



World Heritage Sites

Protected
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SHARK BAY AUSTRALIA

On the Indian Ocean coast at the westernmost point of Australia, Shark Bay's waters, islands and peninsulas have three exceptional natural features: the largest, most diverse sea-grass beds in the world; a large population of dugongs; and the stromatolites of Hamelin Pool: colonies of algae in hard, dome-shaped deposits which are among the oldest life forms on earth. The Bay is also home to nine species of endangered mammals.

COUNTRY

Australia

NAME

Shark Bay

NATURAL WORLD HERITAGE SERIAL SITE

1991: Inscribed on the World Heritage List under Natural Criteria vii, viii, ix and x.

STATEMENT OF OUTSTANDING UNIVERSAL VALUE [pending]

IUCN MANAGEMENT CATEGORY

Shark Bay Marine Park:	Ia Strict Nature Reserve
Zuytdorp Nature Reserve:	Ia Strict Nature Reserve
Freycinet-Double Islands Nature Res:	Ia Strict Nature Reserve
Zuytdorp Historic Shipwreck:	Ia Strict Nature Reserve
Koks Island:	Ia Strict Nature Reserve
Charlie Island:	Ia Strict Nature Reserve
Friday Island:	Ia Strict Nature Reserve
Francois Peron National Park:	II National Park
Monkey Mia Conservation Reserve:	II National Park
Shell Beach Conservation Park:	III Natural Monument
Bernier & Dorre Is. Nature Reserve:	IV Habitat/Species Management Area
Hamelin Pool Marine Nature Reserve:	VI Managed Resource Protected Area

BIOGEOGRAPHICAL PROVINCE

Western Sclerophyll / Western Mulga (6.04.06 / 6.08.08)

GEOGRAPHICAL LOCATION

Shark Bay is situated over 800 km north of Perth on the westernmost point of Australia. The western boundary of the World Heritage site extends three nautical miles (5.56 km) offshore for almost 300 km from the tip of Bernier Island to Zuytdorp cliffs in the south. The eastern boundary follows the mainland coast to the end of Hamlin Pool then drops south about 80 km to the end of Zuytdorp Nature Reserve, between 30 and 70 km inland. The town of Denham and the saltmines of Useless Loop and Useless Inlet, are within but excluded from the World Heritage property which lies between 24°44'S to 27°16'S by 112°49'E to 114°17'E.

DATES AND HISTORY OF ESTABLISHMENT

The component protected areas of the World Heritage site were established on the following dates:

- 1957: Bernier and Dorre Islands Nature Reserve;
- 1961: Freycinet-Double Islands Nature Reserve;
- 1976: Koks I.,Charlie I.,Friday I.;
- 1978: Zuytdorp Historic Shipwreck;
- 1988: Monkey Mia Conservation Reserve;
- 1990: Shark Bay Marine Park, Hamelin Pool Marine Nature Reserve;
- 1991: Zuytdorp Nature Reserve
- 1993: Francois Peron National Park; Shell Beach Conservation Park.

LAND TENURE

The state of Western Australia, the Federal Government and private ownership. Managed primarily by the Western Australian Department of Conservation and Land Management (CALM).

AREA

2,197,300 ha. Protected areas - marine parks, marine nature reserves, terrestrial nature reserves and national park - cover 1,004,000 ha. Public land - marine areas 687,747 ha, vacant Crown Land 55,000 ha, pastoral land 450,000 ha, other reserves 2,500 ha plus private land 750 ha - covers 1,195.997 ha.

Shark Bay Marine Park:	748,725ha
Shell Beach Conservation Park:	518.00 ha
Monkey Mia Conservation Reserve:	477.00 ha
Freycinet-Double Islands Nature Reserve:	205.60 ha
Hamelin Pool Marine Nature Reserve:	132,00 ha
Zuytdorp Historic Shipwreck:	79.00 ha
Zuytdorp Nature Reserve:	58,85 ha
Francois Peron National Park:	52,529ha
Bernier & Dorre Is. Nature Reserve:	9,72 ha
Koks Island:	3.00 ha
Charlie Island:	0.80 ha
Friday Island:	0.80 ha

ALTITUDE

Sea-level to 20m.

PHYSICAL FEATURES

Shark Bay is a large divided semi-enclosed bay on the low-lying coast of the Indian Ocean lying behind a chain of barrier islands. It averages 100km wide from the mainland, is some 200km long from north to south, approximately 13,000 sq.km in area, and has an average depth of 9m with a maximum depth of 29m. The barrier is formed of the narrow Bernier, Dorre and Dirk Hartog islands, continued south in the equally narrow Edel peninsula. The Bay is split from the south by the 110km-long Peron-Nanga peninsula, dividing it into two very wide embayments - Denham Sound-Freycinet Harbour on the west, and L'haridon Bight and Hamelin Pool in the east. The Edel peninsula on the bayward side is fretted by four narrow inlets between four narrow north-south lesser peninsulas, one of which, Useless Inlet is given over to salt mining. The coastline of the property is 1,500km long, including the 200m high Zuytdorp cliffs well to the south, which are among the highest of the Australian coastline.

The area has three distinct landscape types: the Gascoyne-Wooramel province along the eastern coast of the bay which is a low-lying plain with extensive supratidal flats, backed by a limestone escarpment; the Peron province, comprising the Peron-Nanga peninsula and Fauré Island, of low rolling sandy plains with salt and gypsum pans and ancient interdune gypsum-filled depressions (*birridas*), the seaward margin of which is a 3-30m-high scarp with narrow sand beaches; and the Edel province comprising Edel peninsula and the three barrier islands, a landscape of elongated north-trending dunes cemented to loose limestone which ends on the ocean in a series of spectacular cliffs (DASETT, 1990). The area basement rock is Late Cretaceous Toolonga limestone and chalk. The most extensive younger rocks are Peron sandstones and Tamala limestones which form the offshore islands. These are often overlaid by a series of longitudinal fossil dunes accumulated during the Middle to Late Pleistocene (described in DASETT, 1990). Gypsum has formed from the evaporation of saline

groundwater in ponds and broad tidal flats such as those bordering Hamelin Pool. Shell beaches at the southern end of L'haridon Bight form a rare 6 km long scientifically important deposit of organic shells *Fragum erugatum*, coquina limestone, ooid shoals and lithified sediments 8-9m deep. In Wooramel Bank the water currents and the build-up of sand banks and sills by seagrass beds, have created a vast mat of carbonate deposits and sediments.

The outstanding marine feature of the Bay is the steep salinity gradient. Water exchange with the ocean is restricted but oceanic water from the south-flowing Leeuwin current flows through the wide northern Naturaliste Channel between Dorre and Dirk Hartog islands and the South Passage between Dirk Hartog Island and Steep Point, intruding warm low-salinity tropical water. The interaction of wind drift and tidal currents produces an anticlockwise circulation within the Bay, west to south-east, then east and finally north-west. Strong southerly summer winds push about 1-1.5m of water out of the Bay, exposing sandflats up to 2m wide. Tides vary between a spring range of 1.7m and a neap range of 0.6m. The salinity ranges from oceanic (35-40 ppt) in the northern and western parts of the Bay through metahaline (40-56 ppt) to hypersaline in Hamelin Pool and L'haridon Bight (56-70 ppt) which are partly blocked by sills each side of Fauré Island originating in the dense seagrass beds which have, with the low rainfall, high evaporation and low tidal flushing, produced the hypersaline conditions in which subsurface evaporite deposits, lithification and the formation of the 'living fossil' stromatolites occur. The three biotic zones resulting from the gradient have a marked influence on the distribution of marine organisms within the Bay (CALM, n.d.; DASETT, 1990).

Two intermittent rivers drain into the Bay from the east: the Gascoyne and Wooramel Rivers. There is very little surface run-off because of the low rainfall, high evaporation and permeable soils. There is active regional saline groundwater flow however, and some freshwater springs, as in the intertidal zone north of Monkey Mia (DASETT, 1990). There is a large quantity of artesian water approximately 300m below the ground surface, some of it hot.

CLIMATE

Shark Bay is at the meeting point of three major climatic regions but its climate is semi-arid to arid, characterised by hot dry summers and mild winters. Summer temperatures range between 20°C and 35°C; winter temperatures between 10°C and 20°C. Average annual precipitation is low, ranging from 200mm in the east to 400mm in the far southwest. Annual evaporation is high, between 2,000mm in the west to 3,000mm in the east. The Leeuwin Current greatly influences the temperature of the sea surface water in the bay. Seawater temperatures outside the bay vary from 20.9°C in August to 26°C in February. Within the bay water they vary: in the inner bay temperatures drop to 17°C in August but in February a maximum of 27°C has been recorded in Hamelin Pool, 26°C in Freycinet Harbour and 24°C in the oceanic salinity zone.

VEGETATION

The area is semi-desert where the flora is transitional between the South-west botanical province and the arid Eremaean botanical province found over much of central Australia. More than 620 species are recorded for the region, at least 51 being endemic. 283 species are at the limits of their range in Shark Bay about 80% at the northern limit of their range, and 20% at their southern limit. Many vegetation formations and species are found only in the interzone area. 25 species are considered nationally rare or threatened (DASETT, 1990).

The South-west botanical province consists of vegetation rich in *Eucalyptus* species, forming woodland with diverse shrubby understories and heathlands poor in grasses. The Eremaean province is correspondingly rich in wattle *Acacia* species but has large areas dominated by grasses, especially spinifex and prickly hummock grasses of the genera *Triodia* and *Plectrachne*. The Province includes shrublands of *Acacia ligulata*, *Pimelea microcephala* and *Stylobasium spathulatum*. Vegetation on the older dunes includes *Melaleuca cardiophylla*, *Thryptomene baeckeacea* and *Plectrachne bromoides*. The saltier soils are vegetated with halophytes. The area south of Freycinet Harbour contains a unique type of vegetation known as tree heath and shows the most pronounced overlap between botanical provinces: 11 of the site's 28 endemic vascular species occur here on the Tamala sandplain (see DASETT, 1990). Mangroves occur in small relatively isolated areas in the southern and western Bay, only becoming abundant towards the north. The southernmost extensive stand of white mangrove *Avicennia marina* occurs on the Peron Peninsula (Anderson, n.d.).

The marine flora is dominated by two of the most extensive and diverse seagrass meadows in the world where twelve species of seagrass cover more than 400,000 ha to depths of about 12m. The

1,030 sq.km Wooramel Bank of carbonate sediment bound by seagrasses is the world's largest such mat. The most abundant seagrasses are *Amphibolis antarctica* and *Posidonia australis* which cover 90% of the beds, and provides a substrate for 66 species of algal epiphyte. Beds of *Halodule ovalis* and *H. uninervis* cover an area of approximately 50,000 ha. The only deposits of comparable origin and size are the seagrass beds on the Mediterranean coast of France (DASETT, 1990). Over the last 5,000 years, seagrasses have modified the physical, chemical, biological and geological environment of the Bay, contributing to marine barriers such as the Fauré Sill, which creates the hypersaline conditions of Hamelin Pool and L'haridon Bight. These waters nurture photosynthesising micro-algae and cyanobacteria which trap and bind detrital sediments accreting from calcareous epiphytes and their fauna, creating a wide variety of benthic microbial mats and hummocks. The most unusual have mineralised to form stromatolite mounds which are one of the slowest growing and oldest life forms on Earth, dominant in benthic ecosystems for more than 3,500 million years. Hamelin Pool contains the most diverse and extensive examples of living marine stromatolites in the world, comparable to fossils found in Proterozoic rocks. A modern example is the coccoid cyanobacterium thought to be descendants of a 1,900 million year old form, one of the longest continuing biological lineages known. There are very few comparable occurrences in the world - four lakes in western Australia, and Lee Stocking Island in the Exuma cays of the Bahamas (DASETT, 1990; CALM, n.d.).

FAUNA

Shark bay is of great botanical and zoological importance due to the long isolation of its island and peninsular ecosystems; also, being near the northern limit of the transition between temperate and tropical zones, many species are at the limits of their geographical range. It is the habitat of many globally and nationally rare, vulnerable or threatened species.

Of the 26 species of threatened Australian mammals, five are found on Bernier and Dorre islands; the boodie or burrowing bettong *Bettongia lesueur*, rufous hare-wallaby *Lagorchestes hirsutus* (VU), banded hare-wallaby *Lagostrophus fasciatus* (EN), western barred bandicoot *Perameles bougainville* (EN) and Shark Bay mouse *Pseudomys fieldi* (VU). The greater stick-nest rat *Leporillus conditor* (VU) was introduced on Salutation Island in Freycinet Harbour, burrowing bettong was introduced in 1992 on Heirisson Prong, followed with the release of Shark Bay mice in 1994. The Bay is known for its marine fauna. The population of 14,000 dugong *Dugong dugon* (VU) according to CALM (n.d.) is here at the southern end of its distribution and thriving: in 1991, at 10150, it was claimed to be 12.5% of the world population. The only known 'lek' mating in any marine mammal is observable amongst them. Wild Indo-pacific bottlenosed dolphins *Tursiops aduncus* regularly come to be fed at Monkey Mia. The only other similar long term human-wild dolphin interactions are at Banc d'Arguin in Mauritania and one in northern Brazil. Humpback whale *Megaptera novaeangliae* and southern right whales *Eubalaena australis* use the Bay, the first on its migrations, the second for breeding. A minke whale *Balaenoptera acutorostrata* was stranded in 1981 and killer whales *Orchinus orca* were sighted attacking dugongs at Sandy Point in 1983. Humpback whales were reduced by past hunting from an estimated west coast population of 20,000 to 500-800 whales in 1962 but are now estimated at 2,000-3,000 (DASETT, 1990; CALM, n.d.).

The rich avifauna includes over 230 species, 35 per cent of Australia's birds, with 11 breeding marine birds including osprey *Pandion haliaetus* and Caspian tern *Sterna caspia*, for which Fauré Island is a key breeding area. Over 35 Asian migratory species pass through the region, four of these breeding in Shark Bay. A number of birds reach their northern limit there including regent parrot *Polytelis anthropeplus westralis* and yellow robin *Eopsaltria australis griseogularis*, blue-breasted fairy wren *Malurus pulcherrimus*, striated pardalote *Pardalotus striatus* and thick-billed grasswren *Amytornis textilis* (a species list is given in DASETT, 1990).

The region is noted for the diversity of its amphibians and reptiles, supporting nearly 100 species, many at the northern or southern limits of their range, 9 being endemic and 13 being nationally threatened. The area is also notable for the variety of burrowing species, such as the sandhill frog *Arenophryne rotunda*, which needs no surface water but digs into and lives in moist sand. The islands and peninsulas are rich in 'old' Australian species with 12 species of diplodactyline geckos and 12 species of pygopodids (legless lizards). They provide a refuge for nine relict or endemic reptiles: the legless lizards (pygopodids) *Aclys concinna major*, *Aprasia haroldi* and *Pletholax gracilis edelensis*, sand-swimming skinks Hamelin ctenotus *Ctenotus zasticus* (VU) and *C. youngsoni*, and the skinks *Egernia stokessi aethiops*, *Leurista maculosa* and Shark Bay dwarf skink *Menetia amaura*, also ten of the 30 dragon lizard species found in Australia. Several characteristic species are the hylid *Cyclorani maini*, Goldfield's bullfrog *Neobatrachus wilsmorei*, the gecko *Diplodactylus squarrosus*, skinks *Egernia*

depressa, *Lerista muelleri* and *Morethia butleri*, and monitors: the large perentie *Varanus giganteus* and three small, the pygmy *V. eremius*, short-tailed pygmy *V. brevicauda* and stripe-tailed pygmy *V. caudolineatus*. Green turtle *Chelonia mydas* (EN) and loggerhead turtle *Caretta caretta* (EN) are found in Shark Bay near their southern limits, 800-1,000 of the latter nesting on the beaches on the Peron peninsula and Dirk Hartog Island which is the most important nesting site for loggerhead turtles in Western Australia. Leatherback turtles *Dermochelys coriacea* (CR) and hawksbill turtles *Eretmochelys imbricata* (CR) are occasionally seen. The Bay supports populations of at least six sea snakes including the endemic *Aipysurus pooleorum* (DASETT, 1990).

323 species of fish have been recorded of which 83% are tropical, 11% warm temperate and 6% cool temperate. Large numbers of sharks including tiger shark *Galeocerda cuvier*, whale shark *Rhincodon typus* (VU), basking shark *Cetorhinus maximus* (VU), scalloped, great and smooth hammerhead sharks *Sphyrna lewini* (EN), *S. mokarran* (EN) and *S. zygaena* (VU) are observed in Shark Bay. There is also an abundant population of rays, including manta ray *Manta birostris*. Shark Bay is an important nursery for crustaceans, medusae and coelenterates. The marine flora is dominated by the seagrass beds which provide a substrate for some 100 species of zoophytes, juvenile fish and sea snakes. Because of the high organic productivity and development of these beds and carbonate sand flats, the shallows of Shark Bay support a benthic invertebrate fauna of exceptional abundance, diversity and density. Of the 218 species of bivalve in the region, 75% have a tropical range, 10% a southern Australian range and 15% are west coast endemics. However, the invertebrate communities of Shark Bay remain understudied. Coral reefs are present, although not abundant, with over 80 species. Hermatypic reef building corals are found in South Passage and there are large patches along the east coast of Dirk Hartog, Bernier and Dorre Islands (Anderson, n.d.). The initiation of the Leeuwin current coincides with the mass spawning of hermatypic corals and is believed to be a major factor in the distribution and maintenance of coral communities in the region. (DASETT, 1990).

CONSERVATION VALUE

Shark Bay is one of the few World Heritage properties inscribed for all four outstanding natural universal values: showing the earth's evolutionary history, ongoing ecological and biological processes, superlative natural phenomena, and important habitats for in situ conservation of biodiversity. The marine ecosystem contains many significant features: the saline gradient, vast and diverse seagrass beds and carbonate banks, benthic microbial communities and living fossil stromatolites in the hypersaline bays, human-accustomed wild dolphins, endemic and threatened wildlife including a large dugong population, and areas of great natural beauty. The Bay lies within a Conservation International-designated Conservation Hotspot, a WWF Marine Global 200 Eco-region and a WWF/IUCN Centre of Plant Diversity.

CULTURAL HERITAGE

The record of aboriginal occupation of Shark Bay extends to 4,200 years ago. The mild climate favoured permanent settlement: the remains of settlement were found at Eagle Bluff and a considerable number of midden sites have been found, especially on Peron Peninsula and Dirk Hartog Island, providing evidence of some of the foods they ate. In 1616 Dirk Hartog, captain of a Dutch ship trading to Java made the first recorded European landing in Western Australia, commemorated by a pewter plate nailed to a post on the northern tip of Dirk Hartog Island. Shark Bay was so named by the English buccaneer William Dampier in 1699. In 1712 the Dutch East India Company ship *Zuytdorp* was wrecked offshore. In 1800, the French Government sent two ships, the *Geographe* under Captain Baudin and the *Naturaliste* under Captain Hamelin to explore the Southern Hemisphere. The latter spent 49 days charting the area: Louis de Freycinet and Francois Peron surveyed all the inlets between Dirk Hartog Island and the Peron Peninsular, while Pierre Fauré charted the Eastern Bay. Most of the names of the islands and bays were named after members of this expedition.

After 1850, the region was occupied by guano miners, pearlmen, fishermen, sandalwood cutters and pastoralists. Pearlming was the main industry from 1850 to the 1940s. The fishing industry peaked in the 1960s but declined with the introduction of regulations introduced to prevent over-exploitation of fish stocks. From 1904 to 1911, quarantine hospitals were set up for aborigines with leprosy and venereal disease on Bernier and Dorre islands. Between 1950 and 1962, from a whaling station at Carnarvon, 7,852 humpback whales were killed until the hunt collapsed for lack of whales (DASETT, 1990). In the 1960s, the coastal highway was sealed and the area for the first time opened to tourists.

LOCAL HUMAN POPULATION

Shark Bay has a population of approximately 1,000, some being of aboriginal descent (Anderson, n.d.). The town of Denham (population ~450) at its centre is 830 km north of Perth and 130 km west of the North West Coastal Highway. There is also a salt evaporation works at Useless Loop, established in the 1960s. The present economy of the region is based on tourism, fishing, and pastoralism. The town of Carnarvon just north is partly reliant on the fishing industry in the Bay which is fished by 27 boats of the prawn fleet with a harvest reported to have stabilised at 2,000 tonnes (WAFIC, 1991). The scallop fishery catches average at 3,500 tonnes per year from 14 boats based there. These fisheries have a capital investment of some Australian \$80 million, and in the early 1990s employed 500 people harvesting fish worth approximately Australian \$35 million per year (WAFIC, 1991; CALM, *in litt.*, 1996).

VISITORS AND VISITOR FACILITIES

In 1985, when a paved road reached Denham, tourist numbers increased dramatically. Today some 170,000 tourists visit the Bay each year to fish, holiday or meet the wild dolphins which have been regularly fed at Monkey Mia for 30 years, almost the only known such long established interaction in the world. Some 100,000 a year visit them and there is an information centre at Monkey Mia (Edwards, 1988). A Shark Bay World Heritage Discovery Centre has been built at Denham. Local tours, by land, sea or air are rapidly increasing this popularity and several trailer camps, motels and hotels exist. One great attraction is sport fishing catered for by a number of fishing tours and charter vessels (Anderson, n.d.). The Department of Conservation and Land Management has developed a boardwalk and visitor facilities at Hamelin Pool, Shell Beach and Francois Peron National Park, and provides interpretive brochures.

SCIENTIFIC RESEARCH AND FACILITIES

Scientific specimens were first collected in 1699 by William Dampier on Dirk Hartog Island. In 1801, the naturalist Francois Peron, during the Baudin Expedition, made important observations on the marine fauna and made plant collections. Subsequently, the naturalists Quoy and Gaimard collected zoological specimens in Freycinet's second voyage to Shark Bay. Between 1818 and 1822 Phillip Parker King made the first comprehensive charts of the region for the Royal Navy (Fox, 1991). In 1858 the whole of Shark Bay was charted by Captain Denham whose name the town took when it was founded in 1898. The stromatolites have yielded information on the nature, palaeoenvironment and evolution of the Earth's biosphere up to the early Cambrian period. A summary of recent research in the Shark Bay area was produced in 1990 by the France-Australe Bicentenary Expedition Committee (Berry *et al.*, 1990). Recent research tracking feral cats has been done in order to remove them from Project Eden. Dugong have also been tracked, and dolphin behaviour monitored by researchers based at the Dolphins of Monkey Mia Research Foundation. A Scientific Advisory Committee provides advice to the Ministerial Council on scientific research. A Community Consultative Committee provides advice to the Council on protection.

MANAGEMENT

The responsible administrative body is the West Australian Department of Conservation and Land Management under the Department of the Arts, Sports, the Environment, Tourism and Territories (DASETT), in accordance with existing the Western Australian Fisheries Act, Local Government Act, Land Act, Conservation and Land Management Act (1984) and the Environment Protection & Biodiversity Conservation Act (1999). The state's planning strategy for Shark Bay was outlined in the 1986 *Shark Bay Region Plan* which favoured the maintenance of the economic status quo (Humphries, 1990). This was adopted by the government in 1988 and is periodically reviewed. Any future major changes in land-use require further public consultation and Western Australian parliamentary approval (DASETT, 1990). This comprehensive planning framework includes partnership between government and the local community.

The Sustainable Future for Shark Bay contains a broad management plan which should enable conservation values to co-exist with fishing, tourism and the existing salt works; disruption to the region's pastoral industry would be minimal (Humphries, 1990). Commercial fishing in and around Shark Bay is relatively light but damaging use of gill nets which became serious in 1980-81 was effectively curbed by regulations then introduced (Anderson, n.d.). A draft plan for the management of fish resources in the World Heritage Area was released in 1995. Management of the trawl fishery includes restricting the number of boats, minimum mesh sizes, specifications and size of the fishing gear, acceptance of closed seasons and protection of nursery areas (WAFIC, 1991). However, there has been opposition to the assumed loss of livelihood and restriction on the local fisheries resulting from World Heritage designation.

Detailed management plans are prepared for all the conservation reserves in the area and a strategic plan for the Shark Bay World Heritage Property was drawn up. Conservation of the island nature reserves is recognised by restrictions on public access. Draft management plans for the Monkey Mia Reserve and the Marine Reserves were released in 1993 and 1994 respectively. An ongoing feral animal control program has eradicated goats from Bernier Island. A Terrestrial Reserves Management Plan includes a weed control program. Current monitoring indicators include: annual monitoring of loggerhead turtles (from 1994), baseline marine water quality, five-yearly dugong monitoring, a floristic survey of Peron Peninsula, visitor surveys, shell mining, fire buffer zone monitoring, long-term climatic data at Peron, and monitoring of terrestrial ecology by landsat satellite. Proposed actions for 2003-2008 were: the completion of a management plan for South Peron; transfer of Dirk Hartog Island to the National Park; completion of a management plan for Edel Land; extension of the Shark Bay Marine Park; finalization of the strategy plan; completion of a communication plan; completion of a WH Interpretive Centre; continued involvement of indigenous groups; continued feral predator control and control of invasive species (Environment Australia/CALM, 2002).

In 1990, the 105,352 ha Peron pastoral lease was bought by the state government primarily for the conservation, and the north half gazetted as the Francois Peron National Park in 1993. In 1994 Project Eden was launched to recreate the pre-pastoral ecosystem of the Peron peninsula and promote ecotourism by separating the northern from the southern half of the peninsula with a solar-powered double fence. The aim was to eliminate the destructive domestic and non-native animals and replace them with natives translocated from the wild or reintroduced from captive-bred animals, leaving them to repopulate the area. The introductions include emu *Dromaius novahollandiae*, malleefowl *Leipoa ocellata* (VU), short-beaked echidna *Tachyglossus aculeatus acanthion*, euro or common wallaroo *Macropus robustus*, western quoll *Dasyurus geoffroyii* (VU), woylie or brushtailed bettong *Bettongia penicillata* (VU), greater bilby *Macrotis lagotis* (VU), banded hare wallaby, rufus hare-wallaby and many reptiles including the goanna or sand monitor *Varanus gouldii*, the thorny devil *Moloch horridus*, and the rare woma python *Aspidites ramsayi* (EN). The Peron Endangered Species Breeding Centre and the eradication programs have been quite successful except for eradicating feral cats.

MANAGEMENT CONSTRAINTS

The whole land surrounding Shark Bay area has been partially modified in the past, mainly by overgrazing, where areas of high disturbance around homesteads and stock watering points were highly degraded. The most eroded were in the Tamala and Peron stations, where grazing and feral animals, particularly introduced rabbits and goats as well as foxes and feral cats greatly reduced the numbers of native animals. Since Peron station was bought by the Government, and a major feral animal control program begun, the northern part of the station is being rehabilitated as a natural National Park (DCLM n.d.). The marine environment was also somewhat modified by the pearl shell industry, whaling and heavy fishing pressure. The latter continues using bottom trawling, nets, lines and cray pots. Calls by conservationists for a ban on trawling in Shark Bay roused local fishermen to oppose World Heritage listing, claiming that their methods were sustainable (WAFIC, 1991). In 1998 the state government granted a petroleum exploration permit for a site located within the World Heritage site, risking potential oil pollution. Risks remain of exotic biota introduced from ballast water and other invasive species.

Tourism is on the increase. A good road to Denham and Monkey Mia and the building of motels, hotels and caravan parks dramatically increased visitor numbers, seriously affecting the area Tourist activity, such as recreational boating along the inner coast of Dirk Hartog Island, may be a hazard to dugong, dolphins and marine turtles far greater than the few dugong taken annually by local inhabitants for food. Insufficient staff has long been regarded as a hindrance: for long only one fisheries officer was available to patrol the entire region and proved entirely inadequate to prevent poaching. Insufficient management also led to tourist pressure on the habituated population of wild dolphins at Monkey Mia, resulting in the appointment of full-time rangers. In 1989 a dead calf and six dolphins were presumed to have been killed by pollution from a septic tank later removed. The township of Denham and the Useless Loop evaporation salt works and gypsum mine in the centre of the site are potential threats. (Fox, 1991; (Anderson, n.d.; DASETT, 1990; DCLM, *in litt.*, 1996).

STAFF

24 full time and 6 temporary staff in the Department of Conservation and Land Management (Environment Australia/CALM, 2002); 5.5 full time equivalents in the Department of Fisheries (1996). In 1986 five full-time rangers were appointed to Monkey Mia dolphin area to prevent interference with

dolphins and to run public awareness programmes as a consequence of increased human pressure (Edwards, 1986).

BUDGET

For 2002 the estimated budget for Monkey Mia was approximately US\$637,700 for 2002. The Dept. of Fisheries further contributes approximately US\$500,000 annually for fisheries management. In 2001-2002 Commonwealth (Federal) funding for projects within the World Heritage area was US\$200,796 (Environment Australia/CALM, 2002).

LOCAL ADDRESSES

Department of Conservation and Land Management, PO Box 72, Geraldton, Western Australia 6531,
Gascoyne District Headquarters, Department of Conservation and Land Management, 67, Knight Terrace, Denham, WA 6537.

Department of the Environment, Sports and Territories, GPO Box 787, Canberra, ACT

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