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Exploring Arid Lands



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Department of Conservation and Land Management





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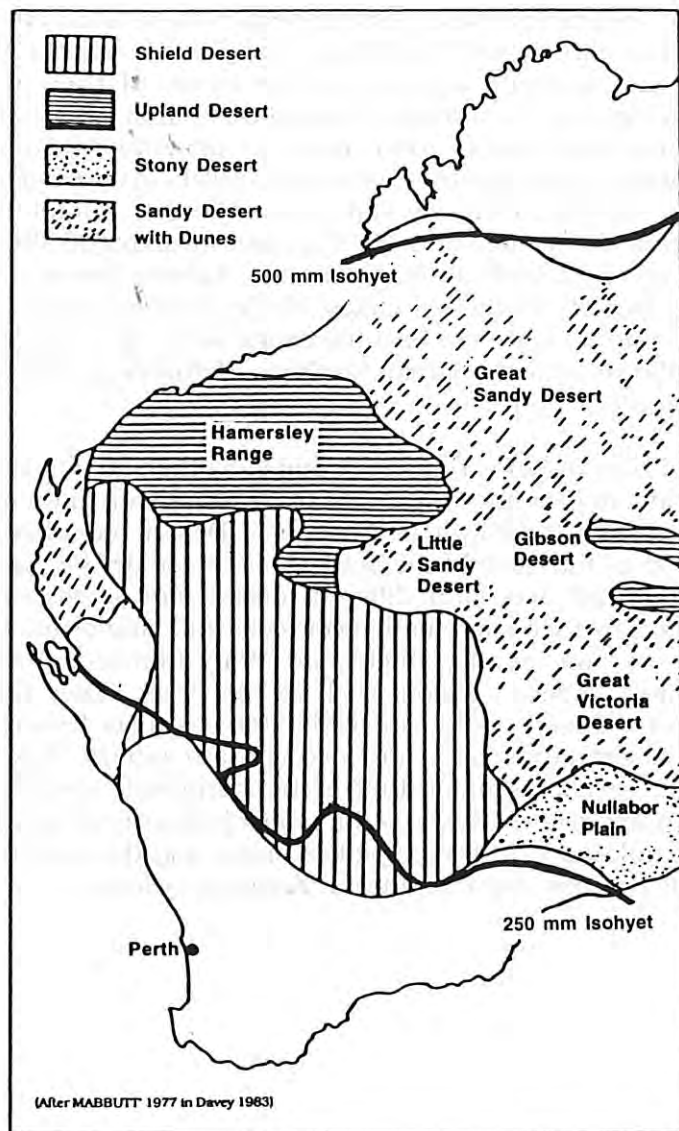
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INTRODUCTION

This booklet is an introduction to the vast arid and semi-arid areas of Western Australia. It briefly defines these areas in terms of location, climate and landforms, and describes some of the plants and animals found there in terms of their inter-relationships and their adaptations to this harsh environment. *Exploring Arid Lands* also aims to provide interesting information to local and international travellers to national parks such as Karijini (formerly Hamersley Range), Rudall River, Millstream-Chichester and Mt Augustus (Burringurrah), and nature reserves such as Barlee Range, Gibson Desert, Great Victoria Desert, Plumridge Lakes, Neale Junction and Queen Victoria Spring. It should be a handy inclusion on a trip across the Nullarbor, up the Great Northern Highway or along the Canning Stock Route.

The arid zone in WA is roughly bounded by the 500 mm isohyet (a line on a map connecting places of equal rainfall) in the north and the 250 mm isohyet in the south. Desert has also been described as that area of the State which is too dry for pastoral or agricultural use. Four different desert landscapes can be recognised by their combinations of rocks and landforms. These are the upland, sandy, shield and stony (limestone) desert landscapes. A desert region, such as the Great Sandy Desert, the Gibson Desert or the Hamersley Ranges, may feature one major desert landscape, but also contain others. Take the Gibson Desert, for example. High in the countryside are the rocky outcrops and slopes. Below is the mulga (a feature of the shield desert landscape), with the spinifex plains and the sand dunes spreading across the wide ancient drainage systems.

Map of WA showing the relevant isohyets and Arid Zone landform features.



Why is so much of Australia arid?

The origins of the Australian arid zone go back 14 million years. On its northward journey, which began with its break from the southern super-continent of Gondwana some 50 million years ago, the continent entered into a belt of strong, dry, anticyclonic winds. Eastern Australia then became subject to the moist south-easterly trade winds that rise over the Great Dividing Range depositing rain then becoming dry. In the west, winds that passed over the cool, off-shore currents and then over the land became warmer and rose, but were unable to form rain. These dry wind patterns still exist today and, together with the present climatic pattern of summer rainfall in the north and winter rainfall in the south, have formed the arid zone. The large size of this continent has also helped in the creation of the dry centre.

The climate of the arid lands is hot and dry, with no reliable rainfall. What rain does fall, tends to come from tropical cyclones or as a result of warm moist air from the north colliding with cold fronts from the south. The considerable variance of water supply in both time and place has a dramatic impact on the landscape and its inhabitants.

What is so special about the plants and animals in the arid environment?

Not only do plants and animals have to survive the extreme variability of rainfall, they also have to adapt to the large seasonal and daily variations in temperature.

Compared with deserts of other continents, most of the desert areas of WA are well vegetated. Formations such as low woodland (usually *Acacia*), hummock grassland (spinifex) and succulent steppe (bluebush, saltbush and samphire) cover the landscape, with ribbons of taller eucalypt woodland along the creeklines. The plants found in any particular region are largely governed

by the types of soils. These soils are generally very infertile due to a long period of leaching and the lack of recent soil building activity resulting in low levels of essential nutrients, such as nitrogen and phosphorous, and high levels of salt.

Plant communities can also vary dramatically after a fire or high rainfall.

Look closely at arid plant life. The strategies that plants have evolved to survive the harsh environment include having small, needle-like, leathery, hairy or succulent leaves; low, compact growth forms; hard, persistent seeds and rapid rates of reproduction once conditions are favourable. Having needle-like (or terete) leaves means the surface to volume ratio is low, thus preventing them from drying out. Hairy leaves catch the moisture in the air and prevent the leaf surface from overheating.

Desert animal life is diverse and fascinating with its wide range of adaptive forms and behaviour.

Reptiles are a prominent group, often filling some of the habitats and ecological niches held by mammals on other continents. They are able to adapt well to the infertility of Australian soils and associated vegetation by eating a variety of insects and plant material. They display a variety of survival strategies and can occupy very selective habitats. By sheltering in burrows and/or by altering their posture and colour, they can reduce body temperature fluctuations. Highly specialised frogs survive deep in burrows for years of drought, storing water and quickly breeding when the rain comes.

The swiftly moving military dragon (*Ctenophorus isolepis*) is a typical desert dwelling lizard. It feeds during the day on ants and other insects and is usually found near spinifex (*Triodia* spp.) where it is quick to take cover if disturbed.



Most mammals use burrows during the day, emerging to feed at night, thereby avoiding moisture loss and dependence on permanent water holes. They can survive on very little water, often only obtained from their food, and can reduce moisture loss by having modified sweat glands and by excreting very concentrated urine. Most animals are nocturnal, but you may be lucky to see some activity in the early morning or evening. The sad fact to note, however, is the alarming number and rate of mammal extinctions in the deserts since European settlement.



The common sandy inland mouse (*Pseudomys hermannsburgensis*) is found in a variety of arid habitats including mulga scrub and dense clumps of spinifex. Spending daytime in burrows up to half a metre deep, it comes out at night to feed on seeds, grass, roots and tubers. Reproduction appears to be dependent on good rainfall and this species may often be the first mammal to recolonise burnt areas.

Insects, in particular termites, contribute significantly to the arid-zone food web and the production, flow and storage of energy. Termites and grasshoppers are the most important arid-land herbivores. Termite mounds are made up from plant fibre, saliva and soil. These mounds provide shelter for other creatures such as marsupial mice and lizards.

Many birds have also adapted to living in semi-arid and arid regions by being insectivorous (obtaining all their moisture requirements from their prey), sheltering in the heat of the day to reduce fluid loss, and by breeding successfully in good seasons. Others are nomadic, being able to fly long distances in search of water.

RED ROCKS AND SPINIFEX

The upland deserts of Western Australia include the spectacular residual plateaus of the Hamersley Range and Chichester Range in the Pilbara, the Cape Range near Exmouth, and the central ranges (including Kennedy, Collier and Robinson Ranges) in the Gascoyne. The deep gorges that cut into the plateaus shelter plants and animals more often found in wetter environments. The steep, bare slopes are the source of desert river systems, and the rocky valleys support many species of plant and animal life.

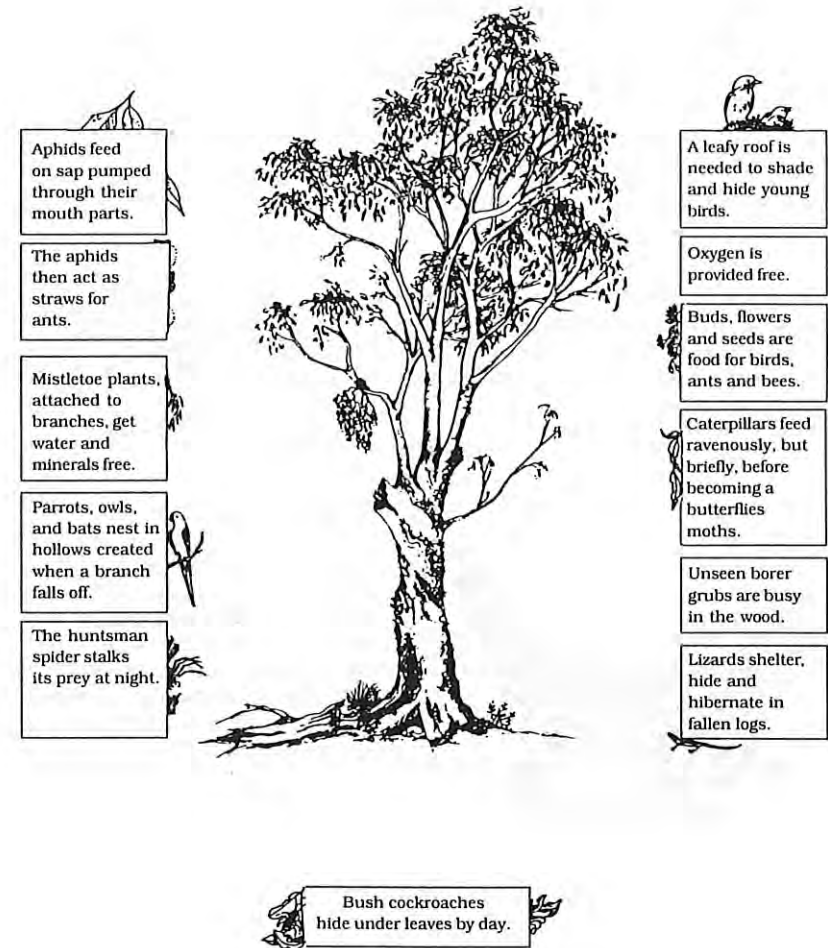
The gorges form refuges for species from wetter times, including the Venus-hair fern (*Adiantum capillus-veneris*) and the Chinese brake fern (*Pteris vittata*), which live deep in the gorges of the Hamersley Range. Also here, clinging precariously to the rock faces, sprawling over ledges in the Cape Range and around granite outcrops in the central ranges, is the rock fig (*Ficus platypoda*). This large, much-branched shrub has thick leathery leaves and fruit, which provide food for birds such as the common bronzewing pigeon. They, in turn, help to disperse the seeds in their droppings. The gorges also shelter plants such as the fig and a native cypress (*Callitris columellaris*) from the onslaught of fire.

Relicts from a time when tropical conditions extended south into the Pilbara are the Millstream palm (*Livistona alfredii*) and certain species of damselfly and dragonfly found along the Fortescue River. The Millstream palm is a member of the cabbage palm group. Its closest relative occurs in the MacDonnell Ranges near Alice Springs, and another species is found in the Kimberley. Dragonflies are very ancient insects with the larvae of different species evolving to complete their life cycles in specific aquatic habitats, such as fast flowing streams, still deep pools and stagnant ponds.

Often, a good place to camp (providing there are no dark clouds in the sky) is near drainage lines and around billabongs under



Nature's Boarding House [*Eucalyptus camaldulensis*]

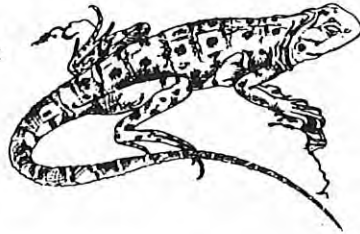


Adapted from 'Nature' Boarding House', a poster published by the Northern Territories Conservation Commission

the deep rooted river gums (*Eucalyptus camaldulensis*). These house a diverse family of insects, birds, and reptiles. Watch out for falling limbs. Termites inside the trees can weaken large branches, which can crash down without warning.

Try wandering out at night (though not too far from your camp!) with a torch held at eye level and see how many little eyes you can see staring back at you. There could be spiders watching from the tree trunks and shrimps swimming in the pools. You may like to hold out a sheet near your camp light to observe the moths and other insects attracted to the light. A magnifying glass can enhance the experience.

When it is not perched on rocks or boulders soaking up the early morning sun, this swift moving ring-tailed dragon (*Ctenophorus caudicinctus*) can often be seen flashing across the road.



An interesting method of water conservation is demonstrated by the thorny devil (*Moloch horridus*). This strange, spiny, desert dragon has a system of channels over its horny skin (epidermis) that direct water towards its mouth. It feeds almost exclusively on ants.

SPINIFEX SOCIETY

Hummock grasslands, commonly called spinifex, cover the rocky slopes and sandy plains from horizon to horizon over more than half of the State. The majority of these grasses are species of the genus *Triodia*, with a few species of *Plectrachne*.



Soft spinifex (*Triodia pungens*)



Hard spinifex (*T. basedowii*)



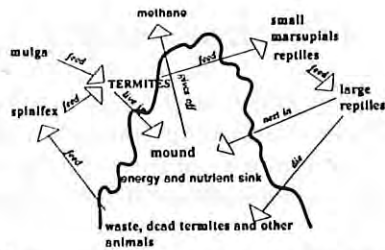
Plectrachne spp.

Unique to the Australian grasses, many of the *Triodia* and *Plectrachne* hummocks have a characteristic ring-shaped growth form, created when the older, central part dies out and new growth takes place on the periphery. The extensive vertical and horizontal root systems seek out moisture, and the needle-like leaves help reduce water loss. Summer rain prompts these grasses to flower.

Driving through the vast hummock grass plains may seem monotonous, but it only takes a night's camping or an early morning walk to reveal the life of the spinifex ecosystem.

Insects, such as the ubiquitous termites or the brightly coloured cockroaches, beetles and grasshoppers, are important members of the spinifex community. They feed on and break down the tough, resinous leaves and litter. In turn, they become food for insectivorous reptiles, mammals and birds.





Termites are a major component of the spinifex society.

The long lasting *Triodia* seeds are important in the diet of the spinifex pigeon. With markings to help it blend in with the grass and stone, this bird can be found in the vicinity of water and around camping areas in the north-west.

Reptiles, such as dragons and skinks, hunt around the spinifex clumps by day, while the night is alive with geckoes, cockroaches, spiders and scorpions as well as the variety of nocturnal marsupials and rodents.

A small, furry, nocturnal inhabitant of the hummock grasslands is the fierce, insect-eating *Ningau* (pronounced 'ning-gowie'). The Pilbara ningau (*Ningau timeleyi*) and southern ningau (*N. yvonnae*) are found in the Pilbara, whereas the wongai ningau (*N. ridei*) inhabits the Great Victoria Desert and the Gibson Desert. They are closely related to the narrow-footed marsupial mice, or dunnarts (*Sminthopsis* species) that eat insects, lizards, small birds and other small mammals.

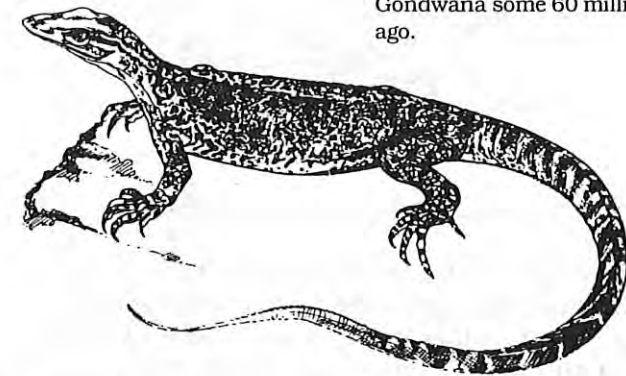
Scattered throughout the rocky spinifex covered plains of the Pilbara region of WA can be found small stones arranged in mounds up to five metres in diameter. These piles of pebbles, mark the home of the pebble mound mouse (*Pseudomys chapmani*). It is thought that the stones may collect dew overnight for the mouse to drink in the morning and the mound may act as a beacon for this nocturnally roaming rodent. Many mounds are no longer in use, indicating that the living population could now be quite low.

TRACKS IN THE SAND

Sandy deserts cover most of the arid region of the State. The seemingly endless pattern of dunes, formed initially by strong winds during the Ice Ages, stabilised 20 000 years ago and now only the crests are stirred by the wind. The red colour is due to a thin coating of iron oxide over each sand grain.

The myriad of tracks covering the dunes in the morning is evidence of the diversity of insects, reptiles, mammals and birds living in this arid environment. Look for tracks in the sand and see if you can identify which animals may have made them.

The perentie (*Varanus giganteus*), with its sensitive tongue and sense organ in the roof of its mouth, is the largest reptile found in the arid lands. They can grow to 2.5 metres and date back to the separation of Gondwana some 60 million years ago.



Legless lizards have reduced ancestral legs to stubs, evolving like snakes to slither over and hide in the sand.

Dragons move very quickly between shady spots, and some can be seen standing on two alternating legs to minimise contact with the scorching sand.



Although the myriad of tracks across the sand could include those of mammals such as dunnarts, hopping mice, and ningau, there should be a lot more. The extinction of the medium-sized mammals is, in large part, due to introduced foxes and cats. It also has been attributed to the changes in fire management practices from patchy burns traditionally carried out by desert-dwelling Aborigines, to a regime of no fires or extensive hot fires after Aborigines moved from the desert areas to missions, stations and towns. Ninety per cent of the mammals weighing between 35 grams and 5.5 kilograms (including the pig-footed bandicoot, lesser bilby, spectacled hare-wallaby, woylie, brush-tailed possum and numbat) have disappeared from the Gibson and other deserts during the past 30-60 years.



Spinifex hopping mouse (*Notomys alexis*)

A widespread species, on areas of sandy soil found on the plains and dunes across the arid zone, is the spinifex hopping-mouse. This little rodent builds burrows with vertical shafts up to a metre deep and several entrances, where it lives in colonies of up to ten individuals. There is survival in numbers. The body heat from the huddled mice creates a warm, moist atmosphere, thus reducing bodily water loss through evaporation. The mothers also drink the urine of their babies to recycle fluid. These mice feed on seeds and other vegetation, as well as insects. They can survive without free water, apparently obtaining enough water from the metabolic breakdown of carbohydrates.

MULGA MYSTERIES

The shield desert landscape, with its sand-plains, rocky hills, and salt lakes, covers much of the remaining semi-arid areas of the State and includes the pastoral country of the Murchison, Gascoyne and Goldfields Regions.

The vegetation is dominated by mulga woodland and other wattle scrub, with areas of saltbush and spinifex. This is the county that shows a spectacular profusion of daisies and other annual wildflowers after rain.

Mulga (*Acacia anuera*), the familiar grey-green scrub of the outback, has several variants with narrow and wide phyllodes (modified leaf-stems). In some areas of the Hamersley Range, large numbers of mulga have died of drought and fire. Seed is only formed when good summer rains are followed by winter rains. Germination is also dependent on good rain and often occurs in a space left when a tree has died of old age, drought or fire. Other wattles take over from mulga in certain areas. These include witchetty bush (*A. ligulata* and *A. kempeana*), kurara (*A. tetragonophylla*) and kanji bush (*A. pyrifolia*).



Kanji bush (*Acacia pyrifolia*) is a straggling glaucous shrub growing to four metres tall

Mulga is involved in an intriguing relationship with ants. Many different species of ants collect food in one form or another from these trees. Some feed on the nectar secreted from tiny glands at the base of the phyllodes, while others harvest the by-products from other sap sucking insects.

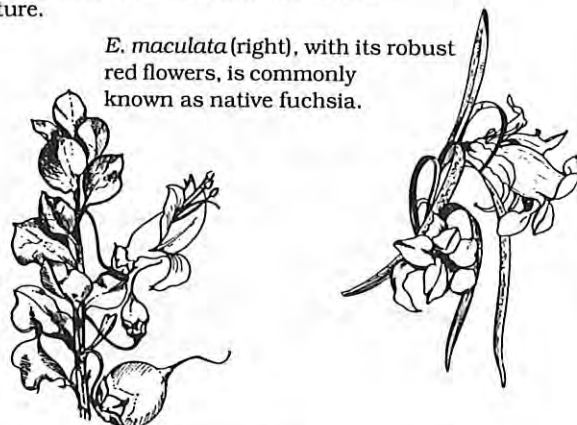
Mulga (*Acacia anuera*) with ant (*Campanotus* sp.) which stores nectar in enlarged bellies—a living honey pot.



There are many different species of *Eremophila*, whose name means 'desert loving'. Their flower structures are modified to attract both insect and bird pollinators. Generally, the white, purple or blue flowers attract bees, while honeyeaters pollinate the large, more robust red and yellow flowers. Most of the flowers have a contrasting colour or clusters of spots to direct their visitors to the pollen or nectar.



Eremophila fraseri (left) has flowers ranging from white through pink to red, and shiny sticky leaves to reflect the sun's heat and retain moisture.



E. maculata (right), with its robust red flowers, is commonly known as native fuchsia.

E. freelingii (right) has purple, bee pollinated flowers and leaves with grey, velvety hairs to trap the dew.

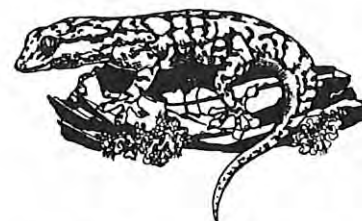
One of the kings of the desert is the mulga snake. As one of the 15 species of highly venomous snakes found in arid Australia, it can be aggressive and unpredictable if unnecessarily provoked. It often measures more than two metres and ranges in colour from reddish brown through light brown to brassy. Hunting in the day or on warm nights, it eats small marsupials, rodents, reptiles, frogs and even others of its own kind.



DANGEROUS

Mulga or king brown snake
(*Pseudechis australis*)

Many species of desert geckoes and skinks can occur at one location. Although they usually feed at night, they eat a variety of foods and exploit a range of different habitats. The tree dtella (*Gehyra variegata*) has adhesive pads on its toes to help it climb trees, shrubs and rocks. It eats a variety of insects, whereas smaller geckos, such as the fat-tailed diplodactylus (*D. conspicillatus*) eats nothing but termites. The claws on Bynoe's gecko (*Heteronotia binoei*) indicate that it is terrestrial, living in rock crevices or among ground litter.



Tree dtella (*Gehyra variegata*)

Bynoe's gecko (*Heteronotia binoei*)



The salt lakes and their associated inland drainage present very impressive patterns from the air.

Saltland plants, such as samphire, store water in their fleshy stems like the cacti of the American deserts. Why are there no cacti in Australia? It's all to do with continental drift and evolution.

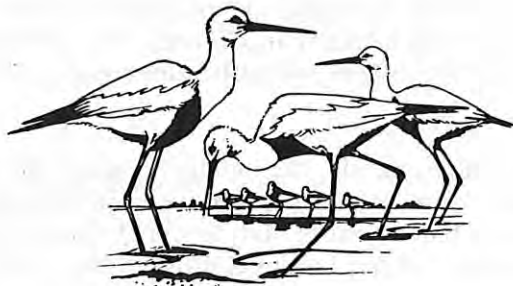
Saltbush, in the *Atriplex* genus, demonstrates some interesting survival strategies. Some species can produce two types of seed; one small, hard and black that is able to remain viable for long periods, and the other larger, soft and brown that is suited for

quicker germination in the short term. The seeds are borne between two bracteoles (modified leaves), which contain a high level of salt—enough to inhibit germination. A considerable amount of rain is needed to leach out the salt and permit successful germination. The seedling quickly develops an extensive root system to maximise water and nutrient uptake. The leaves of certain *Atriplex* have scales of salt crystals that reflect the sun's rays and hence reduce water loss.



Atriplex shrub showing enlargement of leaves and seeds.

Large colonies of waders, such as the banded stilt (*Cladorhynchus leucocephalus*), have been discovered on remote inland salt lakes. This species is thought to be related to the long extinct flamingoes that once inhabited the permanent, inland, freshwater lakes of Australia. These present day, arid land nomads follow supplies of brine shrimp, which inhabit these lakes.



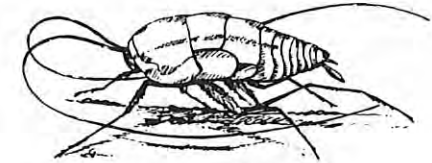
Banded stilts

WOMBATS AND WEDGIES

The stony desert is found in parts of the Gibson Desert and on the Nullarbor Plain. This desert type features outcrops of limestone and shallow soils vegetated by blue bush (*Atriplex* and *Maireana* spp.) and scattered myall (*Acacia papyrocarpa*).

Below the massive surface limestone crust lie a myriad of caves and tunnels, many containing vast underground freshwater lakes. This is home to nearly 100 species of arthropods—small animals such as crabs, insects, spiders, centipedes and cockroaches, which have hard outer-skeletons and pairs of jointed legs.

The blind cockroach (*Trogloblattella nullarborensis*), which spends all of its life cycle in the caves.



On a larger scale is the hairy-nosed wombat (*Lasiorhinus latifrons*), sometimes seen in the early morning feeding on roots and shoots from which it gets its moisture. Living in large colonies, they build extensive burrows to protect themselves from the extremes of the environment. The massive disturbance of these burrows and the surrounding bare grazing areas show up on satellite images. Wombat watching from outer space!

Young wombats occasionally fall prey to wedge-tailed eagles. However, since the spread of pastoral activities and feral animals, the wedge-tailed eagle has become dependent on feral animals and carrion. In most parts of the Nullarbor, rabbits are the sole food item of the eagle's diet.



WHEN THE WET COMES

Rain in the arid lands either comes from occasional cyclones from the north, or from cold fronts or troughs extending from the south. It may not come often, but when it comes, IT COMES!

Sheet flooding and raging rivers carry years of debris and flow into vast inland lakes. Animals climb for shelter, or drown. Others, like Spencer's burrowing frog (*Platyplectron spenceri*), are woken from their sleep by water trickling down through the sandy river-bed. After making their first meal of their protective cocoon, they dig their way to the surface to a world they may not have seen for several years. Their primary task is to mate and breed as soon as possible to give the tadpoles a chance of maturing before the water dries up. When the water threatens to dry up, the young frogs group together in the pools to reduce the area of skin exposed to dry air.



Spencer's frogs mating

Other strategies used by frogs to survive in the deserts include storing large volumes of water under their skin or in their bladders for use in times of need.

Plants have also adopted strategies to capitalise on the rainfall, when it comes.

Sturt's pea (*Clanthus formosus*), like other members of the pea and wattle families, has very hard seeds. The combination of soaking rain and abrasion, as seeds are washed along, encourages germination. Soon, the country is a blaze of shiny red and black 'soldiers' hovering over spreading green leaves.



The annuals survive by producing masses of seed. After the rain, the red earth is carpeted in purple mulla mulla (*Ptilotus* spp.) or covered in a blanket of pink, yellow and white daisies or the bright pink, succulent-leaved parakeelya (*Calandrinia* sp.).



Mulla mulla



Splendid everlasting

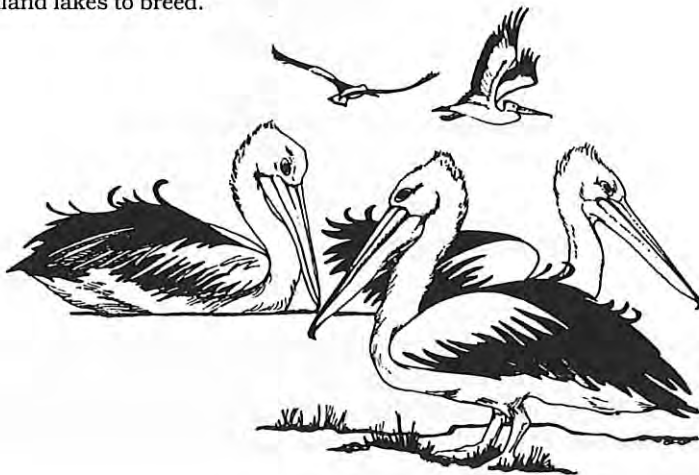


Parakeelya

It is around the temporary waterholes that the real action happens. Insects swarm, frogs call, fish flicker (in creek-bed pools) and flocks of budgerigars and finches swirl and flow through the air. They all undergo population explosions after the rains.

It's when the salt lakes turn fresh that some remarkably spectacular changes in bird life can be seen. Take Lake Gregory, in the remote north-east corner of the Great Sandy Desert, for example. As long as there is water in the lake, usually from the summer tropical rains, there are birds in their hundreds of thousands. Pelicans, ducks, brolgas, waders, terns, cormorants, geese, stilts and plovers have been recorded here. Some quite rare birds breed here. As the lake shrinks in area, the increasing salinity brings changes in the aquatic invertebrates, which in turn, support different species of birds. Bird movements correspond to seasonal conditions of wet and dry.

Thousands of pelicans may be an unusual sight in the desert, but after heavy rains, they flock to inland lakes to breed.



PEOPLE, PESTS AND PARKS

Aboriginal pressure on the arid lands, although significant, was light compared with the impact of European pastoral, exploration and mining activities. Aboriginal people used simple weapons and tools, travelled on foot, employed fire to manage the land and generally perceived a oneness between themselves and the land. Their burning regimes are not fully understood by Europeans, and although these may have had a profound effect on the environment, they spanned tens of thousands of years.

In some ways, the Aborigines were similar to the arid land animals using similar strategies to survive in this harsh environment. Gaining water supplies was obviously a problem, which they overcame by digging 'soaks', covering rock holes to reduce evaporation and using succulent plants. Their tools, weapons and medicines were crafted from the desert plants. This took much time and effort as well as a deep knowledge of the desert environment.

The desert spear-maker may take many days to find a long straight piece of wood (from a tree often identified by women) or he may join smaller pieces that have been straightened over a fire.



Fire was used by Aborigines to drive and flush out animals, to regenerate food plants, for signalling and for clearing the ground for easy access.

The arrival of the European colonists brought with it a severe clash of cultures. In the desert, Aborigines moved from their spiritual, land-orientated, hunter-gatherer lifestyle to a 'westernised' existence on missions, such as Jigalong, and on pastoral stations throughout the north-west. However, there still



exists a vibrant and dynamic Aboriginal heritage today, particularly in many desert areas. This is important to all Australians. In the field of wildlife conservation, desert Aborigines have helped scientists determine the historical fauna composition in an effort to understand the extent and reasons for the decline in the number of desert mammals. Employing some of the age old methods of land management is integral in restoring arid land plant and animal communities.

Aborigines are now involved in the management of national parks, for example at Karijini (formerley Hamersley Range) National Park, and make their skills and knowledge available as rangers and guides.



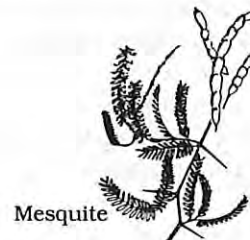
The bilby, or rabbit-eared bandicoot (*Macrotis lagotis*) was once widespread, but is now restricted to remote arid areas

The pastoral industry has had a widespread and sometimes degrading impact on the arid environment of Australia. Reports of endless lush pasture in the 1850s encouraged the large-scale introduction of sheep and cattle into the semi-arid areas. But the good seasons soon turned to drought, and the resulting overstocking, together with rabbit plagues and economic depressions, gave the arid environment a hammering.

The pastoral region of Western Australia lies between the Wheatbelt in the south-west, the Ashburton River in the north and the Great Victoria Desert in the south-east, with areas on the Pilbara coast and across most of the Kimberley. Most

pastoral leases exist today as they did in 1914, but while cattle and sheep numbers for the arid lands have remained static since then (after dropping dramatically from former times), the land has suffered vegetation loss, erosion and weed and feral animal infestations. Pastoralists have removed dense groves of trees and adopted new burning patterns to encourage pasture growth. Today, however, there is a growing landcare ethic to sustain the nature of our arid lands, while providing for pastoral productivity.

Common weeds include ruby dock, wild turnip, mesquite, *Parkinsonia* and Mexican poppy. Some grasses, such as buffel grass, introduced as pasture are now a problem in some areas, while others, such as kapok, were brought in the saddles of camels.



Mesquite



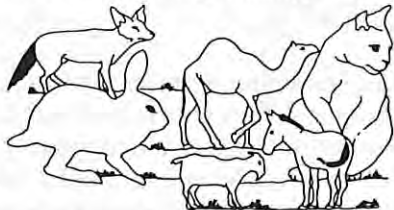
Buffel grass

The rabbit is often considered to be worst pest in Australia. Spreading from its release in Victoria in 1880, as part of a British Acclimatisation Program, it has reached plague proportions many times. Efforts to eradicate these pests include shooting, poisoning, fumigating and ripping burrows, and the introduction of the myxomatosis disease in 1950. Although numbers have declined since this then, the rabbit is showing resistance to the disease and further control measures are being investigated.

The fox, introduced for the 'sport' of hunting, appears to have followed its meal of rabbit across Australia from Victoria to the Kimberley, although about a decade behind. Sheep (as carrion), insects and a wide range of medium-sized native animals also make up its diet.

It is now realised that another great threat to Australian native fauna is the introduced domestic cat, which may have arrived much earlier than the rabbit and fox, possibly from shipwrecks before European settlement. Large numbers of cats were actually released as rabbit predators in the 1880s. They are very efficient killers, eating (often only selected parts of) a wide variety of mammals, birds, reptiles and insects. Analysing a cat's gut contents is a known method of surveying what small animals may be in an area, but it is difficult to be sure of the population sizes. A victim may be rare or it may not be a preferred prey item.

Other feral animals, including goats, donkeys, camels and brumbies (feral horses), compete with native animals for water and food. The hard hooves of horses, goats, sheep and cattle have caused severe erosion around water-holes and along rivers. Camels were released in the 1920s after they became redundant as a means of transportation in arid areas. Although feral in Australia, they are now the only wild camels in the world and efforts are being made to send some disease-free animals back to Arabia for domestic (especially racing) uses.



A rabbit, cat, fox,
goat, horse & camel.

The pastoral industry, most significantly, increased the number of watering points in the arid land. The Canning Stock Route, extending from Halls Creek to Wiluna, is dotted with wells (many not in use now). These wells watered cattle, camels and the humans who drove them, and together with the thousands of wells, tanks, windmills and troughs scattered throughout the pastoral country, resulted in the increased population of kangaroos. The kangaroos generally prefer grass stubble, while

sheep (and rabbits) eat chenopod shrubs, such as saltbush, and the tall grasses. In areas where heavy grazing by sheep has wiped out the chenopod shrubs, kangaroo numbers rose. Joint grazing prevents domination by unpalatable species.

Mining in the arid zone has brought with it endless grids of seismic lines, large holes in the ground and oasis towns. Roads and railways may disrupt the movement of wildlife and carry vehicles and trigger-happy individuals who often claim the lives of native and feral animals. Weeds, such as ruby dock, have been spread as a direct result of mining activities.

To put things in perspective, we should try to picture the landscape before human invasion. Grazing pressure could have been more intense from giant kangaroos and rhinoceros-sized diprotodons, which ambled over the plains.



Wombat-like diprotodon

Were are we now? The arid landscape has been altered significantly by the actions of Aboriginal and European people. The control needed to arrest these changes comes in the form of land rehabilitation and the designation of conservation reserves. Land Conservation Districts have been formed to address landcare problems and rehabilitate degraded areas. Representative samples of some of the different ecosystems are contained in national parks and nature reserves. Although WA has more than twice the area of arid land reserves than all of the other States combined, there are still land systems not reserved.

The rapid decline and, in some cases, extinction of so many of the desert mammal species is an enormous issue. Some land and resources have been allocated to try to understand and rectify this conservation tragedy, but much more is needed. The 'Desert Dreaming' project, carried out by the Department of Conservation and Land Management (CALM) and West Australian Petroleum Pty Ltd (WAPET), was one such undertaking. This involved the experimental translocation of the golden bandicoot and the burrowing bettong from Barrow Island (off the north-west coast) to the Gibson Desert, in an effort to ascertain the cause of their decline and the possibility of their re-establishment.

The future of arid lands is dependent on responsible management by Aborigines, pastoralists, wildlife managers and tourists.

WHERE TO LOOK FOR FURTHER INFORMATION

- *Our Arid Environment—animals of Australia's desert region* by Keith Davey (Reed)
- *Evolution in the Outback* by Jan Taylor (Kangaroo Press)
- *The Wild Pilbara—iron country and its natural wonders* by AG & B Wells, S Foy & C Morris
- *Nature of Australia—a portrait on the island continent* by John Vandenbeld (Collins & the ABC)
- *Flowers and Plants of Western Australia* by R Ericson, A S George, N G Marchant and M K Morcombe
- *Flora of Central Australia* edited by John Jessep (Reed)
- *Wildlife Identikit—common animals of central and arid Australia* by Peter King & Gerry O'Neill
- major mammal, reptile and bird guides
- *Australia Twice Traversed* by Giles
- *Patterns of Life* by M.E Lofgren (Western Australian Museum Information Series No. 6)
- *LANDSCOPE*, Winter 1987 and Summer 1992-3 issues, Department of Conservation and Land Management
- *North-West Bound*, Department of Conservation and Land Management
- *Wildflower Country*, Department of Conservation and Land Management

PLACES TO VISIT

Karijini National Park
Millstream-Chichester National Park
Rudall River National Park
Collier Range National Park
Mt Augustus National Park (Burringurrah)
Cape Range National Park
Kennedy Range

DON'T FORGET

- Notify someone if you are travelling into remote outback areas and inform them when you return.
- Obtain necessary permission from land managers and/or owners.
- Carry plenty of fuel, water, food, spare parts and a two-way radio.
- Leave gates as you find them.
- If you break down, stay with the vehicle.