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REVIEW OF DOLPHIN MANAGEMENT AT MONKEY MIA

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

by

**Dr Barry Wilson FTS
Murex Consultants Pty. Ltd.
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1. INTRODUCTION

As a result of intensive promotion by the tourism industry, the Monkey Mia dolphins have become a major attraction. The number of people visiting the area and taking part in the feeding activity has increased far beyond what was imagined ten years ago when regular feeding ("provisioning") was initiated.

When regular provisioning began, concern was expressed that regular feeding may have detrimental effects on the dolphins. This concern has been raised again in the light of subsequent experience.

Problems and dangers associated with feeding wildlife are well documented. For example, feeding bears and elk in Yellowstone National Park in the US has resulted in serious consequences to humans, wildlife and property (Meagher & Fowler, 1989; Gunther, 1992). Animals become habituated to being fed and become aggressive to the point of being dangerous. There are also changes in behaviour that make them more vulnerable to disease and injury. There is now clear evidence that feeding dolphins in the wild has similar consequences.

In the United States, detrimental consequences of feeding wild dolphins have been documented since 1988 and have led to the wildlife authorities prohibiting the activity in that country (section 2). The same consequences are occurring at Monkey Mia. There are two areas of concern.

1. *Negative impact on dolphin welfare.* There is strong evidence provisioning has caused changes in the social behaviour of the Monkey Mia dolphins and that the mortality rate of provisioned animals is significantly greater than that of non-provisioned dolphins in the vicinity of Monkey Mia.

2. *Continuity of the meet-the-dolphin process.* So far, no infant born to the provisioned females has recruited (past weaning) to the beach group since regular provisioning began. If the present infant mortality rate continues there will be no juvenile recruits to the people-dolphin interaction process.

This review examines the history of the matter, reviews available data and recommends changes to management procedures.

1.1 The aim of dolphin management at Monkey Mia

The draft management plan for the Monkey Mia Reserve (1993) cites two objectives of dolphin management:

"6.7.1. Interaction Management. The objective is to manage the interaction between dolphins and people to protect the dolphins and to preserve the quality of the visitors' experience."

"6.7.2. Dolphin Feeding. The objective is to ensure that dolphins remain wild animals and retain their social structure and natural foraging abilities."

The second quoted objective is not a statement of the reason feeding takes place but an objective of management once the decision to feed the dolphins has been made. Although it is obvious that dolphins enjoy receiving free hand-outs and the contact with people, it cannot be argued that they are fed for their benefit or to ensure that they remain wild etc. Dolphins are fed at the beach for the enjoyment and benefit of humans.

An oft-stated principle of management is that the welfare of the dolphins must always be the primary concern. Yet, there is now clear evidence that provisioning has detrimental effects on the dolphins' health and social relationships among their own kin (see section 4.2). It follows that the aims of management must be reconsidered.

If welfare of the dolphins were to be the *sole* concern, then provisioning individuals at the beach should cease. On the other hand, if some minimal degree of detrimental effects on the dolphins were judged to be acceptable, with a net benefit from the human perspective, a case could be made for provisioning to continue. It is this, second, view that is adopted here. However, it begs the question of what degree of detrimental effects is judged to be "acceptable".

For the purposes of this review, "an acceptable level" of detrimental effects is deemed to be a mortality rate that is within the range of what is believed to be normal in the wild, and a situation wherein provisioned animals spend most of their time behaving as normal wild dolphins without becoming dependent on human hand-outs. The evidence presented below clearly shows that this level is not being achieved at present. Changes in management procedures are essential.

It is important that dolphins continue to visit the beach at Monkey Mia because a very large number of people get immense enjoyment from the experience of contacting them there at such close quarters. There is no doubt that that experience, and the information acquired by people about wildlife and environmental management issues, make a significant contribution to the growth of a conservation ethic in our community.

There is also a significant economic aspect - the recent rapid growth of tourism in Shark Bay has been largely the result of promotion of the Monkey Mia dolphins. Many human livelihoods now depend on continuation of the meet-the-dolphin phenomenon. These educational and economic benefits must be judged against any detrimental effects on the dolphins.

The key factor in maintaining the interaction of people and dolphins at Monkey Mia is undoubtedly provisioning. It is true that interaction may occur without feeding (as is the case at Safety Bay) but the scale of the interaction that occurs at Monkey Mia depends on daily feeding at the beach.

The primary aim of dolphin management at Monkey Mia could be stated thus:

To facilitate contact between people and wild dolphins at Monkey Mia in order that people may enjoy the experience and learn from it, and in order to sustain important commercial tourism operations, while at the same time protecting the animals from undue risk and ensuring that they maintain their natural functions as members of the wild dolphin community in the vicinity.

Assuming that this primary aim is agreed and achievable, it follows that a corollary should be:

To put in place a management program that ensures long-term sustainability of the people-dolphin interaction at Monkey Mia beach, including recruitment of new animals to the team of provisioned dolphins to replace those lost through mortality over the years.

If the recommended changes do not significantly reduce the present problems of high mortality and behavioural change, then consideration must be given to prohibiting hand feeding.

1.2 The aims of this review

This review was commissioned by the Executive Director of the W.A. Department of Conservation and Land Management (CALM) on 13 July, 1994, with the terms of reference shown in Attachment 1.

The aims of the review are to consider the events since provisioning at Monkey Mia began in terms of management procedures and what has been learned about dolphin natural history, to identify means of reducing the detrimental effects of feeding to an acceptable level, and to suggest means by which the meet-the-dolphin phenomenon at Monkey Mia beach can be sustained indefinitely.

2. THE UNITED STATES EXPERIENCE

The following brief notes are drawn from a report published by the US National Marine Fisheries Service (NMFS) (Bryant, 1994).

In 1988 the US Marine Mammal Commission expressed concern that commercial operators had commenced "feed the dolphin" cruises off the coast of South Carolina. Given the well documented experience in that country of detrimental consequences of feeding wild animals, the Commission regarded this activity as "harassment" in terms of the Marine Mammal Protection Act. Regulations were introduced by the NMFS prohibiting it.

Following introduction of the regulations, applications by commercial operators in the south-eastern US for permits to feed wild dolphins were denied. Suits were filed by the operators in the US District Court seeking to invalidate the regulations or compel the issuance of permits. In the course of this litigation the NMFS commissioned six marine mammal scientists to independently review the impacts of feeding dolphins in the wild. All of the contributing scientists concluded that feeding wild dolphins alters their natural behaviour in ways that are harmful to them.

By 1992, 20 commercial cruises and 50 charter operations were actively feeding dolphins, effectively in breach of the regulations. Wherever these activities occurred, dolphins became habituated to accepting food from humans. Habituation substantially altered normal behaviour by creating dependency, negatively modifying foraging strategies and social behaviour and encouraging animals to approach vessels and humans where they beg for food. There are numerous reports of people being bitten by aggressive dolphins seeking handouts and of people maliciously as well as accidentally injuring inquisitive, begging and stealing dolphins.

In October, 1993, after several rounds of decisions and appeals, the Circuit Court found that the NMFS had substantial evidence to show that feeding wild dolphins disturbed their normal behaviour and could make them less able to search for food on their own. Accordingly, amendments to the Marine Mammal Protection Act were finalised in April, 1994, formally establishing the NMFS regulations.

The NMFS now grants permits for feeding captive dolphins for public display purposes. It has introduced a "rule" defining "public display" in such a way that feeding them in the wild is specifically excluded.

3. THE BUNBURY EXPERIENCE

As at Monkey Mia, people have fed dolphins at the beach at Bunbury for many years. In the late 1980s attempts were made to attract larger numbers of dolphins on a regular basis with promotion of the procedure as a local tourist attraction. This review does not consider in any detail the results of the Bunbury program but the following notes are relevant.

No comprehensive research on the Koombana Bay dolphin population has been attempted and there are no written data (at least none seen by this reviewer) on birth rates and mortality rates of the provisioned animals. However, significant changes in the behaviour of the provisioned animals have been reported (pers. comm. CALM Wildlife Officer R. Smith).

The frequency of dolphins begging from fishing boats and stealing bait from fishing lines and crab nets increased markedly following the introduction of regular provisioning. Complaints from fishers also increased, sometimes accompanied by threats against the dolphins. There was at least one incident of a dolphin being killed by a person (with a star picket), presumed to have been a fisherman. These observations are consistent with experience in the US reported by the NMFS (Bryant, 1994).

There is also evidence that the provisioned dolphins at Bunbury have visited the beach less frequently in recent months. At this time it is not clear whether this is a temporary change in behaviour or represents a trend.

4. FEEDING DOLPHINS AT MONKEY MIA

When the Monkey Mia Dolphin Information Centre was established in 1986, the question arose whether provisioning the animals at the beach would cause them to become dependent and lose the ability to fend for themselves. However, there were no precedents and the diverse opinions expressed were based on conjecture and documented cases of detrimental consequences of feeding other wild animals.

CALM proposed a feeding regime that was adopted by the Monkey Mia Reserve Management Committee in 1987. The proposal was made amid considerable public controversy, and after seeking veterinary advice derived from studies on captive dolphins (Gales, pers. comm., 1987; see also Cheal & Gales, 1991, 1992). This feeding regime has been in place, with some modifications, since that date.

4.1 The present feeding regime

The feeding regime initially adopted by the Management Committee was modified in 1989, again following veterinary advice, as follows:

- No more than one third of the estimated daily food requirements of the dolphins should be provided to each individual. For adults this was calculated at 2 kg per day.
- As an exception, larger amounts could be given to lactating females. This was based on the assumption that nursing mothers have a higher requirement.
- Additional rations could be provided to dolphins that reappeared after having been absent for some time. The argument for this was simply that it would induce them to stay around.
- Feeding times should be irregular.

These proposals were intended to encourage the dolphins to continue visiting the beach while preventing them from becoming dependent, based on the assumption that the animals would be compelled to catch the bulk of their needs at sea.

4.2 Experience suggesting the need for review

Subsequent experience has demonstrated that there is indeed a problem with provisioned dolphins becoming dependent, with serious consequences, even with the cautious feeding regime that was adopted. The evidence and the consequences include the following.

4.2.1 High infant mortality

Attachment 2, prepared by the CALM Shark Bay District Office, summarises the history of Monkey Mia dolphin calves since the late 1970s when daily provisioning of dolphins at Monkey Mia began.

Figure 1 shows the descendants of the four original adult females (Holey Fin, Surprise, Beautiful and Crooked Fin) that regularly visited the beach and were fed. Between them, since 1975, those four have produced a total of 17 descendants (12 children and 5 grandchildren) that were seen and named. In addition there were up to 4 calves which did not survive more than a few days and were not seen or named.

Two of the original adult females (Holey Fin and Surprise) survive. Four of their twelve named children survive. Two of these (Nicki and Puck) have become provisioned females while the other two (Joy and Cookie) live nearby but do not accept fish at the beach.

Of the 17 named calves born to the provisioned dolphins since 1975, only 5 survive, i.e., a survival rate of less than 30% [= mortality of >70%].

Of the 11 named calves born since provisioning was regulated in 1986 only 2 survive, i.e., a survival rate of less than 20% [= mortality rate of >80%]. Only 1 has survived past weaning (Cookie - which does not take food at the beach). The other (Picolo) has not yet weaned.

An estimate of survivorship in the first year of life for a coastal population of this species in Florida is about 80% (Bannister pers. comm.). Most pre-weaning mortality there is from shark attack.

Researcher Andrew Richards (1993, pers. comm. August, 1994) has analysed cumulative survivorship of Monkey Mia infant dolphins (Fig. 2). He has shown that infant survival was dramatically lower for offspring of provisioned females than for offspring of non-provisioned females during 1985-93. The biggest difference was in survival of infants in the first year of life, that is 36% for provisioned v. 67% for non-provisioned mothers. These figures are highly significant statistically (Gehan's Wilcoxon test, $p = <0.02$).

If the figures were updated to the present, so as to include the deaths of Hobbit and Finnick, the difference would be even greater.

It seems most unlikely that the very high mortality of calves born to the provisioned females can be explained as entirely due to natural causes. Richards suggests the following explanations of the data:

A. Being a provisioned dolphin may have serious concomitant hazards for mothers and offspring, including one or more of the following:

- prolonged exposure to polluted near-shore waters;
- exposure to human pathogens;
- provisioning may distract the mothers and offspring from attending to potential threats, especially shark attack;
- concentration of fish offal in the area may attract higher numbers of sharks;
- provisioned dolphins may accept poor-quality food items (or non-food items) from boats, causing illness;
- provisions supplied from the Dolphin Information Centre may be nutritionally inappropriate.

B. Provisioned females may be a biased sample:

- the small sample of provisioned females may include a disproportionate number of individuals that are either at the beginning or the end of their reproductive careers, thus affecting the survival of their offspring;
- dolphins that accept dead fish and human contact may do so because they have behavioural or physiological abnormalities in the first place.

There is no direct evidence that age and parity affect infant survival. However, the case of the matriarch Holyfin suggests that this possibility should be kept in mind. Holyfin is clearly close to the end of her reproductive life. Hobbit, a premature calf of Holey Fin, was a runt which could have been a genetic characteristic or a product of her own or her mother's malnutrition. Her observed death by shark attack could have been due to poor condition and vulnerability or because of neglect by her mother.

Although a biased sample of females is a possibility it is not considered to be a likely explanation of the low infant survivorship of provisioned mothers. The four most likely explanations are to be found among those listed in A above.

(i) Pollution

During a period of 18 days in early 1989 seven of the provisioned dolphins disappeared. They included 3 calves (Koorda Fin [of Holey Fin], Nipper [of Nicki] and Puck's Baby [of Puck]), 1 adult female (Holly), and 3 adult males (including Bibi).

There was no doubt that the 3 calves were dead because they had still been nursing from their mothers. The adults were presumed dead because they were never seen again by the researchers who were conducting ongoing surveys of the Monkey Mia dolphins in the vicinity. Emigration is a rare event in bottlenose dolphin communities (Wells & Scott, 1990) and is an improbable explanation of the disappearances.

There has never been a satisfactory conclusion about the cause of these deaths. However, given that all 7 dolphins disappeared during the same period, it is reasonable to assume that they may have all died of the same cause and that it may have been related to the visits made by the provisioned dolphins to the beach. There was no evidence of comparable mortality of non-provisioned dolphins in the vicinity.

At the time, it was suggested that there may have been a pollution event at the Monkey Mia beach, resulting from sewerage contamination. Dolphins are known to be susceptible to pathogen induced mass mortalities (Bannister pers. comm.) It is known that contamination with faecal bacteria did occur about that time (*EPA Bull.* 381, March, 1989) and this explanation is feasible though unproved. [The contamination was stopped immediately and has not recurred.]

(ii) Pathogen induced disease

Marine mammals, including dolphins, are known to be vulnerable to pathogen-induced disease. There are indications that morbillivirus may be responsible for unusually high mortality of dolphins presently occurring in the Gulf of Mexico (Bryant, 1994). Infectious disease may have been the cause of the 1989 mortality event at Monkey Mia. If

so, contact with humans at the beach would seem to be implicated, because there was no comparable mortality in the nearby non-provisioned dolphins.

(iii) High predation

Predation is believed to be a significant cause of mortality of dolphins in Moreton Bay where 36% of the population show evidence of shark attack (Bannister pers. comm.). It is known that Monkey Mia calves are frequently attacked by sharks. Welcome was attacked in March, 1992 but survived. Finnick was attacked in March, 1993 but survived (Fig. 3). Hobbit was attacked and killed in March, 1994 (Fig. 4). [The common month may be coincidental.] It is likely that many of the Monkey Mia calves that have disappeared were victims of shark attack.

Normally, calves are protected from predation by adults in their group. The vulnerability of calves to shark attack is increased if they stray from their group and if the adults are not paying attention. This was apparently the situation when Hobbit was killed. Witnesses reported that she was playing by herself about 70 m from the beach where her mother and other adult females were interacting with people.

(iv) Inadequate nutrition

It can be assumed that, in the wild, the dolphins choose as prey, species of fish that possess the required nutritional qualities, just as other wild animals are known to vary their diet according to the nutritional requirements of the time. No information is available on which fishes are selected by the dolphins under various conditions. Nor is there any information on the relative nutritional values of the fish species eaten.

It is feasible that the selection of frozen fish given to the dolphins is nutritionally inadequate or inappropriate, especially when females are nursing infants. In accepting a significant proportion of such hand-out food the animals may become malnourished, leaving them vulnerable to disease and shark attack.

Whichever way the infant mortality figures are inspected, it is clear that the mortality rate of Monkey Mia dolphins, especially the calves is very high and difficult to explain as due entirely to natural causes. The conclusion that the high mortality is associated in some way with beach provisioning is inescapable.

In this reviewer's opinion, the most likely explanations are:

1. Infants nursing from provisioned females become malnourished and therefore more vulnerable to mortality from disease or predation. They may become malnourished because:
 - a) their mothers spend so much time at the beach that the calves do not learn to catch enough fish for themselves,
 - or
 - b) the food received by the mothers is nutritionally inappropriate for milk production.

2. Behaviour of the mothers become abnormal in that they spend so much of their time begging for food at the beach that they do not pay adequate attention to their offspring, leaving them vulnerable to shark attack.
3. Behaviour of the infants becomes abnormal in that they do not form proper associations with other dolphins, leaving them vulnerable to shark attack.

4.2.2 Juvenile (post-weaning) survival

There are few data on survival of juvenile dolphins after weaning but available information suggests that there may be a problem here also.

Four juveniles born to provisioned Monkey Mia females since research began have survived past weaning (that is about two years of age). Two of these (Finnick and Holly) were provisioned but died within two years of weaning. The two that still survive (Cookie and Joy) have never accepted handouts and, since leaving their mothers, have never been regular beach visitors.

4.2.3 Impacts of feeding on behaviour

Researchers Janet Mann, Barbara Smuts and Amy Samuels (1993; pers. comm. August, 1994) have documented significant differences in the behaviour of provisioned dolphins compared with non-provisioned dolphins at Monkey Mia.

Their study included data on 32 infants, 9 of which were born to the provisioned females. They showed that infants of provisioned females spend less time in contact with their mothers overall. This appears to be due to the fact that provisioned infants spend less time in contact with their mothers when near the feeding area than when they are away from the beach.

The case of Finnick

Finnick was born to Nicky, a long-term provisioned dolphin, on April 16, 1990 and was weaned in early 1993. Janet Mann and Amy Samuels followed the growth of Finnick after his birth and have extensive data on his behaviour (pers. comm. August, 1994).

After weaning Finnick's behaviour differed significantly from that of his non-provisioned peers:

- He never left the vicinity of the beach feeding area during the daytime and obtained almost all of his food at the beach and by begging from recreational fishers in boats.
- Samuels' field data show that he was receiving "casual" feeds from fishers at an average rate of 3 times each hour, and considerably more from this source than from the controlled handouts at the beach. [In addition he was receiving consistently more than his quota from the Rangers.]
- His hunting time progressively declined after he began accepting handouts.
- He did not form any alliance with other male dolphins as a young male of his age should have done.

- He became aggressive and began taking fish from the lines of fishers. Several times he inflicted injuries on people.
- He frequently made close and dangerous approaches to boats that were underway and travelling at speed.

These behavioural abnormalities are typical of wild animals that become dependent on hand feeding by humans.

Early advice from Dr Gales and Dr Mann was that feeding Finnick should be discontinued so that he was forced to forage for himself. This advice was adopted by the Management Committee at its meeting of August, 1992 but the decision was subsequently revoked.

By early 1994 it was apparent that Finnick's health was deteriorating. Blood samples were taken and revealed no sign of pathogens. It was concluded that his poor health was the result of poor nutrition, resulting from habituation to hand feeding.

Finnick disappeared on May 13 of that year. He may have died from malnutrition or from shark attack resulting from vulnerability due to his poor condition and lack of normal associations with other dolphins. Whatever the direct cause of death, there can be no doubt that it was due indirectly to his dependence on provisioning.

4.3 Aspects of provisioning that need review

The observations made by the researchers at Monkey Mia provide a strong indication that the changes in behaviour of the dolphins and the high mortality of calves born to the provisioned females have been direct or indirect consequences of provisioning. Aspects of provisioning that need to be addressed to mitigate these problems are:

(i) The quantity of food provided

One third of the estimated individual daily requirements is still considered to be a reasonable level of provisioning for maintaining regular visits by adult dolphins without making them dependent, although it is clear that it does cause behavioural changes.

However, feeding nursing females impacts upon their calves [see (ii)]. The present practice of providing larger rations to nursing females may exacerbate those impacts. There is a risk that food provided to nursing mother dolphins may not have the necessary nutritional balance for their condition and that providing more of it is unwise. It should be assumed that the dolphins are capable of obtaining for themselves more food if they need it, and of the right kind. Also, giving nursing mothers a larger ration encourages them to spend longer periods at the beach, to the detriment of their calves.

The present practice of providing larger rations to individuals that return to the beach after prolonged absence was intended to be an inducement to stay. There is no evidence that this is either effective or necessary.

(ii) Time spent by the dolphins at the beach

When nursing females are at the beach interacting with humans, calves with them are not learning to feed themselves or the normal patterns of interaction with other dolphins. The evidence discussed above suggests that this is having serious nutritional and behavioural consequences on the calves and may be related to their high mortality. It follows that feeding procedures should be implemented that keep the time spent at the beach to a minimum.

The present practice of feeding the dolphins at irregular times appears to result in them "hanging around" waiting for a feed. During these waiting periods the dolphins are interacting with people, which, in itself, is a positive thing. However, it seems wise to sacrifice that interaction in favour of reducing the impact of the beach-feeding sessions on the calves.

(iii) Feeding calves

It is imperative that calves do not become dependent on provisioning. The lesson learned from the fate of Finnick must not be ignored.

Providing even occasional feeds to suckling infants strongly reinforces begging behaviour and creates irreversible dependence (pers. comm., Prof. Janet Mann, August 1994).

As males are not wanted in the beach-feeding team, there is no advantage in feeding male calves and there are definite detrimental results from doing so. Under no circumstances should male calves be given hand-outs

Female calves naturally remain with their mothers for some time, and may continue suckling for more than four years. Infant females are probably the most appropriate candidates for recruitment to the provisioned dolphin group and a case could be made for introducing them to hand-out feeds during weaning. However, the risk in doing so is considerable. Since regular provisioning began, not one infant that has taken hand-out feeds has survived. Feeding female calves before they are fully weaned is not recommended. If, in future, recruits are needed, they could be sought from young adult females in the wild population.

The only infant alive at present, Picolo, is nearly two years old and entering the weaning phase. It is essential that no attempt be made to feed this individual until she is fully independent. As she will continue to associate with her mother after weaning, there will be later opportunities to recruit her to the provisioned team.

(iv) The nutritional quality of the fish provided.

In the absence of information on the relative nutritional values of prey species, it is imperative that a variety of local fish be offered to the dolphins.

It is known that freezing fish results in the loss of some nutritional values. It is imperative that fish provided to the dolphins be as fresh as possible. The aim should be to provide the same quality that would be desired by humans. Fish frozen for more than 3 months should not be used. Ideally, the fish should not be frozen but chilled and provided within a few days of capture. Frozen fish should only be provided when fresh fish is not available.

Cumulative survivorship of infant bottlenose dolphins, age 1-4, in Shark Bay: Offspring of provisioned females vs. offspring of non-provisioned females.

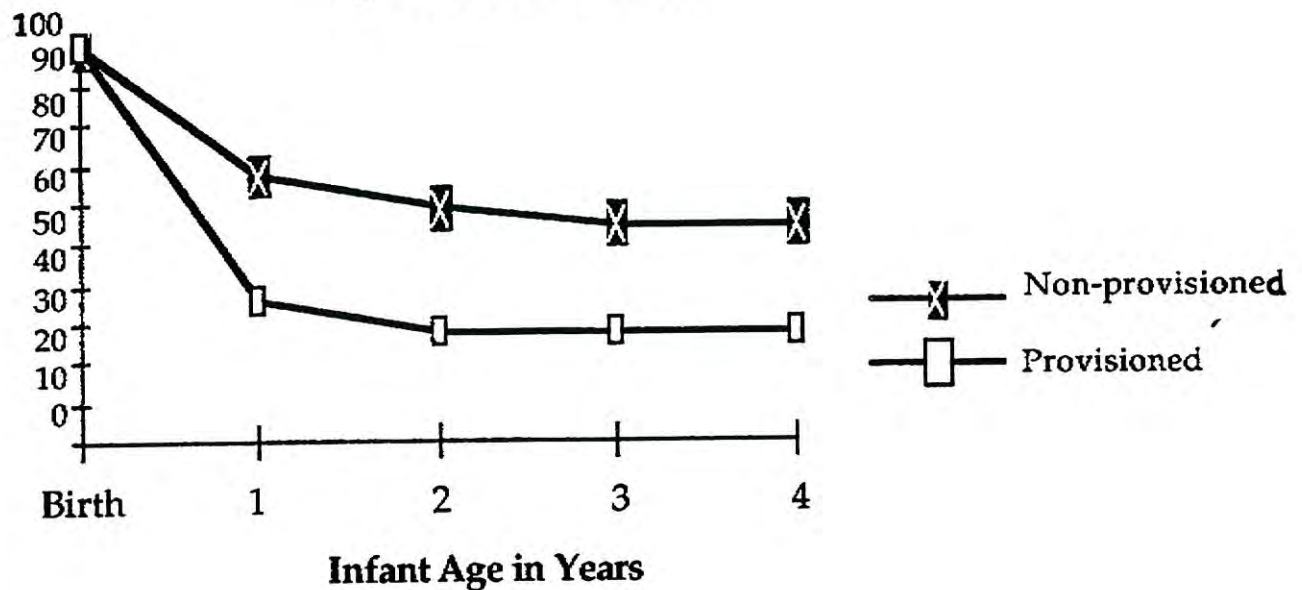


Figure 2: Differences in cumulative survivorship between infants of provisioned and non-provisioned females at Monkey Mia. (From Andrew Richards, August, 1994.)
 N=11 infants of 5 provisioned females;
 N= 62 infants of 43 non-provisioned females.

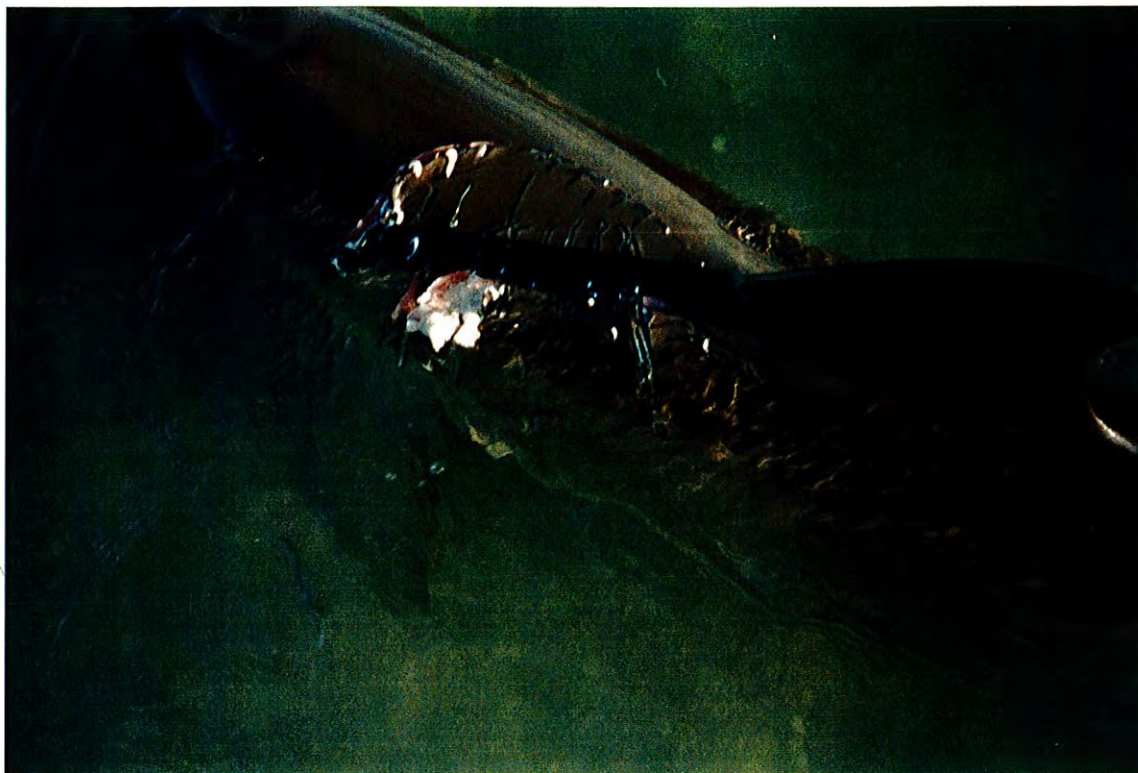


Figure 3 (above). Finnick showing shark bights, March, 1993.

Figure 4 (below). The body of Hobbit after a shark attack, March, 1994



4.4 Recommendations

- 1. As a general rule, an average daily ration of 2 kg of fish per adult dolphin is probably an appropriate amount and should be continued but kept under review.**
- 2. As a general rule, the present practice of providing larger rations to lactating adult females should be discontinued.**
- 3. As exceptions to these general rules, consideration could be given to providing larger rations to individuals if there is evidence that they (or their calves) are in poor health, subject to specific veterinary advice.**
- 4. The present practice of providing larger rations to individuals for a few days following their reappearance at the beach (after having been absent for some time) serves no purpose and should be discontinued.**
- 5. Males should not be encouraged to become provisioned dolphins receiving regular daily rations at the beach.**
- 6. Neither male nor female calves should be fed until they are fully weaned. After about 4 years, female calves could be started on regular rations, based on the principle of one third of daily requirement, estimated according to body weight.**
- 7. Feeding sessions at the beach should be at regular hours, preferably twice a day. The actual times selected should be determined by on-the-spot management.**
- 8. A major effort should be made to eliminate the practice of feeding dolphins from boats, at least in the vicinity of Monkey Mia.**

This should be done by extending the reach and scope of educational material, including at boat ramps and at other resort areas (especially in Denham and Nanga), and by ranger patrols personally speaking to people fishing from boats in the vicinity. A legislative capacity for enforcement is urgently needed, even though enforcement should be a last resort procedure.

- 9. There should be a review of the fish purchasing policy and increased effort to provide fish of high quality and large variety (that is in kind). Storage must not be longer than 3 months. A higher price may need to be paid.**
- 10. Consideration should be given to providing a small chill room at the Information Centre for storage of fresh fish, with frozen fish kept as a back up.**

5. MANAGEMENT

The Monkey Mia Dolphin Information Centre is situated on a reserve jointly vested in and jointly managed by the Shire of Shark Bay and the Department of Conservation and Land Management.

5.1 The Shire / CALM agreement

Recognising the values of the dolphin phenomenon, the two agencies put in place a joint management arrangement. For technical reasons (mainly associated with the provisions of the *Conservation and Land Management Act 1984*) the Agreement has not been formally signed and adopted but it is followed in practice by mutual consent. The contents of the draft agreement are reflected in the draft management plan for the Monkey Mia Reserve.

The Shire employs Rangers to manage the on-beach operation. CALM contributes technical management information and is responsible for managing the marine park and its wildlife (including the dolphins).

5.2 The Monkey Mia Reserve Management Committee

In keeping with the joint vesting of the Monkey Mia Reserve, there is a Management Committee comprising equal representation of the Shire and CALM, with an independent Chair. It has mainly a liaison function. Its terms of reference and the respective responsibilities of the vesting partners are spelled out in the draft agreement.

5.3 The Monkey Mia Research and Education Trust

An early initiative under the collaborative arrangements between the Shire and CALM was the establishment under the Local Government Act of the Monkey Mia Research and Education Trust in 1989. This was done with State Cabinet approval and a Government start-up contribution of \$25,000. Terms of reference of the Trust were:

1. Furthering research on dolphins at Monkey Mia and their marine habitat.
2. Developing research and public education projects relating to the social behaviour and natural history of dolphins at Monkey Mia.
3. Developing public education projects relating to the marine environment of Shark Bay generally.

There was to be a scientific advisory subcommittee of the Trust with responsibility for review of research and education programs and allocation of funds.

After several meetings of the Trust its activities lapsed and it was disbanded in 1992 with its start-up funds allocated to two projects.

5.4 Financial arrangements

These are also spelled out in the draft agreement. Revenue from the Dolphin Information Centre (mainly gate takings and sales) is used to offset set-up and operating costs.

The point has now been reached where set-up costs have been recouped and there is an operating profit which is available to fund maintenance and further development of the facilities.

5.5 Management issues

Details of management and financial arrangements are not the subject of this review, except insofar as they affect the dolphin management program. In this respect there are several issues that need comment.

5.5.1 Scientific input to management decision-making processes

At present there is no direct means of achieving scientific input into management decisions that have an impact on the dolphin management program.

According to the agreement, CALM should be providing that input but no staff scientist is allocated to this task. The scientific advisory committee proposed when the Research and Education Trust was mooted was intended to provide the necessary advice but it did not eventuate.

The CALM District Manager has sought to resolve this matter by seeking scientific advice from the dolphin researchers working at Monkey Mia and other outside sources. Such advice has been freely given and has proved to be of critical value. However, it has been uncoordinated. There has sometimes been confusion in transmitting the advice clearly to the Management Committee and from there to the Rangers who have the task of implementing the decisions.

There is an urgent need for formal input of advice from one or more suitably qualified scientists and for clear lines of communication.

It is critically important that CALM designate a person qualified in marine science as the single coordinator of scientific advice to the Monkey Mia Reserve Management Committee.

[It has been argued that CALM must address its priorities to species conservation and that, as the bottlenose dolphin as a species is not threatened, it should be given no priority. This argument fails to recognise the legitimate need for management of a matter of considerable public interest and economic value.]

Such an appointment would not remove the need for a scientific advisory committee, as no individual is likely to have the range of population biology, social biology, ecological and veterinary skills required.

In the long term, the scientific committee advising the proposed Marine Parks Authority should have that function, as the activity lies within a marine park to be vested in that authority.

In the short term, as an interim measure, a workable arrangement could be established formalising the input of the present dolphin researchers.

5.5.2 Ranger employment, performance and training

Although the Information Centre and the land it is situated on are jointly vested in the Shire and CALM, the marine park where the dolphins live and where the feeding sessions take place is vested in the National Parks and Nature Conservation Authority and CALM is the management agency.

Managing interaction of people and wildlife within a marine park is normally the duty of appropriately trained and authorised staff of the management agency. No Marine Park Rangers are employed by CALM at Shark Bay and there is no boat for marine patrol duties.

The Monkey Mia Rangers are employed by the Shire and their duties are confined to the Information Centre and activities in the Dolphin Interaction Area.

It is essential that appropriately authorised rangers are available for duties encompassing the wide range of public contact and environmental protection normally associated with management of a marine park, not restricted to a single facet of it. To achieve this there are three options:

- (i) appoint separate CALM Marine Park Rangers, complementing the shore-based operations of the Shire Rangers;
- (ii) expand the operations of the Shire Rangers to encompass patrol duties within the wider Marine Park, and devolve to them authority under the CALM and Wildlife Conservation Acts;
- (iii) appoint the Monkey Mia Rangers as CALM officers.

Rangers operating from the Information Centre should function as Marine Park Rangers and their duties should be directed to supervising contact with the dolphins anywhere within the park, not confined to within a few metres of the beach.

It is essential that the standard of presentation of the people-dolphin interaction and interpretive programs be improved, whether or not the present staffing arrangements are to continue.

Interaction with the public in a high profile situation such as exists on the beach during dolphin feeding sessions requires considerable interpersonal skills. The Monkey Mia dolphin "show" has become an event of national and international significance and worthy of the highest possible level of presentation.

The Shire Rangers are committed to their task and provide an honest and effective program. However, they are virtually untrained for such a specialised job and there is a need for improvement in their performance. A training program developing their communication and crowd control skills, and also their knowledge of dolphins and the marine habitats of the park, is urgently needed.

In addition, there is a need for at least one person on-site who is able to develop the interpretive materials presented both by the Rangers and in the Information Centre. This person should be an educator with first class interpersonal skills (see also section 7).

5.5.3 Hours of business

The present situation whereby Rangers are present only during normal working hours is unsatisfactory. Visitors who arrive after hours get in free! That is an obvious problem but, more importantly, interactions between people and any dolphins that arrive after hours are unsupervised.

5.5.4 Enforcement

The Rangers are employees of the Shire and at present have no authority to act on behalf of CALM when enforcement measures are required. The feeding sessions actually take place in the waters of the Marine Park, not on the Monkey Mia Reserve.

At least one person with the authority to enforce the marine park regulations and the Wildlife Conservation Act should be present at the Information Centre, or at least at Monkey Mia, at all times. This requirement will become essential if feeding the dolphins from boats is prohibited.

Assuming that it is impractical to base a Wildlife Officer at the Centre the only option will be to train several of the Rangers appropriately and assign to them the necessary authority to act on CALM's behalf. This action should be implemented without delay.

The issue would not arise if the Rangers were employed as Marine Park Rangers by CALM.

5.6 Recommendations

1. Scientific advice

- (i) CALM should designate a single staff member, with appropriate training in marine science, to act as the co-ordinator of scientific advice on dolphin protection and management at Monkey Mia and routinely provide that advice to the Management Committee.**
- (ii) The scientific advisory committee to the proposed Marine Parks Authority, when it is appointed, should be specifically given a brief for providing advice on dolphin management and should include at least one member with experience of the biology of marine mammals.**
- (iii) Until that advisory committee is established, an informal network involving the voluntary services of the present dolphin researchers at Monkey Mia should be utilised, coordinated by the CALM staff scientist referred to in (i).**

2. Ranger employment

Consideration should be given to the employment of Ranger staff by CALM instead of the Shire, thus opening up for them opportunities for career development as specialised park rangers, widening the scope of their duties to include other aspects of marine park management, and avoiding the need for

devolving authorities to them under the CALM and Wildlife Conservation Acts.

3. Ranger training

As a matter of high priority, a training program for the Rangers should be implemented, concentrating on their interpersonal and communication skills and their knowledge base relating to the natural history of dolphins and the Monkey Mia marine environment generally. The program should be designed and presented by CALM. Incentives should be offered to encourage the Rangers to undertake the program and complete it successfully. [Such training will be necessary whether the Rangers are employed by the Shire or by CALM.]

4. Hours of business

Means should be found to extend the hours during which the Information Centre is open, at least for the collection of entry fees. An appropriately authorised person should be present, on-site, at all times to supervise after-hours contact between people and dolphins.

5. Enforcement

If the present staffing arrangements are maintained, the Shire Rangers should be given appropriate training in enforcement and the authority to enforce marine park and Wildlife Conservation regulations pertaining to the protection of dolphins. A Wildlife Officer should be based in Denham and available for duties at Monkey Mia as the need arises.

6. SCIENTIFIC RESEARCH

When the interaction of people and dolphins at Monkey Mia began there were few scientific data on the behaviour, social structure, reproduction and life history of bottlenose dolphins in the wild, there or anywhere else. Management procedures were proposed and implemented on the basis of information largely gained from animals held in captivity. For that reason, the principles of "experimental management" were adopted, on the assumption that scientific research under way would provide a basis for monitoring and re-evaluation of management procedures.

Dolphin management, especially provisioning, seeks to prevent the animals from becoming dependent and to maintain their health and normal social relationships. Such aims beg the questions of what are normal dolphin feeding rates, nutrition, social behaviour, reproductive rates, growth and survivorship. Clearly, these are the issues that need to be addressed by research.

In addition to research aimed directly at extending knowledge of dolphins, there is a need for better knowledge and understanding of the Monkey Mia marine environment.

6.1 Research program

Dolphin research

The Monkey Mia dolphins are the subject of an ongoing research program coordinated by the University of Michigan. To date, this research has been primarily into the social structure of the dolphin community in the area and the behaviour of the animals as individuals and as groups. Most of the animals in the vicinity, including the provisioned dolphins, are now known and information is building up on their individual history and social behaviour. Data are now available on mortality and birth rates in the wild that provide a comparative base for assessment of management procedures in respect of the provisioned animals.

There are still no data on feeding in the wild, that is, the quantity and variety of fish that are eaten. Nor are there data on predation and the frequency of shark attack. These are aspects of dolphin biology in the wild that are relevant to management and need to be researched.

Another American research group has been studying the same species of dolphin at sites in Florida. Also, a student at Murdoch University has begun a study of bottlenose dolphins in Cockburn Sound. These studies will provide useful comparative data.

The University of Michigan dolphin research program co-ordinator, Richard Connor, has prepared a summary of the current Monkey Mia research projects and additional topics which his group intends to investigate in future (Attachment 3). In this reviewer's opinion this research program covers the topics most relevant to dolphin management and it is highly desirable that it is implemented.

Other marine research

In addition to the present dolphin research program, there is a need for a broader marine research program at Monkey Mia addressing issues relating to environmental protection and a range of human recreational activities.

Most notably, the matter of water quality in the vicinity of Monkey Mia is of vital importance. The presence of the Dolphin Resort and the Information Centre, with so many visitors, and the boat ramp and fishing activities in the vicinity, creates a risk of contamination of the water by faecal bacteria and excessive nutrients. At the time of the 1989 suspected pollution event, the EPA conducted a once-off study of the adjacent waters of the marine park. The results were difficult to interpret because of uncertainty about the natural nutrient loads of the water. The massive seagrass beds that are such a feature of the Monkey Mia marine environment are known to accumulate naturally-produced nutrients and these are released erratically by wave and tide action. There are no data on this natural nutrient production, nor on water circulation in the area. These factors are crucial to an understanding of natural conditions and interpretation of abnormal and unnatural events, should they occur.

Another very important feature of relevance to the dolphins and also to humans recreating in the area, is the fish fauna. There has been no survey of the fishes living in the Monkey Mia area and no information is available on seasonal changes in the relative abundance and the habitat preferences of the species present.

The key to the high biological productivity of the Shark Bay marine environment is the extensive development of seagrass meadows with their associated micro and macro flora and faunas. Seagrasses are known to be highly sensitive to pollution. Base-line studies and on-going monitoring studies of the seagrass ecosystems at Monkey Mia would be most useful for long term management of the marine environment in the interests of both dolphins and humans.

6.2 Co-ordination of research effort

At present the only co-ordination of effort is achieved through the University of Michigan program. The only input to it from CALM is through the scientific licensing process whereby conditions are imposed on the activities, and informally through liaison between CALM district staff and the research team personnel on-site.

There is a need for formal liaison between CALM and the University of Michigan research team to ensure that the needs of management are incorporated into the research program and that results are conveyed to the Department. There is also a need for protocols to deal with likely proposals from other parties to carry out research on dolphins and their habitat at Monkey Mia. These functions should be the responsibility of a scientific advisory committee for the Shark Bay Marine Park, or the proposed scientific committee providing advice to the Marine Parks Authority, when it is appointed. These matters were discussed in section 5.5.2.

6.3 Funding for dolphin research

At present the University of Michigan dolphin research program at Monkey Mia is funded from grants and the research budgets of the individual research staff. CALM makes no contribution to the research. The Monkey Mia Dolphin Resort provides the research team with assistance in terms of accommodation and other facilities.

The University of Michigan research team has indicated that it has difficulty raising the funds for the program from US sources and intends to seek grants and donations from Australian sources in order to keep the program operating.

Given the importance of this program to the maintenance of the people-dolphin interaction process, in terms of the stated management objectives, consideration should be given to dolphin research when a research program for the Shark Bay Marine Park is developed, and to providing financial support for the University of Michigan project.

6.4 Research facilities

There are at present no research facilities available at Monkey Mia (or elsewhere in Shark Bay) for use by marine researchers. The University of Michigan research team operate from a caravan on the Dolphin Resort premises. Their conditions are substandard.

It has been proposed that provision be made at the Dolphin Information Centre for a small marine laboratory, funded from the operating profit of the Centre (see Draft Management Plan, Monkey Mia Reserve, 1993). This could be made available to the dolphin researchers and others carrying out approved studies on dolphins and other marine life and habitats of the area. The laboratory should be equipped with basic communications and other equipment, and the instruments needed for the water quality monitoring program.

Also urgently needed is a suitable vessel at Monkey Mia, for use by CALM staff and the Rangers.

6.5 Recommendations [See also Rec. 5.6 and Rec. 7.1]

1. **CALM should adopt the dolphin research program documented by the University of Michigan research team co-ordinator (Attachment 2) as a provisional program for dolphin research in Shark Bay and collaborate with that team in seeking to have it implemented.**

Additional marine research should be undertaken at Monkey Mia, including:

- **a water quality monitoring program;**
- **a study of water circulation and nutrient flux;**
- **a study of primary production from seagrass meadows;**
- **a study of flora and fauna of seagrass meadows for use as a biological indicator of environmental health and change;**
- **a study of the fish fauna of the area and the relative abundance and habitat preferences of selected species.**

When a Scientific Advisory Committee (either for the Shark Bay Marine Park or the proposed Marine Parks Authority) is appointed, the research program should be reviewed by that committee, in consultation with the University of Michigan group.

2. **When a marine research program is initiated, CALM should give consideration to providing financial support to the University of Michigan dolphin research program, either directly or by assisting the research team apply to Western Australian and Commonwealth funding sources for grant support.**

3. **Current proposals to add a small marine laboratory to the Dolphin Information Centre should be strongly supported. The laboratory should be available for use by CALM and other scientists but with priority given to marine research projects relating to the dolphin research program. Protocols should be established for allocating space at the facility.**

Basic equipment, including a small vessel, should be provided for use of approved scientists allocated space to work at the laboratory.

7. EDUCATION AND INTERPRETATION PROGRAMS

The draft Monkey Mia Management Plan (1993) noted that Monkey Mia "has enormous potential for educating and informing the public on dolphin biology and habitats, and on the wider marine environment". The Dolphin Information Centre has this function. In this section, consideration is given to the effectiveness of the Centre in this regard.

Monkey Mia has now achieved international fame as a place where people and wildlife may interact. It is imperative that the information and interpretive programs there are of the highest possible professional standard.

When the Information Centre was established and staffed, the Marine Park and World Heritage status of the area was not an issue and the intention was simply to manage the interaction of dolphins and people. The situation now is very different. The actual interaction takes place, not on the Monkey Mia Reserve, but in the Marine Park and the interpretive issues that relate to the natural history of the dolphins are those concerning the marine environment and other animals inhabiting the park.

7.1 Rangers

The issue of Ranger performance and training was addressed in Section 5.1. The need for a Ranger training program was noted in that section.

Having observed the Rangers interacting with people at the beach and in the Centre, this reviewer believes that they are generally competent and well received. Nevertheless, it is clear that they lack adequate interpersonal skills and knowledge for the high profile role they now play. In addition, their activities are focused too narrowly on the dolphin feeding process at the beach.

7.2 Quality of the present interpretive material

The display material in the Centre is good but now dated and beginning to show its age. There is a need for a review and update. In particular, there is a need for additional material on other features of the Shark Bay Marine Park and the World Heritage status of the area.

Much of the signage in and around the Centre is now quite shabby and inappropriate for such a popular and important site. For example, the main sign on the entrance wall refers to the Dolphin Welfare Trust which no longer exists. An updated main sign accurately depicting the current management arrangement is urgently needed.

Printed materials available from the Centre are also out-dated and inadequate. There is both a need and a commercial opportunity for a wider range and better quality of brochures and booklets dealing not only with dolphins but also other natural features of the Marine Park such as the seagrass meadows and carbonate flats of the area.

7.3 Education staff

A recommendation that the interpretive material at the Centre should be updated begs the question of how and by whom. A new interpretive program could be commissioned from CALM or an outside agency but a once-off revamp would not be adequate. For such a popular and important situation, an ongoing program is needed.

The operations of the Information Centre are essentially directed at public education and it is important that they be at a high professional level. Selecting and training Ranger staff to be more effective in this respect is part of the answer, but the presence of a qualified, professional educator is now much needed. This person should be responsible for development and implementation of a wide-ranging interpretive program, with an emphasis on dolphins and their natural history but also dealing with the marine habitats and other marine plants and animals of the area.

Ideally, this person should also be responsible for managing the Centre and all aspects of its operations, including liaison with the researchers and enforcement of the dolphin protection measures.

7.5 Recommendations [see also Recs. 5.6 - 2 & 3]

- 1. The display and printed material provided at and by the Information Centre should be revised and updated. The emphasis of the material should remain on dolphins but should be broadened to encompass other aspects of the marine environment of that part of Shark Bay.**
- 2. A full-time, senior person, with appropriate qualifications and high-level interpersonal skills, should be appointed to the Information Centre and given responsibility for development and implementation of an on-going interpretive program. Consideration should be given to creating this position as Manager of the Centre.**

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ATTACHMENT 1

This review of dolphin management at Monkey Mia was commissioned by the Executive Director of the Department of Conservation and Land Management on 13 July 1994. The terms of reference for the review were:

1. Research

- 1.1 Review past and current research on Shark Bay dolphins, their habitat and their social interactions, including social interactions with humans, and the relevance of this research to management issues; suggest any change of emphasis or direction that may be desirable.
- 1.2 Review the present means by which research goals are determined and coordinated, and project progress is assessed.
- 1.3 Review the administrative and management systems that are in place to support dolphin research.
- 1.4 Review the present links between research programs and management authorities and the public.

2. Management

- 2.1 Review the policies and programs for dolphin management, notably the control of public contact with the animals and the level of supplementary feeding.
- 2.2 Review the program for monitoring pollution of the waters at Monkey Mia and assess whether there is any evidence of pollution that might put people or dolphins (and other wildlife) at risk.
- 2.3 Review available data on behaviour, growth and mortality of identified dolphins and investigate whether there is any evidence that the well-being of the animals is jeopardised by current management.
- 2.4 Review the adequacy and appropriateness of the education and interpretation programs provided at Monkey Mia.
- 2.5 Review existing management structures and liaison between researchers, rangers, the Department of Conservation and Land management, the Shire of Shark Bay, and the various private individuals and organisations that have an interest in maintaining an effective people-dolphin interaction at Monkey Mia and other natural features of the Shark Bay Marine Park, Francois Peron National Park and Monkey Mia Reserve.

3. Development

- 3.1 Provide advice and comment regarding the present facilities, both public and private, at Monkey Mia in terms of their relevance and appropriateness to the public recreation and conservation objectives of the Shark Bay Marine Park, Francois Peron National Park and Monkey Mia Reserve, with particular reference to dolphin conservation and management.
- 3.2 Provide advice and comment on proposals for change at Monkey Mia and any possible impacts changes might have on the natural environment (especially the dolphins) and visitors' enjoyment of it.

ATTACHMENT 2

FILE NOTE

10.1.1

HISTORY OF MONKEY MIA DOLPHIN CALVESPrior to April 1989

In January/February 1989 unknown events resulted in the disappearance of seven dolphins. Those lost were:

- * three adult males, Snubnose, BB and Sickle Fin;
- * Holly (female, mother Holey Fin, born Dec 1983) who was five years and 11 months old and who was independent of her mother at the time;
- * Koorda Fin (male, mother Holey Fin, born 11 Dec 1988), five weeks old when disappeared;
- * Nipper (female, mother Nicky, born Nov 1987), 14 months old when disappeared, still being nursed by Nicky;
- * un-named calf (mother Puck, born 22 Jan 1989), disappeared after seven days.

One calf survived the 1989 disappearances. Cookie (male, mother Crooked Fin, born October 1988) is still alive, however has never shown interest in accepting fish or interacting with the public. He is now an occasional visitor to the beach. As yet he has not joined a coalition with other juvenile male dolphins.

Post April 1989Calves of Holey Fin

1. It is possible that Holey Fin lost one or two calves/foetuses in the 1990 calendar year.
 - a) Holey Fin was herded offshore by male coalitions for an extended period in February 1989 following the death of Koorda Fin on 23 January 1989. Holey Fin did not visit the beach in February 1990 and visual observations indicated that she was pregnant. Considering a 12 month gestation period, it is most likely she gave birth to a stillborn calf or a calf that lived for only a short period and was never seen by the researchers or rangers.
 - b) Holey Fin was observed being herded offshore for five days in April 1990. Given that Welcome was not born until September 1991, Holey Fin either did not fall pregnant or lost a foetus in the April to August period in 1990.
2. Welcome (female) was born on 3 September 1991. On 25 March 1992, at six months of age, Welcome came to the beach with

significant shark bite wounds around her head and swellings on her mid body (hypothesised to be a result of ramming by a shark). By 1700 hours that day the body swelling was expansive and she was very lethargic. Her mother and other kin were spending little time with her at this stage and were spatially distant. Welcome was 'bobbing' at the surface like a 'cork' and had difficulty submerging. Welcome disappeared that night, presumably 'finished off' by a second shark attack.

3. Hobbit (female) was born on 29 November 1993. Hobbit was a small newborn and had a significant depression between her blowhole and dorsal fin. At three months of age there were concerns that her growth rate seemed to be stunted (compared to Nakita of the same age), the depression had not filled in, and her social development appeared poor. Holey Fin received supplementary feeding to foster improved development in Hobbit. In the late afternoon of 19 March 1994 Hobbit was killed by a shark within sight of the Monkey Mia beach (see photograph).

Calves of Nicky

1. Finnick (male) was born on 16 April 1990. By early 1993 he was being weaned by Nicky. Finnick interacted with the public and accepted fish. Finnick recovered from severe wounds caused by a shark attack on 4 March 1993. His deterioration in health in early 1994 is well documented and there were signs of lethargy by the end of April. Finnick disappeared on 13 May 1994. It is hypothesised that his weak condition made him an easy target for a shark attack.
2. Nakita (male) born on 1 December 1993. Healthy and strong calf. Disappeared on 10 July 1994.

Calves of Puck

1. Puck's second calf, an un-named male, was born on 2 March 1990. It disappeared six days later on 8 March 1990.
2. Puck's third calf, another un-named male, was born on 18 May 1991. It disappeared six weeks later on 29 June 1991.
3. Puck's fourth calf, a female named Piccolo, was born on 6 December 1992. On 4 March 1992 Piccolo had fishing line entangled around her mouth. At 19 months of age, she is the only surviving calf since April 1989 of those borne by the Monkey Mia dolphins. An interaction and feeding policy is desperately required to facilitate her social development and survival, and possibly to become the foundation for the next generation of the Monkey Mia dolphins.

Calves of Surprise

1. Surprise's first calf, Shadow (male), was born 17 December 1992. Shadow disappeared on 9 March 1993, five days after Finnicks was attacked by a shark. This close proximity led to assumptions that Shadow may also have been attacked by a shark.

Ron Shepherd

Ron Shepherd
DISTRICT MANAGER, GASCOYNE

18 July 1994

SUMMARY OF MONKEY MIA DOLPHIN CALF DEATHS SINCE APRIL 1989

Calf	Mother	Month born	Period lapsed since last calf	Sex	Age at death	Month and year died	Cause of death
Possible? Unknown	Holey Fin	February?	13 months		-	Feb 90?	At birth?
Welcome	Holey Fin	September	19 months	Female	6 months	March 92	Shark attack
Hobbit	Holey Fin	November	20 months	Female	4 months	March 94	Shark attack
Finnick	Nicky	April	15 months	Male	4 yrs 1 mth	May 94	Note: survived shark attack in March 1993.
							Poor health/behavioural problems. Weak, possible target for shark attack.
Nakita	Nicky	December	43 months	Male	7 months	July 94	Unknown
Un-named	Puck	March	13 months	Male	6 days	March 90	Unknown
Un-named	Puck	May	14 months	Male	6 weeks	June 91	Unknown
Shadow	Surprise	December	-	Male	3 months	March 93	Unknown

MONKEY MIA VISITATION STATISTICS - MHIASTAT.WK1

	1987	1988	1989	1990	1991	1992	1993	1994	Total
	Total	Total	Total	Total	Total Overseas	Total Overseas	Total Overseas	Total Overseas	
January	No record	*1 11,370	9,433	10,067	7,019 871	8,345 963	6,966 1,158	6,799 1,845	
February	No record	*1 2,733	1,794	2,993	2,673 733	3,349 1,044	2,904 1,075	2,985 1,373	
March	No record	No record	5,994	4,281	*3 4,319 520	3,864 807	3,404 1,344	4,161 1,574	
April	*1 7,440	No record	9,291	*3 10,246	*3 7,312 1,077	*3 8,653 1,188	*3 7,499 1,298	*3 8,141 1,847	
May	*1 10,387	*1 3,843	7,050	7,627	5,737 855	5,255 806	4,441 1,002	5,085 1,282	
June	*1 10,821	*1 7,098	8,699	7,124	6,110 795	5,157 516	5,001 975	5,332 929	
July	*1 16,422	*2 12,725	17,659	14,981	12,782 1,023	11,681 1,402	12,780 1,599		
August	*1 16,575	10,378	12,856	11,047	10,332 677	9,235 1,221	9,246 1,303		
September	*1 16,299	12,518	13,549	11,423	12,602 1,160	11,011 1,391	10,051 1,355		
October	*1 13,125	10,508	15,227	11,706	13,211 369	10,260 1,379	10,934 1,633		
November	*1 7,536	4,287	5,681	4,896	5,314 687	4,164 1,218	4,620 1,581		
December	*1 7,887	5,501	7,102	5,157	5,906 786	5,409 1,201	5,374 2,258		
	106,492	80,961	114,335	101,548	93,317 9,553	86,383 13,136	83,220 16,581	32,503 8,850	
Annual Variation (%)		-24%	41%	-11%	-8%	-7%	-4%		

NOTES: *1 - Traffic counter used to calculate visitation

*2 - Heads counted

*3 - Easter

ATTACHMENT 3**NOTES ON DOLPHIN RESEARCH AT MONKEY MIA**

prepared by Richard Connor, August, 1994

1. Research Personnel**Current**

Richard Connor, University of Michigan
Rachel Smolker, University of Michigan
Andrew Richards, University of Michigan
Janet Mann, Georgetown University
Amy Samuels, Woods Hole Oceanographic Institution
John Pepper, University of Michigan
Per Berggren, Stockholm University
Bill Sherwin, University of New South Wales
Nick Gales, Department of Conservation, New Zealand

Joining in 94-95

Larry Dill, Simon Fraser University
Colin Zimpfendorfer, Fisheries Dept., WA

2. Summary of research programs

Most research projects have involved two forms of data collection: surveys and focal follows. Surveys are done whenever we encounter a dolphin or group of dolphins. Data collected include identities of individuals, location of the sighting (GPS readings), activity of the group, depth and temp of water, and comments regarding the physical condition of individuals, including sex, ventral speckling, pregnancy/lactation, scars etc. Focal follows involve following particular individuals for as long as possible during the day. Data recorded vary by researcher, but usually include the same data described above for surveys, collected at regular intervals throughout the follow. In addition, data is collected on social interactions and behavior of the focal individual(s).

Collectively, these data allow us to look at questions about the ranging patterns of individuals (limited by our ranging), association patterns and social relationships, reproductive parameters (birth intervals, infant mortality, cycle intervals of females as indicated by herding by males, reproductive behaviors etc.) and activity budgets (how much time spent at different activities in different locations within the bay etc.).

* **Pilot Study 1982 (Connor, Smolker)**

Recorded social interactions among MM dolphins; limited offshore surveys to determine potential for future research.

- * Association Patterns 1984-continuing (Smolker, Richards, Connor, Mann, Samuels)
Record location activity and identity of individuals in groups encountered in an approximately 130 km² area centered on Red Cliff Bay. Study focused on association patterns of about 100 individuals out of the approximately 400 identified dolphins.
- * Life History of Shark Bay bottlenose dolphins. 1984-continuing (Richards, Mann, Connor, Smolker, Samuels)
Record data on size, degree of speckling, presence of a calf, behavioral data, or any other data relevant to dolphin life history during behavioral sampling.
- * Vocalizations of bottlenose dolphins 1984-1988 (Smolker)
Recorded vocalizations of dolphins in a variety of behavioral states to correlate vocalizations with behavior. Documented vocalizations associated with feeding and social interactions. Also focused on recording individually distinctive "whistle" vocalizations from known individuals.
- * Behavior and social relationships of male dolphins 1986-1989 (Connor)
Recorded behavior and social interactions, including pattern of alliance formation and herding of females, of male dolphins in the Red Cliff Bay study area. Data were collected on 21 male dolphins including three that visited Monkey Mia.
- * The development of behavior and social relationships in infants 1988-continuing (Mann)
Recorded the behavior and social interactions of infants of known females in the Red Cliff Bay study area.
- * Behavior and social relationships of female dolphins 1988-1992 (Richards)
Recorded the behavior and social interactions of female dolphins in the Red Cliff Bay study area, focusing on changes during different phases of the reproductive cycle.
- * High frequency dolphin vocalizations (Richards, Smolker, Pepper)
Recorded ultrasonic vocalizations of dolphins in the Red Cliff Bay study area.
- * Vocalizations during mother-infant separations 1991 (Smolker, Mann)
Recorded the whistle vocalizations of infants during mother-infant separations.
- * Community structure, ranging patterns, and habitat use of dolphins on the east side of Peron Peninsula 1991-continuing (Berggren)
Using the catamaran Nortrek, record the location, activity, and identity of individuals in groups encountered during surveys along the coast from just west of Point Peron to Petit point. Focusing on the larger scale population structure of bottlenose dolphins in the area, and how their distribution, ranging and behavior relate to habitat variables
- * Genetic study of social relationships in bottlenose dolphins 1994 and continuing (Sherwin, Gales, behaviour team)
Analysis of DNA microsatellites to determine parentage and, if possible, more distant genetical relationships among the Red Cliff Bay dolphins.

- * Population genetics of Shark Bay bottlenose dolphins 1994 and continuing (Sherwin,)
Material collected in the DNA study will be used to study population structure in Shark Bay and contribute to a study at the University of Queensland on the systematics of Australian bottlenose dolphins.

3. Future Studies

The current research does not address certain questions relevant to a full understanding of bottlenose dolphin biology in Shark Bay. The following studies are envisioned for the future, some of them already planned but others conjectural at this stage.

- * Feeding preferences among the Monkey Mia dolphins; beginning in late 1994 (Dill)
Study of fish preferences among the provisioned Monkey Mia dolphins. Species, size, and seasonal shifts in fish preferences will be examined. Fish will then be analyzed for lipid content for a possible correlation between lipid content and preference.
- * Pathology of beached carcasses. (Mann?)
A systematic examination of the pathology of fresh dolphin carcasses that wash ashore on Peron Peninsula.
- * Age, growth, and maturity of dolphins in Shark Bay (Mann)
We will add to the body of data on reproductive parameters collected during behavioral sampling with a systematic examination of dental layers, size, and degree of speckling among fresh carcasses that will allow a data base to accumulate on age, size, and degree of speckling in Shark bay bottlenose dolphins. Photogrammetric data on dolphin size may also be collected from Nortrek. Data on and and size at which speckling appears will be correlated with data.
- * Genetics of Shark Bay dolphins. (Sherwin, Berggren, etc)
DNA from a much larger sample of dolphins will need to be obtained to answer many questions about relatedness among dolphins and the population genetics of Shark Bay dolphins. The goal of this study would be to sample from a larger number of dolphins, using the Nortrek survey study to identify and target individuals from the entire length of the Peron Peninsula.
- * Ranging patterns of large sharks: planned for early 1995 or 1996 (Zimphendorfer, Mann, Berggren)
Sharks are important predators on bottlenose dolphins in Shark Bay, yet we know nothing of their movements within the study area. In this study several large sharks would have radio tags with acoustic transducers attached to them. They would then be followed using the platform Nortrek, which would allow 24 hr monitoring of the sharks movements for up to two weeks.
- * The ecology and distribution of prey species of fish (????)
We currently know very little of the ecology of dolphin prey species. We envision a series of studies which would examine the ecology of prey species in the various sub-habitats of the Red Cliff Bay area, and eventually the east side of Peron Peninsula,

including (1) distribution, density and seasonal and annual changes in these parameters (this aspect would include habitat requirements for each species), (2) predator-prey relationships for each species, and (3) life-history including age, growth and reproduction. These data could be correlated with our extensive records of dolphin feeding behavior.

* The distribution and ecology of bottlenose dolphins in Shark Bay.

Our current study is limited to the east side of Peron Peninsula. We envision more extensive surveys to map the distribution of bottlenose dolphins in Shark Bay, including the larger, robust form which we have seen on two occasions but which does not normally inhabit our current study area.