REVIEW OF ENVIRONMENTAL IMPACTS OF WATER-BASED TOURISM AT MONKEY MIA

Submitted to the Executive Director, Department of Conservation and Land Management

by

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7 November, 1996

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ENVIRONMENTAL IMPACTS OF WATER-BASED TOURISM IN SHARK BAY MARINE PARK ADJACENT TO MONKEY MIA

I. INTRODUCTION

Within a few decades, commercial tourism at Monkey Mia, Shark Bay, has developed from a commercial caravan park to an up-market beach-side resort. In the 1970s, attention was drawn to the daily interaction between people and a group of wild dolphins which visited the beach. Recognising the potential of this situation, the local Shire and the State Government tourism authorities established a visitor centre at the site and promoted the dolphin-human interaction as a tourist resource. The promotion was an immediate success, to the extent that Monkey Mia quickly became an international tourist destination.

In the 1980s a sealed highway was constructed to Denham, and later to Monkey Mia, and the area became accessible. The classic environmental management dilemma ensued with increasing access to the resource. The State Government response to this was to establish the Francois Peron National Park, the Monkey Mia Reserve, the Shark Bay Marine Park and the Hamelin Pool Marine Nature Reserve, with the objective of enhancing public access to and enjoyment of the area's natural attractions within the capacity of the environment to sustain it. The Commonwealth Government acknowledged the outstanding heritage values of the area by declaring it a World Heritage Area. By these means a management infrastructure was established.

A major planning initiative was undertaken, including a regional plan (State Planning Commission 1988, reviewed 1996), a Monkey Mia Reserve Management Plan (Department of Conservation & Land Management and the Shire of Shark Bay 1993), a Shark Bay fisheries management plan (Department of Fisheries 1994) and a Shark Bay Marine Reserves Management Plan (Department of Conservation & Land Management 1994). In essence, these planning programs defined the natural resources of the area and proposed means by which they can be both utilised and protected for the long term.

Commercial tourism in Shark Bay is a significant provider of services to the local community and international visitors seeking access to the natural resources of the area. It is also a significant "consumer" of those resources in the sense that it has the potential for deleterious impacts that threaten the long term viability not only of the resource but also of the tourism activity itself. In the terrestrial environment, managing commercial tourism activities at levels and practises that are sustainable, is customarily achieved by licensing.

Sustaining the resource by means of licensing and conditions on licences is a long established procedure in the management of commercial (and recreational) fisheries but it is a relatively new approach to the management of tourism in the marine environment. This review considers the observed and potential impacts of recreational activities and commercial tourism operations on the marine environment at Monkey Mia, attempts to set criteria by which the various activities may be assessed in terms of impact, and suggests administrative procedures that may be applied to the management of licensing in a fair and equitable manner.

Study area

For the purposes of this review, the term "adjacent to Monkey Mia" is applied to the waters of Red Cliff Bay and the Monkey Mia Lagoon, as delineated in a current study of flushing (D'Adamo 1996, figure 2).

II. MANAGEMENT

II.1 Legislation and Policy

Marine Parks are established, and their management plans (including zoning schemes) are proclaimed, under the powers of the Conservation and Land Management [CALM] Act. The parks are vested in a public, statutory body which, at present, is the National Parks and Nature Conservation Authority. The Department of Conservation and Land Management [CALM] is the principal management agency.

Certain activities in Marine Parks are regulated under the powers of the CALM Act. These include recreation and commercial tourism. Where necessary, these activities may be regulated under licences issued under the authority of that Act.

Other activities are regulated under other legislation, some of them managed by other Government agencies. Access to wildlife is regulated under the Wildlife Conservation Act, managed by CALM. Fishing (both recreational and commercial and including aquaculture) is regulated under the powers of the Fish Resources Management Act, managed by the Fisheries Department. Boating and the use of vessels in Marine Parks is regulated under the Western Australian Marine Act and managed by the Department of Transport. However, although a vessel is licensed by the Fisheries Department or the Department of Transport, access to the resources of the park may be licensed under the CALM Act as well if the vessel is used for commercial tourism charter purposes.

Inter-departmental structures and protocols are in place to ensure that appropriate liaison takes place between the Government agencies with management authority in Marine Parks and that unnecessary duplication does not occur.

In the course of this review it became apparent that inter-departmental procedures for liaison in relation to management of commercial tourism operations in the Shark Bay Marine Park has been less than fully effective. There have been instances where government agencies have made decisions and set policies without adequate consultation with others that have relevant authority. There is a need for better communication and collaboration between the State Government Departments involved (CALM, Fisheries, Transport) and the Shire of Shark Bay.

II.2 Management plans

The purposes for which marine parks are established include "fulfilling so much of the demand for recreation by members of the public as is consistent with the proper conservation and restoration of the natural environment, the protection of indigenous flora and fauna .....". Management plans are designed to achieve these purposes. The CALM Act (Part V) prescribes that the controlling body (at present the NPNCA) shall be responsible for the preparation of management plans for marine parks, the processes by which the plans are prepared and, in general terms, their content.

Preparation of management plans is a public process involving publication of drafts with opportunities for public comment prior to final approval by the Minister for the Environment. (The Minister for Fisheries must also approve any aspects relating to fishing.) It is standard practise for advisory committees to be appointed, including local community representatives as well as people with relevant technical expertise, to assist with the preparation of management plans.

Activities in marine parks, including commercial tourism operations that are subject to licenses, are normally covered in approved management plans. When there is no

management plan in operation, there are provisions for approval of activities that are considered to be necessary for the protection of the park's values or compatible with the purposes for which the park is managed.

An approved management plan for the Shark Bay Marine Park is soon to be issued.

II.3 Administration

Though the Fisheries and Transport Departments have statutory authority for certain activities in marine parks, CALM is the lead agency for marine park management and is responsible for implementation of the park management plan, including the administration of licensing of commercial tourism operations.

CALM has a regionalised administrative structure with a Head Office in Crawley, a Regional Office in Geraldton and a District Office in Denham. There is also a Marine Conservation Branch, a Wildlife Branch, a Planning Branch and a Parks Policy & Tourism Branch at various city locations, all of which are involved in aspects of marine park management and licensing. Thus, development and implementation of policy and management programs is complex and involves intricate internal liaison pathways even within the Department.

It is current practise for policy to be developed in Head Office and one or more of its branches. Licensing is also administered from Head Office. This is necessary so that there is Statewide consistency in policy and procedure. To be effective, however, especially with licensing, it is essential that there be local (Regional and District) input into the process.

As always with a complex, regionalist administrative structure like this, there is a risk of communication breakdown causing delays and the delivery of misinformation to affected parties. In the course of this review, such problems were observed and an unacceptable level of public confusion and dissatisfaction was experienced. There is a need for sharp protocols and procedures to be set in place to ensure prompt and consistent attention to the issuance of licences.

This problem is more complex in the Shark Bay Marine Park than at most locations because of the other agencies that are involved and the commitment to local public consultation. Besides the other Government Departments and the Shire, there are the proposed World Heritage advisory committees to consider. Although these bodies should not be involved in the hands-on decisions relating to the issuance of licences (in fact they must be at arms length from it) there are sure to be circumstances when they will need to be consulted about practical considerations. Administrative protocols and procedures must be developed that take these consultation pathways into account.

II.4 Types of recreational and commercial activities

This section discusses only activities that take place within the marine park, that is, beyond the high water mark. Activities that take place on the land within the Monkey Mia Reserve are not considered except those that are an essential part of marine activities, for example, storage and infra-structure support.

Types of existing and potential activities are listed and discussed below. The list is derived from discussions with interested parties and perusal of submissions received by CALM. Each activity is identified as either an independent, independent hire, or group activity, and whether or not it requires land based infra-structure support (summarised in Table 1).

The list has been collated with a similar one developed by the Shire of Shark Bay.

Operation of these activities is severely constrained at Monkey Mia by limitations of the site and their potential impact on each other and on the general amenity of the Reserve and the Resort. These constraints are discussed for each activity. (The environmental impacts of the listed activities, if any, are discussed separately in section III.3)

Site constraints relate principally to the bathometry of the area and the fact that close access (from the shore) to relatively deep water, required by most activities, is limited to little more than 100m of the beach. This same area is designated as the dolphin observation area which is undoubtedly, for both public and commercial reasons, the most important activity at Monkey Mia.

Some of the listed activities, though possibly environmentally benign and desirable in principle, are not compatible with the dolphin observation operation. Some of them require infra-structure support, such as over-night storage, which is not compatible with the aesthetics of the site, or which would result in unacceptable crowding on the beach adjacent to the dolphin observation area. Locating them either west of the dolphin observation area or east of the existing jetty (that is, by means of a zoning scheme), might resolve those problems but render the activities nonverbal. These matters are briefly discussed under the respective headings.

1. Dolphin-human interaction

This is the principal visitor activity at Monkey Mia. It is the basis of the tour-bus visits and is the principle objective of most of the resort clients. It is acknowledged as one of Shark Bay's most important nature-based tourism resources and has inestimable economic value.

Management of this activity is strictly managed with the prime objective of sustaining the activity indefinitely. (See Wilson, 1994 for a detailed discussion.) It is here assumed as a fundamental premise that all other recreational and commercial activities in the Monkey Mia area must be secondary to the dolphin-human interaction operation and that nothing is acceptable that puts it at any risk. The precautionary principle must apply.

2. Swimming

a) *Bathing*. Unfortunately, there is little space for swimmers at Monkey Mia. Swimming is prohibited in the dolphin observation area. West of that area the water close to shore is generally too shallow for swimmers, except during periods of high tide. East of the jetty conditions for swimming are reasonable but this is the location of the boat ramp and a popular area for angling.

Safety is an issue for swimmers at Monkey Mia. The lagoon beyond the dolphin observation area and beyond the shallow sills further west and east, is the primary boating channel. It is traversed by most power boats using the boat ramp and the jetty. There is little turning room for larger vessels docking at the jetty. Swimmers put themselves and the vessels at risk when swimming in that area.

There is also a significant danger from sharks in the lagoon. Large tiger sharks are frequently observed and shark attacks on the dolphins have been witnessed there. The practise of disposing of fish offal in the lagoon significantly increases this risk.

b) *Swimming with dolphins and dugong*. Swimming with dolphins is a popular activity at some other localities but it is not permitted at Monkey Mia. Swimming with dugong has been suggested as a possible attraction but has not been attempted on any scale.

This activity is classed as "harassment" under the Wildlife Conservation Act. Detrimental impacts of swimming with marine mammals is discussed in section III.3.2.4.

3. Snorkelling

Monkey Mia is not a good locality for snorkelers. The water of Red Cliff Bay and the lagoon is usually not very clear and there is little to see over the shallow seagrass banks and sand flats, that is, compared with coral reef areas at other locations. Snorkelling in the lagoon is subject to the same safety risks as swimming (see 2 above). It is not an appropriate activity in the dolphin observation area or in those parts of the lagoon which function as a boat channel and mooring area.

4. SCUBA diving

As for snorkelling. Although deep enough and calm enough for beginners, the water of Red Cliff Bay and the lagoon is not usually clear and there are no sites of particular interest. There may be potential for charter boats operating from Monkey Mia offering SCUBA diving elsewhere in Shark Bay.

5. Nature walks (at low tide)

The potential for this activity is not yet realised at Monkey Mia. At low tide the sand sills along the shore are readily accessible and those close to the Resort support a wealth of burrowing invertebrate animals. The large sand flat east of the jetty, that is, off the Monkey Mia spit, has an exceptionally rich and interesting fauna. There is potential for non-guided and guided walk trails, serviced by printed interpretation materials.

6. Canoeing

Canoeing along the eastern side of the Peron Peninsula would be an activity fitting the ethos of the marine park. The potential for harassment of dolphins and dugong could be a concern (see section III.3.4).

The hire of sea kayaks might be a commercially viable operation at Monkey Mia. There would be some concern about safety if the canoes were hired to inexperienced individuals, especially in extreme heat or strong offshore wind conditions.

Storage and security of canoes when not in use would be an issue. A site would need to be designated for that purpose west of the dolphin observation area but where the wide sand sill along the shore would be an inconvenience.

7. Aqua-bikes

Given the frequency of strong off-shore winds at Monkey Mia, the use if aqua-bikes would be hazardous. It would not be appropriate for them to be used in the lagoon in the vicinity of the dolphin observation area for both environmental and aesthetic reasons. Storage and security of the units when not in use would be an issue as they are large objects requiring allocation of a considerable area.

8. Sailing

Red Cliff Bay is an ideal site for sailing small craft. There is potential for the use of private craft and hire craft services at Monkey Mia although there are serious environmental constraints (see section III.3.4). Two types of sail craft have been considered previously:

a) sail boards (windsurfing);
b) small catamarans.

With limited space adjacent to the dolphin observation area storage and security of the craft when not in use would be an issue. A storage and launch site west of the dolphin observation area or east of the jetty could be considered.

9. Power boating

At present privately owned power boats are launched at the ramp on the east side of the jetty. Many of them belong to Resort guests and are moored or beached opposite the Resort west of the dolphin observation area. Most of the boats are used for recreational fishing.

Besides the environmental constraints (III.3.4), there are user constraints on the mooring and beaching of power boats at Monkey Mia. At present the most popular mooring/beaching area is adjacent to the dolphin observation area and is also used for swimming. Anchor and mooring lines are a source or some irritation to other users of the beach and there is a safety issue relating to the presence of the boats and swimmers in the same place. (See also notes under item 2 above in relation to swimmers in the lagoon boat channel.) Mooring poles on the flats and the beach are regarded by some as unsightly.

Consideration could be given to moving the mooring/beaching area further west although there would be greater inconvenience because of the wider sand sill there.

10. Para sailing

Red Cliff Bay is a suitable site for para sailing but there are serious environmental constraints (see section III.3.4).

11. Jet boating (jet skis)

Red Cliff Bay is a suitable site for jet skis but there are serious environmental constraints (see section III.3.4). In addition, the noise of this activity would be commonly regarded as unacceptable in the Monkey Mia situation.

12. Bare-boat charters

Bare-boat charters have potential in Shark Bay, although there would be constraints at Monkey Mia. The main constraint would be the limited space in the lagoon for mooring vessels when not in use (see also item 14 below). There is also a safety issue as the sailing conditions in Shark Bay (both the weather and the complexity of the bathometry) can be difficult and rescue facilities are limited.

Bare-boat charter vessels operating within the Marine Park would be licensed by the Department of Transport under the provisions of the WA Marine Act, subject to consultation with CALM.

13. Wildlife & scenic tours

Nature-based activities are basic to Monkey Mia as a tourist and recreational user destination. While many people prefer to "do their own thing" in this regard, there is a growing demand for guided tours. This applies particularly to marine wildlife and scenery where most visitors are not suitably equipped.

While the principal resource for marine nature-based tourism in the vicinity of Monkey Mia are the dolphins of Red Cliff Bay and dugong that pass by and sometimes dally on the offshore banks, there are other things to see, including turtles and seabirds and the coastal scenery. The pearl farm is a special case.

The potential for guided walk trails at low tide is discussed above.

a) *Sailing vessels.* At present an effective tour is available at Monkey Mia aboard a sailing catamaran, viewing dolphins and dugong in the wild, that is, off-shore in Red Cliff Bay and beyond. The activity is an important part of the Monkey Mia experience.

As this is such an important supplement to the visitor experience of dolphins at the beach, it is an activity that should be encouraged (subject to controls to ensure minimal environmental impacts). Licensing arrangements should ensure that the service is provided all year round and not solely during the peak season.

The question whether there is room for additional vessels providing this service, taking account of its environmental impacts, is discussed in section III.3.

There is potential for cruises originating from the Monkey Mia base sailing further afield in the eastern part of Shark Bay.

b) *Motorised vessels.* A motorised vessel is not an appropriate way to approach dolphins or dugong (unless for research purposes and under strict conditions) (section III.3.4). On environmental grounds, there is no potential for developing this activity in the close proximity of Monkey Mia. However, the docking facilities at Monkey Mia could provide support for tours that travel further afield in the eastern parts of Shark Bay.

c) *Glass bottom boat viewing.* There are limited opportunities for glass bottom boat tours at Monkey Mia because the underwater scenery is not spectacular. The present service that visits the pearl farm off Red Cliff depends on the farm operation itself as the prime attraction and viewing the seagrass communities (and dolphins and dugong along the route) are secondary. Additional services are unlikely to be viable.

14. Recreational fishing

Recreational fishing is a "traditional" activity at Monkey Mia. Fishers operate from the beach, from small vessels launched at the boat ramp, and from charter vessels based at the Monkey Mia jetty. Most recreational fishing vessels go out beyond Red Cliff Bay.

Regulations governing recreational fishing and charter boat operations within the Marine Park are administered by the Fisheries Department under the provisions of fisheries legislation, subject to consultation with CALM, and are not considered in this review. Aspects relating to the use of power boats in the vicinity of Monkey Mia are considered in item 9 above.

15. Sea transport

Few visitors come to Monkey Mia by sea. Nevertheless, two aspects treated under this heading are included here for reference.

a) *Hovercraft.* A hovercraft ferry service that operated between Carnarvon and Monkey Mia appears to have been unsuccessful and was discontinued after a trial period. As the Gascoyne tourism industry develops, such a service may be tried again. It has serious environmental constraints.

Passenger-carrying vessels within the Marine Park are licensed by the Department of Transport under the provisions of the WA Marine Act, subject to consultation with CALM.

b) *Moorings.* This is included here as an "activity" on the grounds that it has significant environmental impacts (III.3.4) and affects other users of the area. Vessels using permanent or semi-permanent moorings in the lagoon include those that operate tour services, commercial fishing vessels and private and research vessels "parked" for extended periods.

There is limited space in the lagoon which is also the principal access/egress channel for small vessels using the boat ramp and the jetty. There will be a limit to the number of additional moorings that can be installed without causing congestion.

Table 1. Existing and potential recreational marine activities (independent or commercial) at Monkey Mia. (Numbers in the first column are the same as those applying in section II.2 text.)

"independent" means operating independently and self-equipped;
"independent hire" means operating independently but using hire equipment;
"group" means a guided commercial operation run either by ticketing or charter;
"land support" means storage, docking, ticketing or other facilities.

Activity	independent	independent hire	group	land support
1. Dolphin-human interaction	-	-	*	*
2. Swimming	*	-	-	-
3. Snorkelling	*	*	*	-
4. SCUBA diving	*	*	*	-
5. Nature walks (at low tide)	*	-	*	-
6. Canoeing	*	*	*	*
7. Aqua bikes	-	*	-	*
8. Sailing				
a) sail boards (windsurfing)	*	*	-	*
b) small catamarans or mono-hulls	*	*	*	*
9. Power boating	*	*	-	*
10. Para sailing				
11. Jet boating	*	*	-	*
12. Bare-boat charters				
13. Wildlife & scenic tours				
a) sailing vessels	-	-	*	*
b) motorised vessels	-	-	*	*
c) glass bottom boat viewing	-	-	*	*
14. Recreational fishing	*	-	*	*
15. Sea transport				
a) hovercraft	-	-	*	*
b) moorings	*	-	*	-

III. ENVIRONMENTAL IMPACTS

III.1 Marine habitats and flora and fauna of the area

A conspicuous feature of the Shark Bay marine environment is the development of shallow sand sills comprising reworked, calcareous skeletal remains of invertebrates. In Red Cliff Bay the shore is bordered by a wide sill with oblique sand banks that are emergent at low tide (figure 1). This sill narrows down to nothing on the north side of the Monkey Mia spit where relatively deep water of the lagoon abuts the beach. South of the Monkey Mia spit there is a very wide sand sill, much of which is left bare at extreme low tide. Off the Monkey Mia spit there is a series of offshore banks which enclose the lagoon except for the broad opening to Red Cliff Bay in the north west.

The shore sill of Red Cliff Bay is steep sided, its slopes vegetated with seagrass (*Amphibolus* and *Posidonia).* The offshore banks tend to be slightly deeper, although there are some banks that are left bare at extreme low tide. Much of their surface is vegetated with dense seagrass meadows.

While the sand comprising the sills is relatively coarse, being constantly turned over by wave and tidal action (except where it is fixed by the growth of seagrass), the sediment of the floor of the lagoon consists of fine silt that appears to have a high organic content, presumably derived from the adjacent seagrass meadows on the sills. This suggests that water circulation within the lagoon is restricted, as should be expected given its partial enclosure.

Three broad habitat types may be recognised in the vicinity of Monkey Mia:

1. The shore sill of Red Cliff Bay

The sand of this area is fine but "clean" and is the habitat of a diverse community of burrowing invertebrates. They include a number of species of venerid and other bivalved molluscs, some of which are very abundant. At high tide fishes forage across the sand feeding on the invertebrates. The dolphins also make occasional forays over these shallows feeding on the fishes.

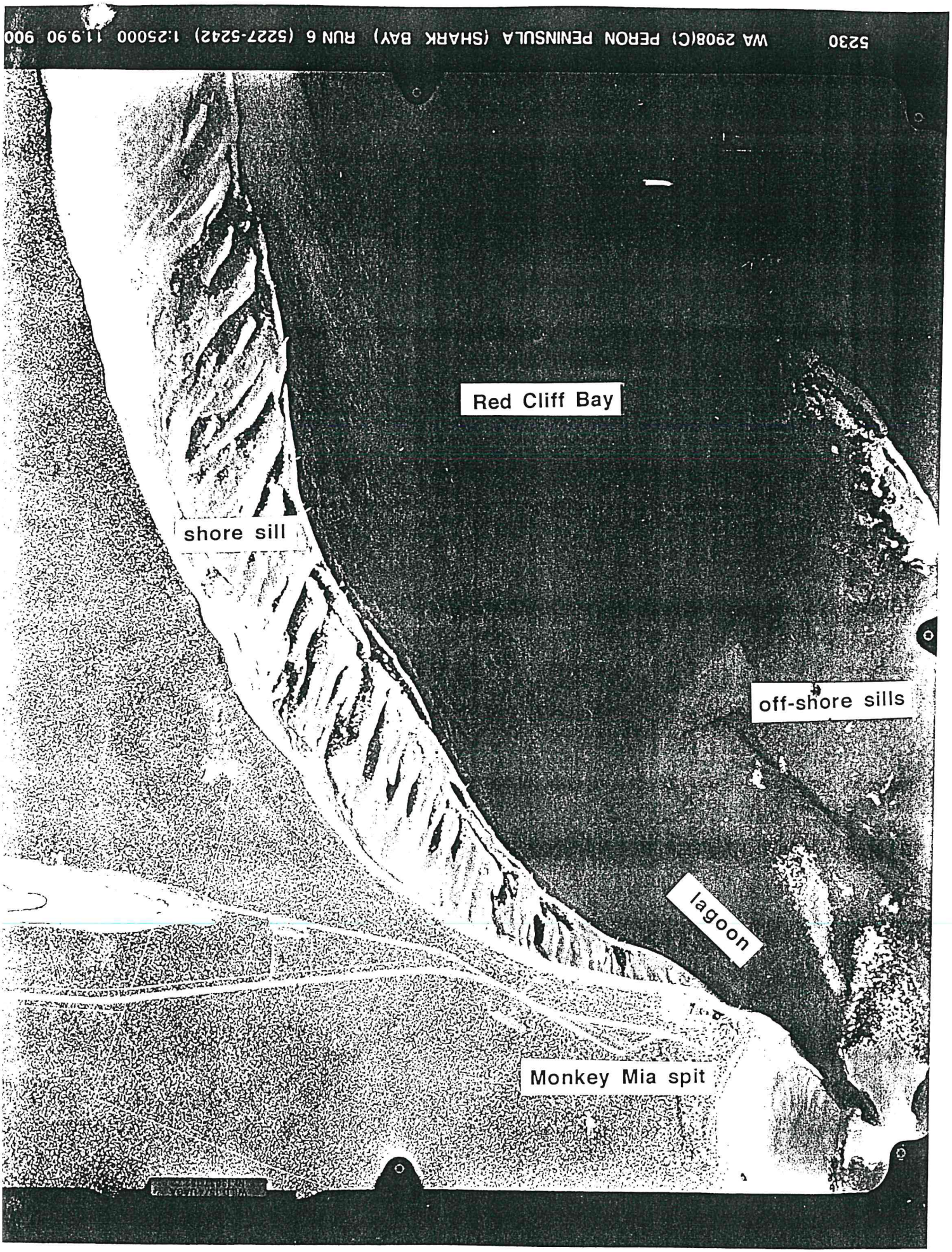
Between the oblique, emergent sand banks there are pools, a few centimetres deep, in which there are scattered clusters of the seagrass *Amphibolus* (figure 1). These carry an epifauna of herbivorous and detrital-feeding gastropods and provide shelter for a variety of other invertebrates and small fishes. The seaward edge of the sill also bears a fringe of seagrass, both *Amphibolus* and *Posidonia.*

Monkey Mia spit is a tombola of Holocene sand at the end of broad "corner" of the Pleistocene mainland. It has a southerly tail comprising an emergent sand bank bordering the blind end of the lagoon. The wide sill south of the spit is fringed with seagrass along its outer edge but does not have the oblique emergent banks that are such a feature of the Red Cliff Bay sill. In this area south of Monkey Mia there is a rapid increase in salinity.

2. Off-shore sills and banks

These tend to align north west-southeast, that is, parallel with the shore, and are separated by channels. In places they are at or close to extreme low tide level but, for the most part, they are sublittoral. Higher areas tend to be bare sand but most of their surfaces are covered in dense seagrass meadows.

The seagrasses carry a rich and diverse epifauna of herbivorous and detrital-feeding invertebrates and provide shelter for a very diverse and abundant assemblage of algae,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Red Cliff Bay
shore sill
off-shore sills
lagoon
Monkey Mia spit

Figure 1

fishes and benthic invertebrates. This is the principal habitat of the Shark Bay pearl oyster. It is also feeding ground for dugong.

3. Lagoon

The Monkey Mia lagoon is about 4-6 m deep with a silty bottom. It is broadly open to Red Cliff Bay in the north but blind-ending in the south. There is no information about its fauna and flora but it may be assumed that it supports a benthic infauna (burrowing) of invertebrates and some algae and some fishes. The floor of the lagoon grades into the bottom habitat of Red Cliff Bay which is an important feeding area for dugong.

III.2 Monitoring and research

Elsewhere in this report (III.4) it has been observed that managing to meet environmental quality objectives requires baseline data against which change, or lack of it, may be assessed. A comprehensive research program for Monkey Mia was recommended in an earlier report (Wilson 1994). Topics relevant in the present context are:

1. *Water quality.* Establish baseline data on the levels of salinity, temperature, heavy metals, nutrients, organics and hydrocarbons. Establish permanent sample stations in the lagoon and regularly monitor them. Reference stations should also be established elsewhere in the vicinity.

2. *Water circulation.* Determine basic circulation patterns and flushing cycles in the lagoon and beyond. [Already initiated.]

3. *Biodiversity and biomass.* Determine faunal and floral species community structure of key ecosystems in the vicinity of the Monkey Mia spit, namely: intertidal sand flats, lagoon bottom, seagrass meadows. Establish baseline data on species diversity, relative species abundance, and total biomass. Monitor selected species at permanent sites.

4. *Dolphin biology and behaviour.* Continue the current studies.

5. *Dugong behaviour and migration patterns.* Establish and maintain a data base.

6. *Impact of charter tour vessels on dolphin behaviour.* Establish and maintain a data base.

III.3 Threat analysis of recreational and commercial activities

The following threat analysis, in the form of an annotated classification (summarised in Tables 2 & 3) is based on past experience at Monkey Mia, observations of present circumstances, and consideration of potential threats taking into account the physical and biological characteristics of the habitats and key species. Not all these threats are posed by recreational or tourism activities. Those that are are noted at the end of each section.

The Western Australian Environmental Protection Authority and Department of Environmental Protection have drafted *Environmental Quality Objectives* (EQOs) and *Environmental Quality Criteria* (EQCs) for Perth metropolitan coastal waters (DEP in press). This important document is based on national policies relating to water quality guidelines (ANZEC, 1992). It would be useful to apply them to water quality at Monkey Mia and to other aspects of environmental protection as well.

The policies have a set of 5 principal objectives, that is:

* maintenance of biodiversity;
* maintenance of ecosystem integrity;
* maintenance of aquatic life for human consumption;
* maintenance of recreational values;
* maintenance of aesthetic values.

All of these objectives apply at Monkey Mia. It must be stressed that the maintenance of these values at Monkey Mia is not only a conservation matter but one upon which a valuable economic resource depends. Maintenance of the dolphin-human interaction and the pristine natural environment are the essential ingredients of visitor experience there.

Noting that some pollutants are naturally present in the marine environment and that there are critical (threshold) concentrations beyond which ecological degradation occurs, and that for others there is a natural assimilative capacity, the EPA acknowledged that EQOs and EQCs must be defined that are specific to each situation. Given the utmost importance of maintaining water quality at Monkey Mia, the EPA guidelines should be applied there in general but it is essential that threshold limits and criteria are determined that apply specifically to this locality.

In relation to Southern Metropolitan Coastal Waters, the EPA also recognised three classes of EQOs:

* *Class 1 - conservation zone;*
* *Class 2 - multiple-use zone;*
* *Class 3 - industrial buffer zone.*

Conservation zone was equated with Marine Nature Reserve, or Sanctuary Zone in Marine Park, in which the objectives should be no detectable change in water or sediment quality and no change in the abundance/biomass or diversity of biota.

Multiple-use zone was equated with Recreation, Special Purpose and General Use Zones of Marine Parks, in which detectable change in water and sediment quality would be allowed within specified environmental criteria, but without detectable change in the abundance/biomass or diversity of biota.

The Shark Bay Marine Park draft management plan (August 1996 version) proposes that the waters up to HWM within a radius of 800m of the north west corner of the Monkey Mia jetty will be a Recreation Zone with the specified objective to:

provide for a wide variety of recreation uses compatible with the protection of dolphins and the maintenance of the dolphin interaction experience.

The EPA water quality guidelines for Class 2 would thus apply to Monkey Mia, that is, with detectable change allowed within specified criteria. A management objective at Monkey Mia must be, at least, to set relevant criteria. However, given the known sensitivity of dolphins to pollution and the importance of maintaining the present situation there, it is here suggested that the EPA standards for Class 1 should apply, that is, the water quality objective should be no detectable change.

As noted above, the water quality guidelines provide a useful model that could be applied to other aspects of environmental protection. The same criteria could be applied, for example, to risk assessment of commercial tourism proposals.

III.3.1 Threats to habitat

1. Pollution

There is evidence (currently the subject of investigation) that there is limited water circulation (flushing) in the blind-ending Monkey Mia lagoon. If this is confirmed, it follows that there is a relatively high risk of pollution in the lagoon. Maintenance of water quality is of paramount concern.

There are two main potential sources of pollutants to the Monkey Mia lagoon.

i) *Beach seepage*

This issue relates to the development of infra-structure on the Monkey Mia Reserve and is not, strictly speaking, relevant to licences and conditions pertaining to the operation of recreation and commercial tourism activities. Nevertheless, because of its importance it is briefly discussed here.

Seepage of interstitial water is common along beaches where the water table intersects a beach slope. This is a feature of the Monkey Mia beach as much as elsewhere. Given the porosity of beach sands, the quantity of seepage water can be considerable (especially during periods of low tide) and pollutants may be readily transported from the adjacent supratidal lands to the intertidal zone of the shore.

Common sources of dangerous pollutants are nutrients used for fertilising lawns and gardens, toxic heavy metals and bacterial materials from sewage, and hydrocarbons from fuel tanks and pipes or surface spillage. All these are associated with human beachside activities, requiring special care and management.

There is a high potential for eutrophication of the lagoon waters through nutrient pollution derived from adjacent lawns and human activity. The lagoon (and adjacent seagrass meadows) may have a degree of assimilative capacity in respect of nutrient pollution but that capacity needs to be estimated and the nutrient load needs to be monitored to ensure that it is not exceeded to the extent that environmental degradation occurs.

Of greatest concern at Monkey Mia is the potential for bacterial pollution. Beach seepage and bacterial pollution derived from septic tank sewage was a suspected cause of the death of six beach-fed dolphins at Monkey Mia in 1989 (EPA 1989). That source of pollution was promptly removed by construction of a disposal facility well inland but the lesson learned was that the Monkey Mia situation is especially sensitive to pollution from beach seepage and must be closely monitored.

ii) *Oil & fuel spillage*

Direct spillage of oil and fuel into the sea is a common source of hydrocarbon pollution. Spillage most commonly occurs at fuel loading facilities, such as at the present jetty, and at

anchorages, boat ramps and launching areas. There is also significant hydrocarbon pollution from engine exhausts in areas where power boat traffic is high.

Hydrocarbons are known to accumulate and remain for extended periods in sediments, like those at the bottom of the Monkey Mia lagoon, which have a high organic content. This problem may be exacerbated when the bottom water is poorly flushed, as appears to be the case in the Monkey Mia lagoon.

The sensitivity of the various elements comprising the ecosystem at Monkey Mia to toxicants, including hydrocarbons, is unkown. Threshold levels need to be established and criteria set. Hydrocarbons in the lagoon sediment should be carefully monitored.

In the absence of set criteria and threshold limits, the precautionary principle should apply and management should endeavour to limit the potential for hydrocarbon pollution.

Ideally, launching and refuelling should be located elsewhere. Re-fuelling facilities should not be provided on the existing jetty (which is located near the end of the lagoon, that is, in the worst possible position). Power boats should be beached and moored west of the dolphin observation area and discouraged from traversing the length of the lagoon. Preference should be given to vessels powered by sail over those powered by motor

iii) *Sullage disposal*
Sullage should not be disposed of in the Monkey Mia lagoon where water circulation is limited. Even a single flushing event from an infected person could lead to contamination of the lagoon with a significant risk to the dolphins.

Vessels moored in the lagoon should be required to have sullage tanks which should be emptied only at sea.

Charter boats operating in Red Cliff Bay should also be equipped with sullage tanks but, if not, operators should instruct passengers that their toilets should not be used within the lagoon area.

2. Physical disturbance

i) *Jetty construction*
There are no data on natural long-shore transport of sediment at Monkey Mia but, anticipating that some may occur, jetty construction across the sand sills should be designed not to impede it. A groyne type jetty would have the potential to cause a change in the profile of the shore sill and lagoon with drastic consequences for the dolphin feeding area.

This issue does not relate directly to environmental impacts of recreation and commercial tourism, except that greater numbers of vessels would require improved and/or additional docking facilities.

On environmental grounds there are advantages in providing alternative docking facilities west of the dolphin observation area and closer to the mouth of the lagoon where there is less risk of pollution.

An alternative, western jetty would also reduce the boat traffic within the sensitive lagoon with positive safety and environmental advantages.

ii) *Moorings*
Permanent moorings with swinging chains can have severe, though localised effects on bottom profile and vegetation. In a restricted area like the Monkey Mia lagoon this would be a problem if there were a high density of moorings but the few that currently exist should not be a concern.

Permanent moorings on the shore sill, if at high density, may have a significant impact on the burrowing fauna and seagrass beds. Also, wallows develop around moored vessels stranded on sand at low tide and these may have significant effects on the burrowing fauna. The present practise of mooring small vessels over the shore sill close to the dolphin observation area should be discouraged.

Note the discussion in 1 (iii) recommending that moored vessels in the lagoon should be equipped with sullage tanks.

iii) *Channel dredging*
Channels dredged across the shore or off-shore sills could have significant local impact. Of most concern would be channels dredged across the off-shore banks which would have potential to drastically alter the water circulation.

[Not a recreation or commercial tourism issue.]

iv) *Propeller damage*
Constant passage of powered vessels over the sand and vegetated areas of shallow sills can have severe effects. Seagrass beds are especially vulnerable to direct damage by propellers as well as sedimentation caused by their disturbance.

The environmental impact of power boats driven at speed over the banks, especially from the south, in order to reach the lagoon anchorage and launching areas should be examined. If unacceptable damage is confirmed, management options are to impose speed limits and to confine boats to marked passages. The latter, however, may concentrate the damage to particular areas.

3. Excessive collecting/harvesting

The rich burrowing invertebrate fauna of the intertidal sand sills is at present a virtually unused resource. It includes many molluscs, crustaceans and echinoderms of potential interest to visitors. Low-tide walks on the sand-flats could be a popular activity.

Collecting should not be permitted on the flats in the vicinity of Monkey Mia. There are three gastropod species of particular concern. These are the direct-developing volutes *Melo amphora* (baler shell) and *Cymbiola nivosa* (snowy volute) and the giant conch *Syrinx aruanus*. Excessive collecting of most other species would not cause permanent damage to the intertidal communities because the majority of species have larval dispersal stages and their local populations would be quickly re-established with recruits from elsewhere. Nevertheless, if guided sand-flat walks are to be considered, the intertidal communities should be sustained without interference.

Some of the bivalved molluscs which are abundant on the sand-flats are currently harvested for eating or for bait. This activity should not be permitted in the vicinity of Monkey Mia.

4. Change in salinity/temperature
Monkey Mia is within the mesohaline zone of the eastern part of Shark Bay. There is evidence that the water of the lagoon has a higher salinity and temperature than that beyond the outer banks in Red Cliff Bay. This may be due to local evaporation and limited flushing, or to the influx of denser water from the more hypersaline areas of Lharidon Bight. In either case, the habitat of the lagoon could be significantly altered if there were natural or artificial changes to the bathometry in the vicinity of the Monkey Mia spit.

Great care must be taken with any activity, such as dredging channels or jetty construction, to ensure that no irrevocable changes to the lagoon's water flushing/circulation patterns are produced. The current hydrological study at Monkey Mia will provide useful information in this regard.

[Not a recreation or commercial tourism issue.]

5. Sedimentation

The sand sills and bathometry in the vicinity of Monkey Mia are subject to natural change but also sensitive to human activities such as jetty, boat ramp and channel construction.

i) *Seagrass mortality*
Seagrass is particularly vulnerable to silting brought about by frequent disturbance (for example, by power boats - see 2 (iv)) and to eutrophication which reduces light penetration. The health of seagrass meadows on the off-shore shallow sills should be monitored.

[Not a recreation or commercial tourism issue except in regard to propeller damage by power boats.]

ii) *In-fill of lagoon*
The lagoon is blind ending at present although there is evidence that it was once a channel open to the south. It may be vulnerable to in-fill by sand moving over the intertidal flats south of the Monkey Mia spit.

[Not a recreation or commercial tourism issue.]

Table 2: Threats to habitats

N.B. * numbers in the second column relate to those of text in section III.3.1;
* numbers in the third column relate to those in Table 1 and text in section II.2.1;
na = not directly relevant to recreation & tourism.

Habitat type	Vulnerable to	recr./tourism activity
Shore sills	1. pollution from:	
	i) beach seepage (esp.nutrients & sullage)	na
	ii) oil & fuel spillage (hydrocarbons)	9; 10; 11; 12; 13b; 13b; 15
	2. physical disturbance by:	
	i) jetty construction	na
	ii) moorings	na
	iii) channel dredging	na
	3. excessive collecting/harvesting	5
	4. change in salinity/temperature	na
Off-shore sills - a) seagrass meadows b) sand banks	1. pollution from:	
	ii) oil & fuel spillage (hydrocarbons)	9; 10; 11; 12; 13b; 13c; 15
	2 physical disturbance by:	
	iii) channel dredging	na
	iv) propeller damage	9
	4. change in salinity/temperature	na
	5. sedimentation causing:	
	i) seagrass mortality	na
Lagoon	1. pollution from:	
	i) beach seepage (esp. nutrients & sullage)	na
	ii) oil & fuel spillage (hydrocarbons)	9; 10; 11; 12; 13b; 13c; 15
	iii) sullage disposal	12; 13; 15b
	4. change in salinity/.temperature	na
	5. sedimentation causing:	
	ii) in-fill of lagoon	na

III.3.2 Threats to key species

Besides the impact of habitat damage (III.3.1) there are threats that apply directly to key species.

1. Pollution

Some key species are particularly vulnerable to certain kinds of pollution.

Dolphins are known to be very susceptible to bacterial infection, especially from human sewage. Given the high level of human contact, the proximity of human dwellings, and the restricted water circulation of the lagoon, the provisioned dolphins are at risk of infection at Monkey Mia [see III.3.1 1 (i)]. Dugong may also be susceptible but they have less exposure to this potential risk.

It has been suggested that toxicants from swimmers' body creams and hydrocarbons from fuel spillage and power boat exhausts may have detrimental effects on the dolphins. Any such effects would be minimised if swimmers were not permitted in the dolphin viewing area and if power boat traffic through that part of the lagoon was limited. These actions are proposed for other reasons and this source of pollution is not considered to be of major concern.

2. Shark attack

Shark attack is a significant cause of infant mortality in dolphins. This is probably the case for dugong as well. The risk of shark attack to juveniles is believed to be increased where normal social structure is disturbed (Wilson 1994). It is an important consideration in the matter of feeding dolphins and swimming with dolphins and dugong (see item 4 below).

3. Physical damage by vessels

There are many recorded cases of injury to both dolphins and dugong by vessels. These animals are normally capable of avoiding vessels but there may be difficulties when the vessel is fast moving. Fast-moving but silent sail boats are particularly dangerous.

There is anecdotal evidence that dugong hear boat engines that are slow revving but that they are less able to detect the high pitched sound of outboard motors running at high speed.

Strict speed limits must apply to vessels passing through the lagoon. The ever-present risk of injury to dolphins and dugong from fast-moving power boats in Red Cliff Bay should not be exacerbated by commercial recreational activities involving high speed vessels, especially silent sailing vessels such as wind surfers and small catamarans. The potential for high speed collisions with marine mammals in Red Cliff Bay is also a human safety issue.

4. Disturbance to normal behaviour

i) *Harassment*

Direct harassment occurs when humans approach animals in the wild in such a way that they disturb their normal activities, such as social interaction, mating, resting or feeding.

Birds.
Obvious examples:

* people putting to flight seabirds resting on tidal flats during periods of low tide;
* power boat drivers charging at swimming cormorants.

When such harassment occurs frequently it will result in the birds avoiding the area.

Marine mammals.
Observation of dolphins and dugong going about their everyday affairs at sea is a popular activity of visitors to the area, including commercial tours, but will have detrimental consequences if overdone.

There is a set of guidelines for observation of marine mammals at sea to which individuals and charter operators are expected to follow. Vessels are obliged to restrict speed and approach these animals only to within specified distances. Close contact with the animals must be limited to brief periods.

Individual dolphins sometimes initiate contact with humans themselves. However, at other times while they are feeding or socialising with their own kind, contact is avoided. Approaching them at those times may disturb their normal activities. If this is done too frequently or too aggressively, it may seriously disrupt the population. As the Monkey Mia dolphin group inhabits a restricted territory in Red Cliff Bay, there is a limit to how much interference they can tolerate.

A particular problem at Monkey Mia is the current practise of people swimming out beyond the no-swim area where the dolphins may be intercepted as they come and go from the interaction area. This activity, though well intentioned, has been shown to disturb the animals, including separating calves from their mothers and interrupting feeding and socialising (Dr Janet Mann, pers. comm.). The practise should be discouraged.

Swimming with dugong has also been proposed as an interesting and harmless activity. The assumption that the docile dugong are not "harmed" by close contact is based on a lack of understanding of their habits. Dugong are probably more vulnerable to disturbance than dolphins (Prof. Paul Anderson, pers. comm.). These animals graze on plants on the sea floor. The favoured plants are patchily distributed and not abundant (i.e. not the seagrasses of the banks). The animals spend much time searching for food. They do not echo-locate and rely on sight. A dugong will respond to a swimmer by approaching to make a brief visual investigation and then quietly leave. Thus, although the contact may seem benign, it is actually severely disturbing to the animal.

ii) *Noise*
There is a large literature on the effects of noise on marine mammals (Richardson *et al.* 1995). Cetaceans, including dolphins, do most of their hunting by means of echo-location. Too much noise from vessel engines can be disruptive. Dugong are more shy than dolphins and tend to move away from boat engine noise - obviously, this is undesirable at Monkey Mia where dugong are an important attraction.

Viewing dolphins and dugong in the wild is better done from sailing from vessels than motorised vessels.

iii) Feeding
It is well documented that artificial feeding wild animals, though well intentioned, eventually results in disruption of natural order in the animals' communities and other deleterious consequences. Previous inappropriate feeding management at Monkey Mia was implicated in higher than normal juvenile mortality (Wilson 1994). Feeding the dolphins at the beach has become a valued feature of visitor experience but is now strictly regulated. Feeding dolphins from boats is prohibited.

Fish feeding is a common and popular activity at many marine tourist locations. Although fish feeding also undoubtedly has deleterious consequences, there is less public concern about it. Whether or not the practise was regarded as acceptable in principle, it should not be permitted in the Monkey Mia lagoon because of the risk of pollution.

5. Drowning in fish nets
Drowning in fish nets is a common cause of mortality in marine mammals. There have been cases of dolphins being caught in nets at Monkey Mia, though no confirmed cases of mortality from that cause - relates to the commercial fishing industry.

[This is not a recreational or commercial tourism issue.]

6. Reduced food stocks
Food is a primary resource limiting many populations of wildlife. It is of particular concern for animals such as the dolphins which have limited territories and where humans directly compete for the same resource.

The preferred food of the Monkey Mia dolphins is under investigation. At present there is no information on whether recreational and commercial fishing is competing with them for the same species. Although not currently of concern, this matter should be monitored.

The same issue relates to the seabird populations of the area.

Dugong feed mainly on seagrass. It is conceivable that their food resource could become limiting in the Monkey Mia area if there were pollution affecting the seagrass meadows.

7. Hunting
All seabirds and marine mammals are protected under the provisions of the Wildlife Conservation Act. An exception is the right of Aboriginal people to hunt dugong and turtle for food and cultural purposes.

[This is not a recreation or commercial tourism matter.]

[NB. By a quirk of the English language, "hunting" is a term used applying to birds and mammals while "fishing" applies to the same process in respect of fish - see below.]

8. Over harvesting-collecting
This issue applies to fishing and to the collection and gathering of invertebrates and is discussed in section III.3.1. 3. These activities are regulated under fisheries legislation and are not considered this review.

Table 3: Threats to key species

N.B. * numbers in the second column relate to those of text in section III.3.1;
* numbers in the third column relate to those in Table 1 and text in section II.2.1;
na = not directly relevant to recreation & tourism.

Key species	Vulnerable to	recreation/tourism activities
D. Dolphins	1. pollution, esp. from bacterial infection	1; 2; 12; 13; 15b
	2. shark attack	1
	3. physical damage by vessels	8a,b; 9; 10; 11; 15a
	4. disturbance to behaviour/feeding activities	
	i) harassment	1; 2; 3; 6; 7; 8a; 12; 13a,b,c
	ii) noise	9; 10; 11; 15a
	iii) feeding	1; 6; 9; 12; 13a,b,c; 14
	5. reduced food stocks (eg. over-fishing)	14
	6. drowning in fish nets	na
E. Dugong	1. pollution	1; 13; 15b
	2. shark attack	-
	3. physical damage by vessels	8a,b; 9; 10; 11; 15a
	4. disturbance to behaviour/feeding activities	
	i) harassment	1; 2; 3; 6; 7; 8a; 12; 13a,b,c
	ii) noise	9; 10; 11; 15a
	5. reduced food stocks	-
	6. drowning in fish nets	14
	7. hunting	na
F. Seabirds	4. disturbance to behaviour, nesting etc.	5; 9; 10; 11; 12; 13a,b,c; 14; 15a
	5. reduced food stocks (eg. over-fishing)	14
G. Intertidal invertebrates	1. pollution of habitat	na
	2. physical damage to habitat	5; 9; 15
	8. over harvesting-collecting	14
H. Fish	1. pollution of habitat	na
	2. physical damage to habitat	na
	8. over harvesting-collecting	14

III.4 Licensing conditions as an approach to environmental protection

Licences for commercial tourist activities in marine parks are issued by CALM under the provisions of the CALM Act and the CALM Regulations. The licences contain conditions that ensure that the activity is sustainable and compatible with the management purpose. Two types of licence are issued:

Class T which are open access, that is, with no limit on the number of licences available;

Class E which are limited in number in order to protect the resource from over-use.

Class T licences are commonly issued on request but Class E licences are normally issued after public expressions of interest are called for.

Monkey Mia is an environmentally sensitive area where the considerable natural assets are at once both attractive and vulnerable to human enjoyment. The basic principle of management must be to maximise the enjoyment while sustaining the assets.

A principal asset at Monkey Mia is the clean, clear and spacious environment which provides a wilderness atmosphere in which the various activities take place. It can be validly argued that tight regulation of human activity is at odds with that atmosphere. Yet the popularity of the place and the commercialisation of its natural assets have already passed the point where the quality of the asset will suffer without control. For example, uncontrolled contact with the dolphins at the beach would certainly result in them choosing to go somewhere else or, as occurred previously, an unacceptable level of interference with their well-being.

In this situation, regulation of activities must be limited to the level judged necessary to protect the resource in perpetuity.

Regulation of individual activities, that is, those not performed in organised or directed groups, is best achieved by ensuring that users of the resource understand the impact of what they are doing and by informing them of ways to enjoy the resource without interfering with it or with the opportunities of others who may follow them. In other words, provision of information and interpretation materials is an essential part of management.

Nevertheless, it is necessary to impose some rules (and, ultimately, penalties for those who disregard them). The need for a no-swimming zone at the dolphin observation area is an example. Establishment of zones for specified activities is a standard means of regulating activities in Marine Parks, and is achieved under the powers of the Conservation and Land Management Act. Regulations proclaimed under fisheries and wildlife conservation legislation are used to control direct access to wild plants and animals. Permits are rarely used for this purpose.

Licensing is commonly used to exclude commercial activities that are considered to be unacceptable and to limit commercial tourism activities to levels that are sustainable in the long term. They are also used to impose conditions conducive to the same purpose.

Licence fees are set to recover costs of management and, in some cases, such subsidiary costs as research and promotion.

Criteria for granting licenses and imposing conditions at Monkey Mia

Two basic principles apply:

1. user equity, and
2. environmental quality must be maintained to acceptable standards.

User equity issues are beyond the scope of this review.

It is possible to determine environmental standards for recreational activities in the same way as water quality standards are set (see II.3.1.1). The same overall environmental quality objective should apply, *viz.:*

> *To maintain or enhance environmental quality for the widest possible range of environmental values while recognising the current and projected future uses (eg. recreation, industry etc.* (Department of Environmental Protection, 1996).

Acknowledging that Monkey Mia is to be designated as a Recreation Zone but one with particularly sensitive and vulnerable environmental values, appropriate environmental quality objectives would be to allow:

* no detectable change in water or sediment quality;
* no detectable change in the abundance/biomass or diversity of biota;
* no detectable change in the mortality rates of key species (dolphins and dugong);
* detectable change in social behaviour of key species (dolphins and dugong) but not exceeding specified quality criteria.

Proposals for concessions to run commercial tourism operations should be judged in terms of how they meet these quality objectives.

Each of these objectives requires that there must be baseline data against which change, or lack of it, may be assessed. The data base for water quality, biological diversity, marine mammal population dynamics and social behaviour is growing but is yet far from adequate for this purpose. Therefore the principles of precautionary and experimental management must apply. (Baseline research is also essential but that is another subject.)

Precautionary management means that where there is doubt about the environmental impact of an proposed activity, the decision regarding its approval should err on the side of caution and that no risks should be taken. This is critically important in regard to activities that might impact upon the dolphins and dolphin-human interaction.

Experimental management means that the environmental impact of every activity should be monitored and recorded so that something is learned from it.

IV. CONCLUSIONS AND RECOMMENDATIONS

IV.1 General

Maintenance of the dolphin-human interaction and the pristine natural environment are the essential ingredients of visitor experience at Monkey Mia. Maintenance of these natural values is not only a conservation matter but one upon which a valuable economic resource depends.

Recreation and commercial tourism activities at Monkey Mia are severely constrained by limitations of the site and by their potential impact on each other.

All other recreational and commercial activities in the Monkey Mia area must be secondary to the dolphin-human interaction operation and nothing should be acceptable that puts it at any risk. The precautionary principle must apply.

IV.2 Major site constraints

There is a very short stretch on the north side of the Monkey Mia spit where there is relatively deep water close to the shore. Many recreational activities naturally seek to focus there, including interacting with the dolphins, swimming, angling and boat launching, docking and mooring. Some of these are becoming mutually incompatible as intensity of use increases.

There is evidence that there is restricted water circulation in the lagoon so that it is vulnerable to pollution. Of particular concern is the potential for sewage and nutrient pollutants entering the lagoon by seepage at the beach, and for hydrocarbon pollution derived from oil spillage and engine exhaust.

IV.3 Environmental standards and criteria

The acceptability of commercial tourism activities (and all others) in the vicinity of Monkey Mia should be judged according to the 5 principal objectives of the *Environmental Quality Objectives* proposed for Perth metropolitan coastal waters (DEP in press) *viz:*

* maintenance of biodiversity;
* maintenance of ecosystem integrity;
* maintenance of aquatic life for human consumption;
* maintenance of recreational values;
* maintenance of aesthetic values.

The environmental criteria that apply at Monkey Mia should equate with "*Class 1 - conservation zone* " of the DEP *Environmental Quality Criteria,* that is, no detectable change in water or sediment quality and no change in the abundance/biomass or diversity of biota. [Notwithstanding the fact that the area is to be zoned for joint conservation and recreation uses.]

IV.4 Thresholds and monitoring

In order to set appropriate threshold limits against which environmental impacts of human activities can be judged, baseline data should be established and monitoring should be conducted in the lagoon and on the adjacent sand banks and seagrass meadows:

* biodiversity and biomass of seagrass, sandflat and seafloor communities;
* water quality, in particular concentrations of bacteria, hydrocarbons and nutrients.

IV.5 Dolphin-human interaction at the beach

This important matter is discussed elsewhere and is not part of this review (Wilson 1994)

IV.6 Dolphin observation in Red Cliff Bay

Conditions should apply to charter operation licences. The CALM draft *Shark Bay Marine Mammal Guidelines* provide a basis and should be appended to licences as an appendix but further discussion of some points therein is required.

The Monkey Mia dolphins belong to a community that lives within a restricted area of Red Cliff Bay. There is a limit to how much contact with humans they can tolerate without disruption of their natural life-style and habits. The limit is not known but the precautionary principle must apply.

An important issue for resolution is whether there is "room" for more than one charter vessel operation viewing dolphins in the Bay.

The guidelines stipulate that no dolphin should be subjected to close contact for more than 30 minutes at any one session. One charter vessel operating in Red Cliff Bay is likely to run up to 4 trips per day. Sometimes it is not possible to locate more than one group of dolphins. In that circumstance one charter vessel would be likely to spend up to 2 hours with the same animal/s during a day. It is easy to see that, with more than one vessel operating in that area, the dolphins residing there may well be subjected to levels of contact that would constitute "harassment". (In fact, this situation did occur at times during the period when two charter vessels were operating dolphin observation tours at Monkey Mia.)

There is also the likelihood that two or more charter vessels operating would interfere with the effective work of the dolphin researchers who also seek to follow the same animals.

It is here concluded that, applying the precautionary principle, there should be only one vessel operating dolphin observation tours in Red Cliff Bay. That vessel should be under sail and not motorised (except for emergency use).

Class E licence should apply for set terms, say 3 years. Once issued, the licence should be renewable subject to regular review of operator performance. If the operator performance is unsatisfactory, expressions of interest should be publicly called, with the existing operator invited to resubmit.

IV. 7. Dolphin and dugong observation beyond Red Cliff Bay

There is capacity for additional vessels to operate longer tours beyond the bay. The draft *Shark Bay Marine Mammal Guidelines* should apply to licences here also.

Class T licences should apply, that is, on application and without limits on numbers (except limitations that might be applied because of limited docking and land infra-structure facilities).

IV.8. Boat hire services

(i) Aqua bikes. Not considered to be have detrimental environmental impacts but are not recommended for aesthetic and safety reasons.

(ii) Wind surfers (sail boards). Not recommended because of risk of injury to marine mammals.

(iii) Small catamarans (surf cat etc.). Pose a smaller risk of physical injury to marine mammals than wind surfers. Harassment of marine mammals would be likely. Not recommended but, if approved, should be located west of the present dolphin viewing area - a location that might make the operation nonviable.

(iv) Canoes. No risk of injury to marine mammals but harassment would be likely if hired and operated by individuals independently. In fact personal observation of dolphins at sea would be a likely objective of many canoe hirers with harassment an inevitable consequence. The latter problem could perhaps be managed by conditions on the hire documents but policing would be difficult. If implemented this activity should be carefully monitored and the hire service rescinded if any significant degree of harassment were observed.

(v) Bare boat charter. Not likely to be on a scale to have any detrimental environmental impact. Dubious on safety grounds. Must be equipped with sullage tanks and hirers required to adhere to draft *Shark Bay Marine Mammal Guidelines* .

IV.9 Swimming with marine mammals

The present prohibition on swimming with dolphins should be maintained. The no-swimming area at the Monkey Mia beach should be extended out to sea and swimmers (including snorkelers) not permitted to block the way of dolphins coming to and from the beach.

Before swimming with dugong is permitted, further study is needed on the potential impacts of this activity.

IV.10. Administration of licensing

Licensing should continue to be administered by the CALM Head Office but, acknowledging the unusual complexity of Shark Bay Marine Park administration and public consultation requirements, special care must be taken to set up protocols and administrative procedures that:

* ensure consistency of application and minimal delays;
* ensure Regional and District office input;
* ensure consultation with other Government departments, the Shire and the various consultative and advisory committees whenever that is appropriate.

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