun by bulbous invaders. A classic example is the picture showing a wetland succumbing to a wave of *Babiana* (Baboon flowers - so named because Baboons eat the corms). Heathlands, especially coastal areas, are also at risk, because the invaders can overrun the locals.

Woodlands, too, are susceptible; freesias have helped eliminate native orchids in banksia woodlands in Kings Park, and *Gladiolus caryophyllaceus* (a rare species in its native South Africa) is now spreading along the Swan coastal plain woodlands.

One final example can demonstrate how unpredictable plants' responses can be. *Amaryllis belladonna* (Easter lily) was a very popular nineteenth century garden plant in W.A. Generally, small, slowly spreading (adventive) clumps or persisting bulbs mark old



G. Keighery



G. Keighery

A wave of babianas engulfing a wetland at Waterloo, near Bunbury (top).

Easter lilies invade a woodland (above).

townsites, houses or farms. At Arumvale (north of Augusta), however, the bulb is widespread in the tall jarrah-marri forest. Here the species spreads by seeds, and evidence for this can be found by noting that the normal deep pink flowered cultivar has hybridized with the white-flowered cultivar (cv Hawthor).

The remedy is simple: if rubbish containing bulbs was not dumped in bushland, there wouldn't be a problem. Prevention is much easier than importing a troop of bulb hunting baboons, or CALM staff being paid to act as bulb hunters.

Unfortunately, public awareness of the problem is not high, and our

Weeds

What's in a name?

A weed is a plant growing where it is not wanted, so runs the old definition. Any plant can be a weed, then, depending upon your point of view. Most commonly, weeds are unwanted plants in gardens and crops, or introduced plants in bushlands, but there are more specific definitions.

Agricultural weeds are usually plants which compete for crop space and/or nutrients. They may parasitise plants, be poisonous, cause injury to animals, damage machinery, taint produce or harbour pests and diseases. Within this definition, native plants within their natural ranges can often be classified as agricultural weeds (a recent publication, *Weeds - An Illustrated Guide to the Weeds of Australia*, lists 108 native species as weeds). Some of the more serious agricultural weeds are listed (declared) in a legal sense by the Agricultural Protection Board, to ensure that landholders are bound to control them. The types of declared plants are listed on page 46. These are largely, though not entirely, agricultural weeds affecting primary production.

Obviously, native species are rarely considered undesirable for conservation. Some **agriculturally** undesirable native species such as native poison peas, however, are now very rare due, in part, to their history as agricultural weeds. Conversely some very desirable agricultural plants are pests in conservation areas.

Environmental weeds are plants which affect the conservation values of conservation lands. These plants may include some declared plants (e.g. blackberries) and even some native species introduced outside their normal range and subsequently escaping from those plantings (e.g. peppermint [*Agonis flexuosa*] in Yanchep National Park, or lemon-scented gums [*E. citriodora*] in Kings Park bushland). These are categorised as invasive natives.



Marie Lochman



G. Keighery

A weed introduced from South Africa. (top)

They look like they belong, but they are in fact invasive natives: lemon-scented gums in Kings Park.

Our weed flora mainly originates overseas (alien plants, for example, the blackberries which are such a nuisance along our waterways). These plants were introduced intentionally or unintentionally with European settlement, and can be documented as originating in this manner. Some species, however, appear to have been introduced naturally, by long-distance dispersal, before European settlement and are considered acquired species. Examples are capers and sow thistles. These acquired species would probably have differentiated over time into native species, different from those species initially introduced. Currently, an acquired species would not be considered a weed.

The weed flora of W.A. is in a constant state of flux, highly dynamic with species constantly being added or removed due to changes in their status. Weeds (alien, acquired or invasive native) all pass through various stages. A plant is first planted, it can then persist after cultivation has ceased, spread (adventive) and become locally common then widespread (naturalised).

This process is still occurring, and there are examples of all these stages to be found in W.A., and every gradation in between.

Currently, after 162 years of settlement, W.A. has acquired 838 species of alien plants, and more are always being added. It is estimated that Australia now has over 2 000 species of naturalised alien plants, and studies on South Australian flora suggest that in that State it is growing at the rate of about six species per year. Many of these species do not directly affect bushland, but many do, and may, by invading our nature reserves and national parks, eventually cause the extinction of many of our local plants.



A valley near Harvey overwhelmed by wood sorrel.

weed flora continues to expand and change. Recently, I read a management plan for Booragoon Lake (part of series undertaken for the city of Melville to manage their bushland heritage, probably a first for W.A. local government). In the flora list I noted with surprise a *Commelina* sp. (tradescantia or wandering jew) recorded. Since CALM had no record of this as a naturalised plant or a garden escape, we visited the Lake, and to my dismay found not only *Commelina* (*Commelina ?benghalensis*), but also populations of lion flowers (*Leonotis leonurus*), potato creeper (*Anredra* [*Boussin-gaultia*] *cordifolia*) and fresh garden rubbish.

The potato creeper is particularly disturbing. Although sterile, it derives its name from the numerous tubers formed in the leaf axils. Infestations of this species in Queensland and northern New South Wales have proved very difficult to eradicate.

Wetlands are particularly bad sites to dump garden rubbish because establishment of weeds in this material is enhanced by the better soils, and lower summer drought stress.

CALM is very concerned about the growing threat of garden escapes. We need to rate how serious a



Lantana. (top)



Potato creeper. (below)

threat each environmental weed is, and to document control measures and remove them before they become too widespread.

Even more important is making people aware of just how dangerous dumping garden rubbish is to our bushland areas. Garden refuse belongs on the compost heap to be recycled into a better garden, or at least taken to an approved refuse site. Garden plants are indeed nice in their place, but we already have too many weeds threatening our native bushland without carelessly adding more.



Bats, Bats, and More Bats.

For far too long bats have conjured up images of Count Dracula and spooky castles. In reality they are an amazingly diverse group of warm-blooded animals. **Tony Start**, CALM'S Pilbara Regional Manager, and **Norm McKenzie**, Senior Research Scientist, look at some of W.A.'s fascinating bat species.

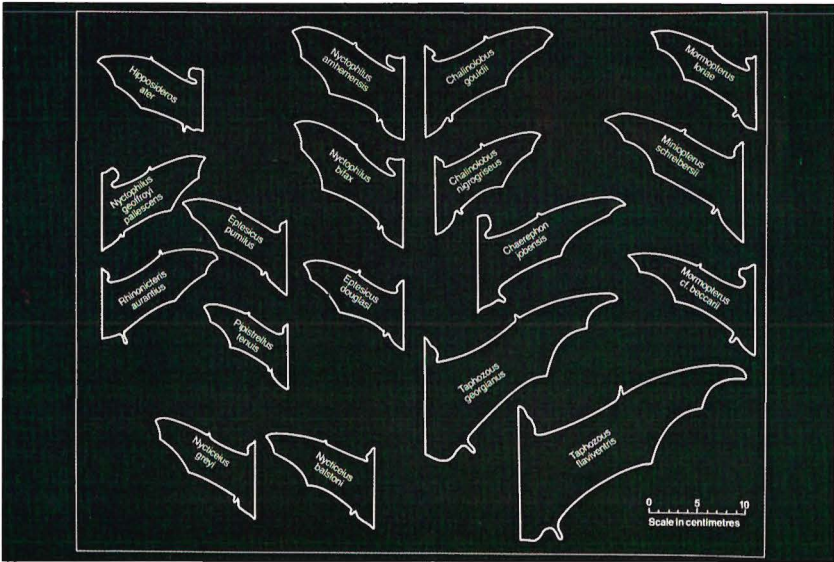
Deep in a maze of shafts that had been a copper mine, a pile of debris, including feathers and bones, provide evidence of the diet of one of W.A.'s most spectacular (and secretive) carnivores.

The old mine was in a spinifex-clad hill in the arid Pilbara region and the carnivores were Ghost

Bats. The remains suggest that the flavour-of-the-month had been shared, almost equally, between birds and other bats. All that remained of the birds were wingbones from the shoulder outwards, the unfeathered sections of legs, occasional beaks and some crumpled feathers. Bright green and yellow Budgerygah feathers

and the three-toed feet of Little Button-quail were common in the debris.

There was little left of the eaten bats, except the bones of wings which were broken off between the shoulder and the elbows. Ironically, the commonest prey species were the two which shared the



N. McKenzie

Wing shapes of various W.A. bats (left).
 Ghost Bat with young (below).
 A little cave *Eptesicus* (below right).



J. Lochman



mine with the Ghost Bats, *Eptesicus findlaysoni*, a tiny brown bat, and *Taphozos georgianus*, a moderate sized Sheath-tailed Bat. (The *Eptesicus*, at any rate, even breeds in the mine!)

Among the remaining bits and pieces, tails and feet of mice were quite common. There were a few mandibles and feet of Dasyurids (tiny marsupial insectivores such as Dunnarts and Planigales), and occasional wings from large beetles.

It seems that reptiles were not much liked because the Ghost Bats had dropped large pieces of the few individuals that they had taken back to the roost.

Ghost Bats are the only Australian members of a peculiar family commonly called False Vampire Bats. The family contains only four other species world wide. Three of them are also carnivores (two in South East Asia and one in Africa). The fourth, the Orange-winged Bat of Africa, is perhaps the world's only diurnal bat, and certainly one of the world's most brightly coloured bats. It hunts large insects from a perch, usually in a low, thorn tree.

Hanging quietly, watching for prey, its grey fur makes it quite inconspicuous, but when it takes flight, suddenly spreading bright yellow-orange wings, it is as brilliantly coloured as many birds.

The Ghost Bat is not only the largest of the False Vampires, but, weighing 150 g, it is the world's largest member of the sub-order Microchiroptera which contains all bats except the Flying Foxes and their allies. The little *Eptesicus*, which the Ghost Bats found so tasty, are at the other end of the scale. Weighing little more than four or five grams they are among Australia's smallest bats.

Microchiropterans are mostly insectivorous and in W.A., except for the Ghost Bats, they all eat insects. In the Americas (where there are no old world 'fruit bats'), however, the range of Microchiropteran diets includes insects, scorpions, fish, fruit, nectar, and, of course, blood. (Vampires don't suck blood from their victims. They make a small incision with razor sharp teeth. Anticoagulants in their saliva ensure the wound bleeds freely and the bats lap their meal.)

There are about 30 species of insectivorous bats in W.A. It is difficult to be precise about this number because taxonomists are still recognising new species. For instance, as recently as last year, Dr Darryl Kitchener of the W.A. Museum, re-examined the species within the genus *Eptesicus*. Some of these species are very similar in appearance; yet following detailed examination he has shown that there are, in fact, five discrete species of *Eptesicus* in the State. As well, zoologists are still discovering distinctive species that are completely new to science. It is likely that the former process will result in further changes, but it is unlikely that many distinctive bats still await discovery in Australia.

Like other animals, bats generally partition a habitat so that co-existing species do not compete directly for resources such as food. CALM research has shown that this is true for the insectivorous bats living in W.A.'s mangrove communities. In the Kimberley 15 species feed on insects in and around mangrove forests. Some fly high over the canopy, some feed adjacent to or in clear areas within the stands, while the rest hunt inside the forests. None of the mangrove forests studied contained all of the 15 species; instead each stand contained a subset of them.

The research found that when wing loading (the weight supported per unit area of the wing) and aspect ratio (the ratio between the wing length and width) are both taken into account, each species of insectivorous bat that occurred in any particular stand of mangroves had unique flight capabilities and thus the ability to exploit different parts of the habitat for food. Each stand of mangroves had its own 'foraging guild' of insectivorous bats.

For example, bats which have high wing loadings and relatively narrow wings (rather like jet



J. Lochman

aeroplanes) feed above the mangroves where speed is more important than manoeuvrability, whereas those with low wing loadings and relatively broad wings (rather like crop dusters) feed inside the forests where manoeuvrability is more important than speed. Our subsequent research has shown that the structure of the bat guild is disrupted in disturbed mangrove habitats.

One genus of mangrove tree that occurs widely around the Indian Ocean, including the Kimberley Region, has a particularly interesting association with bats. The genus *Sonneratia* has large flowers which consist of a hard green calyx and a tuft of numerous stamens which are white in one species and maroon with white tips in another. The whole flower looks like a shaving brush.

Sonneratia flowers are pollinated by a Blossom Bat, *Macroglossus minimus*. Blossom Bats feed almost exclusively on nectar and pollen. They are small, about 15 g, and highly adapted to their diets, with long muzzles and very long tongues which have a patch of filamentous papillae at the tip. These 'absorb' nectar like a sponge absorbs liquid. Further back on their tongues there are stouter, backward pointing papillae that are used to comb out the pollen which collects on their fur as they land among the anthers to acquire nectar.

Flowers pollinated by bats are also well adapted to their visitors. They usually open at dusk, provide copious nectar and pollen and are always presented so they are easily accessible to the bats, on the outside of the canopy and often with long stems to hold them away from the crown. Most bat-pollinated flowers are white, but some may be darker colours, typically maroon and purple. The dark colours enhance their silhouette against a relatively pale skyline. Dark coloured

flowers always have strategically located white markings to help the bats approach from the correct direction.

The enhancement of visibility is essential because Blossom Bats are members of the other sub-order, the Megachiroptera. As the name suggests, members of this sub-order are generally large. They include the fruit bats and flying foxes which occur throughout the old world tropics.

One of the features separating Megachiroptera from Microchiroptera is the use of eyesight by the former. Echolocation is an efficient means by which insectivorous bats can detect moving prey in the air, but it is not effective for locating stationary fruits or flowers in the canopy of a forest. Megachiroptera, therefore, use their eyesight to find their way around. With the exception of one genus (which does not occur in Australia, and which has independently evolved a crude

system of echolocation to help navigate in its cave roosts) megachiropterans don't echolocate.

The other two species of Megachiroptera that live in W.A. are both flying foxes, and occur in the Kimberley and in the coastal areas of the Pilbara.

Their habit of roosting in large colonies in the tops of trees, and their large size, allows flying foxes to be easily observed in daylight. Colonies of 100 000 individuals are not unusual. Furthermore, they are very active in their roosts, often moving from perch to perch and squabbling for position, thus drawing attention to themselves.

Although flying foxes are more common and widespread in the Kimberley than the Pilbara, one of the most readily accessible colonies lives in the date palms close to the Millstream-Chichester National Park headquarters. Each year thousands of people marvel at



W. Hughes/Lochman Transparencies

them after being attracted by the continuous squawks of the squabbling colony.

Flying foxes have prodigious powers of flight and many species are known to fly more than 50 km from their roosts to their feeding grounds, returning before dawn. Partly because it is difficult to study such mobile species while they are off feeding at night, little is known of their diets in W.A. Fruit growers in the tropics suffer some losses from their crops, but cultivated fruit would not usually form a very significant proportion of the bats' diet.

It is known that bats from the Millstream colony feed on the flowers of river gums, cajeput trees and dragon trees (*Sesbania formosa*) as well as the fruit of the introduced date palms in which they roost. Each year numbers in the colony decline markedly at the

same time as a wild fig, *Ficus virens*, fruits in the Hamersley Range. Flying foxes feed on the figs. Perhaps some of the Millstream bats move to the Hamersley Range when the figs are fruiting? Each of the food supplies so far identified is available for only a short time during the year and nothing is known of their diet when none of these items is available.

When these bats are travelling from their roost to their feeding grounds, they fly at considerable heights, well above the tree tops. Therefore, it is curious that sometimes dead flying foxes are found hooked up in the barbed wire fences that criss-cross the wide open, spinifex-dominated Pilbara landscape. Presumably they're looking for food, but what they would eat so close to the ground in that environment remains a mystery.

CALM researchers have recently

reviewed the conservation status of W.A.'s bats. The good news is that none have become extinct since European settlement of this State, unlike many of the ground-dwelling mammals. The ability to fly allows bats to forage widely and quickly re-colonise areas following periods of food shortage.

The news is not so good elsewhere in the world. Bat numbers are declining in several countries. Breeding caves are being mined, either for their guano deposits, a rich source of fertiliser, or for cement. The mining of limestone strata adjacent to Ghost Bat caves at Mt Etna, in Queensland, is an Australian example.

Widespread use of agricultural insecticides is thought to be another cause of their decline. Insectivorous bats are voracious eaters; many of the insects they eat are pests of man (e.g. mosquitoes) and his crops. For example, the guano bat, *Tadarida brasiliensis*, is known to consume thousands of tonnes of insects per year in the American State of Texas alone; in summer this species is the sole vertebrate predator capable of limiting the numbers of night-flying insects.

Fruit bats also play an important ecological role in the dispersal of seed and in cross-pollination. They consume more than their own body weight in ripe fruit each night and visit many trees in the process. These bats, being powerful flyers with a fast rate of digestion, disperse undamaged seeds widely. The fruit and flower-eating bats of South East Asia are known to visit more than 130 plant species that yield products useful to human beings. For example, durian and kapok trees are pollinated by bats.

Bats, therefore, are far more useful than their Transylvanian PR agents would have us believe. True survivors, they should inspire respect rather than fear.



Red-shouldered Fruit-bat (far left).

Flying Foxes take to the sky (left).

Common Sheathtail Bat (below).



A. Start

J. Lochman

ENDANGERED!

Brown's Banksia (*Banksia brownii*)

by Greg Keighery

Banksia, the genus, is an original Australian. All 75 species occur on the continent, and 60 of these are confined to southern W.A. With such a rich variety of banksias, it is not surprising that eight are so restricted in location that they have been declared specially protected as rare flora.

One such species is the attractive and widely cultivated *Banksia brownii*. Described in 1830, the specific name commemorated Robert Brown, botanist on the *Investigator*, under Mathew Flinders. Brown later became one of the great botanists of the nineteenth century, naming almost 2 000 species of Australian plants.

Related to the widespread species *Banksia littoralis* and *Banksia occidentalis* (both of which have entire leaves), *Banksia brownii* is confined to a small area between Albany and the Stirling Ranges in the far south of W.A.

Plants are erect, open shrubs or (when protected from fire) may grow into small trees to 6 m tall.



The coastal form of *Banksia brownii*.

The leaves are finely divided and fern-like (hence the alternative common name feather-leaved banksia), borne in whorls on the young branches. New foliage is reddish-brown. The flowers are pale-brown (rarely golden-brown) with red styles, and are borne on the ends of branches forming an attractive display. Plants flower in autumn and winter, and are visited and pollinated by nectar-seeking honeyeaters.

Current research by the Department of Conservation and Land

Management has shown that *Banksia brownii* consists of two distinct forms. One, confined to the Stirling Ranges, has short, thin hard leaves and grows on acid sandy clay soils. The other, occurring north and east of Albany, has long, wide soft leaves and grows on lateritic sands. Investigations show that the two forms are genetically distinct.

Both forms are now well protected in secure national parks or nature reserves, but the species is still declining in the wild, because it is so susceptible to dieback fungus (*Phytophthora cinnamomi*). Many populations have been or are being devastated by this disease. Currently, only two of the Albany form and two of the Stirling Range form populations appear to be free of this disease.

Banksia brownii is a beautiful plant, but faces a bleak future unless we as a community are prepared to forego some freedom of access to parts of our parks.



Banksias dead from dieback in Stirling Range National Park. (above)

The inland form of *Banksia brownii* at Coyerup Peak in the Stirling Range. (right)



LETTERS

Then and Now

I would like you to know that I enjoy looking at, and reading, your magazine.

As a young man I worked on a farm at Pingelly, and early on in the forties I was in the 2/10th Light Horse, and rode over a lot of land around Perth, from Safety Bay in the south to Yanchep and up to the Moore River north, so I see a vast difference in the pictures that you show.

I am very glad to see that people in W.A. are very conscious of looking after their countryside.

Thanking you once again for a really good publication.

*C.F. Allwright
Rose Farm, Berkshire, U.K.*

The Canadian Connection

I have just finished reading your Spring (Sept.) 1987 edition of *Landscape*. I would like to compliment you on your excellent magazine. Your department is obviously a very dynamic group of professionals and your articles are more than interesting.

I am a Conservation Officer in Saskatchewan. I found it very interesting to relate to Wildlife Officer Coughran Starey and Osborne's articles. As wildlife officers here we do not protect Red Kangaroos from hunters with roo dogs but our black bears (as your saltwater crocodiles) shouldn't be disturbed either. But they are unlikely to eat you!

Our appreciation and respect of our natural resources is obviously a common bond.

*L.M. (Les) Oystryk
Saskatchewan, Canada*

Your letters are welcome. Please address any correspondence to:

The Editor
Landscape
50 Hayman Road
Como WA 6152

It's a Dog's Life

I was very interested to read the letter from A.J. Taylor in your April issue.

Like him, my family and I enjoy the solitude and quiet of our bush. There are spots all over this State where we camp with our dog, who is of course part of the family. My children have grown up with memories of camp-fire evenings after the days have been spent just enjoying the bush. This is what Australia is all about.

Now national park regulations have restricted where we can go. Being law-abiding people we avoid the parks because I cannot imagine camping without my dog; and just as surely I cannot imagine camping in a designated area restricted to benches and barbecues.

Of course the rules have been made for a good reason: to contain the litterbugs and the unruly. Unfortunately, these rules, for whatever reason, are not adequately policed. So what is the result?: people with pets are not permitted entry but the noisy and anti-social are; the very ones at whom these regulations are targeted.

Where then can families with pets go? Well fortunately there are still lovely areas where one can camp, but they are getting fewer. Recently a few of these are showing that larrikins have 'found' them: spray paint on tree trunks, scattered garbage and broken glass.

*M.A. Lewis,
Bedfordale*

Blinded with Science

I have just received my autumn issue of *Landscape*. On the basis of my two years' collection, I bought my cousin in Melbourne a subscription for 1988 because in the past I found your magazine quite informative of what W.A. has to offer, especially through the beautiful photographs.

But this latest issue, while I am not averse to graphs, seems a little too overloaded with statistics. I might as well go and buy *Habitat* magazine which is just a newspaper in an elaborate format, or so it was four years ago.

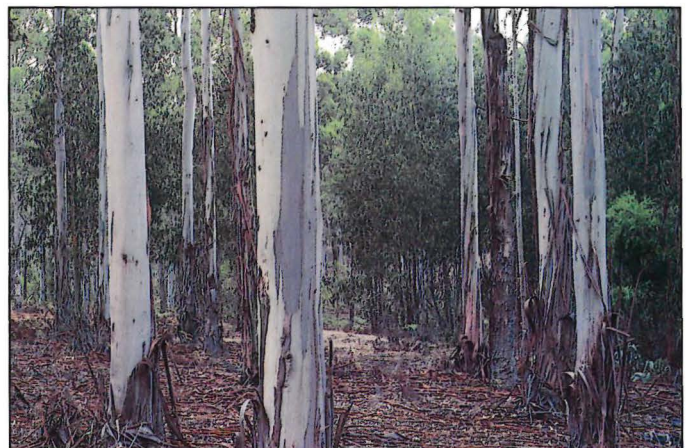
The article on treated timber was extremely interesting but could it have fitted quite well onto one page to make way for some more informative photographs? I am afraid I am terribly biased towards nature photographs of which you have displayed plenty in the past two years. And when diagrams are used, as in the Fungi article page 49, these can be most helpful.

I suppose I am one of your 'glossies' readers, but as an avid reader of the *Australian Natural History Magazine* for the past five years I look on your publication as a relaxing extension of that.

Top marks for the cover of the autumn edition.

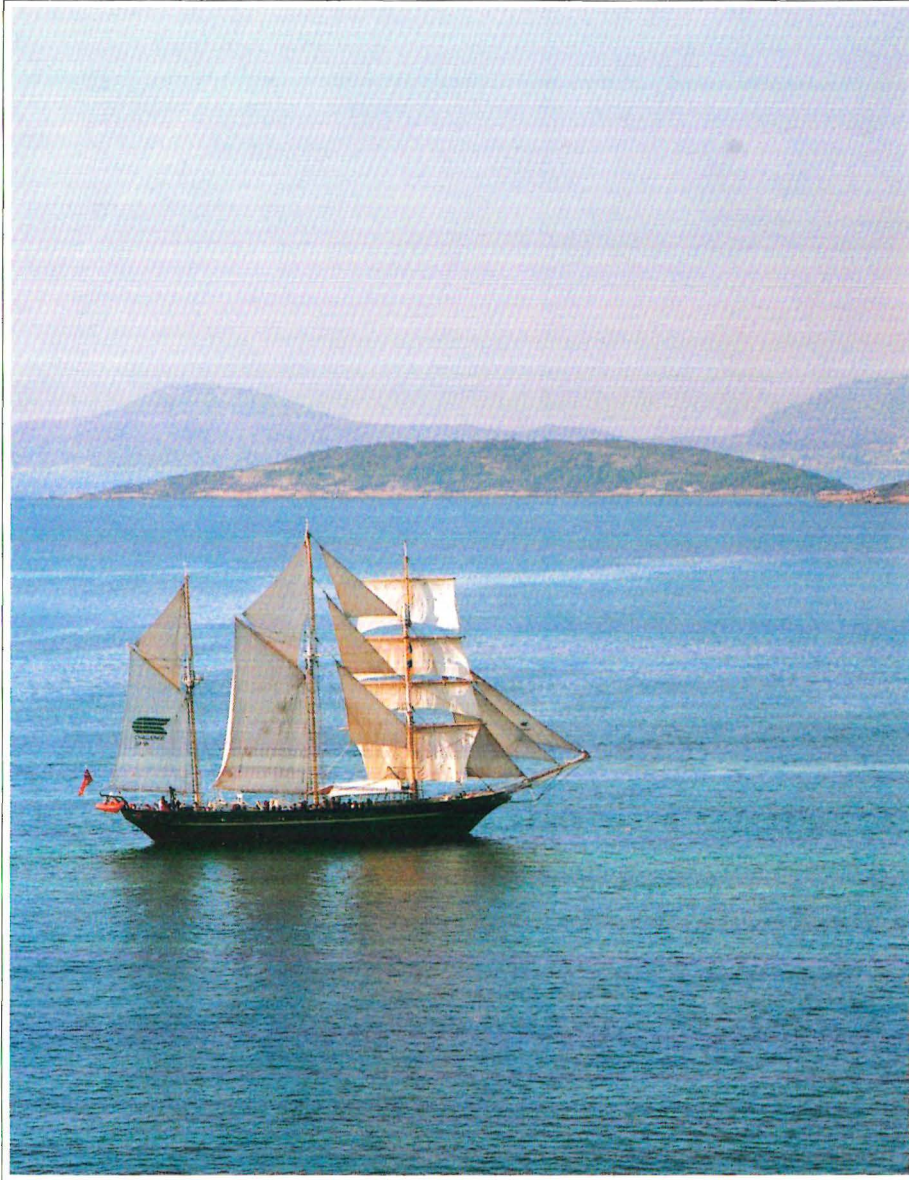
*Sandra Worrall-Hart,
Newman*

A picture is worth a thousand graphs.



M. Lochman

Looking Back



The Sail Training Ship Leeuwin II in King George Sound. Returning from its hour of glory with the Tall Ships in Sydney, Leeuwin II sails serenely past Mistaken Island Nature Reserve (middle distance) and Isthmus Hill, Torndirrup National Park (beyond). John Watson, CALM's Regional Manager for Albany, was up early enough to capture this shot of the graceful ship.