

Carnac Island Nature Reserve

Management Plan

2003



Management Plan No. 47

 Conservation
Commission
WESTERN AUSTRALIA



DEPARTMENT OF 
Conservation
AND LAND MANAGEMENT
Conserving the nature of WA

A INTRODUCTION

PLANNING AREA

Carnac Island is a Nature Reserve encompassing approximately 19 hectares. It is located 10 kilometres south-west of Fremantle, WA (see Figure 1). The Nature Reserve extends to the low-water mark and includes the main island as well as Shag, Flat and South West Rocks (See Figure 2) and it is to these areas to which this management plan applies. The waters beyond low-water mark are not part of the Nature Reserve, although they have been proposed for future addition to the Shoalwater Islands Marine Park (Department of Conservation and Land Management, 1994). Until protected area status is achieved for the waters around Carnac Island, environmental protection and safety is under the jurisdiction of a number of agencies with responsibilities in marine matters (e.g. Department for Planning and Infrastructure; Department of Fisheries; Department of Environment, Water and Catchment Protection; and the Department of Conservation and Land Management, through the *Wildlife Conservation Act 1950*). The Department of Conservation and Land Management (the Department) will liaise with these agencies as necessary to facilitate conservation objectives on Carnac Island.

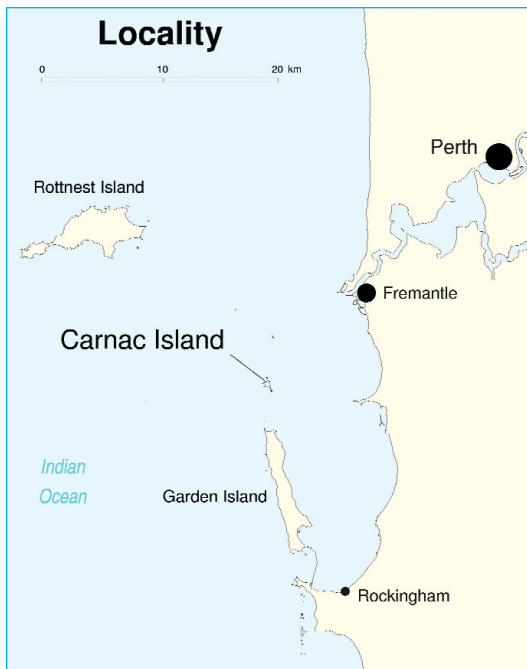


Figure 1

B MANAGEMENT DIRECTIONS AND PURPOSE

CORPORATE MISSION AND VISIONS

The Department manages nature reserves according to the legislative specifications of the *Conservation and Land Management Act 1984* (CALM Act), the *Wildlife Conservation Act 1950* (Wildlife Conservation Act)¹, and the policies of the Department and the Conservation Commission of Western Australia. The Department's decision making and management is further guided by the principles included in its *Corporate Plan (2002-2005)*, in which the following mission statement is found:

'In partnership with the community, to conserve Western Australia's biodiversity, and manage the lands and waters entrusted to us, for their intrinsic value and the appreciation and benefit of present and future generations'.

The Department's primary objective in the management of nature reserves, as defined in Section 56 of the CALM Act is to:

'Maintain and restore the natural environment and to protect, care for, and promote the study of indigenous flora and fauna, and to preserve any feature of archaeological, historic or scientific interest'.

The vision for Carnac Island Nature Reserve (CINR) is:

'In the year 2013, the habitat and refuge value of CINR will be improved to the state in which it was in the 1980s (1980-1985), and will support the same or greater diversity of native fauna species that it does in the year 2003. The local community and other users will recognise Carnac Island as an important natural asset'.

LEGISLATIVE FRAMEWORK

Legislation

Nature reserves are declared under the *Land Administration Act 1997*, vested in the Conservation Commission and managed by the Department in accordance with the CALM Act. The *Wildlife Conservation Act* provides legislative protection for flora and fauna across the State's lands and waters.

Existing tenure

Carnac Island has had Class 'A'² reserve status since 1963 when Cockburn Sound Location 692 was reserved for the purpose of 'recreation and conservation of fauna'. The Reserve was

¹ Including Regulations made under these Acts, or any subsequent legislation that replaces these Acts or Regulations.

² Reserves that require any proposals for a cancellation, or change of purpose or classification, to be laid before both houses of Parliament.

gazetted as 'Carnac Island Wildlife Sanctuary' in 1972 (A Class Reserve No 26646), and later, in 1979, was made a Nature Reserve and named 'Carnac Island Nature Reserve'. The purpose of the Reserve, however, remained unchanged. In recognition of the primary importance of Carnac Island for the conservation of fauna, one of the strategies of this management plan is to have 'recreation' deleted from the purpose for the reserve. This will not, however, prevent the island being used for low impact recreation consistent with nature appreciation activities and will require minimal changes to current use.

MANAGEMENT PLANNING PROCESS

This management plan for CINR ('the plan') identifies the reserve's key values and outlines strategies to protect those values. The plan has been derived from a draft management plan for Carnac Island, which was released in December 2001 for a five-month public submission period. The 22 submissions received were considered in preparing the final management plan, as was input from the Carnac Island Nature Reserve Advisory Committee. This plan was approved by the Conservation Commission and the Minister for Environment and Heritage before release.

MEASURING PERFORMANCE

The Department's *Corporate Plan 2002-2005* reflects its responsibilities and details strategies for fulfilling these responsibilities. The success of this management plan will be determined by measuring progress against relevant aspects of the following strategies included in the corporate plan:

- Recover threatened flora, fauna and ecological communities.
- Protect biodiversity from threatening processes, agents and activities, including feral animals, weeds, dieback and other exotic diseases, salinity and inappropriate fire regimes.
- Improve community knowledge of biodiversity conservation issues and promote awareness, understanding and support for the Department's activities, services and policies.

In assessing the success of the plan, Key Performance Indicators (KPIs) will be used to gauge the extent to which the plan has contributed to fulfilling the Department's responsibilities, and, at a lower level, the extent to which specific objectives of the plan have been achieved. KPIs are developed and implemented in accordance with a Departmental protocol. The use of KPIs enables managers to assess their management approaches and make modifications if/as necessary. Where assessment reveals that a KPI has not been met, the Department will liaise with the Conservation Commission in determining whether management needs to be adjusted, or the relevant objective changed (see Section G).

C MANAGING THE NATURAL ENVIRONMENT

GEOLOGY AND GEOMORPHOLOGY

Carnac Island is thought to have formed as a result of the large fluctuations in sea level that occurred with successive periods of glaciation and deglaciation. The associated exposure of broad areas of the continental shelf to wind erosion is thought to have created extensive parallel dune systems, which subsequently hardened to form limestone, part of which now makes up Carnac Island. The various limestone features that have gradually formed over years of exposure to weathering processes are fragile. Collapses of these limestone structures may be exacerbated or caused by human activities and can be a safety hazard. Management strategies to prevent such human induced changes are incorporated into this plan.

NATIVE PLANTS AND PLANT COMMUNITIES

The Wildlife Conservation Act provides legislative protection for flora and fauna across the State's lands and waters, and under this Act it is an offence to remove protected flora without lawful authority.

The vegetation of Carnac Island is typically low and dominated by salt tolerant species. It does not contain any known threatened flora species or plant communities. A recent study investigating long-term change in the flora of Carnac Island revealed changes in the floristic composition of the island over time (Abbott *et al.* 2000). The flora of Carnac Island has been documented relatively regularly since 1951 allowing changes to be assessed. The most dramatic changes occurred between 1975/6 and 1995/6 when there was a 37 per cent reduction in the number of flora species. Since 1951, the proportion of exotic species on Carnac Island has increased from 34 per cent in 1951 to 63 per cent. The study also revealed that a reduction in native species such as summer-scented wattle (*Acacia rostellifera*) and coastal daisy bush (*Olearia axillaris*) had coincided with an increasing proliferation of weed species such as ice plant (*Mesembryanthemum crystallinum*) and marshmallow (*Malva parviflora*). This has had the effect of causing an overall reduction in height of the island's vegetation. Changes to the vegetation structure can have flow-on effects on fauna dependent on specific habitats (see *Seabirds* in Section C). Abbott *et al.* (2000) says that nesting seabird populations, the eradication of rabbits in 1969, drought, increased salt-load from occasional cyclones in summer or autumn, and competition from increasing dominance of several weed species may have contributed to the vegetation changes.

NATIVE ANIMALS AND HABITATS

The most conspicuous fauna of Carnac Island are the seabirds, Australian sea lions (*Neophoca cinerea*), tiger

snakes (*Notechis scutatus*) and king skinks (*Egernia kingii*).

Little is known about the invertebrate fauna of Carnac Island and while further research into the entomology of the island would be desirable, it is not a management priority at this stage.

Seabirds and sea lions that inhabit Carnac Island are part of larger regional populations. The influence of activities on islands such as Garden, Rottnest and the Shoalwater group on CINR, and the dispersal of fauna that use it, need to be considered. Consequently, management of key fauna groups such as sea lions and seabirds is best facilitated by a coordinated approach across all metropolitan islands.

Sea lions

Carnac Island is an important habitat for the Australian sea lion, a species endemic to Australia and among the rarest of the world's seal species. It is thought the island may have once been used as a breeding site by sea lions (Abbott *et al.* 2000), but it is now used only as a haul out site for males. Another species, the New Zealand fur seal (*Arctocephalus forsteri*), is also an occasional visitor to the island. This species, which was once close to extinction, is now becoming increasingly visible in the metropolitan area, as its population continues to recover along the south coast. In contrast, populations of the Australian sea lion remain low for reasons largely unknown and further research is required. As a result, the Australian sea lion is gazetted as 'a species in need of special protection' under the Wildlife Conservation Act.

The males of the west coast population of Australian sea lions occupy several islands off the Perth metropolitan area during non-breeding periods; Carnac Island is one of these. Of the five islands used in the metropolitan area, Carnac Island is one of the most important as it, along with Seal Island further to the south, is used by the greatest number of sea lions (Gales *et al.* 1992). Sea lion numbers on the island show regular synchronous fluctuations. Approximately six out of every 18 months, the males migrate north to islands off the central-west coast to breed with resident females. After this, they return to the islands off the metropolitan coast for approximately 12 months. It is thought that this spatial separation of the population, at least in part, occurs to relieve pressures on the limited food resources for females and pups (Gales *et al.* 1992). The retention of the metropolitan haul out sites is therefore important to the survival of the broader west coast population.

The north-eastern beach area of Carnac Island is of particular significance to the sea lions. Most sea lions haul out on the eastern beach and many of these seek the shelter offered by the embayment at its northern end (see Figure 2). The only other suitable haul out site on the island is the small and seasonal beach near its south-western end.



Figure 2

Human interactions with sea lions in the water are regulated under the *Wildlife Conservation (Close Season for Marine Mammals) Notice 1998* (made under the Wildlife Conservation Act). On land sea lions are protected from disturbance under Section 16 of the Wildlife Conservation Act. Although attacks on non-breeding islands are rare, a small but nonetheless potential risk to visitor safety exists and needs to be considered in the island's management. To reduce the likelihood of attack by sea lions and to ensure that resting sea lions are not disturbed by human activity, the Department has developed guidelines for viewing wild seals and sea lions. These guidelines specify that visitors must:

- maintain a distance of at least five metres from any sea lion hauled out on Carnac Island (stricter restrictions apply for islands on which sea lions breed);
- not get between sea lions and the water;
- not encircle sea lions;
- not attempt to induce sea lions to re-enter the water; and
- supervise children at all times.

In addition, for Carnac Island at least, visitors must also comply with the access restrictions described in *Zoning* (in Section C). The education of visitors regarding appropriate visitor behavior will also be a key management requirement for protecting the island's native fauna.

As the use of CINR by Australian sea lions is a key value of the reserve, this management plan specifies an indicator to assess management effectiveness in protecting sea lions from visitor impacts (see *Native Animals and Habitats* in the Management Summary Table). However, due to a current incomplete knowledge about disturbance effects on this species, this indicator and the relevant management strategies should be revised if necessary during the life of the plan in light of new research.

Seabirds

Carnac Island is an important seabird-breeding island and is used by species that are recognised in international agreements on migratory birds. Carnac Island is used for breeding by the little penguin (*Eudyptula minor*), wedge-tailed shearwater (*Puffinus pacificus*), pied cormorant (*Phalacrocorax varius*), pied oystercatcher (*Haematopus longirostris*), fairy tern (*Sterna nereis*), caspian tern (*Hydroprogne caspia*), bridled tern (*Sterna anaethetus*), crested tern (*Sterna bergii*) and the silver gull (*Larus novae-hollandiae*) (Dunlop and Storr 1981).

A dramatic increase in the number of pied cormorants breeding on CINR in the last 20 years has led to concerns about the impacts this may have on other nesting seabirds. According to Rippey *et al.* (2002), the increase in the number of pied cormorants is associated with marked changes in vegetation. Cormorant breeding impacts the vegetation through direct destruction during breeding and the addition of nutrients and thereby facilitates weed proliferation. If this continues, other seabirds using the vegetation for breeding may potentially be displaced. However, it is probable that the increase is part of a natural, cyclical phenomenon (Andrew Burbidge, pers. comm.). Monitoring of the pied cormorant colony will be an important aspect of management, and strategies to mitigate further cormorant-related habitat destruction may need to be considered.

The island is noteworthy as being the only area of overlap between the breeding ranges of the little penguin (northern limit) and the wedge-tailed shearwater (southern limit) on Australia's west coast (Department of Conservation and Environment, 1983). These species are not normally found in the same range, however, at CINR both species can co-exist due to the occurrence of both tropical and temperate currents, which bring appropriate food sources into the foraging range of both species (N Dunlop, pers. comm.).

Visitors to Carnac Island can potentially have both direct and indirect impacts on breeding seabirds. People trampling seabird nests and burrows can increase chick mortality. In addition, humans may introduce predators, such as domestic dogs and cats, which would be devastating to a breeding colony. The

introduction of weeds can dramatically change an island's vegetation structure and in this way particular habitats used for nesting can be lost. The extent to which human disturbance will affect nesting seabirds varies from species to species. A discussion of these differences is included in a paper prepared by Dunlop and Rippey (unpubl.). They consider that seabirds that have a tendency to use the same nesting site for subsequent seasons are less likely to abandon breeding attempts due to intermittent disturbance by humans in the colony area. The wedge-tailed shearwaters are an example of this theory and have developed methods of reducing the risks associated with strong site attachment. Strategies include concealing the nest, rearing offspring in a burrow and arriving at and departing from the colony at night. These adaptations mean that human visitors present at colonies during the day rarely disrupt colony formation.

Seabirds exhibiting low nest site fidelity (such as fairy, caspian and crested terns) are likely to abandon the nesting site if disturbed during the colony formation stage. Disturbance to nesting birds is of concern as shifts in colony distribution to sub-optimal breeding habitats and delayed breeding lead to lower breeding success.

Confining human use of Carnac Island (as indicated in *Zoning* in Section C) will avoid most of the problems associated with seabird disturbance as most breeding activity occurs in areas that will not be accessed by visitors. However, fairy terns and pied oystercatchers intermittently use beach areas for nesting, and since they will not sit on the nest while people are nearby, it is important that visitors do not approach or remain in the vicinity of the nests. The education of visitors about appropriate approach distances will be an important aspect of management for seabirds with a tendency to readily abandon nesting sites.

Preventing human disturbance to seabirds exhibiting low nest site fidelity will not in itself prevent losses of breeding sites, as this can also occur through natural events. For example, fairy tern breeding sites have been lost as a result of the natural seasonal movements of beach sand, and these birds have also been noted to occasionally establish nesting sites in areas of the island prone to rock falls. Studies in environments similar to Carnac Island suggest that terns could potentially be encouraged to breed in specific, 'safer' habitats (Jeffries and Brunton 2001). Fairy terns were successfully encouraged to breed in a particular area of Tern Island (near Safety Bay) by increasing the shell content of specific 'safer' areas near low vegetation, and the use of polyurethane tern decoys (N Dunlop, pers. comm.). Similar trials are proposed for Carnac Island.

Additional ways to avoid disturbance to nesting seabirds also need to be communicated to visitors, and guidelines for visiting seabird-nesting islands should be developed. Such guidelines should include information on the prohibition of access that applies between sunset and sunrise (see *Zoning* in Section C), and of the importance of minimising noise (e.g. not operating horns, radios, or loud speakers within the vicinity of nesting seabirds).

Reptiles

Reptiles inhabiting Carnac Island include tiger snakes (one of the world's deadliest snakes) and king skinks. Carnac Island is noted for having the most concentrated tiger snake population in Western Australia. As a small isolated population, the tiger snakes and king skinks of Carnac Island are valuable for research into reptilian ecology and adaptation. The island's tiger snakes have also been used as an important source of snake venom for scientific research. The snakes are known to feed on the common house mouse (*Mus musculus*) and the young of nesting seabirds. Both silver gull and tern chicks have been recovered from the stomachs of tiger snakes.

King skinks on Carnac Island are an important predator of silver gull eggs. Injury markings on tiger snakes indicate that there is regular confrontation between king skinks and tiger snakes.

Marine fauna

Since CINR extends to the low-water mark it also incorporates the marine fauna that inhabits the rocky shores, tidal pools and beaches of the inter-tidal zone. There has been little recent study of the marine fauna living on the inter-tidal reef platforms around the island, however insights into these systems have been gained by studies of these environments in similar areas.

The land classification categories to be implemented on Carnac Island (see *Zoning* in Section C) permit access to almost all inter-tidal areas, and consequently, the taking of fish can occur (under the *Fish Resources Management Act 1994*) in those areas where access is permitted. Most of the shoreline is abutted by fragile limestone cliffs and caves that are prone to regular collapse and as access to these areas is prohibited (see *Zoning* in Section C) people will not be able to fish from the rocky outcrops around the island. The inter-tidal areas are likely to be used for snorkeling or fishing from a boat. The need for restrictions on fishing activities around the island will be considered further at the time that the extension to the Shoalwater Islands Marine Park is being investigated, or when this management plan is next reviewed.

ENVIRONMENTAL WEEDS

Unwanted plant species growing in natural ecosystems can displace indigenous plants, and this is particularly the case on disturbed sites where they compete with them for light, nutrients and water. Weeds can also have a significant adverse impact on other conservation values by altering animal habitats, harbouring pests and diseases, and creating a potential fire hazard.

Given the importance of the woody native vegetation structure on Carnac Island in providing seabird rookery habitat, it will be particularly important to monitor for and remove weeds that compete with the native species and diminish habitat value (perennial and woody species pose a particular threat). One

woody weed species on the island, African boxthorn (*Lycium ferocissimum*) is an aggressive coloniser of islands and is removed by departmental officers during their regular patrols throughout the year. It is thought that if its removal from Carnac Island were discontinued, boxthorn would eventually dominate the vegetation, as silver gulls disperse its fruits (Abbott *et al.* 2000). Another weed species, arum lily (*Zantedeschia aethiopica*) also competes with native vegetation, and has the potential to become more prevalent, just as it is on nearby Garden Island. Both weed species should be removed from the island. Introduced mallows (*Malvaceae*) have the potential to create significant changes to habitat structure, and while these can be very difficult to eradicate, it will also be important to monitor the distribution and abundance of these on CINR and at least control their further spread.

An integrated approach to environmental weed management was developed in the *Environmental Weed Strategy for Western Australia (Department of Conservation and Land Management, 1999)*. Since the inter-relationship between soil disturbance, weed invasion and native plants is complex, weed control should be undertaken in a strategic and integrated manner with guidance from the *Environmental Weed Strategy*. However, weed management on islands can require a specific, local level of knowledge that may not necessarily be provided by the *Environmental Weed Strategy*, and consequently, weed control priorities will need to reflect this. On CINR for example, allowing mallows (which are not considered a significant threat in the *Environmental Weed Strategy*) to spread could significantly reduce suitable seabird habitat.

While rehabilitation of areas from which extensive patches of weeds have been removed can be difficult, it is important, and should be undertaken using seed and cuttings, which have been obtained from the island or nearby sources.

PROBLEM ANIMALS AND DOMESTIC SPECIES

Rabbits inhabited the island in abundance between 1827 and 1897 (Landor and Long, cited in Abbott *et al.* 2000), but were eradicated in 1969. Eradication of the rabbit is thought to have made a significant contribution to botanical change on the island, with vegetation density increasing significantly after its removal. The introduced house mouse also occurs on the island. Domestic animals can disturb wildlife and visitors, and introduce disease. In accordance with the CALM Regulations 2002, domestic animals are not permitted on Carnac Island.

FIRE

Most of Carnac Island is believed to have escaped disturbance by wildfire for at least 5000 years (Abbott *et al.* 2000) and hence provides a valuable example of coastal vegetation that has developed without this influence. According to Abbott *et al.* (2000), the influence of Aboriginal burning practices is not seen on the island as it is on the mainland, as Aboriginal people did not his-

torically access Carnac Island or other offshore islands of South-west Western Australia. In 1969 a portion of the island was burnt as part of the rabbit eradication program.

Strategies aimed at fire prevention are an important component of management of Carnac Island as fire control on islands poses particular difficulties. The relative isolation, difficult access, and strong winds present rather unique challenges for fire control.

The lighting of fires, use of portable barbecues/stoves etc is not permissible on Carnac Island. People unlawfully lighting campfires and lightning are the most likely causes of fire on Carnac Island. Given that the feasibility of actively suppressing fires on the island is low, fire management will rely heavily on educating visitors of the potential impacts of fire, and informing them of regulations prohibiting the deliberate lighting of fires in nature reserves. Further detail of actions required in the event of a fire on the island is provided in a Fire Response Plan covering the area.

ZONING

Managing access on the island is critical to avoid the impact of visitors on its ecological values. Section 62 of the CALM Act provides for the classification of lands into various categories (these are sometimes called zones). Three zones are proposed for Carnac Island: prohibited areas, limited access areas and temporary control areas. Prohibited areas are those which may not be entered except as authorised by the Executive Director of the Department of Conservation and Land Management, and then only to carry out activities pursuant to the plan. Limited access areas have conditions or limits imposed on their access. Temporary control areas are used for the purposes of public safety or the protection of flora and fauna for a period not exceeding 90 days, though it may be made more than once for the same purpose over the same area.

Unmanaged human use of CINR has the potential to damage key ecological values. However, the use of zoning as described above can assist in ameliorating any negative impacts of human use on the island and protect key values. Access restrictions can also provide for safer recreation use (e.g. by reducing risks of cliff collapses, snakebites etc). On the basis of the above, visitors will be restricted to using a limited access area (i.e. day use only) at the southern portion of the eastern beach (see Figure 2). The rest of the island is designated prohibited access. Inter-tidal areas are open to access with the exception of the western beaches. The prohibited access area of the north-eastern section of beach will be delineated from the limited access area with permanent field markers. Temporary control areas (and/or alternative legal mechanisms available under the CALM Act to facilitate temporary closure of an area) will be used on the island to provide temporary or seasonal protection to fauna. For example, a temporary control area could be used to protect seabirds nesting on the beach. The need for use of a temporary control area will be assessed on a case-by-case basis.

D MANAGING OUR CULTURAL HERITAGE

INDIGENOUS HERITAGE

The Aboriginal name for Carnac Island is thought to be Ngooloomayup. The Nature Reserve forms part of a registered Aboriginal site under the *Aboriginal Heritage Act 1972* (site type: mythological).

Several Nyoongar dreaming stories are associated with local coastal environments, including offshore islands such as Carnac.

In 1832 three Aborigines including Yagan, a tribal leader, were imprisoned on the island in the care of RM Lyon and a number of soldiers for allegedly killing one of the European settlers. Their confinement lasted only a few weeks as the prisoners escaped in a stolen government stores boat.

NON- INDIGENOUS HERITAGE

Carnac Island has served as a prison, a whaling enterprise, and a quarantine station. It was originally named Bertholet Island by French explorers in 1801, and was renamed Carnac Island in 1827 by Captain James Stirling after his First Lieutenant, John Carnac. When Stirling later returned as Lieutenant Governor with the first settlers of the colony, his ship the *Parmelia* ran aground on the sand bar that runs between Woodman Point and Carnac Island. Twenty-nine passengers spent five days on the island while the ship was retrieved.

One of the first two whaling enterprises in Perth waters was established on Carnac Island in 1836-37. The whalers brought and transported Perth's first church to serve as a store. The whaling station closed a few years later after the loss of several lives, damage to boats and frequent theft of their supplies.

In 1884, the State Government gazetted Carnac Island as a quarantine station for the Port of Fremantle. Although several buildings were constructed, the island is thought to have never been used for this purpose. The Commonwealth acquired the island for defence purposes in 1916, but transferred it back to the State in 1961 (Byfield 1989).

E MANAGING RECREATION AND TOURISM

VISITOR ACCESS

Appropriate access on Carnac Island is designated through the implementation of the measures outlined in *Zoning* (in Section C). In addition, in order to reduce the safety risks to sea lions and to maximise the area of beach available for haul out, vessels will not be permitted to anchor on the island. The potential for disturbance to sea lions by vessels mooring near the prohibited

access area of beach may arise and hence visitor education should discourage the mooring of vessels close to hauled out sea lions. Nonetheless, it may become necessary for the Department to liaise with the Department for Planning and Infrastructure to investigate formal strategies to prevent such disturbance (e.g. mooring and anchoring controls).

RECREATIONAL USE AND OPPORTUNITIES

Carnac Island's proximity to and ease of access from the mainland makes it a popular focus for recreational pursuits, particularly on weekends and public holidays. The eastern side of the island provides a sheltered anchorage for commercial and recreational boats. Some boats will also occasionally shelter in the bay north east of South West Rock.

Certain biological and physical features of Carnac Island, such as its relatively thick vegetation, rocky cliffs and the presence of tiger snakes have imposed natural restrictions on which areas have been used for recreational pursuits. As a result, recreational activity has generally concentrated on the sheltered eastern beach.

The eastern beach is also the favoured haul out area for the island's sea lion colony, and the opportunity to view these animals is a significant attraction to visitors. The area of beach on the island varies with the natural erosion and accretion processes occurring on an annual and seasonal basis. The potential for negative impacts on sea lions as a direct result of human use in such a limited space is exacerbated by the increasing number of visitors.

Although Carnac Island is reserved primarily for nature conservation, passive recreational activities that do not impact on nature conservation values are permitted. It is recommended that these activities be limited to the areas of eastern beach as described in *Zoning* (in Section C). Active sports such as cricket, football and other ball games are not permitted. The use of beach umbrellas and small sun-shelters, whilst not encouraged, is considered relatively benign and hence will be permitted at this stage. However, the use of these items may be prohibited in the future if they are considered to be having a significant impact on the island's fauna (e.g. interfering with sea lion's use of the beach).

Litter can provide major hazards for island fauna as well as having negative impacts on aesthetics. There are no facilities provided for the disposal of litter on the island, and it is illegal to leave litter behind. Even so, litter such as flotsam and jetsam and beer cans/bottles are occasionally found on the island and therefore regular refuse collection is required. Ensuring that visitors are educated about the potential impacts of litter in marine environments is important to try to reduce inappropriate behaviour.

While the education of visitors and access restrictions will be helpful in managing visitation, it may become necessary during

the life of the plan to place restrictions on the number of visitors to Carnac Island if there are associated impacts that degrade the island's ecological values. Restrictions on the number of people on commercially conducted tours are already in place (see *Commercial Operations*). A variety of restrictions on visitation in general (i.e. regardless of an association with a tour party) may also need to be considered if negative impacts of recreational activity become evident. Such restrictions may, for example, occur as seasonal closures of the island, limiting visitation to seasonally operated guided tours or prohibiting access where there are severe threats or where impacts cannot be reasonably managed.

The attraction of Carnac Island is its relatively undisturbed and undeveloped state and the visibility of its wildlife, in particular sea lions and seabirds. The installation of further formal facilities for visitors (e.g. bins, toilets, and shelters) would detract from this value. Information brochures should inform visitors of the limits of facilities on the island.

COMMERCIAL OPERATIONS

Any commercial tour operator who takes or allows passengers onto Carnac Island must have a commercial activity licence under the CALM Act and must abide by the associated licence conditions. These conditions currently include, for example, limits on the number of passengers permitted on the island, requirements for data collection, and prescribed distances to be maintained from sea lions. These licences are not permits for sea lion interactions, as the issuing of wildlife interaction licences is administered under the Wildlife Conservation Act. Furthermore, wildlife interaction licences pertinent to Carnac Island (e.g. licences for boat-based interactions with sea lions) do not allow operators to take passengers onto the island.

To enable assessment for impacts of commercial tourism operations on fauna such as nesting/roosting seabirds, sea lions and the near island benthic marine communities, it is important that a monitoring program be established to collect baseline information about the island's natural environment. The information derived will contribute to assessments of the impacts of commercial operations and recreational users. Monitoring will be ongoing and, if the level of commercial tour activity is found to be beyond sustainable levels, appropriate action will be taken to amend the situation.

The Department issues two types of licences—'T' Class (no immediate limits on the number of operators) and 'E' Class (limited number of licences issued due to environmental or management issues). It is recommended that only 'E' Class licences be issued in consideration of Carnac Island's physical size and its high conservation value. These would only be issued following a public 'Expression of Interest'. Licences to access the island will only be issued where they are consistent with the management plan and where they do not compromise the island's values. Commercial operators conducting activities on

the island will also be required to become accredited under the National Ecotourism Accreditation Program (NEAP) or an equivalent accreditation program.

VISITOR SAFETY

Factors such as difficulty of access, potential hazards from Australian sea lions and tiger snakes, and the danger of fragile and undercut cliffs present a considerable degree of risk of injury to visitors. The Department has a legal responsibility to consider the personal safety and welfare of visitors to the land it manages by implementing measures that are reasonable and prudent in the context of the hazard, intensity of visitor usage and character of the site. Measures such as the access plan described in *Zoning* (in Section C) will greatly assist with minimising visitor safety risks, as will the implementation of a visitor risk management program. These approaches are consistent with the Department's *Visitor Risk Management Policy Statement 53*.

The provisions of the *Wildlife Conservation (Close Season for Marine Mammals) Notice 1998* introduced to protect sea lions from human interactions, have the added advantage of helping to reduce risks to visitor safety.

F INVOLVING THE COMMUNITY

INFORMATION, EDUCATION AND INTERPRETATION

Carnac Island Nature Reserve provides a valuable opportunity for improving community awareness about island ecosystems. An effective information, education and interpretation program is vital to achieve the vision and objectives for the management of the island. Such a program informs the public of the attractions and opportunities available, and assists the community to appreciate and understand the natural and cultural environments. Such programs should also foster a sense of community ownership of the island, engender support for its management, and encourage appropriate behaviours that minimise adverse impacts on the environment.

Education and interpretation programs will concentrate on raising awareness about the island's conservation values, potential human impacts, the land classification scheme (see *Zoning* in Section C) and other rules to be observed on the island, and the positive actions visitors can take to support island management.

WORKING WITH THE COMMUNITY

Community involvement is an integral component of the Department's operations. The community, as groups or individuals, is encouraged to be involved in both the planning and implementation of many of the Department's activities. Prior to

the preparation of this final management plan for Carnac Island, a community advisory committee was established to allow further community input into management planning for CINR and foster community ownership. The use of volunteers to assist with implementation of the management plan may also be appropriate and the development of volunteer programs to assist with activities such as monitoring and weed management (for example) should be considered. Further opportunities for the community to be involved in managing the island may also be possible through community advisory committees that are established to consider regional level issues.

G MONITORING AND IMPLEMENTING THE PLAN

The strategies outlined in this management plan will be built into the works program of the District responsible for the day-to-day management of CINR.

The Department is responsible for providing periodic reports to the Conservation Commission to allow it to assess the success of the Department's management in meeting the KPIs. The frequency of these reports will depend on the requirements of each KPI, the satisfactory establishment of baseline Information against which to audit, and any unforeseen changes to the environmental conditions. If the Commission determines that, based on the KPIs, values of the planning area are being degraded, they may instruct the Department to:

- alter its management to better address threats,
- change the objective in this management plan where it is considered unrealistic, or
- change the KPI where it is considered unrealistic.

The Carnac Island Nature Reserve management plan will be current for a period of 10 years from the date of approval by the Minister for Environment and Heritage. However, if the plan is not revised after 10 years, it will remain in force unless it is either revoked by the Minister, or a new plan is released. Revision may be required sooner than 10 years in the light of significant, improved knowledge. If any proposed revisions are contrary to this management plan, it will be amended through a public consultation process.

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Carnac Island Nature Reserve: Management Summary

Objective and key points	Strategies	Key Performance Indicators (KPIs)
<p>ZONING Objective: To implement the land classification (<i>Zoning</i>) scheme for the island within six months of implementation of the plan.</p> <p>Key points:</p> <ul style="list-style-type: none"> The application of prohibited and limited access areas on CINR will assist in the protection of the island's geomorphology and flora and fauna from human visitation impacts and also reduce the risks to visitor safety. Temporary control areas can be used to provide seasonal protection to fauna. 	<ol style="list-style-type: none"> Initiate appropriate notices under Section 62 of the CALM Act to implement the proposed land classification scheme for the island (see Figure 2). Provide appropriate information for visitors and stakeholders regarding the land classification scheme. Initiate appropriate notices under Section 62 of the CALM Act to implement temporary control areas (and/or utilise alternative legal mechanisms available under the CALM Act, to facilitate temporary closure of an area) where deemed necessary. 	
<p>GEOLOGY and GEOMORPHOLOGY Objective: To conserve the structural complexity of the island's geological features.</p> <p>Key points:</p> <ul style="list-style-type: none"> Collapses of the island's fragile limestone structures may be exacerbated or caused by human activities and can be a significant safety hazard. Current human pressures on this value are minimal as the presence of tiger snakes discourages visitors from leaving the beach area. 	<ol style="list-style-type: none"> Apply access controls as per <i>Zoning</i>. Rehabilitate eroding areas as necessary. Provide information for island users about the ecological importance and fragility of the island's geomorphology. 	
<p>VEGETATION Objective: To conserve indigenous plant species and communities (particularly threatened or priority species and communities with significant habitat value).</p> <p>Key points:</p> <ul style="list-style-type: none"> There are no known threatened flora species or plant communities on CINR. There has been a significant increase in the proportion of exotic species in the island's flora over time (currently 63 per cent). A primary value of the native plant communities on CINR is the provision of habitat for a diversity of seabirds. Invasive perennial weed species (e.g. African boxthorn, arum lily and introduced mallows) pose a significant threat to the island's conservation values. The occurrence of tiger snakes on CINR makes the spread of weeds via human transportation unlikely. 	<ol style="list-style-type: none"> Identify and protect flora that is rare, unique or in need of special consideration. Apply access controls as per <i>Zoning</i>. Establish a monitoring program to measure and record weed invasion and loss of native vegetation. Implement weed removal programs in accordance with the <i>Environmental Weed Strategy for Western Australia</i>, or as otherwise deemed necessary, where weed invasion threatens the island's values (e.g. African boxthorn, arum lilies and introduced mallows). Implement a rehabilitation program (using seeds sourced from the island) to re-establish a woody native vegetation structure that can provide habitat for a diversity of fauna (and a range of seabirds in particular). Provide information to island users about the importance of the island vegetation and potential human impacts on this. 	<ul style="list-style-type: none"> Restoration of woody and succulent native shrub cover to those little penguin and wedge-tailed shearwater colony areas mapped in 1979 (Dunlop and Storr 1981). Increase in the area of woody and succulent native shrub habitat elsewhere on the island from 2003 levels. Eradication of boxthorn and arum lily from CINR during the life of the plan. No decrease in the area of preferred seabird breeding habitat due to introduced mallows.
<p>RECREATIONAL USE Objective: To ensure that the passive recreational activities that are permitted on CINR do not compromise the island's conservation purpose.</p> <p>Key points:</p> <ul style="list-style-type: none"> The island's primary importance is for the conservation of fauna. The eastern beach is a focus for passive recreational activities (e.g. nature appreciation). The education of island visitors is crucial in managing visitor behaviour on the island. 	<ol style="list-style-type: none"> Progress the removal of 'recreation' from the purpose of the reserve. Apply access controls as per <i>Zoning</i>. Issue only 'E' Class licences to commercial tour operators. Monitor visitor use patterns through the formal collection of data (e.g. records of visitor and vessel numbers, and types of recreational use). Liase with the Department for Planning and Infrastructure about the investigation of mooring and anchoring controls that are necessary to prevent disturbance to sea lions. Provide information, education and interpretation opportunities to assist visitors to appreciate and understand the natural and cultural environment. Implement visitor risk management program. Conduct staff patrols to coincide with peak visitation times as much as possible, to facilitate visitor education and discourage inappropriate behaviour. 	

NATIVE ANIMALS AND HABITATS

Objective: To conserve indigenous fauna on CINR with an emphasis on 'specially protected' fauna.

Key points:

- Australian sea-lions are listed as 'specially protected' under the Wildlife Conservation Act.
- CINR is one of the most important haul out sites for male sea-lions in the metropolitan area, and the retention of metropolitan haul out sites is important to the survival of the entire west coast population.
- CINR is an important breeding site for a variety of seabirds.
- Generally, only seabirds that nest on or near the beaches of CINR are at risk from human disturbance.
- Continued increase in the number of pied cormorants nesting on CINR may have a detrimental impact on other seabirds breeding on the island.
- Introduced perennial weed species pose a significant threat to the habitat used for seabird breeding.

- 1) Apply access controls as per *Zoning*.
- 2) Inform visitors regarding guidelines (appropriate and inappropriate behaviour) for viewing sea-lions and the requirements of the *Wildlife Conservation (Close Season for Marine Mammals) Notice 1998*.
- 3) Implement strategies for weed monitoring and control, and habitat restoration, as described in section entitled *Vegetation*.
- 4) Protect native fauna from introduced predators through appropriate control regimes.
- 5) Conduct regular surveillance of the eastern beach for nesting sites of fairy terns, caspian terns and other species with low nest site fidelity, and utilise access control mechanisms (see *Zoning*) as necessary.
- 6) Establish and implement (or facilitate implementation by tertiary institutions or other agencies) an integrated research and monitoring program that will aid management of CINR. Specific monitoring and research requirements include three main areas:
 - a) Sea-lions (e.g. population ecology and dynamics; and indicators of, or responses to, disturbance).
 - b) Seabirds (e.g. population ecology and dynamics of selected species, critical approach distances; the use of artificial cormorant nesting sites; influencing fairy tern nest-site selection; habitat restoration).
 - c) Visitors (e.g. visitor behaviour and use patterns and potential impacts on the island's indigenous fauna).
- 7) Implement changes to management regimes if the review of data obtained from research and monitoring programs reveal significant negative impacts on wildlife populations.
- 8) Support the preparation and implementation of recovery plans for any threatened fauna species that are identified on the island.
- 9) Liaise with Department for Planning and Infrastructure regarding the possibility of mooring/anchoring controls etc to protect island fauna if necessary.
- 10) Seek to develop and/or support a coordinated approach to planning, monitoring and management of key fauna groups and their habitat across the Shoalwater-Garden-Carnac-Rottneest island chain (eg sea-lions, invasive weeds).

- Decrease or no increase in the number of reported disturbances or Wildlife Conservation Act breaches regarding sea-lions on Carnac island.
- Human disturbance does not interfere with the successful completion of nesting attempts by seabirds most sensitive to human disturbance (e.g. fairy, caspian and crested terns).
- The number of seabird species breeding in the region is stable or increasing.

PROBLEM AND DOMESTIC ANIMALS

Objective: To prevent, and where possible, negate the impact of introduced animals on the island's ecosystems.

Key points:

- Few introduced fauna species have been recorded on the island.
- Rabbits were successfully eliminated from the island in 1969.
- Domestic animals are a potential threat to the ecological values of CINR.

- 1) Monitor for the presence of introduced species on the island.
- 2) Implement measures to eradicate introduced species from the island, where their impacts on ecological values are known or found to be negative.
- 3) Provide information for island visitors about the impacts of animal introductions on ecological values.
- 4) Inform visitors that CALM Regulations prohibit domestic animals in nature reserves.

- No increase in the number of introduced animal species from 2003 levels.

FIRE

Objective: To minimise the potential for human-caused fire and safeguard against habitat loss as a result of fire.

Key points:

- CINR is significant in that it is thought to have escaped wildfire for thousands of years.
- Frequent burning could alter the island's vegetation structure from shrublands to grasses and weeds. This would affect the habitat available to fauna and further increase the risk of fire.
- Fire control on islands poses particular difficulties and hence management strategies aimed at prevention are particularly important.

- 1) Provide information to island users of the impact that fire can have on the island values and visitor safety, and that the lighting of fires is prohibited.
- 2) Document the occurrence and effects of any fires that do occur on the island.
- 3) In the event of fire on the island, undertake direct suppression response wherever possible.
- 4) Rehabilitate fire-affected areas where necessary.
- 5) Develop and maintain a Fire Response Plan for CINR.

- No wildfires on CINR over the life of the plan.