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SUMMER 91/92

LANDSCOPE

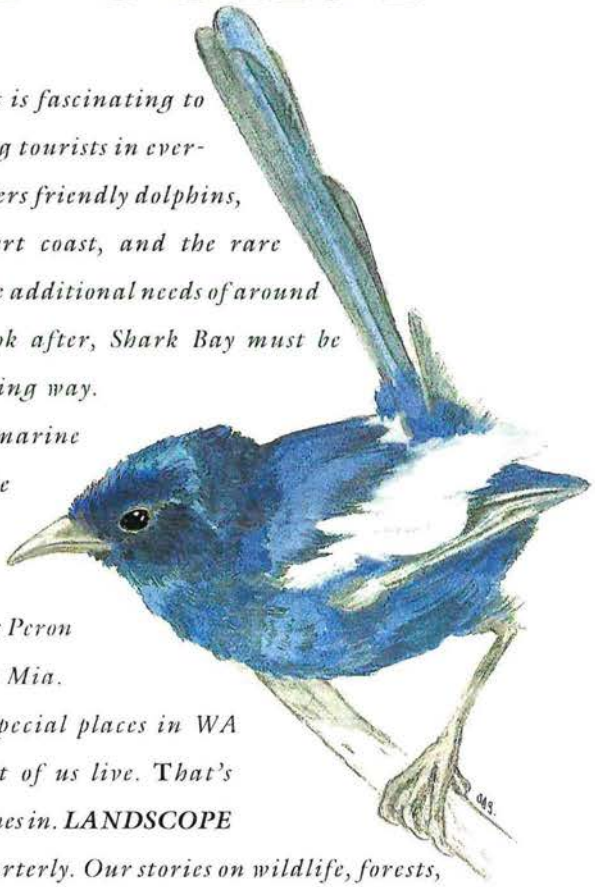
W.A.'S CONSERVATION, FORESTS AND WILDLIFE MAGAZINE

DESERT COAST
Introducing Shark Bay

LILLIPUT'S CASTLES
Home to Earth's microscopic master builders

PERON THE EXPLORER
Lost on Bernier Island

DOLPHINS, DUGONGS AND DESERT COAST



Shark Bay's unique environment is fascinating to ecologists - but it is also attracting tourists in ever-increasing numbers. The area offers friendly dolphins, slow-moving dugongs, wild desert coast, and the rare white-winged fairy-wren. With the additional needs of around 1 000 human inhabitants to look after, Shark Bay must be managed in a balanced and caring way.

The Bay itself is WA's largest marine park and the area also includes the Hamelin Pool Marine Nature Reserve, home of the world-famous stromatolites, and the new François Peron National Park, north of Monkey Mia.

But Shark Bay and most other special places in WA are a long way from where most of us live. That's *where* **LANDSCOPE** *magazine comes in.* **LANDSCOPE** *is WA's premier conservation quarterly. Our stories on wildlife, forests, reserves, and national and marine parks are well informed and scientifically researched. We pack each issue with facts, problems, solutions and achievements, and we take you to places like Shark Bay four times each year. If you'd like to subscribe to* **LANDSCOPE**, *for yourself or a friend, please write or telephone.*

LANDSCOPE

window on the west

Department of Conservation and Land Management
50 Hayman Road COMO Western Australia 6152
Tel: (09) 389 8644 Fax: (09) 389 8296

When European scientists first set foot on our shores they found a bewildering array of animals and plants. Péron the Explorer *takes an intimate look at the French scientist whose name lives in Western Australia's newest national park. See page 20.*

Seagrass covers 3 700 square kilometres of the ocean floor around Shark Bay. Grasses of the Sea, *on page 42, takes us on a journey through these underwater meadows.*

LANDSCOPE

VOLUME SEVEN NO.2 SUMMER EDITION 1991-92

This tour of the Gascoyne's desert coast guides you through Shark Bay and WA's newest national park. See page 10.

Close to where the fictional Gulliver is believed to have been shipwrecked lives one of the world's oldest organisms. Lilliput's Castles, *on page 34, describes the creatures and the ecosystem they have built.*

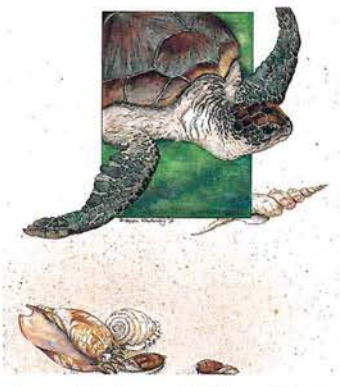
At first glance, Shark Bay is dry, arid and inhospitable. But if you look more closely you discover its Hidden Treasures. *See page 16.*

F E A T U R E S

R E G U L A R S

C O V E R

Green turtles (Chelonia mydas), *the commonest turtles found along our coast, begin to congregate in the waters of Shark Bay from the end of July. The Bay is the southernmost nesting area for these long-lived animals. During summer, female green turtles lay their eggs on the white sandy beaches of Bernier, Dorre and Dirk Hartog Islands, and occasionally at the northern tip of Peron Peninsula. Illustration by Philippa Nikulinsky.*



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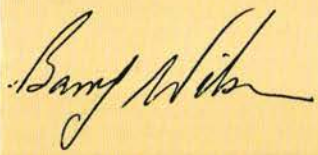
EONS OF TIME

With an average lifespan of threescore years and ten, we humans tend to think of our environment as naturally permanent. It is anything but that. The coastal zones of our planet are perhaps the best evidence of its changeability over eons, and there are few better places to see this than Shark Bay.

About 10 000 years ago sea level was much lower than it is today. In the Shark Bay region the coastline would then have been west of what is now Edel Land, and also of Dirk Hartog, Dorre and Bernier Islands. What are now islands and peninsulas were then high limestone ridges and dunes, and where the waters of the bay now lie there were wide plains of dry land. When the world's climate changed, the sea level rose to flood the low spaces and Shark Bay was created.

There were profound effects on land and sea and on the plants and animals of the region. Modern-day Shark Bay and its islands and peninsulas preserve many relics of these dramatic events in the recent history of our planet. The region is a treasure-chest for scientific study.

Shark Bay has a special place in our natural heritage. The articles in this edition of LANDSCOPE *illustrate some of the features of this wonderful place.*



Director,
Nature Conservation

ECHIDNAS IN THE YARD

The other day we were puzzled to see a small dark bundle moving slowly across the paddock on our farm. On closer inspection we were thrilled to discover that it was an echidna. We occasionally see them in the nearby park, and sometimes dead on the side of the road, but to find one on our farm was marvellous.

We live on red clay and suffer from an over-abundance of large ants. (Mingenew, by the way, means 'place of many ants'.) I was wondering if it might be possible to keep a couple of echidnas around the house to keep the ants down. I presume that they are protected, and of course I wouldn't be able to buy one from the local pet shop!

I was also wondering if you could send me some information on echidnas or publish something on them. I'd like to know their habitat, diet, etc.

MRS E.J. DEMPSTER
MINGENEW

It sounds like a great idea, Mrs Dempster, but echidnas are protected under the Wildlife Conservation Act. That means they can only be kept for specified purposes such as research and education, and the necessary permit (from CALM's Wildlife Licensing Branch) is not easy to get. Besides, it's doubtful if even the ants of Mingenew would be enough to feed a pair of backyard echidnas - they eat thousands! - Ed.

STAMP OF QUALITY

Congratulations on a wonderful magazine. I have just borrowed the Spring '91 issue from the Resources Centre at the Melbourne Zoo. It is stunning! Superb photography, reproduction and paper stock, plus such interesting, well-written and informative articles - fascinating to me over here in the East!

As a botanical artist, I particularly admired the cover illustration by Philippa Nikulinsky, whose work I know. I am a member of the Wildlife Art Society of Australia, and have exhibited her work in past exhibitions.

My main claim to fame is as the designer of the watercolour work for the Australia Post "Thinking of You" Wildflower bouquet stamp, now in its third issue. I have also just released six limited editions and botanical prints, all of Australian flora. The original water colours of these works are at present featured in the "Australian Five" exhibition at the Omell Gallery in Albermarle Street, Piccadilly, London.

I have included this information in the hope you may be interested in our work and our society (WASA). Members come from all over Australia and send work to our exhibitions. So we in the East are also trying to promote Australian flora and fauna with our paintings and sculpture!

BEVERLEY GRAHAM
CAULFIELD, VICTORIA

Thank you, Ms Graham - we're impressed with your work, too!

WOODEN GOLD

Sandalwood has been exported from Shark Bay for 100 years. The timber was extracted and carted to the beaches, where it was taken by small craft to a waiting "mother ship" for export. One can only marvel at the perseverance of early harvesters, who had to cross the wattle thickets where sandalwood grows best.

There is currently a small sandalwood-pulling operation on Nanga Station. Unlike that growing in other parts of WA, Shark Bay sandalwood is able to coppice - that is, after the tree is cut down, the stump and roots will send up new stems. The coppice shoots start producing seed again in three to four years. The tree will continue to fruit and provide the potential for new trees to grow from seed, ensuring that harvesting can be sustained. In fact, the pullers on Nanga Station are reworking old sandalwood tracks from the 1930s, using timber that has since regenerated. This suggests that sandalwood can probably be removed on a 60-year rotational basis on Nanga, even with stock grazing.

Left: *A sandalwood cutter's camp on Nanga Station. Sandalwood taken from this area will regrow to harvestable size in about 60 years.*
Photo - Bill Bachman

Below: *The aromatic sandalwood is exported to south-east Asia, where it is used to make joss sticks for religious ceremonies.*
Photo - Bill Bachman

The reasons for the special qualities of Shark Bay sandalwood are not clearly understood. Perhaps the deeper red sand loams and more regular rainfall results in a much bigger tap root system; this stores higher reserves of energy which can encourage coppice growth. In the more arid areas, tap root development is usually hindered by hard pans, and rainfall is much more sporadic. In these areas, sandalwood is usually pulled out by machine so that the plant is fully utilised. At Shark Bay, the tree is cut off at ground level, so that there is no damage to the surrounding environment and the stump can send out new stems.

The unpalatable leaves are another unusual characteristic of Shark Bay sandalwood. The leaves taste bitter and are thus avoided by domestic stock, rabbits and other herbivores. Shoots of new seedlings and coppice stems are able to flourish without grazing pressure, a factor that also helps Shark Bay sandalwood regenerate after the mature trees are removed. Elsewhere in the State, sandalwood is extensively grazed by sheep, rabbits and goats.

Research is under way to try to increase the overall population of sandalwood by sowing fresh seed beside potential hosts. Preferred hosts seem to include wattle species, especially kurara (*Acacia tetragonophylla*). This work is encouraging and it is hoped that there will be good germination after the heavy winter rains of 1991.

BUSH AND OCEAN THEME FOR PAINTINGS

The bush and the ocean were the main themes of a series of paintings by the children at Denham Primary School.

Living close to the natural environment is a way of life for the children of Denham, especially as many of their fathers are fishermen.

Grades 5, 6 and 7 students were asked to develop four paintings, and decided to use Aboriginal painting styles.

One of the paintings, featured on the back cover of this issue of *LANDSCOPE*, depicts many of the marine animals of Shark Bay, including the dugong, manta ray, turtles and sea snakes. Another shows the land animals that survive on the area's dry red earth (concept by Grade 5 student Michelle Dunne). It illustrates a harsh environment and its impact on the soil surface, and shows how the animals evolved with this landscape.

A third painting, suggested by Christopher Jones in Grade 7, highlights Big Lagoon, in François Peron National Park. It is one of the spectacular scenic areas of Shark Bay. The idea was to show the backdrop of Big Lagoon against the land and sea animals that live in this unique area.

The fourth painting is based on a story by Grade 6 student Quoin Sellenger. In the story, two Aboriginal boys go hunting by themselves. Because of their inexperience, they are noisy and scare all the animals away as they approach a waterhole. Grade 1 students helped with the painting, which took several weeks.

Their work was so spectacular that the local office of the Department of Conservation and Land Management (CALM) asked the schoolchildren to produce another set of paintings, which will become an integral part of an interpretive display planned by CALM for Shark Bay.

NEW NATURE RESERVE NEAR GINGIN

A new nature reserve, of 9250 ha, has been set aside at Boonanarring Hill, north of Gingin.

In 1976 the area was recommended as a nature reserve in the study's final report, the System Six Red Book, in 1983.

The area is representative of the Dandaragan Plateau and its scarp, and contains a variety of soils: laterite, orange sand, grey sand and peaty winter-wet soils.

The flora is rich and varied and a number of plant species have special interest. These include pouched grevillea (*Grevillea saccata*), which is gazetted as rare, and fishbone banksia (*Banksia chamaephyton*).Two poorly known species are also present: *Dryandra* aff. *polycephala* and *Calytrix superba*. The area is the main location of the *Calytrix*. In addition, two species of spider-orchid are not yet named or described. The trigger-plant *Stylidium leptocalyx* and the shrub *Dryandra polycephala* are restricted and are poorly represented in reserves. The slender mallee (*Eucalyptus decurva*) and paper-lily (*Laxmannia omnifertilis*) occur here well outside their normal ranges.

The dominant trees include salmon white-gum (*Eucalyptus lane-poolei*), an uncommon species. Two other dominant tree species - jarrah and pricklybark - have hybridised here. No hybrids of these species are known anywhere else.

A fairly brief fauna survey in 1986 revealed 10 species of mammals, 54 species of birds and 20 species of reptiles.

The System Six study also proposed that some adjoining reserves be included, and also, if possible, some land be purchased to include further valuable conservation land in the proposed nature reserve. It is hoped that ultimately an area similar to that recommended in the System Six Report will be consolidated as a nature reserve.

IN HOT WATER

There is no shortage of hot water at the old station homestead in the recently declared François Peron National Park. Now used as a recreational spa, the hot artesian bore water was once essential to the survival of Peron Station.

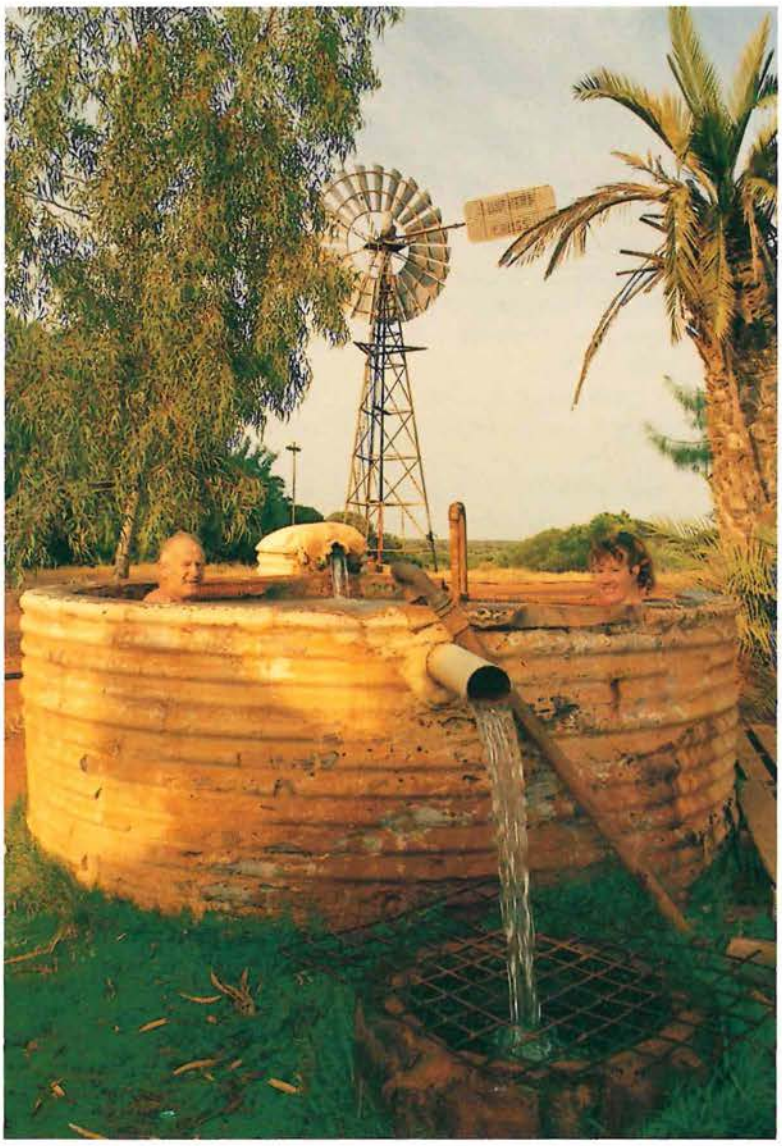
Peron Peninsula lies within the Carnarvon Basin, a geological structure lacking permanent fresh surface water. In the late 1800s, when pastoral stations such as Peron were established, shallow beach wells were built to provide ground water of marginal quality for stock. In the early 1900s, most of the wells became redundant as artesian bores were put down to provide a greater quantity and quality of water. Over 100 bores have been built for pastoral use in the Carnarvon Basin.

Artesian ground water exists, under pressure, in the sandstone below an impenetrable layer of shale.

The pressure is created because the point where the coastal bore meets the artesian water is deeper than the source of the groundwater further inland. When a bore is established, drilling continues until water is forced by pressure to the surface.

The Peron homestead artesian bore was drilled between September 1922 and July 1923, to a depth of 542 metres. The 44-degree Celsius water flows at a rate of five litres per second or 432 000 litres per day. As the water has been allowed to flow freely over the years there has been a gradual decline in pressure and flow rate. When Peron was run as a station, the water was pumped from the reservoir tank by three windmills to nine watering points located in five different directions. Elsewhere on the station, windmills were used to pump water 12 kilometres from the bore. The station's five artesian bores provided water for up to 17 000 sheep.

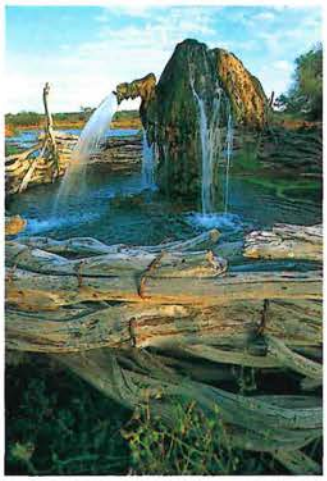
The unusual combination of artesian water and a reservoir tank at the Peron homestead is a unique cultural feature for the new park and provides a glimpse of the pioneering history of the north. CALM's development plans for the homestead will highlight the feature, allowing the public to experience a semi-natural hot spa.



Left: *The artesian bore at the old homestead on François Peron National Park will be developed for public use.*
Photo - Ron Shepherd

Below: *An artesian bore on Nanga Station was built in the 1920s.*
Photo - Bill Bachman

Bottom: The Peron artesian bore is a warm 44°C.
Photo - Marion White



DOLPHIN DANGERS

People and dolphins mingling together at Monkey Mia may seem idyllic, but it creates special problems for managers of the area.

In 1990, the dolphin researchers at Shark Bay noticed Peglet, the calf of one of the offshore dolphins, entangled in fishing line. The calf's predicament was first seen when the dolphins were swimming among boats moored offshore from Monkey Mia. They followed the mother and calf for an hour as the two headed out to sea.

By the next day the calf had become disentangled, which was fortunate, as it would have been almost impossible for local staff to catch it. However, the calf suffered lacerations to the melon (forehead) and dorsal fin.

In another incident, Nipper, a calf of Nicky, a regular beach visitor, became entangled in fishing line near Monkey Mia. Nipper's habit of following his mother to the beach allowed locals to catch him and remove the line.

In both cases, the offending fishing line may have originated from the activities of recreational fishers using the jetty. As a result, it was decided to ban fishing from the Monkey Mia jetty for the first nine months after the birth of a calf.

Young dolphins have a high mortality rate. Despite their apparently playful and carefree nature, infants must learn to negotiate the marine environment, find fish, find friends, find mum and avoid sharks from an early age. Let's hope that humans can learn not to add to the many hazards that these delightful mammals already face.

Nicky, the mother of a calf who became entangled in fishing line. Photo - Carolyn Thomson

ARTIST IN RESIDENCE

Over the years, CALM has enlisted the services of artists to interpret the natural environment and educate the community. One such artist works with children, helping them to express through art what they see and feel about the environment. In another medium, CALM recently commissioned three plays for the Woodworks Festival organised by Curtin University.

CALM's commitment to art as communication was taken a step further in 1990 with the appointment of an artist-in-residence, Guundie Kuchling-Fesser.

The challenge of portraying the Western Australian bush has been a driving force for the Austrian-born artist since her arrival in WA in 1987.

"The land is very important to me and I'm acutely aware of its deep meaning for us all," she said.

An artist and her work. Photo - David Gough

Taking up her appointment after two successful solo exhibitions in Perth, Guundie travelled to Karijini National Park, then known as Hamersley Range National Park.

"I'd visited the area once before and found the complexity of its forms quite overwhelming," she said.

"It's only when you sit down quietly and look with patience and perseverance that the land reveals its structures. Only then do you feel the spiritual significance of the land, and only then do you begin to see through the complexity and understand the order and meaning.

"Then everything falls into place. All is clear, distinct and serene - for one fleeting moment - and this has to flow onto the paper.

"This is the challenge for me and my work, the process being symbolic and transferable to all other areas of my life."

After bringing home more than 100 drawings and watercolour paintings from Karijini, Guundie selected a few motifs and worked on them in a different medium again - the lino-cut. In October, 1991 she held another solo exhibition with 23 hand-coloured lino prints. Her next step will be to combine the drawing and sculpting of figures she had done in Austria with her landscape drawing in WA.

Guundie graduated with a Master of Fine Arts degree in Vienna in 1980. She became a teacher of arts and has completed study tours through Europe, north Africa, Madagascar and the Seychelles. Between 1981 and 1987 her work was featured at 10 exhibitions in Austria and once in Madagascar. Between 1989 and 1991 Guundie's work has been shown in three solo and several group exhibitions in the Perth metropolitan area, where she continues to work as a painter, sculptor, printmaker, and writer.

TALKING TURTLE

Up to 6 000 marine turtles inhabit the waters of Shark Bay. Most are green turtles.

Congregations of turtles may be seen in Shark Bay from the end of July, although the start of the breeding season is usually later. At mating time, males cluster around and compete for individual females, which inevitably breed with more than one male. Within a short time the female lays her first eggs on the beach, repeating this on a fortnightly basis up to six or even eight times.

During summer, female green turtles lay their eggs on the white sandy beaches of Bernier, Dorre, and Dirk Hartog Islands, and occasionally at the northern tip of Peron Peninsula. This is the southern limit of green turtle nesting in Western Australia.

The loggerhead turtle, considered the most endangered turtle that nests in the Australian region, is also found in the waters of Shark Bay. At present it is estimated that only 300 to 500 females nest annually in Western Australia, predominantly between Shark Bay and Exmouth Gulf. The sandy beaches of Turtle Bay, at the northern end of Dirk Hartog Island, are among the few key nesting sites in WA. It is thought that between 10 and 20 females nest there each night at the peak of the summer season.

While as few as 300 to 500 female loggerheads are estimated to nest in WA each year, the adult female population could be three to four times this number. Individual females do not nest every year. They commonly "skip" several years, with some perhaps not returning for seven years or more.

Above: *A green turtle breathing in between dives.*
Photo - Jiri Lochman

Left: *Herbivorous green turtles are generally more numerous than other marine turtles, which are carnivores.*
Photo - Carolyn Thomson

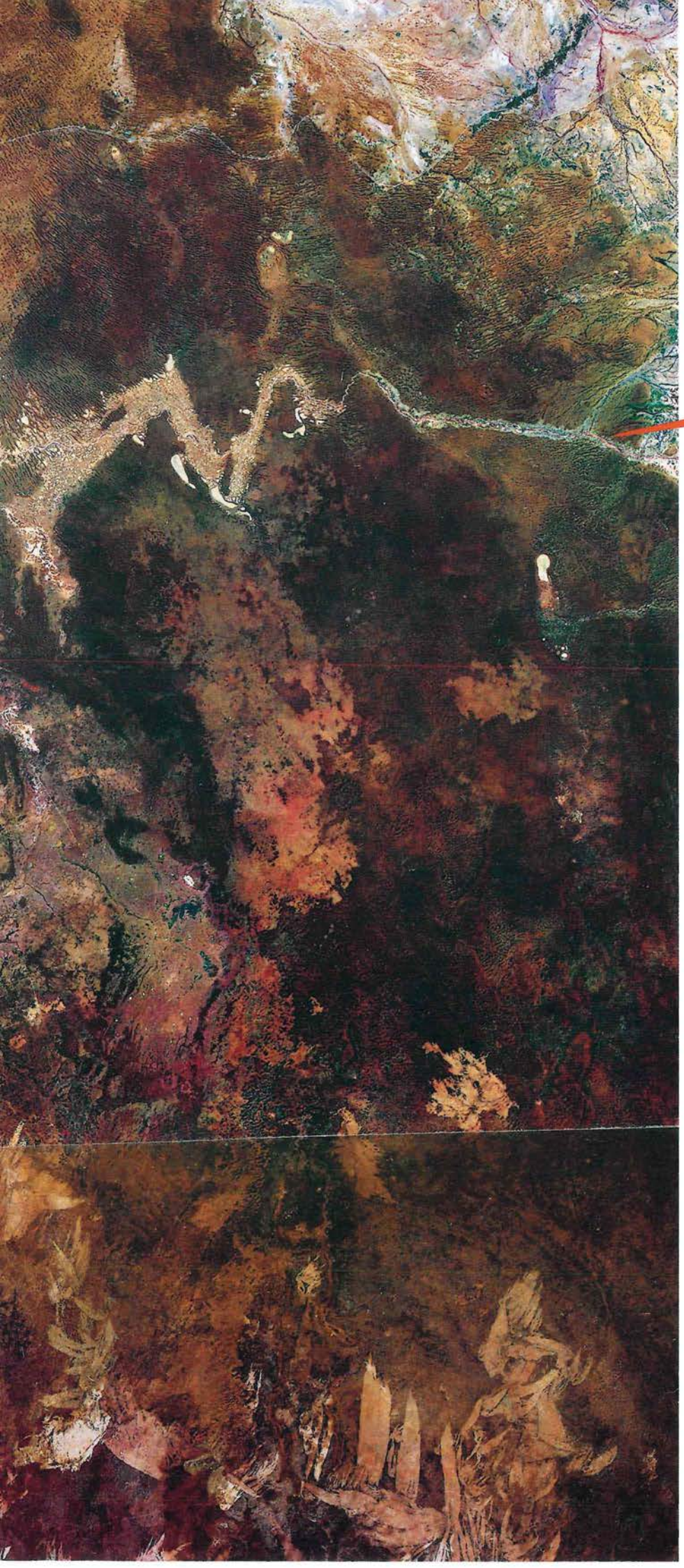
Information from recreational yachtsmen and fishers, anchoring overnight in the lee shore of Turtle Bay, has indicated that loggerhead nesting was active there during the summer of 1990-1991. Other yachtsmen moored there over Easter 1991 saw large numbers of hatchlings emerge from the beach and head for the open water.

Identifying marine turtle species is easiest when the females come ashore during the nesting season. To date, the most reliable way to gain accurate identification is to take close-up photographs and send them to CALM for confirmation.*

The Western Australian Marine Turtle Project run by the Department of Conservation and Land Management (CALM) aims to increase knowledge of marine turtle populations in our part of the world, and of their conservation needs. Research to determine the significance of the WA nesting sites to the survival of the endangered loggerhead species is most important. This research is particularly difficult because of the isolation of nesting sites. To date, public assistance, particularly from the recreational fishing and yachting communities, has been extremely important to researchers compiling the data.

*Leaflets which include information on how to identify species are available to anyone who is keen to assist. For more information contact the Supervisor of the Marine Turtle Research project, Dr Bob Prince, or the Senior Technical Officer, Andy Williams, on (09) 405 5100, or staff at any CALM District Office.


Bernier Island
Dorre Island
Cape Peron
Wooramel Seagrass Bank
Cape Inscription
Herald Bight
Shark Bay Marine Park
François Peron National Park
MONKEY MIA
Fauré Island
Big Lagoon
PERON PENINSULA
FREYCINET
DENHAM
NANGA PENINSULA
Dirk Hartog Island
Eagle Bluff
Lharidon Bight
USELESS LOOP
Shell Beach
Steep Point
REACH
Hamelin Pool
EDEL LAND
Freycinet Estuary
Zuytdorp Cliffs
TAMALA



Desert Coast

One of the most fascinating places on earth straddles the 26th parallel on the coast of Western Australia.

It is one of the world's most important natural areas, but few people have ventured beyond its more popular destinations.

Carolyn Thomson joined a natural history course run by the University of Western Australia to see why Shark Bay is unique.

BY CAROLYN THOMSON

Many people go to Shark Bay just to see the dolphins, then go home without seeing what the rest of the area has to offer. But a new course offered through the University of Western Australia's extension program takes us beyond the dolphins of Monkey Mia and has managed to pack almost every feature of natural or historic significance into a four-day educational tour of Shark Bay's arid environment, described by Dirk Hartog as a 'useless southland'.

When the course members arrived in June this year, one of the first things they noticed were emus, present in their thousands. The birds had descended on the area in plague proportions, many of them having walked up to 600 kilometres from drought-stricken inland areas such as Mount Augustus to reach the water and food sources replenished by winter rains near the coast.

This was the first time the extension course had been offered by the university. Ron Shepherd, the Conservation and Land Management (CALM) District Manager at Shark Bay, who has been based in the region for over two years, was the course leader. He met the group at Hamelin Station, gateway to the world-famous stromatolites. Like many of this region's most fascinating features, the stromatolites don't look very impressive on the surface - they look like someone has strewn hundreds of mound-like rocks into the shallow water. But scientists who discovered these unique formations, as recently as the 1950s, said that their discovery was like finding a living dinosaur.

Stromatolites (see 'Lilliput's Castles' in this issue of *LANDSCOPE*) are made by tiny single-celled organisms that are among the most primitive life forms on earth, appearing some 3.5 billion years ago. The dome-shaped structures may reach beyond a metre high and some at Hamelin Pool are thought to be about 2 000 years old. Even the mud-like layer that people were walking on was a kind of smooth microbial mat.

Nearby, at Hamelin, is the shell block quarry. Millions of shells of a tiny bivalve (*Fragum erugatum*) have been deposited in beds up to 10 metres deep along a stretch of coastline. Over time, the older and lower deposits compacted together, and early settlers found that the compacted shell made a handy building material. The settlers initially used cross-cut saws to cut through the shell - today they use chainsaws! As a result, many of the buildings in and around Denham and on local stations are made of shell blocks. Today, this activity is strictly controlled and blocks can only be cut to repair existing shell block buildings.

Denham, where course participants were based for two nights, was originally a pearling base known as Freshwater Camp. Today there is no timber near Denham, or the other old pearlers' camps around the Bay, because all the wood was used to heat the large pots in which the pearlers used to boil down the oysters. The women and children had the job of keeping the fires alight. Once a week the pots would be emptied to obtain the pearls and shells, which had sunk to the bottom. The streets of Freshwater Camp were constructed from the discarded pearl shells.

A trip on board the *MV Explorer*, a charter boat operated out of Denham, gave the group an opportunity to view the bay from a different perspective. The distinctive prongs of Peron and Edel Land Peninsulas, like fingers sticking out into the sea, form the massive bay, which is one tenth the size of Tasmania.

The Bay's important marine features include seagrass, growing in vast meadows; dugongs - 10 000 of them; wide intertidal flats; and sharks. When William Dampier visited the area in 1699 he noted: 'The sea fish that we saw here are chiefly sharks. There are an abundance of them in this particular Sound and I therefore give it the name of Shark's Bay'.

SEASNAKES AND SALT

The first port of call was Useless Loop. Town Manager Roy Tarpey showed everyone over the saltworks and the town.

It is a closed town with a population of 135, established in 1962 by the Adelaide Steamship Company but now owned by Shark Bay Salt. Around 700 000 tonnes of salt are exported each year.

The group were driven out to the salt harvesting area by minibus. Here, salt water from the Indian Ocean is channelled into a series of evaporation ponds until it finally precipitates as salt crystals. Useless Loop came by its name when French explorers put longboats ashore, thinking they were at the mouth of an inland river that would be a safe harbour: today, the geographical names of Useless Loop, Useless Inlet and Disappointment Loop are testimony to their frustration.

Even here, where the salt ponds look totally barren, there is an abundance of wildlife. Edel Land Peninsula has 12 snake species, and in the water there are seasnakes and stonefish. Wedge-tailed shearwaters nest under the conveyor belt on the salt island, built on the site of a former shearwater nesting colony. Ospreys nest on the ship loader, while up to 25 000 migrating waders visit Useless Loop every winter from as far away as Siberia.

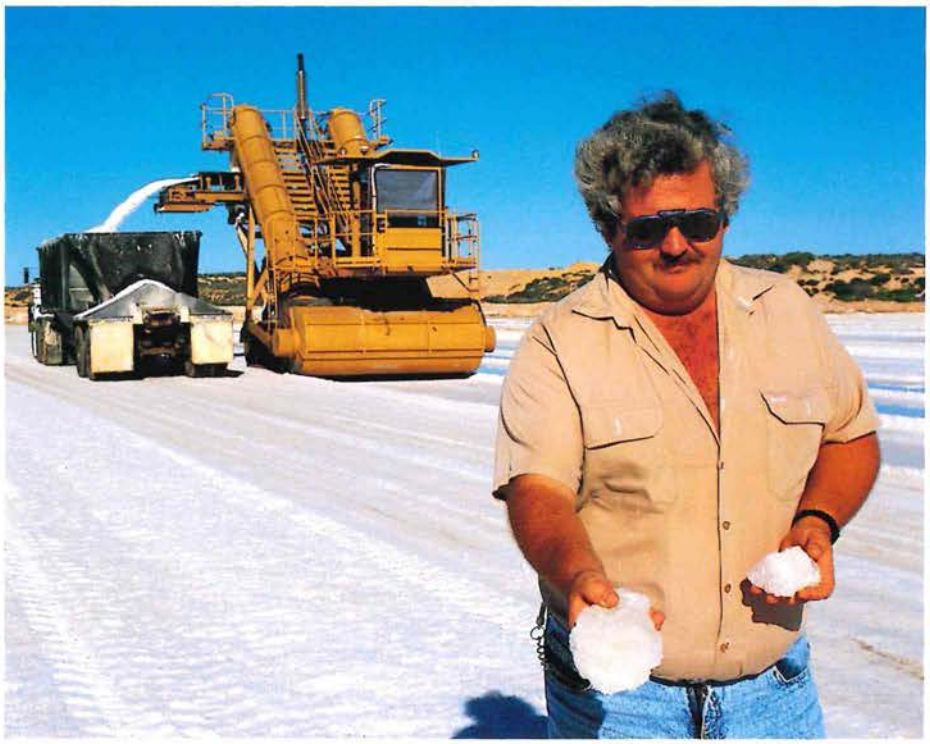
The Useless Loop community has instigated an important nature conservation program run in conjunction with CALM and the CSIRO. Local residents have erected an electric fence across Heirisson Prong, and the Agricultural Protection Board eradicated foxes, rabbits and cats from the area. Next year the CSIRO will reintroduce the endangered boodie back on to the mainland and will monitor the mammals' progress. The company will eventually hand the whole area over to the State government to manage as a nature reserve or national park.

SEAGRASS AND DUGONGS

Ron Shepherd gave a lecture on the natural history of Shark Bay to a fascinated audience.

He explained that the Shark Bay Marine Park was officially declared only a week before the visit. The park covers 1 000 nautical miles of coastline and an area three times the size of the Ningaloo Marine Park. Shark Bay has enormous biodiversity, lying on the transition line between vastly different environments: it is on the northern extremity of many species typical of the south and the southern extremity of many northern species.

The Wooramel seagrass bank is the most striking and important feature of the park (see 'Grasses of the Sea' in this issue of *LANDSCOPE*). Other marine life includes tropical species typical of



Pages 10-11
Main: Landsat imagery of Shark Bay supplied from the Australian Centre for Remote Sensing (ACRES) and digitally enhanced by the Remote Sensing Applications Centre.
Department of Land Administration, WA

Cape Peron in the new François Peron National Park.
Photo - Carolyn Thomson

Emus are common in the Shark Bay area.
Photo - Jon Green

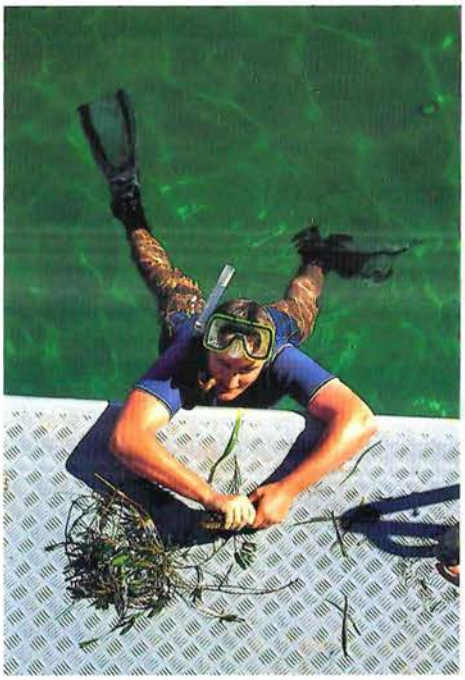
Top right: The Zuytdorp Cliffs, south of Shark Bay, are buffeted by heavy swells.
Photo - M&I Morcombe

Town Manager Ray Tarpey at the Useless Loop saltworks.
Photo - Carolyn Thomson

Green turtles are often found in the shallow seagrass beds.
Photo - Jiri Lochman

CALM District Manager Ron Shepherd examines seagrass from the Shark Bay Marine Park.
Photo - Carolyn Thomson

Curious dugongs often come to investigate boats and human visitors to the Bay.
Photo - Van Worley



Ningaloo, as well as temperate species found near Perth.

Aborigines have inhabited the Shark Bay region for many thousands of years and at least 103 Aboriginal sites are documented on Peron Peninsula. They were probably among the first Australian Aboriginals who had contact with Europeans. It is believed that the survivors of the *Zuytdorp* wreck made it to shore and may have integrated with the local Aborigines, becoming the first European inhabitants of Australia. Genetic research is under way to investigate this theory.

With the lecture over, the boat was on the move again. Several large pods of dolphins, often accompanied by calves, were spotted and the boat stopped several times to give everyone the chance to watch them at close quarters. The Shark Bay dolphins are accustomed to people and they often treat visitors to synchronised swimming displays, with four or five dolphins surfing the same waves together. This time they also accompanied the boat, swimming around and under it for several minutes.

Eventually, the *Explorer* anchored on a shallow seagrass bed, where an ancient green turtle was sitting motionless on the sea floor, only a few metres from the boat. It soon decided to come up for a breath of air and a swim. The bulky old animal may have been anywhere from 30 to 70 years old.

The most intrepid members of the group ventured into the Bay's cool winter waters with wetsuits and snorkels to see what they could spy in the seagrass. Ron Shepherd brought up some sea cucumbers, various molluscs and some seagrass, and everybody returned to the boat to examine his finds and have lunch. When he swam out to look for a bailer shell, a curious dugong came to investigate and made a slow circuit around the boat, giving everyone a good opportunity to see one of these shy mammals. It was the first dugong of the year to be seen in this spot, which is a favourite winter feeding area. Male animals are often solitary but females generally live in herds, affording protection for the young calves. The large brown animals are fairly slow-moving.

Twice in the last decade a number of killer whales herded a big group of dugong into a shallow bay and embarked on a killing and feeding frenzy. The fishermen who went out to investigate what they thought was a large school of fish came face-to-face with huge dorsal fins slicing through the red and boiling water, and made a hasty retreat.

After lunch the boat moved through South Passage, between the mainland and Dirk Hartog Island, to reach Steep Point, the westernmost point of Western Australia. It was fairly calm, and the boat continued for a couple of kilometres along the Zuytdorp Cliffs, named after the Dutch merchant ship *Zuytdorp*, wrecked along this coast in 1712. The

cliffs are a magnificent sight, rising to 170 metres above sea level. They are greatly undercut by the heavy swells of the Indian Ocean, which constantly buffet and tear away at the limestone.

Later, the *Explorer* anchored just off Dirk Hartog Island. The passengers enjoyed a spectacular sunset while boat operators Al and Kaye Dyson prepared a fish barbecue. It was a fitting end to an enjoyable and enlightening day.

WILD DOLPHINS

No trip to Shark Bay would be complete without a visit to the dolphins of Monkey Mia. These wild animals have been coming to the beach for 30 years of their own free will to interact with humans. They are not the only regular visitors to Monkey Mia - dolphin researchers from the University of Michigan have been based in the area since the early 1980s.

A big group of people, which included members of the course and other interested passers-by, gathered on the beach to hear researcher Andrew Richards impart some fascinating information about dolphin social dynamics and other aspects of the research. But the talk was cut short when the dolphins came in to the shore, and everyone deserted the scientist to meet the animals.

Before heading to the State's newest national park, most of the people in the group took the chance to explore the Monkey Mia Nature Trail, which crosses the coastal dunes to the red sandhills and returns along a quiet beach.

PARK AT PERON

Peron Station was purchased by the Government in October last year in order to establish a national park. The peninsula and the new national park are named after François Péron, who was aboard the *Géographe* during its explorations along the Western Australian coast in 1801 and 1803.

Peron's natural features include the dramatic colour contrasts of the coast at Cape Peron, at the end of the Peninsula. Big Lagoon is another scenic feature. Many of the interdune depressions contain evaporite pans called birridas. The pans range from 100 metres to a kilometre wide and several contain marine lagoons.

The park is covered in low acacia shrubland which is home to the thick-billed grass wren, once widespread in the arid areas of the State but now restricted to a small area that includes Peron. Since CALM took over the management of the area, 16 500 sheep, 1 000 goats, a small number of horses and cattle, and many kilometres of fenceline have been removed from Peron during its conversion to a national park.

The old homestead provided the ideal spot for a bush barbecue and billy tea, and some of the group members took a refreshing dip in the artesian bore, the only water available at the station.

The next day, group members readied themselves for the return to Perth and the routine of their nine-to-five jobs. But they hadn't quite finished with Shark Bay. On the way to the main highway, the bus pulled in to Shell Beach, a stretch of coastline about 60 kilometres long, where billions of *Fragum* shells have been deposited 25 to 30 feet deep.

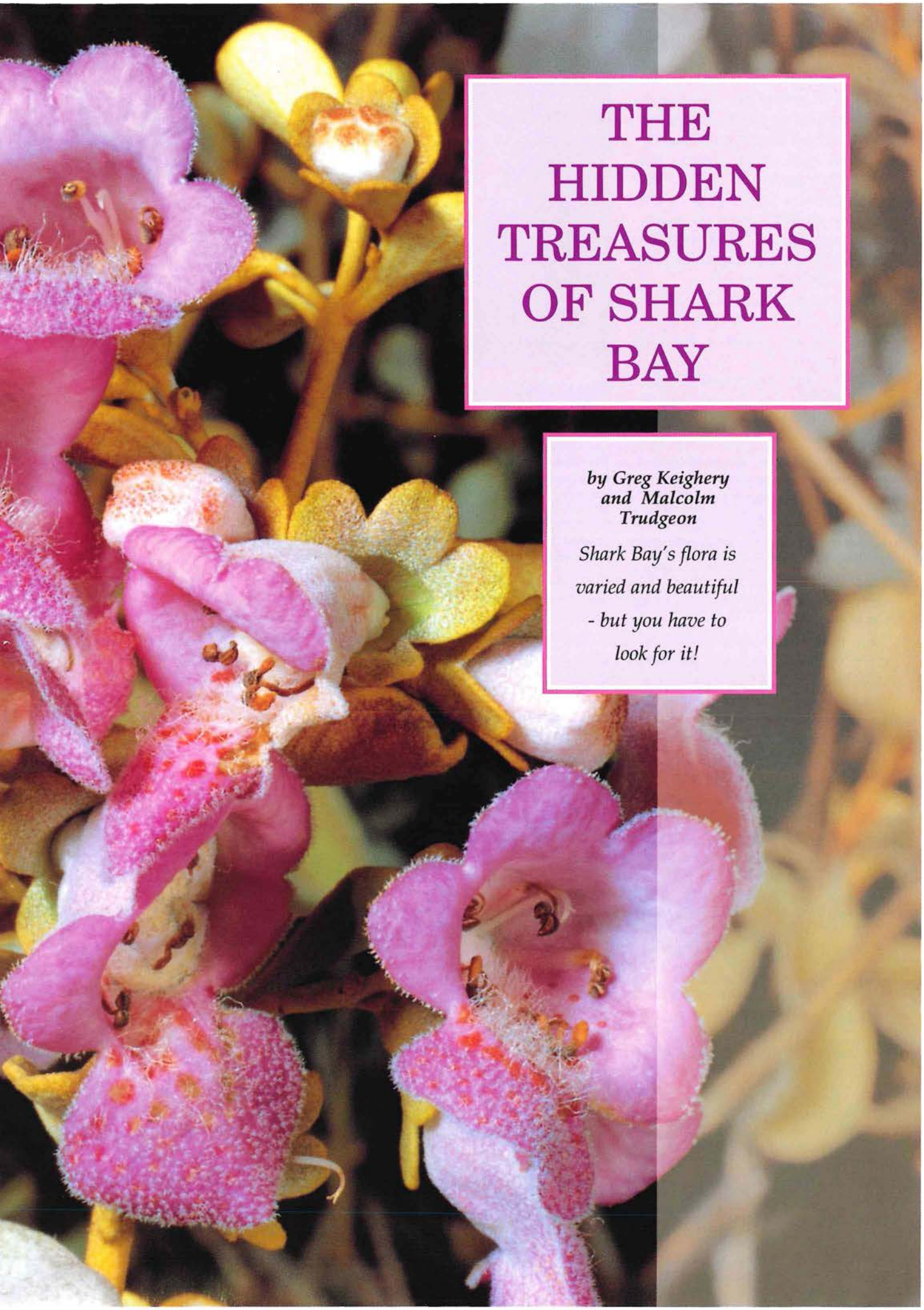
There was also a chance to examine the unique Shark Bay sandalwood, which differs from that found in other parts of WA. Sandalwood was one of the State's major exports late last century and early this century. This small tree is a semi-parasite that partly feeds from the roots of other plants. The heartwood is highly valued in South East Asia for its aromatic oils. Sandalwood growth is very slow; in the arid regions it takes 50 to 90 years to reach 125 mm in diameter. In the Shark Bay region, sandalwood regrows from the stump. Research also indicates that it grows and regenerates much faster than in other arid areas.

The Shark Bay region is an acquired taste. But those who take the time to look past the friendly dolphins never fail to fall in love with this unforgettable place.

Dolphin researcher Andrew Richards talking to the course participants about his work at Monkey Mia.
Photo - Carolyn Thomson

Group members were treated to a bush barbeque at the Peron Homestead.
Photo - Carolyn Thomson

Carolyn Thomson is a CALM Communications Officer and the editor of *North-West Bound* and *Wildflower Country*. She can be contacted at CALM Corporate Relations Division on (09) 389 8644. The Shark Bay course will be run again in 1992. Those interested in participating should contact Jean Collins at the University of Western Australia on (09) 380 2579.



THE HIDDEN TREASURES OF SHARK BAY

by Greg Keighery and Malcolm Trudgeon

Shark Bay's flora is varied and beautiful - but you have to look for it!

Travelling along the main road to Denham, on Peron Peninsula, visitors to Shark Bay see only sandhills covered by wattle scrub, saltpans and spinifex grasslands. In spring, the contrast between this and the bright fields of everlastings along the north-west coastal highway, or the species-rich heath of Kalbarri, can give a false impression of the region's flora.

In fact, detailed studies of Shark Bay's vegetation show a rich diversity, an unusual species composition and many endemic species.

While the peninsulas are characterised by low, wind-pruned and relatively uniform vegetation, the small circular saltpans, known as birridas, seen from the main road have their own unique spring-flowering annuals. The saline creeks and estuaries are lined with mangroves, which are found as far south as Bunbury on the WA mainland, and there are brilliant contrasts along the beaches, where white sand meets red desert dunes, each soil type supporting its own 'heath suite'.

A unique tree heath grows on red sand between Peron and Edel Land peninsulas. Many endemic floral species and species at the ends of their range grow within it, and unlike other heaths it has many tall shrubs and mallees.

On Edel Land, the heaths are a blend of arid and south-western species. They include unusual vegetation types like speargrass (*Stipa*) communities and low wind-pruned succulent shrublands and heaths on the Zuytdorp Cliffs.

SHARK BAY PLANTS ARE SPECIAL

Shark Bay lies at the Northern end of the vegetation of the temperate South West, and is a region of major botanical significance. Its diverse flora comes not from unusual geology (such as major topographic features, a highly variable range of soils or numerous habitats - for example, rivers and swamps), but from the juxtaposition of two botanical 'provinces'.

WA has three major climatic zones: the tropical Kimberley, the deserts, and the South West. Each region has its own distinctive flora, with a broad change-over zone between species of converging regions. The desert and the south-western flora meet, mingle and change in a broad zone that stretches from Lake Moore to Cocklebiddy in the south. At Shark Bay, however, the flora of the South West and the desert meet at the base of Peron Peninsula and Edel Land, and change abruptly. Here it is possible to stand in a tree heath surrounded by south-western banksias, grevilleas, melaleucas and eucalypts, and see the start of the desert's spinifex plains.

The Shark Bay region has about 700 species of flowering plants (Kalbarri National Park to the south has 600 species). This alone is a high figure for an arid region, but of these species, 146 (more than 24 per cent) are at the northern limits of their ranges. These include such well-known flowers as the State emblem (the red and green kangaroo paw), three species of coneflowers (*Conostylis*), a smokebush, two orchids (the rattlebeak and bunny orchid), woollybush, and running postman.

Outside the heath on Tamala and Edel Land, the Shark Bay flora is essentially made up of desert elements. This is reflected in the major flora groups of the area: the grasses (52 species),

Previous page: Native foxglove, a widespread arid and coastal species.
Photo - Bert Wells

Top: The small-flowered rose (*Diplolaena microcephala*) grows at the northern limit of its distribution in Shark Bay.
Photo - Bert Wells

Right: Coastal fanflower, a wind-pruned shrub growing on Zuytdorp Cliffs.
Photo - Greg Keighery

Left: Pink everlastings growing in Acacia shrubland.
Photo - Greg Keighery

Below: A speargrass community in Edel Land, the only place where such a vegetation community grows.
Photo - Malcolm Trudgeon

samphires (51 species), myrtles (43 species) and daisies (70 species). These four groups make up about a third of the region's plants.

PLANTS EXCLUSIVE TO SHARK BAY

About 30 species of flowering plants are confined to the Shark Bay mainland and offshore islands. Most of these have close relatives in the South West, and only occur in the more temperate parts of Shark Bay, especially Edel Land and the areas to the south.

More than half of the species unique to the Bay are confined to the tree heath vegetation, which is also the end of the South West. These species are nearly all large or small shrubs, with few bulbous herbs or annuals. Some of the more spectacular are a one-sided bottlebrush (*Calothamnus formosus*), a subspecies of limestone melaleuca (*Melaleuca cardiophylla* spp. *princeps*), a lamarchea (*Lamarchea hakeifolia* var. *brevifolia*), Royce's gum (*Eucalyptus roycei*), prickly woollybush (*Adenanthos acanthophyllus*) and golden lambstail (*Newcastelia chrysophylla*). The best selection of these can be seen in an area between 24 and 29 km from the Denham Road, on the road to Useless Loop.

Shark Bay's floral gems may be hidden from immediate view, but then here, first impressions don't count. It takes several visits, a detour from the beaten tracks and an enquiring eye to find out just what the Bay has to offer. But then, we always appreciate what is hardest to find... ▣

Right: Pom-pom everlastings on the saltflats on Tamala Station.
Photo - Greg Keighery

Below: Halgania littoralis, probably one of the blue-flowered plants noted by Dampier, growing in coastal limestone country.
Photo - Bert Wells

CALM botanist Greg Keighery and consultant botanist Malcolm Trudgeon are completing a detailed study of the vegetation communities of the Shark Bay peninsulas. Greg is based at the Wildlife Research Centre at Woodvale on (09) 405 5100, while Malcolm can be contacted at CALM's WA Herbarium on (09) 367 0500.

PERON THE EXPLORER

by Barry Wilson

The map of Shark Bay shows the influence of early explorers. Many place-names in the Bay are French, derived from Baudin's expedition a quarter-century or so before British settlement. One of the scientists on that great journey was François Péron, whose name lives on in one of Shark Bay's peninsulas. What kind of man was Péron? Barry Wilson helps us find out.

Illustrations from Voyage de Découvertes aux Terres Australes *(Paris, 1807) and Part 1 of the accompanying Atlas. (Courtesy of the Royal Society of Western Australia)*

Nicolas Baudin's expedition to southern and western Australia, initially with the two ships *Naturaliste* and *Géographe*, was one of the great events in the history of science. It was sponsored by the Imperial Institute of France, aimed at exploring the southern and western coasts of the poorly known Australian continent and at providing new material to promote the standing of French science in Europe. In spite of controversy, mismanagement and appalling casualties, the expedition was successful. More than 100 000 specimens of animals were taken back to France, most of them collected at King George Sound and Shark Bay.

Death and desertion claimed the majority of the scientific personnel of the expedition. Of the 23 scientists who embarked, only three returned to France. François Péron was the only one of the original five zoologists to complete the trip and to him fell the task of writing up the zoological results. His work was illustrated by Charles Lesueur, who had joined the expedition originally as a gunner.

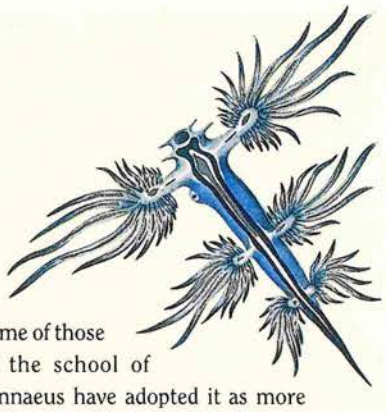
Péron died in Paris before the task was completed and it was finished by his ship-board colleague Louis Freycinet. (Freycinet later commanded the *Astrolabe* on a second scientific expedition in the region.) These works have great importance for Western Australian natural science. Very many of the local marine species, and some terrestrial species, were described and named in these publications and in the works of other scientists using the collections made by this expedition.

Writing in the preface to Péron's narrative (1809) the great French scientist Cuvier said, 'Péron and Lesueur alone, have discovered more new animals than all the naturalist voyagers of our times.'

MISGUIDED PROPHECY

Regrettably, only a handful of the species names introduced by Péron himself are technically valid - these being indicated in the text by the letter N. Cuvier also wrote:

> 'Owing to an irregular or false method of description which has been introduced into science [referring to the binomial Linnaean system], its progress has been much retarded. Travellers, and particularly



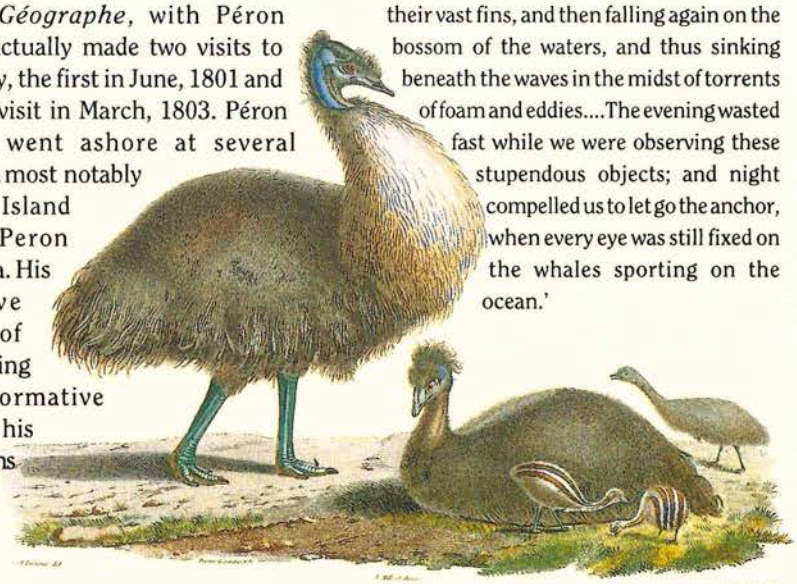
some of those of the school of Linnaeus have adopted it as more expeditious and easy, the consequence has been, that they have only acquired *relative* descriptions, scarcely sufficient for scientific explanations at the epoch when they studied, and which become more useless in proportion as new subjects are discovered: M. Péron knew how to get over this error. His descriptions, according with a constant and regular plan which has been formed, embrace all the details of the exterior organization of the animal, explain all its characters in an absolute manner, and will, in consequence, survive all the revolutions of methods and systems.' *

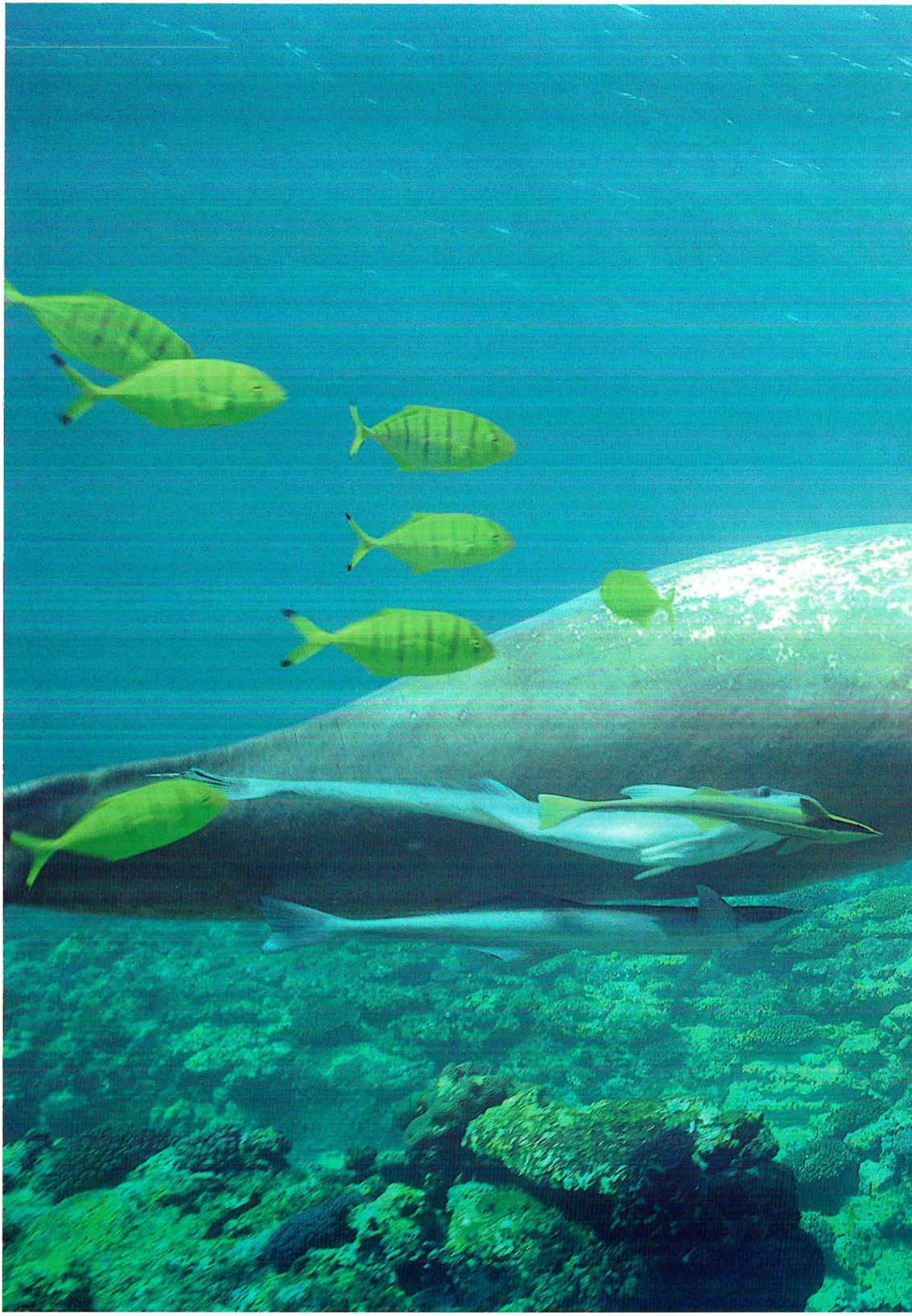
Sadly for Cuvier, this prophecy was misguided. The Linnaean system has since been universally adopted as the standard, and works like that of Péron which do not follow it have no standing in the science of naming animals and plants. Consequently, the names used by Péron in his technical volumes are not 'available', although subsequently the descriptions and illustrations have been used by other authors who based valid names on them. Only a few names introduced in the narrative follow the binomial Linnaean system and are in current use.

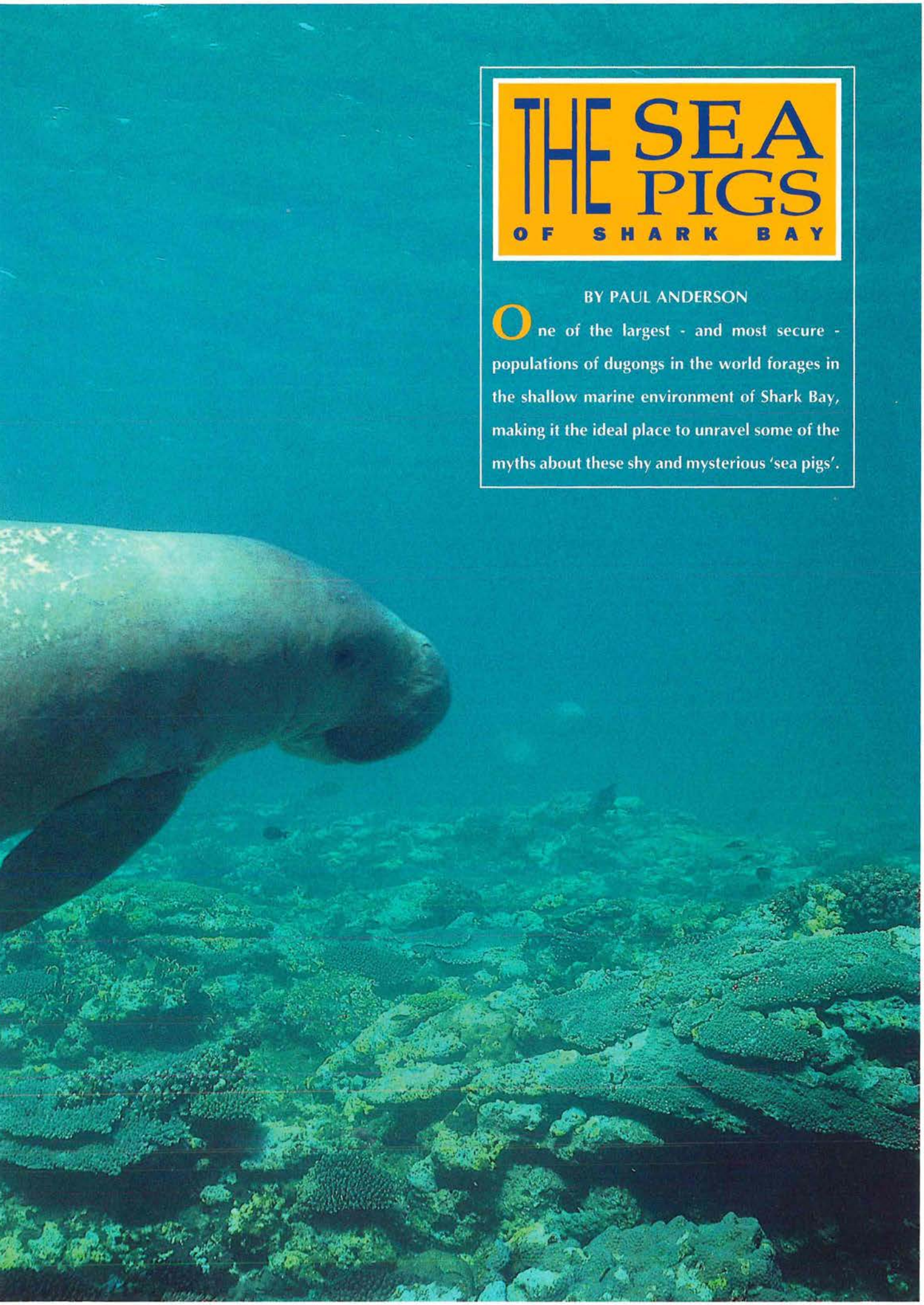
TWO VISITS

The *Géographe*, with Péron aboard, actually made two visits to Shark Bay, the first in June, 1801 and a return visit in March, 1803. Péron himself went ashore at several localities, most notably Bernier Island and Peron Peninsula. His narrative is full of entertaining and informative notes on his observations there.

> 'On the 27th [June, 1801] in the morning we ran in left of the continent, having on the right the isles Dorre and Bernier: the appearance of the continent in this part was as barren as that we had seen on the preceding days....the shore consisted of either white or red sand, and had no other verdure than here and there a few miserable looking shrubs. To this dismal sterility of the continent and the isles, may be pleasantly contrasted the productions of the sea, which are astonishingly numerous and in very great variety.'
>
> 'Among these numerous and harmless animals, were also a great many venomous reptiles....some of them are entirely of one colour, either grey, or yellow, or green, or bluish; others are striped in rings of blue, white, red, green, black, &c. &c. some are varied with large spots, more or less regularly disposed; others again are beautifully marked with small specks all over the body. One species is particularly remarkable for the colour of its head, which is of a bright purplish red; this is the sea-serpent with the red head, mentioned by Dampier, who first discovered it in these latitudes....'
>
> 'While the general attention was still occupied on so many different objects, we discovered all at once a vast shoal of whales, which came towards us with great rapidity. Never had we seen so extraordinary a spectacle. The amazing number of these sea monsters, their gigantic size, their quick evolutions, and their spouting up the water, all appeared to me to be surprizing, but less so than to see these mighty Colossi springing perpendicularly above the waves, and standing, if I may be allowed the expression, on the extremity of their tails, spreading their vast fins, and then falling again on the bossom of the waters, and thus sinking beneath the waves in the midst of torrents of foam and eddies....The evening wasted fast while we were observing these stupendous objects; and night compelled us to let go the anchor, when every eye was still fixed on the whales sporting on the ocean.'





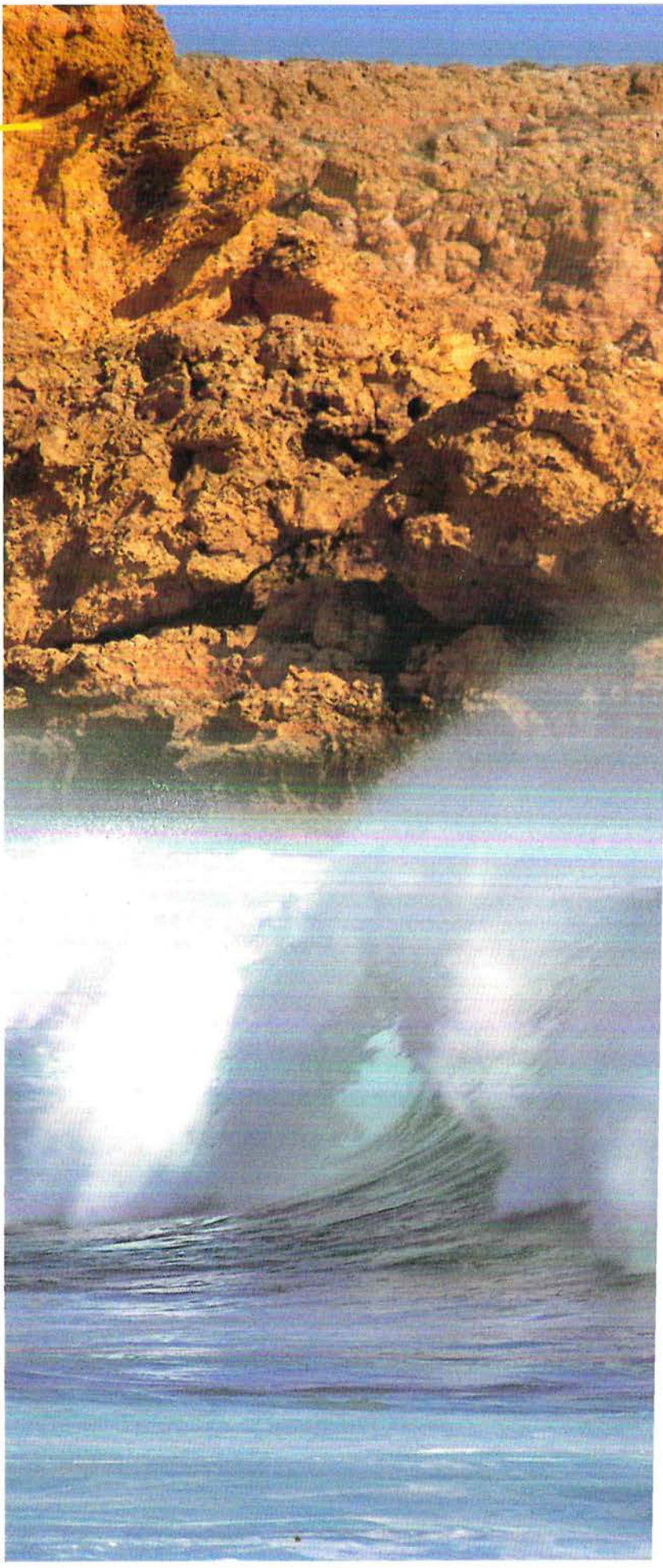


THE SEA PIGS OF SHARK BAY

BY PAUL ANDERSON

One of the largest - and most secure - populations of dugongs in the world forages in the shallow marine environment of Shark Bay, making it the ideal place to unravel some of the myths about these shy and mysterious 'sea pigs'.

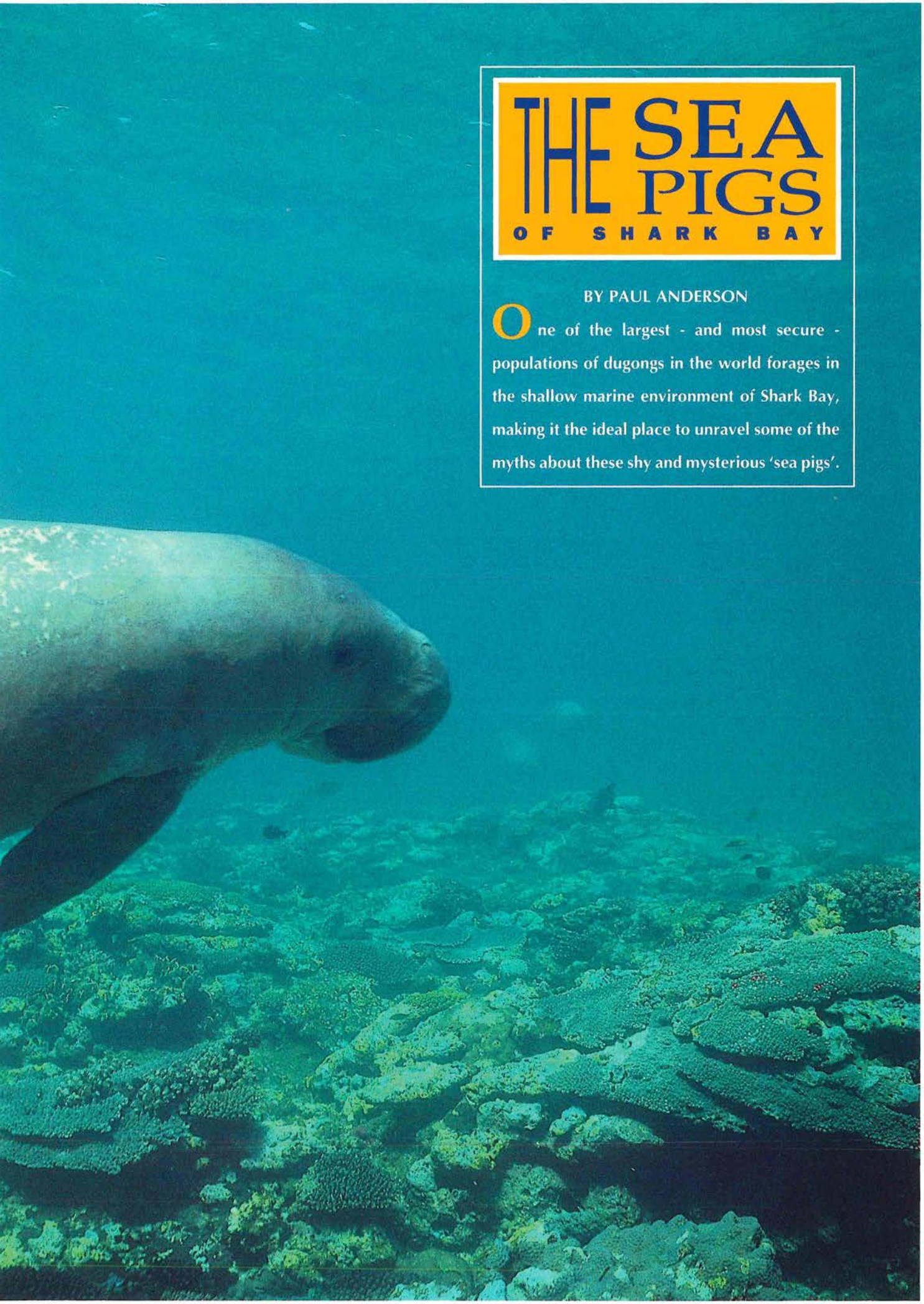
Islands of CONTRAST



The islands that dot Shark Bay were belittled by early explorers of New Holland who believed them to be devoid of life.

Yet today they are remnants of how Australia once was: rich in wildlife and vegetation.

By Keith Morris
Jeni Alford
and
Ron Shepherd



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Bay in winter. My observations of local movements along the east coast of Dirk Hartog Island during June and July suggest that animals there are living on the edge of their tolerance for low temperatures. Studies of the metabolism of dugongs' distant relatives, the West Indian manatees, suggest that vegetable matter cannot be processed fast enough to maintain body temperature in cold water; the dugong's closer relative, the recently extinct sea-cow of the North Pacific, did get around the cold water problem, but primarily through its huge size. More must be learned about dugong movements to help avoid conflicts between habitat requirements and human use of the Bay.

The temperature factor may be complicated by a dietary problem. In summer, dugongs feed mainly on a few small beds of rhizome-rich tropical seagrasses in the eastern Bay and the lower part of Freycinet Estuary. Over 90 per cent of the Bay's seagrass belongs to a cool-water species, wireweed. This is the only seagrass available in quantity in the areas to which dugongs move in winter. As wireweed does not store reserves in easily excavated rhizomes, and dugong snouts probably cannot harvest the tough leaf clusters efficiently, Shark Bay dugongs may survive stressful cool winters on low-quality diets. Further research is needed to determine if high-quality animal foods such as bottom-dwelling invertebrates allow the Shark Bay dugong population to survive the winter months.

Dugongs have a very low reproductive rate. Females may live to 70 years of age, but don't produce their first calves until 12 to 17 years of age. The interval between births may vary between three and seven years. Dugongs cannot haul out on land, and reportedly give birth in very shallow water. The single calf stays close to its mother for 18 months or more.

Although dugongs begin to eat seagrass within two weeks of birth, females continue to suckle their young during their long association - although not by cuddling them in their flippers, as folklore has it. Young dugongs hide above the mother's back when danger threatens.

Dugong behaviour and ecology have been encumbered with myth and shrouded in mystery. The clear waters and relative lack of human harassment make Shark Bay an exceptional place to probe this mystery. Contrary to myth, dugongs do not form family groups and herds are not governed by a bull. Recent data suggest that, like male elephants, adult male dugongs may be solitary. A startling discovery, made in the Bay in 1988-89, is that male dugongs may attempt to attract mates by gathering at a 'dancing ground', where each defends a small private area in which to carry out behavioural and acoustic displays. Such behaviour has not been recorded elsewhere and may be unique to this population. Much remains to be learned about the dugong, and the Shark Bay population is a unique and valuable resource for scientific study.

Dugongs are alert, shy, and very curious. Recent studies of the brains of manatees suggest that they, and by extrapolation dugongs, may be more intelligent than previously thought. Their hearing is excellent, allowing them to detect boats and other disturbances at a distance. They are easily frightened and will leave a feeding area if disturbed. When not frightened by fast movements or loud noises they respond to the presence of a boat or a swimmer by coming to investigate, then disappearing when their curiosity is satisfied.

Dugongs are best watched from a boat on a nearly calm day. The boat should be worked around at low speed to a position 100 metres or more upwind, where the engine can be cut and the boat allowed to drift. As the vessel drifts closer, the animals will come to investigate. The boat should be allowed to drift at least 100 metres past the animals before restarting the engine.

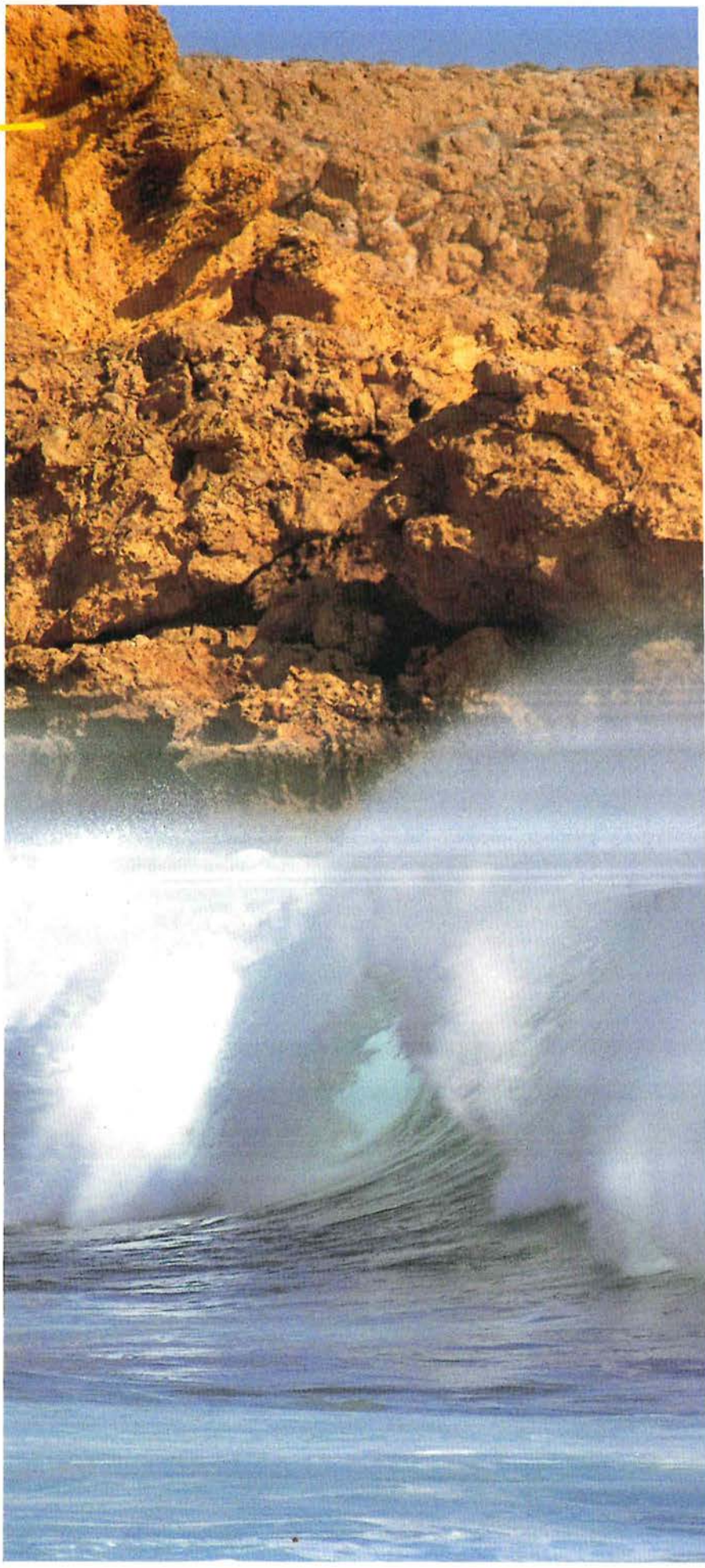
Dugongs can detect and avoid a power boat moving at under 10 knots. They are unable to take evasive action if a boat approaches at higher speeds and collisions may damage both the animal and the boat. They should never be followed continuously, or forced to escape at top speed. Harassment may cause them to leave feeding areas, and prolonged high-speed swimming may cause damaging stress.

THREATS TO THE SHARK BAY POPULATION

The latter half of the 20th century has seen unprecedented expansion of human populations, and increasing human demands on the environment. These activities inevitably threaten non-human species. In Shark Bay, individual dugongs are at risk from illegal hunting, drowning in gill nets, collisions with fast-moving boats, and capture in trawls. At present, these are rare events, and none appears seriously to threaten the population. The ultimate threats come through alteration of the habitat. Development could disrupt the dugongs' mating sites or the still unknown calving areas. It is up to us to ensure that the environment of Shark Bay and its unique wildlife are given adequate protection.

Dr Paul K Anderson is Emeritus Professor of Zoology at the University of Calgary in Alberta, Canada. He has studied dugongs at Shark Bay since 1978.

Islands of CONTRAST



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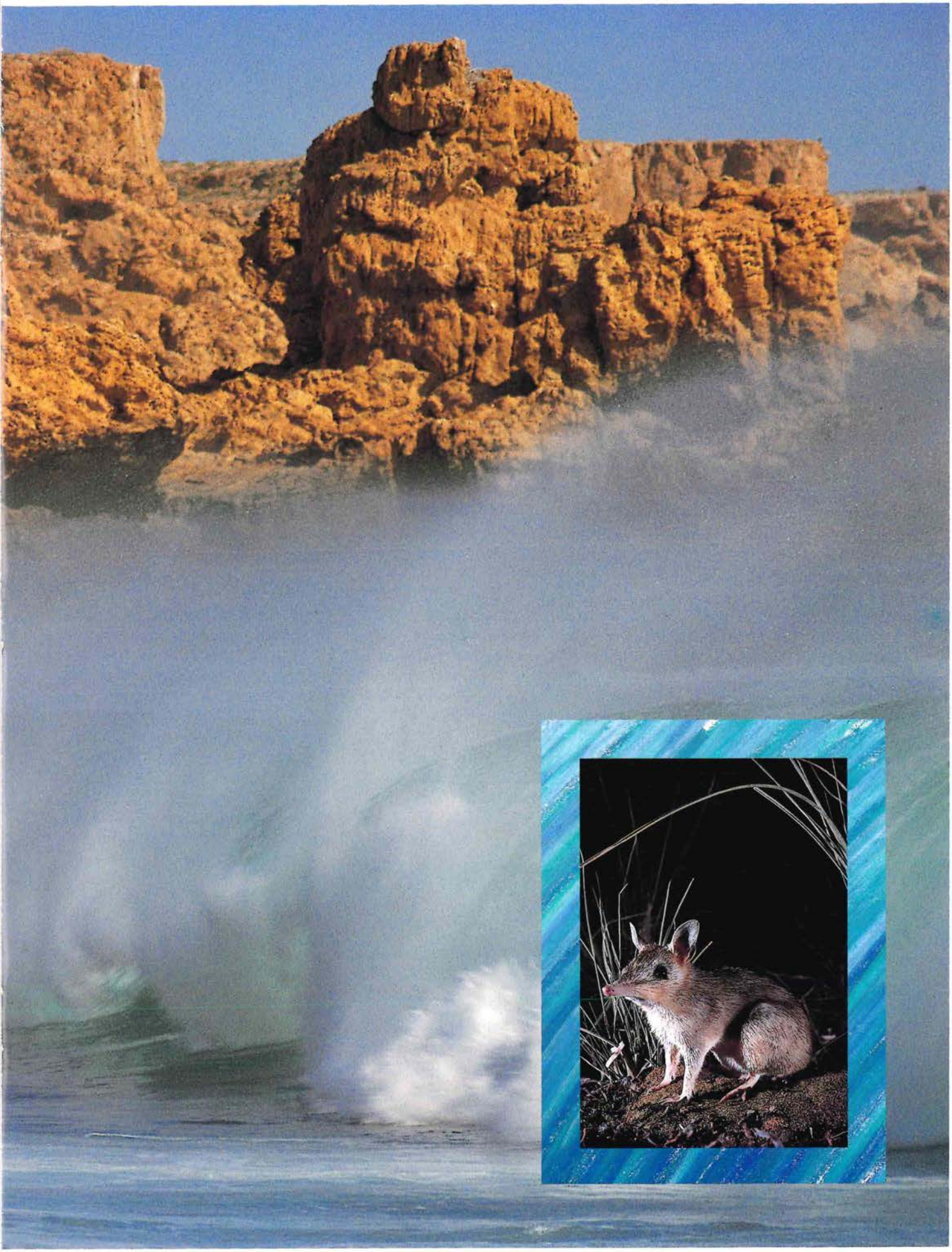


"For its entire length it looked arid, disagreeable and dreary. It was in fact worse than the part of Terres de la Concorde that we had seen the day before."

So wrote Nicolas Baudin about Dirk Hartog Island in 1801 as he sailed up the west coast of Australia. Further north he named two islands the 'Barren Isles', since renamed Bernier and Dorre - now two of Australia's most important nature reserves!

Baudin was not the first explorer to make derogatory comments about the Shark Bay area - Dirk Hartog in 1616 and William Dampier in 1699 were equally unimpressed. But despite their misgivings, the Shark Bay islands are anything but barren. They support mammals and birds extinct on the mainland, and offer a snapshot of pre-European ecosystems. This natural diversity is a result of Shark Bay's location at the boundary of two botanical provinces, the dry Eremaean and the moist South West.

The islands, particularly Bernier, Dirk Hartog, and Dorre, have been visited by several naturalists and expeditions since their discovery. The mariners' interests were understandable, as the peninsulas and bays of Shark Bay were depicted on early charts as some of the few safe anchorages along the west coast.

Some of the earliest botanical collections by Europeans in Australia were made in the area by William Dampier in 1699, probably from Dirk Hartog Island. Seventeen of the specimens were the first to be incorporated into European herbaria. Twelve of these are still preserved in the Oxford Herbarium in England, while Dampier himself was commemorated by the plant genus *Dampiera*. Leschenault de la Tour also collected plants extensively during the Baudin expedition in 1801.

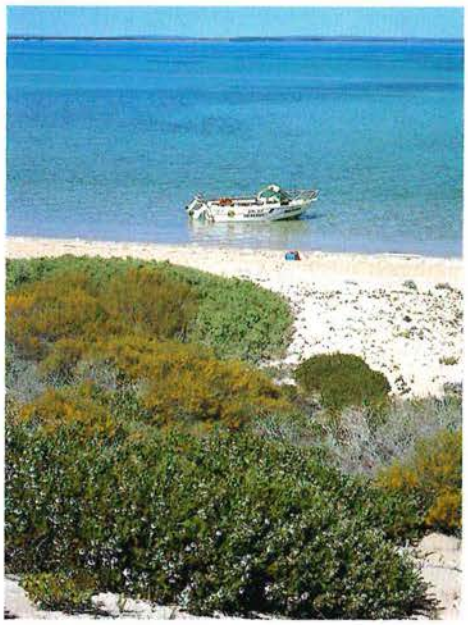
Dirk Hartog Island has one of the most diverse island floras in the South West, with species such as Fraser's lantern bush.
Photo - Bert Wells

Naturalists with the Baudin and Freycinet (1818) expeditions also collected and described many of the now rare mammals on Bernier and Dorre Islands. Between 1916 and 1920, noted ornithologists Thomas Carter and F. Lawson Whitlock documented the islands' breeding seabirds. More recently, the Department of Conservation and Land Management (CALM) surveyed the fauna of the small islands within the Freycinet Estuary.

CHEQUERED HISTORY

The Shark Bay islands were formed about 6 000 years ago when the sea rose to present levels, and they are geologically similar to the rest of the Shark Bay area. The three largest islands in the region - Dirk Hartog, Bernier and Dorre - form the first group. Dirk Hartog Island, at 62 000 hectares, is the largest island in Western Australia, and one of the largest in Australia. These islands are essentially northern extensions of the Edel Land Peninsula and are limestone overlain by extensive white sand drifts.

The second group of about 22 small



Previous page
Main: Bernier Island, a pastoral lease for 11 years, is now one of Australia's most important nature reserves.
Photo - Jiri Lochman

Inset: The western barred bandicoot is only found on Bernier and Dorre Islands.
Photo - M&I Morcombe

A variety of wildflowers occur on the islands.
Photo - Keith Morris

One of the more attractive inhabitants of the islands - the variegated fairy-wren.
Photo - Bert Wells

Salutation Island now supports a thriving stick-nest rat population after a successful translocation program.
Photo - Keith Morris

islands within the Freycinet Estuary lie to the west of Peron Peninsula. The largest, Salutation Island, is 160 hectares, while the others are all less than five hectares. These islands are also limestone, with little soil. Many lie in shallow water near the mainland and were probably connected to it for longer than the larger islands. The third group, Fauré (5 000 hectares) and Pelican Islands to the east of Peron Peninsula, are sandstone islands overlain with red and white windblown sands.

Most of the islands are nature reserves managed by CALM. Some are isolated from human disturbances found on the mainland, such as grazing, frequent fires and introduced predators, and in some cases mirror the mainland before European settlement. However, many have been subjected to a wide range of uses. In the colony's early days, guano (the accumulated droppings of thousands of seabirds) was mined from some of the small islands near Dirk Hartog and in the Freycinet Estuary, forming part of the State's first export trade. This activity declined by the 1880s as the guano became depleted and pearling and sandalwood-collecting gained momentum in the area.

Dirk Hartog and Fauré Islands have been pastoral leases since the late 19th century, and are still grazed by sheep and goats. Bernier Island was also a pastoral lease between 1896 and 1907. In 1959, the botanist Royce noted the widespread sand drifts and unstable vegetation on Bernier, compared to the ungrazed Dorre Island. All the sheep were removed when the pastoral activities ceased, but the last goats were only removed from the island in 1984. In the 1920s and 1930s Salutation Island was used as a 'ram paddock' by the former Nilemah (Hamelin spelt backwards) Station over the winter months.

Between 1907 and 1917 a 'Lock' hospital operated on Bernier and Dorre Islands, where Aboriginals with venereal disease were forced to stay on the islands in isolation, the males on one and the females on the other. They were allowed to live as naturally as possible, hunting game, fishing, and collecting turtles and turtle eggs.

With the exception of Dorre, which can only be visited with CALM permission, the islands are now occasionally visited by fishing parties.

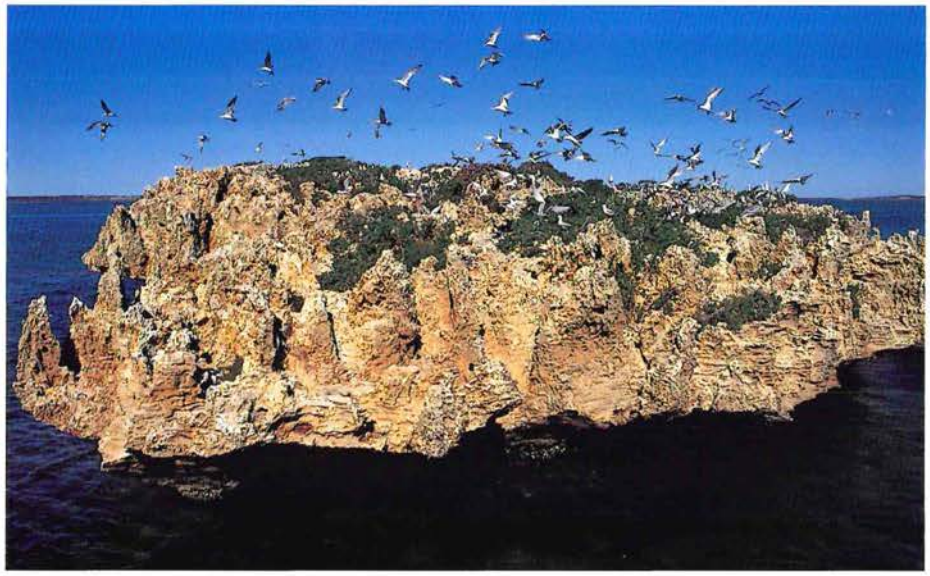
MAMMALS ON THE BRINK

Despite these uses, most of the Shark Bay islands are still free of introduced plants and animals, particularly predators. The larger islands are particularly important habitats for mammals no longer found on the mainland. Bernier and Dorre Islands support eight species, many of which are now extinct or have declined on the mainland.

The Shark Bay mouse, a small native rodent that survives on leaves, stems and flowers, was once found throughout southern WA. Now Australia's most restricted mammal, it is found nowhere else but Bernier Island. The western barred bandicoot and banded hare-wallaby are now found only on Bernier and Dorre Islands.

The boodie (burrowing bettong), a small rat-like kangaroo closely related to the woylie that was once widespread on mainland Australia, only occurs on Bernier and Dorre Islands, and on Barrow Island off the Pilbara coast. This species was also recorded on Dirk Hartog Island

Australia's most restricted mammal, the Shark Bay mouse, is now found only on Bernier Island.
Photo - Bert Wells



Protected seabird nesting sites are among the most important conservation values of the islands.
Photo - Carolyn Thomson

by the early French expeditions, but the introduction of grazing stock and the domestic cat were probably responsible for its demise there.

Important research into conservation of these mammals is now under way on Bernier and Dorre Islands. CALM scientists are studying the ecology of the western barred bandicoot in an attempt to discover why this once widespread species is now restricted to these few islands. Information on population numbers, diet, home ranges, reproduction and nest sites is being obtained and will be useful if a future translocation program is developed for this rare species.

On Bernier Island, research is also proposed for the Shark Bay mouse. In 1989, a search for this species on the Shark Bay mainland was unsuccessful. When research goes ahead, the rodent's population size, diet and distribution on Bernier Island will be determined, and then it will be reintroduced to protected areas (free of foxes, cats, rabbits and stock) on the mainland, and perhaps later to Dirk Hartog Island, where it also once occurred.

The introduction of the greater stick-nest rat - extinct in WA - to Salutation Island represented a significant contribution to the conservation of rare mammals in Australia (see box on p. 33).

BIRDS AND REPTILES

About 35 per cent (95 species) of the birds in the Shark Bay region are found on the islands. The islands are protected breeding sites for 17 species of sea and shore birds, including the white-bellied sea-eagle, pied cormorant, pacific gull and roseate tern. As boats approach the islands, ospreys can often be seen sitting like sentinels on their impressive stick nests. Pelican Island, to the east of Fauré Island, is one of only nine pelican breeding sites in WA. Most seabird breeding in Shark Bay occurs in winter and spring and, between September and April, migratory waders feed on the shores of the islands on their way to and from their breeding grounds in the northern hemisphere.

The islands are also safe breeding sites for ground-nesting land birds such as the rock parrot, stubble quail and pipit. Their isolation has also resulted in some land birds evolving into different forms from those on the mainland. Subspecies of the white-winged fairy-wren and southern emu-wren are found only on Dirk Hartog Island, and a subspecies of the variegated fairy-wren occurs only on Bernier and Dorre Islands.

Isolation has also produced fascinating distribution patterns among reptiles. Several skinks are confined to islands, while others are found on islands and a small part of the adjacent mainland. King's skink, which was recently discovered on Three Bays Island, is 200 kilometres north of its mainland distribution near Geraldton. A subspecies of Stokes' skink is confined to Baudin Island, just three kilometres north of Three Bays Island. Dirk Hartog is the only island in the State on which the poisonous gwardar snake occurs. The mulga snake, also poisonous, occurs there as well as on Bernier, Dorre and Salutation Islands.

Loggerhead and green turtles nest on the beaches of Dirk Hartog, Bernier and Dorre Islands during the summer months. These are their most southerly nesting sites. The animals also feed in the shallows around the island. Baudin referred to Fauré Island as 'Ile de Tortues' after finding a plentiful supply of turtles there for food.

CLINGING TO THE PAST

One third of the 30 plant species confined to Shark Bay are restricted to the islands, a further example of how islands can shelter relic populations. Precipitous limestone cliffs, generally standing higher above sea level than most of the mainland to the east, flank the western side of the larger islands. These contribute to increased rainfall,

Many different forms of animals have evolved on the islands, such as the dark form of Stokes' skink.
Photo - Keith Morris

particularly on Dirk Hartog, which has one of the richest floras of any island in the south-west of Australia.

Apart from buffel, the introduced stock-fodder grass on Fauré and Dirk Hartog, few exotic plant species are found on the islands. The limestone islands support an essentially South Western Province flora and are particularly rich in plant species from the daisy and grass families. Heaths, sundews and buttercups, the typically South Western families, do not occur on the islands, and the banksia family is poorly represented.

The diminutive islands within the Freycinet Estuary have a remarkably diverse flora for their size, with more than 150 species recorded. This richness reflects the number of microhabitats on each island. These are often more numerous on islands than they are within areas of equal size on the mainland. This is because of the influences of the sea, wind, and nesting seabirds. Plant diversity is also influenced by island size, with the larger islands supporting more species. In the Freycinet Estuary, Salutation Island supports 99 plant species, whereas the simplest limestone rock habitats only support one or two plant species. Islands on which guano has been mined, in particular North Guano, White and Freycinet, have been reduced in species richness. After the guano was removed, the dense shrublands that grew on the deep deposits were reduced to simple herbfields on exposed limestone sheets.

Given the changes to Australia over the last 200 years, and the importance that islands around the country have assumed in conservation terms, it would be interesting to bring Nicolas Baudin back to Shark Bay to see if he still viewed the islands in the same way. ◻

Keith Morris is a Senior Research Scientist at CALM's Wildlife Research Centre at Woodvale and can be contacted on (09) 405 5100. Jeni Alford is the regional ecologist for CALM's Swan Region, and Ron Shepherd is CALM's District Manager in Denham. All participated in the Department's recent surveys of the Shark Bay islands.

THE STICK-NEST RAT RETURNS TO THE WEST

Among the passengers on Ansett flight 23 from Adelaide on 3 July, 1990 were 40 stick-nest rats, destined for release on Salutation Island in Shark Bay. Their arrival at Perth Airport was a significant step towards conserving one of Australia's rarest mammals.

An ambitious reintroduction program for the greater stick-nest rat was prepared by Peter Copley from the South Australian National Parks and Wildlife Service. Peter aimed to return the stick-nest rat to parts of its former range. The rats reintroduced to Salutation Island came from a successful captive breeding program initiated in Adelaide in 1985. At that time, the greater stick-nest rat was known only on Franklin Island, in the Nuyts Archipelago off the South Australian coast. One thousand individuals were all that remained of a species once found across southern Australia, from the central west coast of WA, through SA and into western NSW. It was last recorded on the mainland in the 1920s. Its extinction on the mainland was probably caused by stock grazing and trampling natural vegetation and by predation by foxes and cats. The rats' habit of building a home of intertwined sticks above the ground (unlike most rodents, which burrow) made them prone to such disturbances.

Salutation Island is in the former range of the stick-nest rat, it has many of the same perennial, semi-succulent plants which form the basis of their diet on Franklin Island, and it has no introduced animals. It is also a similar size to Franklin Island.

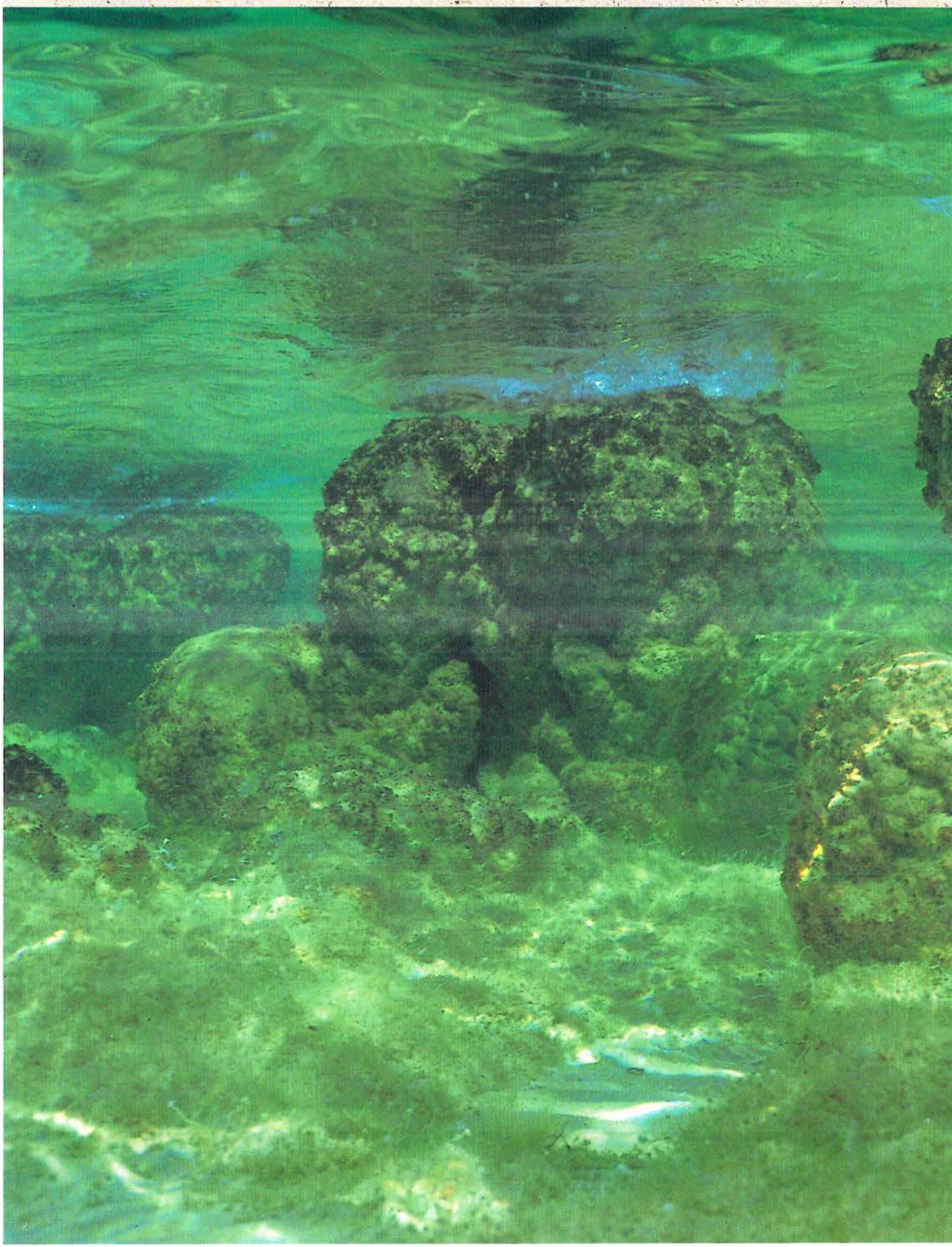
After 40 hours of air and road travel from Adelaide, the stick-nest rats were fitted with radio-collars and released. Over the next three days the rats were tracked almost continuously as they settled in to their new home. Six weeks later monitoring showed that, despite some initial mortality, the stick-nest rats had settled in well. Some stick nests had been built under bushes and the animals had gained weight.

The true test of the rats' ability to adapt to their new environment came over the dry summer months that followed. Only 70 mm of rain fell on the island between their release in July 1990 and April 1991. However, visits in April and October showed the rats were breeding and had spread over the 160 ha island. They seemed to have passed their first survival test! Further visits will be made to monitor the progress of these unique animals. With luck, the population will grow until it is in equilibrium with its new environment, and numbers will be controlled by the abundance of food and natural predators.

The greater stick-nest rat has also been reintroduced to Reevesby Island, another island off the SA coast, and it appears that this has also been successful. It is fortunate that Australia, and in particular WA, has a selection of islands, making such rescue missions possible.

Photo - Keith Morris

LILLIPUT'S



CASTLES

STROMATOLITES OF HAMELIN POOL

Robert V. Burne

On November 5, 1699, three months after Dampier visited Dirk Hartog Island and named it 'Shark's Bay', another vessel, the *Antelope*, is said to have been wrecked off the WA coast. The sole survivor staggered ashore, on what evidence suggests was Dorre Island. There he encountered an amazing world, one twelfth the scale of normal existence. He is known to us all as Gulliver, and his story was written by Jonathan Swift. Little did Swift know that, very close to his fictional Lilliput, there's a coastal ecosystem dominated by microscopic organisms which form the stromatolites of Hamelin Pool. . .

The micro-organisms that live on the margins of Hamelin Pool are invisible to human eyes. These organisms are able to form cohesive carpets extending for tens of square kilometres over intertidal and shallow subtidal environments. These 'microbial mats' are actually communities of diverse inhabitants with population densities of over 3 000 million individuals per square metre!

They concentrate and recycle nutrients gleaned from the external environment, regulate their internal environment and dispose of their waste products. Even more amazing is the fact that some of these communities are able, as a by-product of these processes, to construct protective towers up to 1.5 metres high. These constructions, upon which the microbes dwell, are up to ten million times larger than the organisms that build them.

When these real-life Lilliputian castles were discovered in 1956, they were the first growing examples ever recorded of structures, found fossilised in very old rocks, that had puzzled geologists for more than a century. They had been named 'stromatolites' (literally 'layered rocks') because they had a finely laminated internal structure. The discovery of modern examples had far-reaching significance. They have helped us understand the significance of micro-organisms in the environment, unravel the long history of life on Earth and establish a view of planetary ecology in which the survival of life is dependent on interaction more than competition.

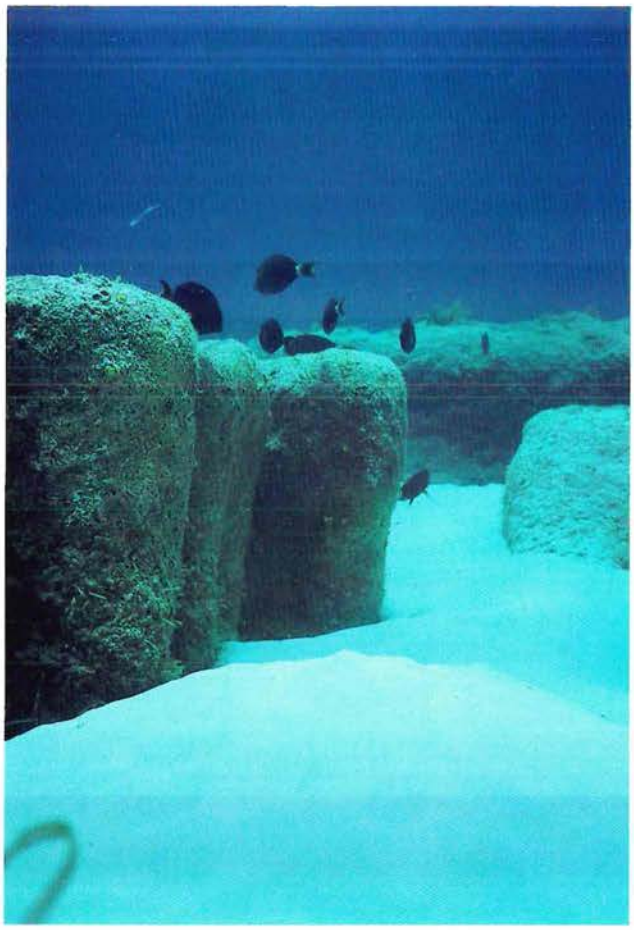
Previous page: An underwater view of the Hamelin Pool stromatolites.
Photo - Jiri Lochman

Left: Stromatolites growing at Hamelin Pool in a zone that is permanently under water.
Photo - Bob Burne

Right: Stromatolites similar to those at Hamelin Pool have recently been discovered in the Bahamas.
Photo - Bob Burne

WHAT ARE STROMATOLITES?

The same microbes that form stromatolites are dispersed through many shallow marine environments. However, bottom-dwelling communities dominated by microbes only become established in places where larger organisms are unable to survive. Microbes live in a world where surface forces are far more significant than gravity because they have high surface area and negligible weight. Many microbial cells have sticky surface coatings which trap sediment grains like fly-paper, and, in some microbes, cells are able to join together to form filaments that can intertwine and trap sediment. As a result, microbial communities can construct cohesive mats, composed of both sediment and organic material, that provide protection from erosion and allow a stable microbial community to develop and thrive.



Far left: A jellyfish swims among the stromatolites at Hamelin Pool, just as its ancestor, one of the first animals, did millions of years ago.
Photo - Bob Burne

Left: A stromatolite cross-section showing the laminated structure. This specimen was attached to a nodule of flint.
Photo - Bob Burne

Where the mats are growing under water rich in dissolved calcium and carbonate ions, some microbes help these ions form crystals of calcium carbonate. The mats thus become cemented, and, as successive cemented layers build up, a stromatolite is formed. Marine plants and animals may also contribute to the structure, but the stromatolite results principally from interaction between the microbial community and the physical and chemical environment. They can be compared to a self-organising system such as a coral reef. However, as stromatolites are not built by skeletons they grow very slowly - about five centimetres in 100 years (coral reefs grow ten times faster).

A metre-high stromatolite would be about 2 000 years old!

MICROBES AND THE HISTORY OF LIFE

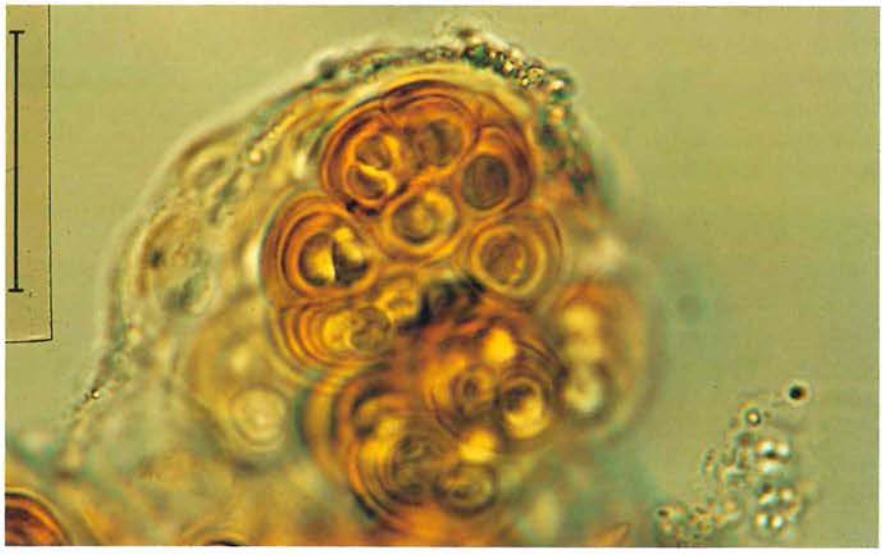
The first living thing on Earth was probably a microbe composed of a single cell with no internal organisation. Similar microbes, known as bacteria or prokaryotes, built the first stromatolites. The oldest ones known were discovered near the mining centre of North Pole in the Pilbara and are about 3 500 million years old. Between the first appearance of life and the evolution of the first animals (about 650 million years ago), stromatolites and the microbial mats that formed them were the only macroscopic evidence of life of Earth.

Over this period microbes evolved most of the survival techniques that living things use today, and the stromatolites they constructed dominated the clear, shallow seas and formed extensive reef tracts rivalling those of modern coral reefs. One type of photosynthetic prokaryote that was abundant about 2 500 million years ago had a dramatic effect on the Earth's atmosphere and the course of evolution. These were called cyanobacteria, and they could release free oxygen. About 2 000 million years ago, this caused dissolved iron from the ancient seas to form the rich iron ore deposits of the Hamersley Range. At this time oxygen formed only one per cent of the atmosphere. When there was no more iron to precipitate, the free oxygen leaked into the atmosphere, until it formed 21 per cent of atmospheric gases.

Somewhere between 2 000 and 1 700 million years ago, two symbiotic prokaryotic microbes merged to form one organism, resulting in a single cell with internal organisation (known as a eukaryotic cell). This represented the most important step in the history of evolution. The more complex cell established the essential building block for the later evolution of higher life forms. Eukaryotic microbes joined the stromatolite-forming microbial communities and are present, alongside prokaryotes, in the microbial mats that form the modern stromatolites of Hamelin Pool.

Six hundred and fifty million years ago, rising levels of oxygen in the atmosphere and the oceans allowed the first oxygen-breathing animals to evolve. Although the biosphere has since been dominated by plant and animal species, microbes have remained a vitally

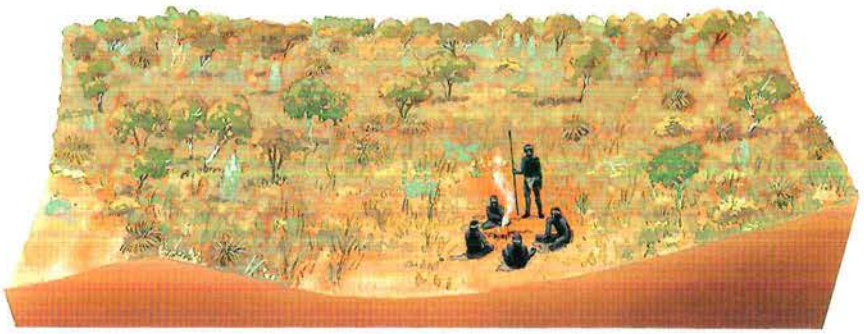
This modern-day microbe variety (*Entophysalis*) is similar to microbes which flourished two billion years ago.
Photo - John Bauld



EVOLUTION OF HAMELIN POOL AND ITS STROMATOLITES

10 000 YEARS AGO

The sea level was much lower than today and the entire area of Hamelin Pool was dry land.

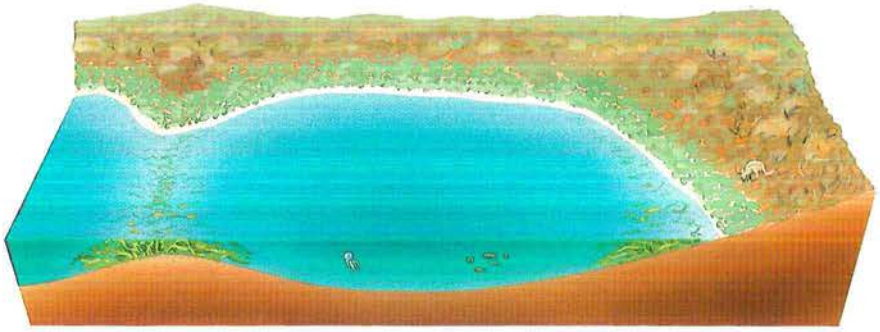


7 000 YEARS AGO

A barrier at the site of the Fauré Sill protected Hamelin Pool from the rising sea level. A lake with seasonally fluctuating salinity formed in the deeper part of the Hamelin Pool basin, indicating that the climate was wetter than today.

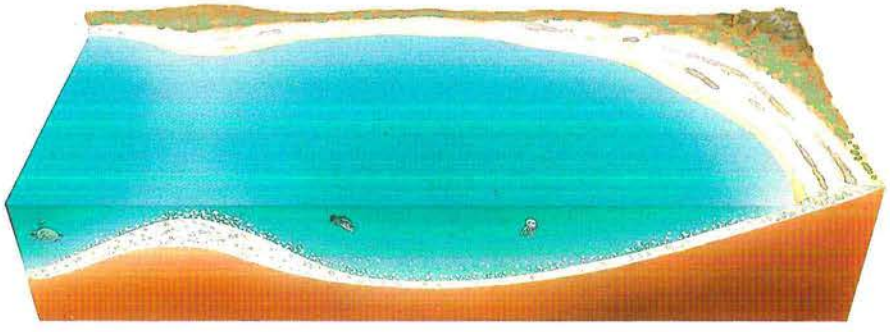
6 000 YEARS AGO

Hamelin Pool was flooded with sea water of normal salinity. Seagrass grew around the margins of the pool and on the Fauré Sill.



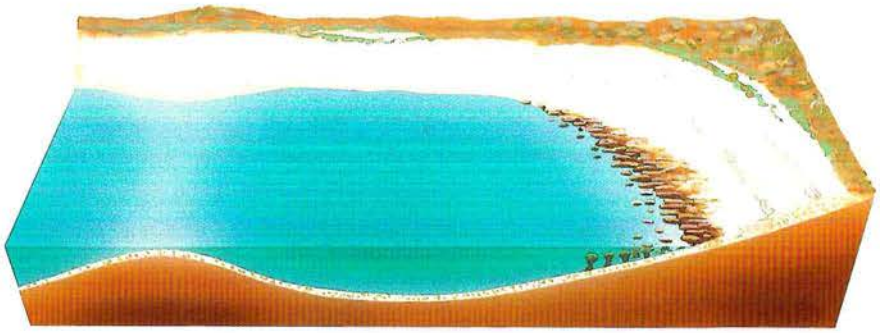
4 000 YEARS AGO

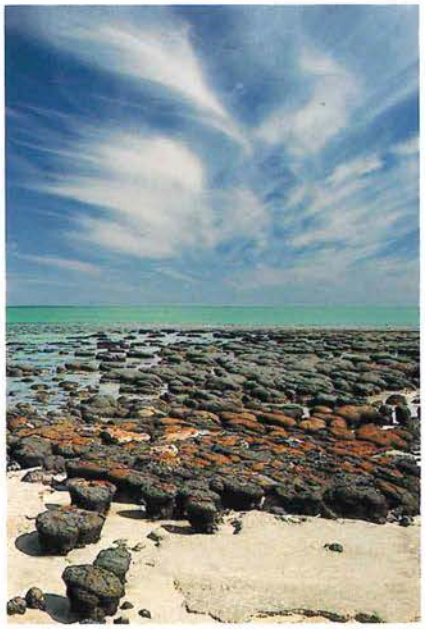
Sea level was two metres higher than at present. Sediment from the seagrass banks raised the Fauré Sill to near sea level, restricting water flow from the sea and increasing salinity. Seagrasses no longer grew in Hamelin Pool and other organisms were restricted. Large populations of the bivalve *Fragum erugatum* flourished.



PRESENT DAY

The Fauré Sill eroded as sea level fell. Hamelin Pool's water became twice as saline as sea water. Stromatolites first colonised shallow waters less than four metres deep around 2 000-3 000 years ago. Some are now stranded in the intertidal zone.





Above left: Stromatolites were stranded in the intertidal zone as the sea level fell over the past 2 000 years.
Photo - Bob Burne

The Shark Bay stromatolites are the most accessible in the world.
Photo - Jiri Lochman

important part of these ecosystems. However, stromatolites and related structures have declined, as it became more efficient for microbes to exist, either in microhabitats in ecosystems dominated by faster growing organisms, such as corals, or even within the organisms themselves. In the digestive systems of ruminant animals such as cattle, sheep, goats, camels and elephants, the descendants of the earliest microbes can still find the environmental conditions that once typified the Earth's surface.

WHY HAVE STROMATOLITES FORMED AT HAMELIN POOL?

Stromatolites are now able to develop only in environments where biotic diversity is limited for one reason or another, allowing the slow-growing structures to gain a foothold. These conditions are satisfied in Shark Bay around the shallow margins of Hamelin Pool, to a depth of about four metres.

The unique history of this area has created a perfect environment for stromatolites. At the end of the last Ice Age, some 10 000 years ago, the sea level was much lower than it is today and the entire area of Hamelin Pool was dry land. By 7 000 years ago the sea had flooded much of Shark Bay, but was prevented from entering Hamelin Pool by a barrier at the site of the Fauré Sill. A lake with seasonally fluctuating salinity formed in the deeper part of the Hamelin Pool Basin, indicating that the climate of the area was wetter than it is today.

By 6 000 years ago Hamelin Pool was flooded with sea water, and seagrass grew around the Pool's margins and on the Fauré Sill. When sedimentation from the seagrass banks raised the level of the Fauré Sill to near sea level, the flow of water into Hamelin Pool was further restricted. As a result, salinity increased to a point where seagrasses no longer grew in Hamelin Pool and other living organisms were restricted. The lack of competitors allowed large populations of the bivalve *Fragum erugatum* to flourish, and their shells accumulated as extensive beach ridges. About this time, the relative sea level in Hamelin Pool began to fall and the salinity of Hamelin Pool increased to almost twice that of normal sea water.

Microbes were also able to flourish in mat-forming communities, as their major competitors and predators could not survive in the hypersaline conditions. Calcium and carbonate enabled the stromatolites to calcify, and the low rate of sedimentation was not enough to swamp the slow-growing structures. As a result, the stromatolites began growing about 2 000 to 3 000 years ago. They are now part of a flourishing ecosystem that provides shelter for small organisms, a substrate for marine plants, and a source of food for fish and crustaceans.

CLUBS, COLUMNS AND LOAFS

Although they have been studied for the past 35 years, the relationship between the distribution of microbial mats and the occurrence of stromatolites is still controversial. All the stromatolites in Hamelin Pool were once thought to have originated in the intertidal zone, where many are found today. However, a wide variety of club-shaped, columnar and reef-like forms were discovered in subtidal environments down to about four metres. This led to the conclusion that similar club-shaped stromatolites could be formed both intertidally and subtidally by different forms of microbial mat.

However, recent research suggests that many of the club-shaped, columnar and loaf-shaped stromatolites presently located in the intertidal zone originated beneath the sea. Here, they would have had the chance to grow up to the water surface. It seems likely that their distinctive shapes are a result of moulding by waves and currents and the action of sand being washed around them. They were probably exposed by falling relative sea levels over the past 2 000 years. Once they were stranded in the intertidal zone, these stromatolites were either colonised by intertidal microbial mats or eroded.

Although microbial mats can grow over any stable, moist surface, the stromatolites around Hamelin Pool cannot grow above mean sea level, or deeper than four metres below it. They grow only 0.5 mm per year, while sea-level has fallen 0.5 mm a year over the period of growth. This explains why stromatolites grow to a maximum height of about 1.5 metres in the shallow subtidal zone, but decrease in overall height upward through the intertidal zone and downward towards the maximum depth of colonisation.

Will stromatolites continue to inhabit Hamelin Pool long into the future? What changes would cause them to die out? Their future is linked to the fate of the Fauré Sill. As long as the current pattern of seawater exchange across the sill is maintained, stromatolites will continue much as they are today. If the inflow of water is further restricted, the waters of Hamelin Pool will become even more salty and stromatolites will colonise deeper waters. If the inflow of sea water is totally cut off, then Hamelin Pool will eventually dry out. If, on the other hand, the Fauré Sill was breached, with full exchange with normal sea water, then seagrass and perhaps corals would displace the stromatolites.

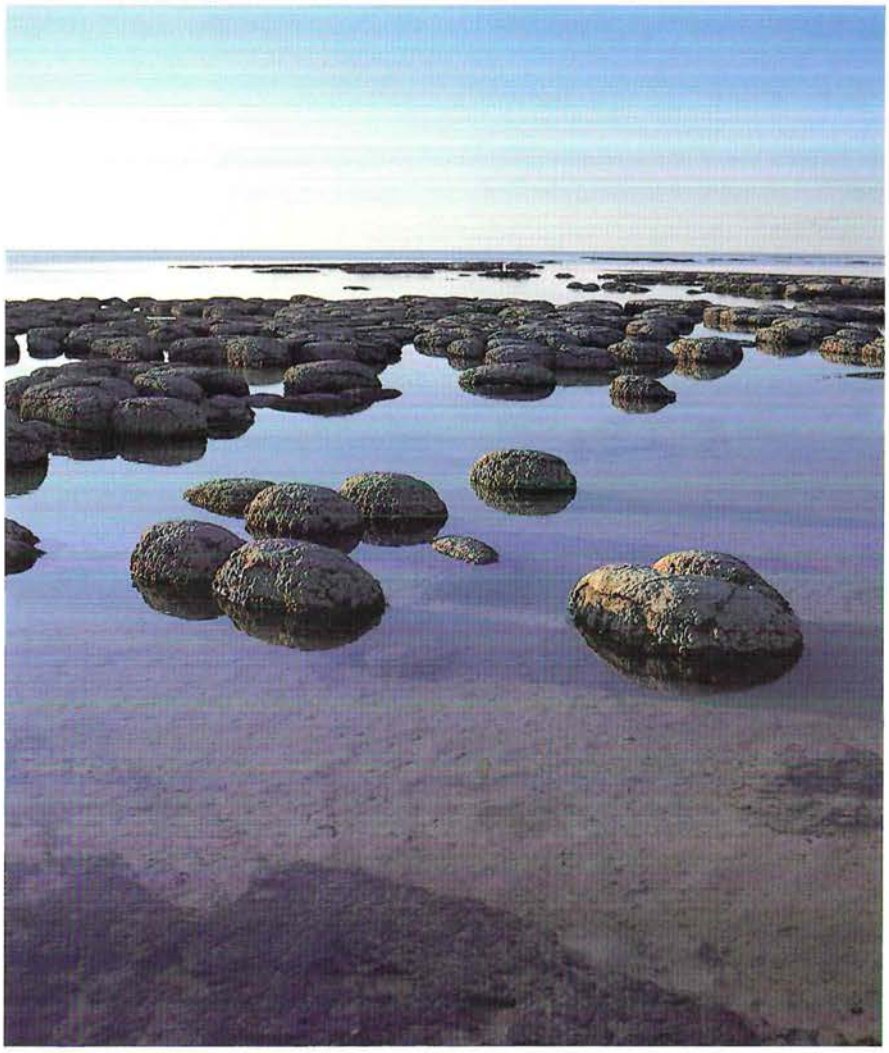
THE EARTH'S OLDEST LIFESTYLE

While the stromatolites are the result of an ecological strategy that dates back almost to the origin of life, most of the organisms forming the communities in Hamelin Pool are not themselves primitive, but are modern organisms well-adapted to and successful in their ecological niches. Some microbes are, however, similar to very ancient forms. For example, the cyanobacterium which dominates one widespread type of intertidal mat in Hamelin Pool is thought to have descended from a similar form that flourished 1 900 million years ago. Thus, it represents one of the longest continuous biological lineages known.

Since they were discovered in Hamelin Pool, only two other marine subtidal stromatolite-dominated ecosystems have been discovered - both in the Bahamas. The stromatolites there are very similar to those of Hamelin Pool, but are larger and grow in deeper water of more normal salinity.

Non-marine stromatolites and related structures (thrombolites) are found in several lakes throughout the world. They are also fairly rare, and many are threatened by human activities that lead to increased nutrient loadings in lake water or artificial drainage of lake basins. Thrombolites are also formed by microbes but have an unlaminated structure composed of small clots of carbonate cement. Some of the best examples of non-marine stromatolites and thrombolites occur in Western Australia at Pink Lake (Lake Spencer) near Esperance, Lakes Preston and Clifton in the Yalgorup National Park, Lake Richmond at Rockingham, and Lake Thetis near Cervantes.

However, the Hamelin Pool stromatolites remain the most abundant and diverse examples of growing marine stromatolites in the world today. They date back only for the past 2 000 years or so, and are therefore one of Australia's newest ecosystems. Nevertheless, they provide a unique look at what life was like at the dawn of evolution. ▣



The stromatolites of Hamelin Pool have only been growing for the past 2 000 years, but represent the Earth's oldest lifestyle.
Photo - Bob Burne

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ENDANGERED!

THICK-BILLED GRASSWREN

The thick-billed grasswren (*Amytornis textilis*) has declined dramatically since the turn of the century. It was once widespread in the southern arid zone, from Shark Bay to western New South Wales. However, the three subspecies are now well separated and confined to very small areas.

One subspecies occurs only in the basins of Lake Eyre, Lake Torrens and Lake Frome, the second is restricted to South Australia's northern Eyre Peninsula, and the third is only known definitely from near Shark Bay. Even in this area, it has disappeared from Dirk Hartog Island. It may still occur on the Nullarbor Plain, but a sighting in 1984 is the only record since early this century. Grasswrens have not been found in subsequent searches in the area.

Thick-billed grasswrens are slightly larger than the well-known splendid fairy-wrens. Their plumage is earthy brown, with fine white streaks, and the birds have long tails which are held erect.

They eat seeds, vegetable matter and some insects. The birds seem to eat more seeds than other grasswrens, which probably explains why they have heavier bills than these species. Thick-billed grasswrens breed in late winter and usually lay two eggs. Their nests are cup-shaped, with a rough hood, and are usually near the ground in a low shrub.

In the Shark Bay area, thick-billed grasswrens can be seen on Peron Peninsula and south and east of Hamelin Pool. Their distribution is patchy, but the best place to see them is at Monkey Mia, where two to three birds inhabit each hectare. Sometimes they perch briefly on exposed branches, but often all that can be seen is a glimpse of a bird, with head held low, in a blurring run to the heart of the next patch of cover. They prefer areas containing shrubs of the saltbush family, and shrubs of various other species that are 1-3 metres tall, and spreading.

The reasons for the thick-billed grasswren's massive decline are unclear. Perhaps the species declined as a result of stock and rabbits degrading their habitat, and through cat predation. However, the bird is still found in some areas that are heavily grazed. On Peron Peninsula it is found close to Denham, even though the cat population there is probably high.

More research is needed on habitat requirements and on the effects of grazing on the habitat if the species is to be made more secure.

Photos
Bert Wells (inset) and Jon Green

ALLAN BURBIDGE

GRASSES OF THE SEA

by Diana Walker

Imagine peeling back the shallow waters of Shark Bay. You would find a series of sandy basins lined with banks of green seagrasses - a huge underwater meadow. Seagrasses are the dominant organisms in Shark Bay, covering more than 4 000 square kilometres. They have changed the nature of the region's shallow seabed.

Shark Bay has the largest area of seagrass and largest number of species ever recorded in one place in the world. Elsewhere, one or two species cover large geographic areas. For example, there is only one species of seagrass found in most of North America and Europe. But in Shark Bay there are 12 species, and, in some places in the Bay, nine can easily be identified in a square metre.

Unlike other tropical and subtropical areas in the world which have small seagrasses, Shark Bay has lush, long seagrasses that cover nearly a third of the shallow Bay. This dense growth is not only a major source of photosynthetic production, but also provides a home and food for a rich diversity of marine fauna.

Here, zones overlap. Tropical species meet temperate species from the colder southern waters. Shark Bay provides the ideal breeding pool with its high light intensity, protection from large oceanic movements and lack of fresh water run-off.

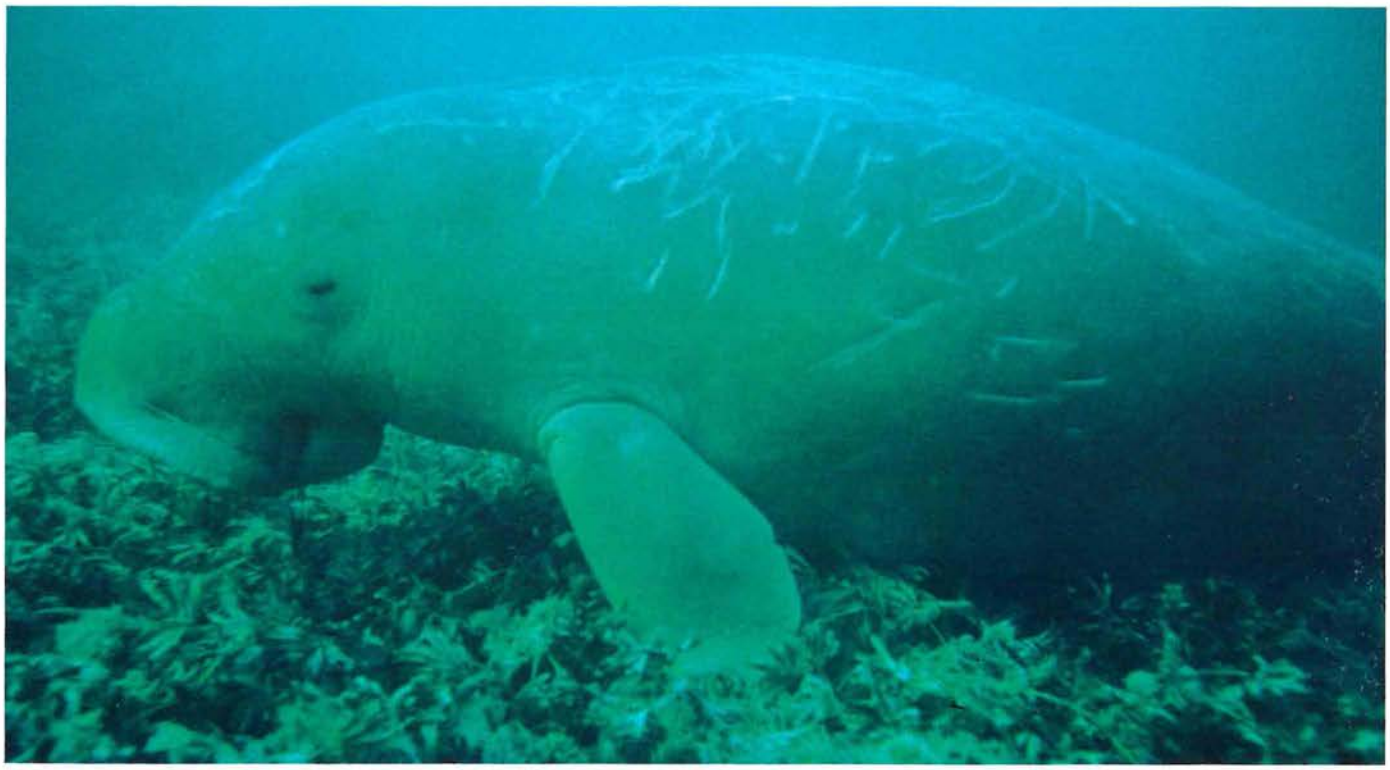
Seagrasses resemble grasses that form lawns on land, but they are not closely related. They are green flowering plants with different leaf shapes connected to an underground runner, or rhizome, which grows through the sand. There are few species of flowering plants - perhaps 50 in the world - that manage to cope with a salty, underwater existence; most forms of plant life in the sea are seaweeds (algae), simple organisms with no roots or flowers.

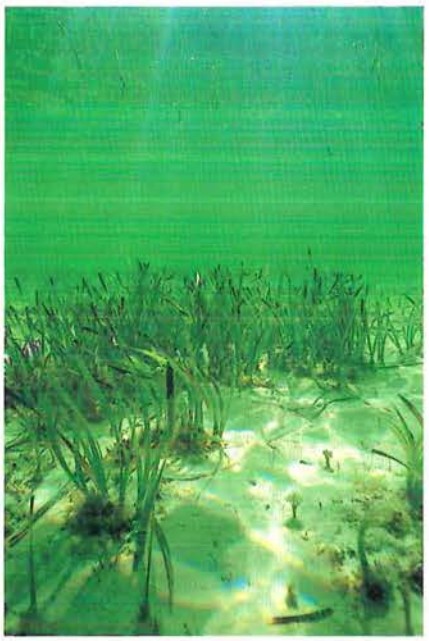
Twelve species of seagrass grow in Shark Bay. The most abundant is wireweed (*Amphibolis antarctica*), covering nearly 3 700 square kilometres of the Bay's sandy bottom. This seagrass - one of two large species - forms meadows which look like underwater wheatfields. It has branched woody upright stems up to two metres long, with clusters of leaves at the end of each branch. The meadows make up a dense canopy, with 300 to 500 erect shoots and 4 500 leaf clusters for every square metre of sea-floor. The plant's leaf surface covers about 15 times the area of the sea-floor on which it grows. These leaves form platforms on which small seaweeds and animals can attach and grow. Sixty-six species of algae

Previous page
Inset: The ribbon weed of Shark Bay shares its home with small algae.
Photo - Diana Walker

Main: Seagrasses cover nearly a third of Shark Bay's shallow waters.
Photo - Van Worley

The Wooramel seagrass bank lies on the eastern shores of Shark Bay and is known dugong habitat.
Photos - *Right:* Clay Bryce, Lochman Transparencies. *Below:* Anthony Preen





Ribbon weed seagrass is home for many attached plants and animals.
Photo - Clay Bryce, Lochman Transparencies

Far right: Penicillus is one of the most abundant species of algae in Shark Bay.
Photo - Diana Walker

and about 40 animal species can be found on the wireweed of Shark Bay. These in turn are eaten directly by fish and smaller crustaceans such as amphipods, which form an important part of the food chain. The seagrass canopy is also a good hiding place for small fish and prawns.

Dugongs and turtles, as well as some fish and crustaceans, feed on the seagrass. Shark Bay is the only location in the world where dugongs feed on wireweed. This is the only place where the two species - one tropical, and the other more typical of colder climes - occur together, and in summer it is the only food available for dugongs. Most seagrass is not eaten directly, as these animals eat it, but is broken down into smaller particles. Bacteria and fungi associated with this decomposition form a high-energy food source that is rich in nutrients. The particles themselves are consumed by filter-feeding animals, which are also an important component in the food chains.

Ribbon weed (*Posidonia australis*) is the other large seagrass growing in meadows that cover about 200 square kilometres of Shark Bay. The ribbon-like leaves are home for many attached plants and animals. This species has a more extensive rhizome system than wireweed - up to 90 per cent of the plant resides below the sediment.

The meadows of wireweed and ribbon weed mostly contain only the dominant seagrass species, but in some areas with a less dense canopy, other smaller seagrasses form an understorey. Where the larger species are quite absent, these smaller species grow, often in varying combinations. They are also found with green seaweeds that can grow on sand. One of the most abundant species of algae is *Penicillus*, which resembles a small grey-green shaving brush.

Halodule uninervis, a smaller tropical seagrass species with straight, narrow leaves, occasionally forms meadows. At the mouth of the Wooramel delta lies a meadow of this seagrass covering about five square kilometres in fine black mud. The mass of these plants is high in summer but low in winter, when the water temperature falls from 26 to 17 degrees Celsius. This area is the most important summer feeding ground for dugongs.

Within the meadows, there are often

Small seagrasses such as paddleweed (*Halophila*)cover about four per cent of the Bay.
Photo - Diana Walker

small sand-patches, or blow-outs, which range from less than a metre in diameter to more than 30 metres. These may contain up to nine species of seagrasses: some of the most diverse seagrass assemblages ever recorded. There are good examples of these off Nanga, on the western side of Peron Peninsula, but they also occur throughout the Shark Bay waters.

Sand flats up to two kilometres wide fringe the Bay, representing the extent to which water is blown out of the Bay during summer by southerly winds. On aerial photographs they seem to be bare of vegetation, because of the absence of large seagrasses. However, they support many small seagrasses, particularly paddleweed (*Halophila*) and *Halodule*. Though small, these species are highly productive and are a preferred food source for dugongs when covered at high tide. They are very tolerant of high temperatures and the intense summer sunlight. The area covered by these species is about 500 square kilometres, or about four per cent of the Bay.

Patterns of seagrass growth are more obvious from the air than from under the water. Most conspicuous is the ridge and furrow structure of the Fauré Sill, a bank running between Peron Peninsula and the eastern shores of the Bay. The dark patches of seagrass form lines at right angles to the major tidal channels. As the tide rises, water flows along the channels then spreads across the banks, so that the lines of seagrass are parallel to the prevailing currents.

Above left: Ribbon weed flowers produce floating fleshy fruits from December to January.
Photo - Diana Walker

Above right: From the air, the extensive seagrass meadows are clearly visible.
Photo - Bill Bachman

Above: Wireweed is the most abundant seagrass in Shark Bay.
Photo - Diana Walker

UNDERWATER FLOWERS

Seagrasses flower underwater and produce thread-like pollen. The flowers' shapes are adapted to an aquatic environment and can hardly be recognised as flowers at all.

Wireweed flowers every year around October, and has an unusual form of reproduction, having separate male and female plants. Pollen is produced by the male flowers and is shed underwater. The thread-like pollen grains join up to form rafts and drift until they find and fertilise a female flower. The seedlings then develop from the female flower and remain attached to the 'mother' seagrass. Each seedling develops a 'grappling apparatus' and 'comb anchor', which catch on to other seagrasses or algae. By the time they detach from the mother in May, each seedling has about 10 leaves. Large numbers of seedlings may be collected from the drift, but very few will settle in a suitable area and grow up to form part of another meadow.

Ribbon weed (*Posidonia*) flowers are bisexual. Pollen forms in anthers, with the egg at the base of the flower. These flowers produce floating fleshy fruits from December to January.

BUILDING BANKS

Seagrasses play an important role in coastal stability. The well-developed canopy formed by the plants slows the rate at which water flows over the sea-

floor. A well-developed seagrass bed can negate the effects of a two-knot current, or a 0.6 metre-high wave. This reduction in water movement makes the seabed more stable. Sand particles do not move around, and particles in the water column drop under the canopy. As a result, large banks build up under the seagrass meadows, reducing the depth of the Bay.

Not only does the seagrass trap sediment, it also helps to form new material. Wireweed produces its new leaves in the centre of each leaf cluster and sheds the old leaves from the base. Older seagrass leaves are covered in a thin layer of calcium carbonate. This pink-white layer is deposited by coralline red algae, which make up to 20 per cent of the sediments of Shark Bay. The algae grow on the leaves, often covering them completely. The old leaves fall off the plant and most remain within the meadow. The organic matter of the leaf breaks down, and the calcium carbonate of the algae becomes incorporated into the sediments of the Bay. New leaves are produced continuously by the seagrass, and so form a 'conveyor belt' for the production of new sediment.

Over the past 5 000 years, the combined processes of producing calcium carbonate and trapping sediments have resulted in large banks of calcium carbonate being formed, such as the Fauré Sill. These banks may be up to 10 metres thick, thus accumulating faster than many coral reefs.

The build-up of these banks and sills has restricted the circulation of oceanic sea water. The combination of low rainfall, high evaporation and restricted circulation in the Bay results in a dramatic increase in salinity. The hypersaline waters of Hamelin Pool, for example, are twice as salty as normal sea water - conditions too salty for seagrasses to continue growing. However, they do provide suitable conditions for the development of stromatolites (see 'Lilliput's Castles' in this issue of *LANDSCOPE*).

Studies of Shark Bay's seagrasses were sparked by geologists from the University of Western Australia, who discovered their geological significance. This work was followed up by other sections of the university, which ran a large research program on the Bay's seagrass from 1982 until 1985. This work also concentrated on aspects of water chemistry and circulation in the Bay. However, there is much we do not know about the Bay's marine biology.

Further research on seagrasses has been carried out in the southern part of the State, especially in relation to pollution problems. Seagrass is very sensitive to the build-up of nutrients resulting from sewage outfalls, and industrial and agricultural wastes. Massive areas of seagrass have been lost from the Perth area (Cockburn Sound has lost 90 per cent of its seagrass) and from Princess Royal and Oyster Harbours in Albany. The significance of these losses has been studied by many scientists from the universities, State Government departments, CSIRO and the WA Museum.

Once the larger seagrasses have gone they don't come back. We need to look after seagrasses where they are - particularly in an environment like Shark Bay, where the whole marine system depends upon them. ▣

Top left and right: Coralline red algae grows on seagrasses, leaving a pink-white layer, which, as the leaves die and break off, contributes to the sediments of the Bay.
Photos - Diana Walker

Wireweed seedlings develop ways to catch on to other seagrasses or algae.
Photo - Diana Walker

Diana Walker is a lecturer in the University of Western Australia's Botany Department, and has been studying seagrasses at Shark Bay since 1982. She can be contacted on (09) 380 2089.

BIRDS OF THE BAY

Purple swamphen

Yellow-billed spoonbill

Rainbow bee-eater

Orange chat

Photos by Michael Morcombe

Text by Allan Burbidge

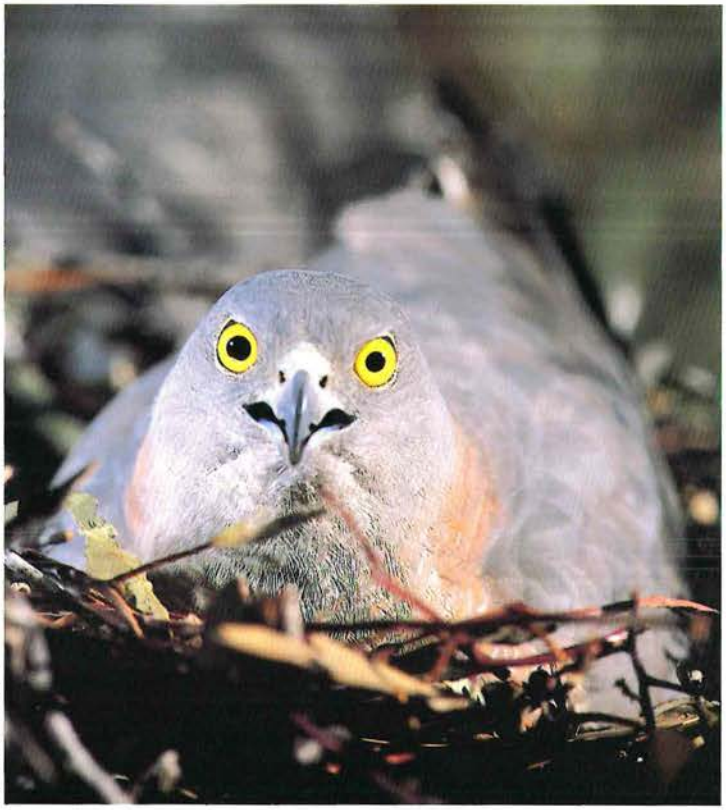
In Shark Bay, birds from the south-west intermingle with those from the arid and semi-arid areas, and there is a wealth of waterbirds. Over 230 species are known from the area.

The yellow robin, golden whistler, blue-breasted fairy-wren and brown-headed honeyeater are south-western species found at their northern limit on the southern edge of Shark Bay. Birds of the arid and semi-arid areas include the wedgebill, southern whiteface, orange and crimson chats and spiny-cheeked honeyeater, which tend to be more common to the east and on Peron Peninsula.

The Peninsula is a good area for birdwatching. One can often hear wedgebills continually calling 'did you get drunk', and the really lucky observer may glimpse the rare thick-billed

Red-capped plover

Crimson chat



Collared sparrowhawk

Australian bustard chick

grasswren. The northern part of the Peninsula contains some of the most extensive stands of mangroves in the southern half of the State. The mangrove heron, mangrove grey fantail and yellow white-eye, all of which are found at their southern limit in Shark Bay, live in and around the mangroves.

Various marine birds inhabit this area and several, including the wedge-tailed shearwater, the silver and Pacific gulls, and four different species of terns, breed on small islands in and near Freycinet Estuary. Waterbirds and shorebirds - great cormorants, pelicans, yellowbilled spoonbills, red-capped plovers and greenshanks - can be seen in several places. However, many of these species avoid Hamelin Pool because it is too saline.

Spiny-cheeked honeyeater

Pink cockatoo

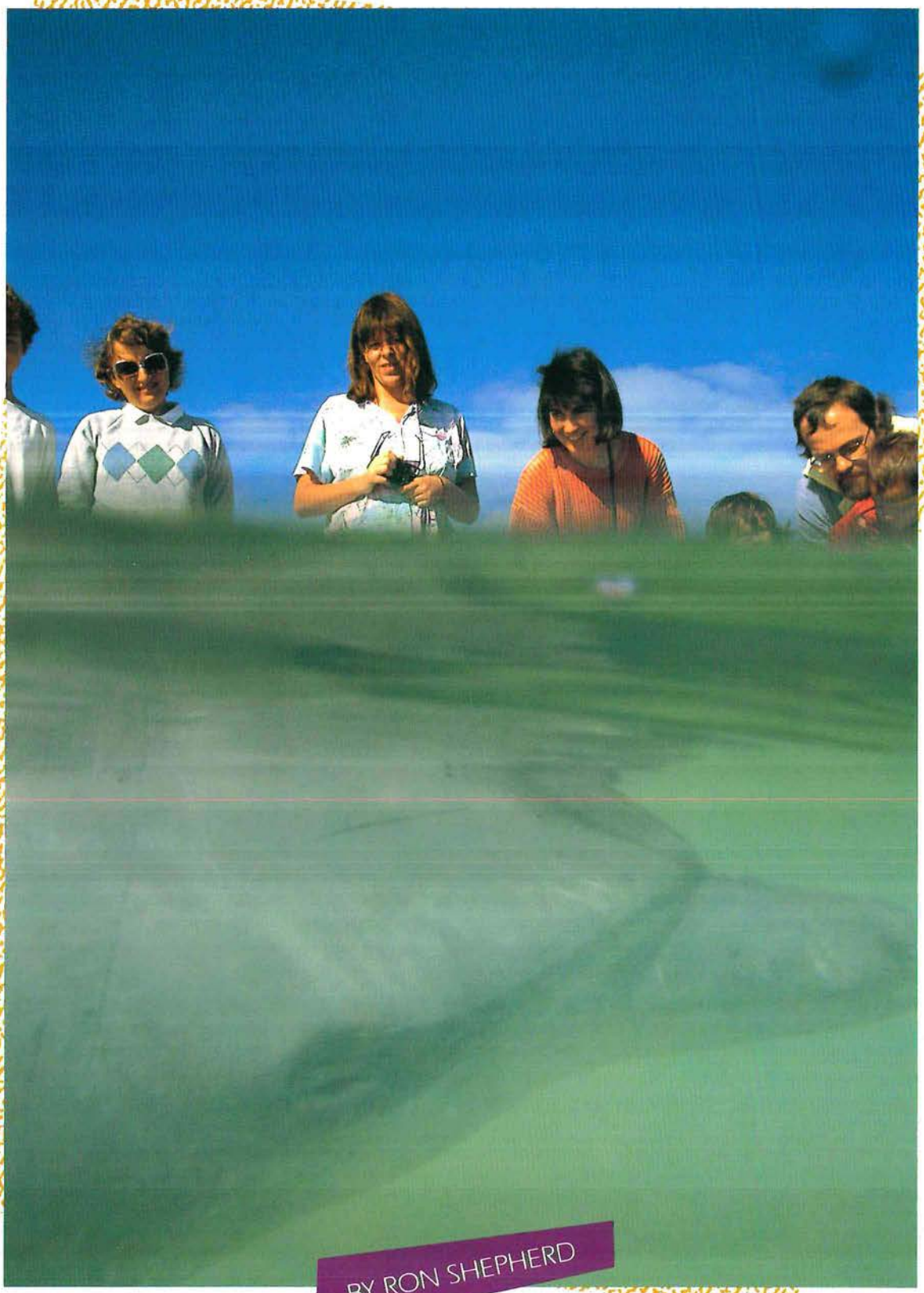
Great cormorant

Southern whiteface

Variegated fairy-wren

MANAGING FOR DIVERSITY

At Shark Bay, land managers must care for an incredible diversity of wildlife, habitats and landforms - ranging from the most primitive ecosystem on Earth at Hamelin Pool to the bottlenose dolphin, one of the most highly evolved animals in the world.
How do they do it?



BY RON SHEPHERD

The Department of Conservation and Land Management (CALM) is responsible for managing much of Shark Bay's varied conservation estate. However, if this process is to work, the local shire, pastoralists and the Shark Bay community must all be committed to and involved in caring for their unique region.

Each ecosystem presents special management challenges. At one extreme of the region's biological diversity are the primitive single-celled organisms that flourish in Hamelin Pool. Through forming simple communities and trapping sediment and other particles over thousands of years, the micro-organisms have created a large array of rock-like features, called stromatolites, that lie adjacent to the shoreline. Similar stromatolites occur elsewhere in the world, but nowhere else are they as extensive or as easy to reach. As a result, Hamelin Pool is the best place in the world to view stromatolites and gain an understanding of the beginning of life on Earth. Hamelin Pool was declared a marine nature reserve in 1990 in recognition of its significance and to manage the impact of escalating public interest in the area.

Stromatolites are incredibly fragile, as they are still developing from living microbial communities. Since communities can grow less than one millimetre per year, an embedded footprint may take many years to disappear and a car track could take a human lifetime. CALM aims to develop one site (adjacent to the Historic Telegraph Station) for public access and to construct a boardwalk that will minimise human impact on the stromatolites, while giving people the chance to see them. The challenge is to design a structure that does not damage the stromatolites, overcomes tidal wetting and drying and other engineering problems, and will not have long-term impact on the site.

Stromatolites are not self-explanatory. Visitors to the area are often encountered innocently walking over the stromatolites waiting for something to jump out and identify itself. One couple was said to have spent four hours waiting for the stromatolites to 'come in'. CALM will eventually provide interpretative information along the boardwalk to help all visitors to the Bay enjoy and appreciate the stromatolites. Meanwhile, the old Telegraph Station adjacent to the visitor site has an interesting display on stromatolites.

South of Hamelin Pool is Cooloomia Nature Reserve, one of Shark Bay's earliest conservation reserves. Cooloomia encompasses the transition between two botanical provinces, the Eremaean and the South West, giving it a high botanical diversity. Surrounding Cooloomia are vegetation communities that are not represented in the reserve, and the WA Government intends to expand this reserve to include a greater array of plant associations. Access to the reserve is limited, but the flora can be viewed from the gravel road to Useless Loop between Hamelin and Tamala Stations. In spring, the array of colours along this section of road is impressive.

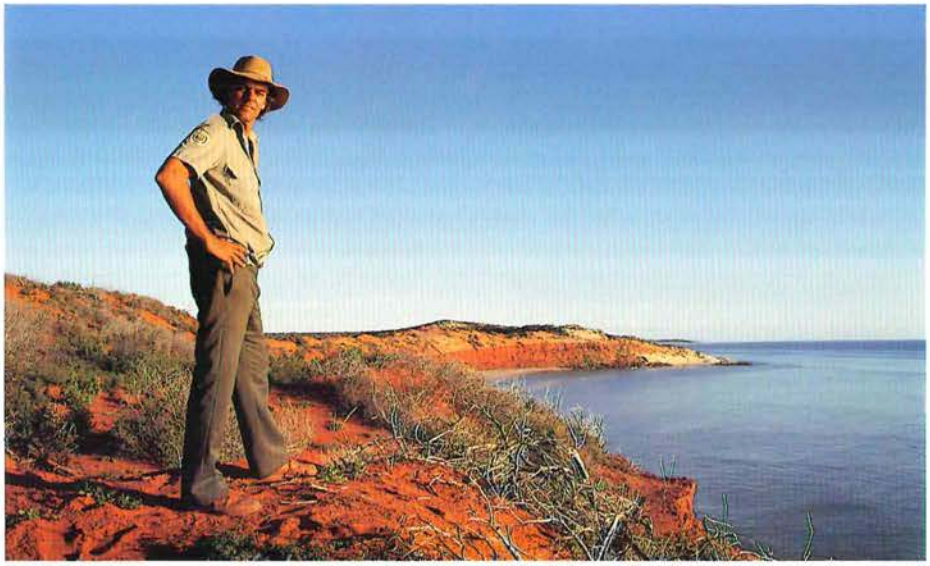
LANDSCAPE OF ATTRACTIONS

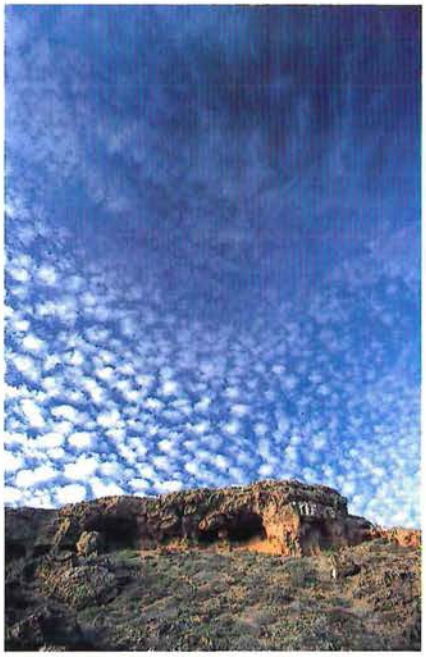
Peron Peninsula is a landscape of attractions. The rolling red sand dunes and dense acacia shrublands afford four-wheel-drive visitors a wilderness experience. Small birds and reptiles are abundant amongst the wattle. The coastline provides a contrast of colour and stunning scenery, from red vertical cliffs to sweeping white beaches. A unique geological feature on Peron is the series of gypsum-filled hollows known as birridas. Most birridas were land-locked saline lakes when sea levels were much higher than at present, and gypsum was deposited on the floors of these lakes. Big Lagoon, dissecting the Peninsula, is essentially a birrida that has been flooded by the ocean.

Peron Peninsula was run as a pastoral lease from the early 1900s. However, pastoral activities ceased in 1990 after the State Government purchased the land to establish François Peron National Park on the northern end of the Peninsula. Converting the area from a station to a national park was a mammoth job. More than 15 000 domestic stock had to be mustered and trapped during the hot summer months, with a second clean-up being required this summer. About 100 kilometres of fenceline was dismantled and the massive accumulation of rubbish in the homestead and camping areas was removed. Without the stock, the park's vegetation has already begun to regenerate and return to a more pristine condition. Many of the pioneering pastoral features, such as the homestead block which is the gateway to the Peninsula, will be maintained and

Previous page: One of the Monkey Mia dolphins.
Photo - Robert Garvey

Big Lagoon is a 'birrida', or gypsum-filled hollow that has been swamped by the ocean.
Photo - Bill Bachman





National park ranger Lyndsay Brown at Cape Peron in the François Peron National Park.
Photo - Carolyn Thomson

The burrowing sandhill frog lives without access to water.
Photo - Jiri Lochman

Above right: The Zuytdorp Cliffs, near the site of the Dutch wreck after which they were named.
Photo - Pat Baker

Right: Beard's eucalypt is a small tree or mallee that grows from the Murchison River to Shark Bay.
Photo - Greg Keighery

developed as a key contact point for visitors.

Because camping is popular along the Peron coastline, facilities will be provided for offshore recreational fishers and visitors seeking wilderness experiences. However, the facilities will be managed so that the acacia shrublands are not damaged.

Edel Land Peninsula lies across the Bay to the west of Peron. Like Peron, it offers a wilderness experience to hardy four-wheel-drivers, but with a distinctly different landscape. Edel Land is dominated by large undulating white sand dunes, extensive sand drifts, and a vegetation community with a large number of species from the South West botanical province. The Zuytdorp Cliffs, on the east coast, provide stunning scenery, but are a hazard to boaters - as the early Dutch traders discovered. Steep Point is a popular cliff fishing destination.

Edel Land also has a rich fauna of small birds and reptiles and is home to one of the most unusual frogs - the rotund sandhill frog, which lives without access to water. Its eggs are laid in the sand and the tadpole stage occurs within the egg. Edel Land is the only area where the sandhill frog is common.

Access on Edel Land is a significant management problem. The large sand dunes and extensive sand drifts are highly unstable and prone to erosion. In the past, tracks have become impassable in a relatively short time, with a sequence of new ones being established. In recent years, many of the resulting spider webs of tracks have been closed to allow regeneration. Negotiations with the pastoral company currently managing the area are under way, in an attempt to attain national park status for the Peninsula.

RECOLONISING THE PRONG

To the east of Edel Land is the small peninsula known as Heirisson Prong. This site is a classic example of how cooperation between community groups can achieve outstanding conservation results. The local Useless Loop community has teamed up with the town's mining company, local school, CSIRO and Government departments to conduct a scientific project on the Prong. The aim of the project is to establish a population of endangered boodies from Bernier Island on Heirisson Prong, and will involve the local school children throughout.

A vermin-proof fence was built and large-scale vermin eradication is under way. The company managing the pastoral lease has agreed to relinquish Heirisson Prong to create a conservation reserve that will provide security for establishing populations of endangered mammals. The local community continues to help manage the reserve, particularly in supervising access and recreational activities on the Prong. The main challenge will be to prevent feral animals, such as foxes and rabbits, from recolonising. This will require regular maintenance of the barrier fence and periodic baiting to remove residual feral populations. If the boodie successfully establishes itself, it is likely that other species will be reintroduced to the Prong.

A second area on the mainland that could be used for reintroductions is Point Petit, north of Nanga, which may become a nature reserve in the near future. A shorter barrier fence at the narrow neck of the Peninsula will create an 'island' effect, as at Heirisson Prong. On Point Petit there are bluebush plains, not found elsewhere in Shark Bay, that provide an additional habitat type not represented in other conservation reserves.

MARINE LIFEBLOOD

The jewel in Shark Bay's conservation crown is the newly declared Shark Bay Marine Park. The Bay's waters are rich and prolific, but it is the extensive seagrass assemblages that are the lifeblood of this underwater haven. They are nursery grounds for the array of fish and crustaceans on which commercial and recreational fisheries rely. They also provide food for the abundant and unique wildlife such as dugongs and marine turtles. Coral outcrops occur in a number of areas, providing a habitat where temperate and sub-tropical fish species co-exist.

The Marine Park was established to protect and manage this unique marine environment. Monitoring the ocean life is essential to managing the park. CALM will identify zones in the marine park that help separate and manage conflicting uses. Different zones provide for varying levels of recreational and commercial use and may also protect special areas from exploitation. Scientists will identify sanctuary zones to provide important benchmark information. People will be asked to 'look but not take' in sanctuary zones. For instance, most of Big Lagoon, an important nursery ground for fish species and other marine life, would make a good sanctuary zone.

Monkey Mia lies within the Marine Park. Here, bottlenose dolphins come to the beach each day to interact with people. The dolphins are at the other end of the biological scale to the stromatolite builders. Their high intelligence and complex social organisation calls for innovative management. Within the last decade, the number of visitors at Monkey Mia has increased from 10 000 to 100 000 a year. CALM and the Shire Council, who jointly manage the area, have responded with greater public supervision to prevent the dolphins from being 'loved to death'. In other places around the world, interaction between people and dolphins has ended in doom for the dolphins. At Monkey Mia the public, local community and CALM have the challenge of ensuring that this scenario is not repeated.

Because of the dolphins' high intelligence, a flexible management style is needed to respond to individual changes in behaviour and physiology, and the population's altering social structure. Routines cannot be rigid, as the dolphins learn and respond to standard procedures. The animals' health is checked regularly and, despite normal calf losses, no adult has had any significant problem for over two and a half years. The amount of fish given to the dolphins is set at a level that ensures they continue to forage naturally and maintain their wild instincts. The water at Monkey Mia is also tested regularly to check for contamination that could harm the dolphins.

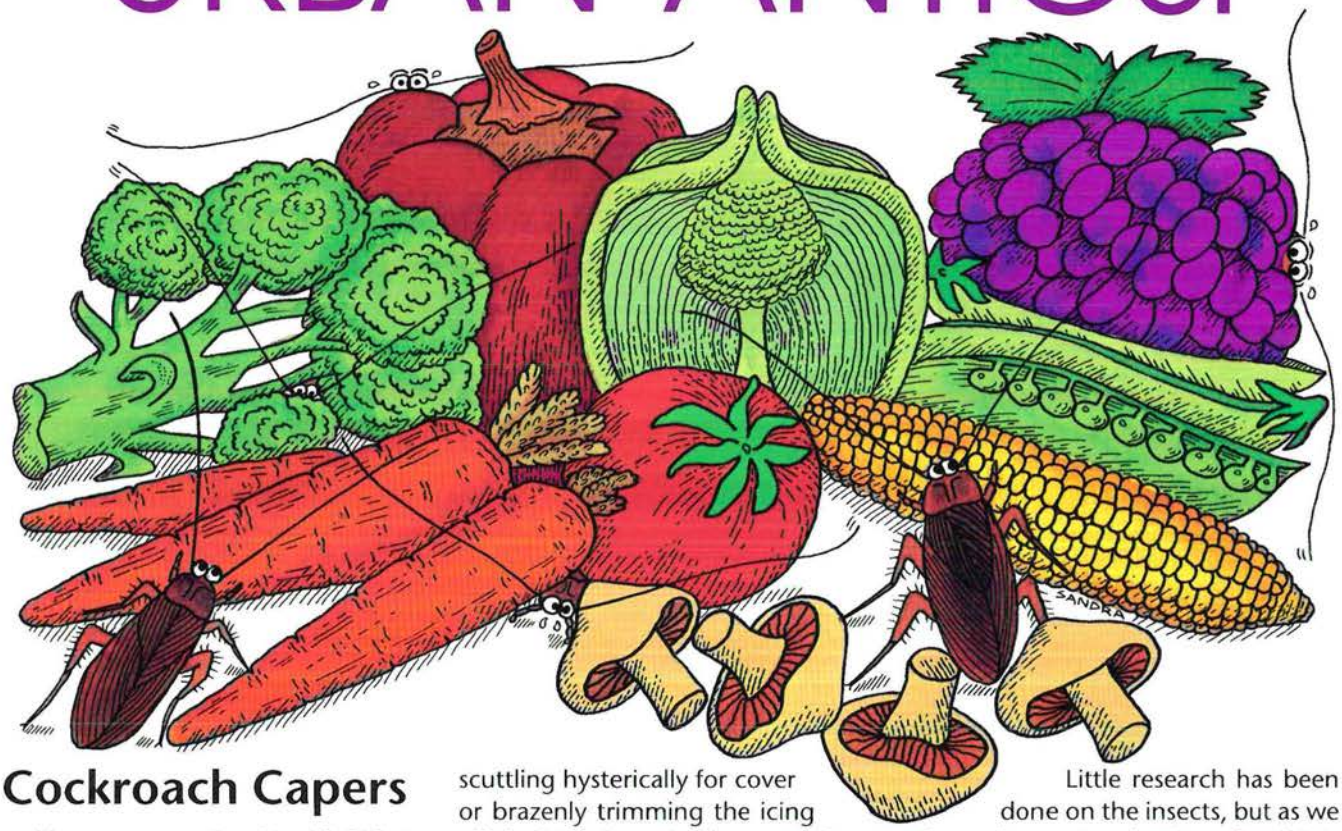
Public awareness of the uniqueness and diversity of Shark Bay's natural environment is mushrooming. Fortunately, the complex system of conservation reserves that is proposed should protect the Bay's natural values, while allowing our generation to use and appreciate these features.

Seasnakes and corals at Shark Bay Marine Park.
Photo - Eva Boogaard, Lochman Transparencies

An anti-vermin fence was built to allow the reintroduction of endangered mammals to Heirisson Prong.
Photo - Jiri Lochman

Ron Shepherd is CALM's District Manager at Shark Bay. He can be contacted on (099) 481 208.

URBAN ANTICS!



Cockroach Capers

'I've got a question,' I said. 'What beasts can you find in remote Shark Bay as well as in a Perth city home?'

'Cockroaches,' came the quick humourless reply from my distant colleague. And he was right.

It was nearly summer again. While we yearned for those lazy days and balmy nights, we remembered that more than half of all households would soon be mercilessly besieged by hordes of revolting, disgusting, grotesque cockroaches.

Australia has about 450 native species of cockroach, which live in the bush quite independently of humans. They eat vegetation and, as scavengers and recyclers, are vital to a balanced environment.

It's the few introduced household pest species that scare the living daylights out of us on our late-night trips to the kitchen or toilet. They're the ones that give all the others a bad reputation.

While native cockroaches are all shapes and sizes, the pest species are generally flat and thick-set. They are omnivorous and able to run extremely fast. Mature insects have thick leathery wings which lie flat on the abdomen.

The four main types, often seen scuttling hysterically for cover or brazenly trimming the icing off the birthday cake that you left on the sink to set, are the American, smokey-brown, Australian and German cockroaches - named after the places where they were first identified.

The beasts were thought to have originally emigrated from the caves of Africa when, at the dawn of *Homo sapiens*, they attached themselves to humanity and eventually spread on ships of trade throughout the world.

The small German speedster (10-15 mm) is the most widespread of any pest species, preferring to be indoors under the water heater where it's moist and warm. However, it is the big dark-brown American brute (28-44 mm) which is equally at home indoors or outdoors - needing only shelter, warmth, moist surroundings and a ready source of food.

The warm WA climate has been readily adopted by the voracious American cockroach, and the past 10-20 years have seen them become prolific in woodpiles, laneways, gardens, sewers, drains and any room in the house. Cockroaches can live on old leather, human hair, bird droppings, or the smear of oil on a cleaned kitchen bench.

Little research has been done on the insects, but as we know they eat and soil our food, it is logical to conclude that they contribute to the spread of disease.

The way to reduce the numbers of cockroaches in our homes is to make entry difficult, deny all food sources and disturb known hideouts as often as possible.

JOHN HUNTER

DID YOU KNOW?

- *The rhinoceros cockroach from Queensland is the largest species on earth. This bush burrower grows to 80 mm long, weighs 30 gm, is armour-plated, and builds an underground tunnel up to 6 m in length.*
- *The female of most cockroach species lays eggs in a progressively grown, horny, purse-like case formed by special glands. In a few weeks the nymphs break out and begin to forage.*
- *Cockroaches roamed ancient fern forests 250 million years ago - 150 million before the dinosaurs and some 240 million before humans. They have survived plagues, radiation and modern insecticides to remain unchanged.*

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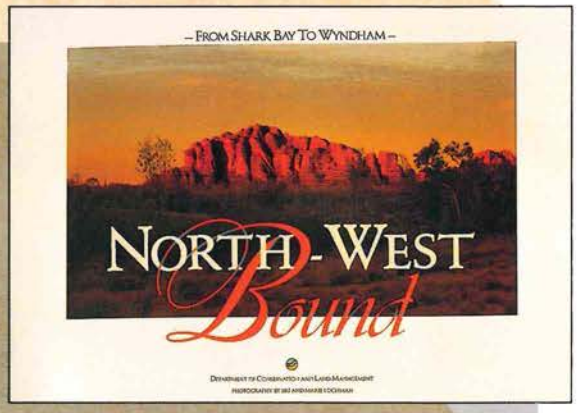
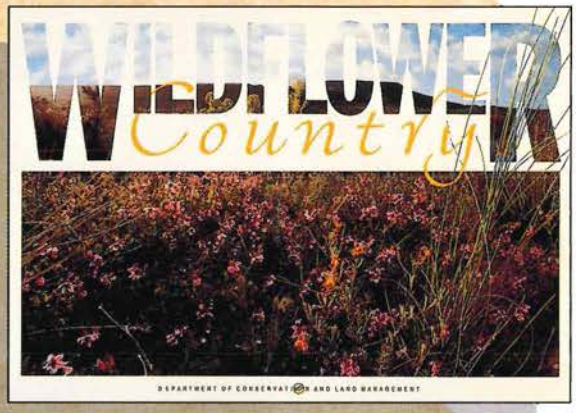


North-West Bound $19.95
Shark Bay to Wyndham - ideas, maps, places to go



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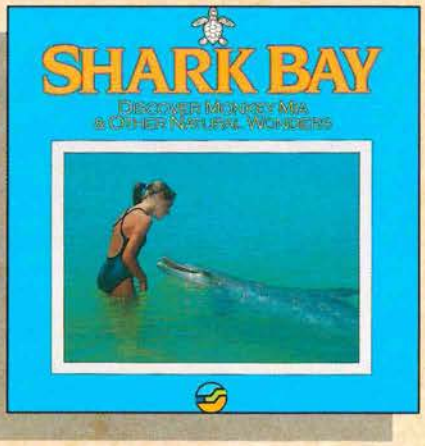
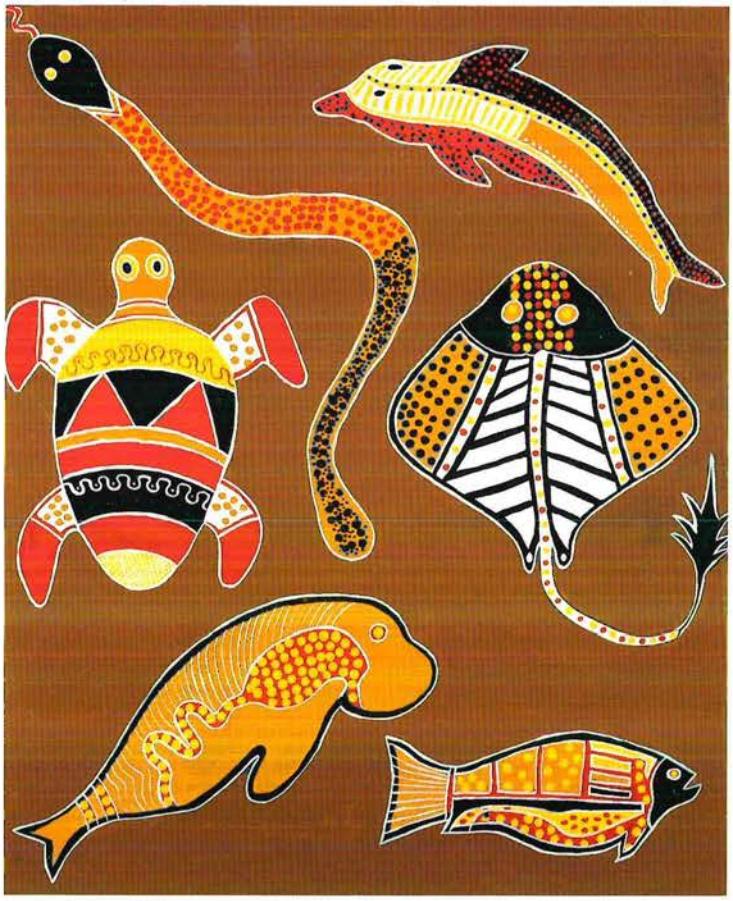


Shark Bay $5.95
Shark Bay itself - facts and features of this special place



The vibrant colours and ancient shapes of Aboriginal art. Shark Bay primary schoolchildren celebrate in paint the abundant marine life that surrounds them.