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Commercial Dugong Tourism At Shark Bay

A Report to the Western Australian Department of Conservation and Land Management

Based in Part on Studies Funded by at Grant from The Australian Heritage Commission
September-November 1997

Paul K. Anderson
Emeritus Professor of Zoology
Department of Biological Sciences
University of Calgary
Calgary, Alberta,
Canada T2N 1N4

Phones: 403-220-5268
403-932-5459
Facsimile 403-289-9311
E-mail: pkanders@acs.ucalgary.ca
pkanders@cadvision.com

"many forms of ecotourism may not be sustainable, and if ecotourism is to contribute to sustainable development, then careful planning and management will be required"

Geoffry Wall (1997)

April 1998

1. Introduction:

Compared with whale watching, viewing sirenians has had a low profile and a largely unexploited tourism potential. Only the Caribbean manatee has captured public attention, becoming an important resource for the Florida tourist industry. Two factors have been largely responsible for manatee "success." Florida manatees are easily viewed and filmed in clear springs and oceanaria, and they are frequently injured or killed when struck by power boats in overcrowded and overdeveloped waterways. Public interest has resulted in popular books, magazine articles, a better than 30,000 strong membership of the Save the Manatee Club, "Save the Manatee" vehicle license plates, and the expenditure of millions of dollars annually on manatee protection and research (despite which the fatalities continue to mount). Western Australia is in a position to emulate the best, and avoid the worst, of the Florida situation.

The dugong is one of the most unusual of all mammals. Shark Bay's dugong population is the densest and one of the largest remaining. As a major factor in World Heritage recognition, the dugong is an appropriate "flagship" for the Shark Bay World Heritage Area and Shark Bay Marine Park. Nowhere else can dugongs be found as reliably and shown to the public as well. Dugong cruises have proven a popular and profitable attraction at Monkey Mia and viewing of dugongs is a highlight of wildlife cruises based at Denham. The dugong population of Shark Bay is a unique resource, and preservation of that resource is both and opportunity and an obligation of the Western Australia government.

This report is written from a background 23 years of study of dugong behaviour, and approximately 34 months spent in the field at Shark Bay. My experience includes numerous aerial surveys, many hours swimming with dugongs, and observation from

vantage points on land and from a variety of watercraft (3-4 metre kayaks, 5-7 metre outboard powered skiffs, an 8 metre outboard powered barge, and 4 to 10 metre sailing catamarans). I have joined tourist cruises on the jet-driven catamaran "Shark Bay Explorer," the motor-sailing catamaran "James Scheerer", and the auxiliary-powered sailing catamaran "Shotover," and observed Shotover dugong cruises from my own vessel.

This report is qualitative. A more quantitative report detailing the impact of dugong tourism, and tourist attitudes preceding and following cruises, is expected when Mr. Cedric Gerrard completes his MSc. thesis at the University of Calgary. I begin by reviewing aspects of dugong biology that need to be taken into account in the dugong viewing industry and suggest an appropriate set of interaction rules. These are followed by accounts of dugong tourism at Shark Bay as I have been privileged to observe it. I conclude with a critique of the current policies of the Western Australia Department of Conservation and Land Management. The intent of my critique is to contribute to dugong conservation and further the development of a viable dugong viewing industry.

2.0 - Dugong Biology in the Commercial Eco-tourism Context

2.1 - Dugong Metabolism

Dugong metabolism has never been studied under controlled conditions. It is assumed that, like manatees, dugongs have a very low metabolic rate. Because, like manatees, dugongs tend to avoid water temperatures below about 19°C this assumption is supported.

When undisturbed, dugongs surface to breath at intervals of from 45 seconds to six minutes. The longest recorded submergence is 11 minutes. When submerged for more than two or three minutes they may remain at the surface and breath

repeatedly before submerging again. Although dugongs are powerful swimmers, they become exhausted after a few minutes of violent exertion, and recovery of normal patterns of breathing after such exertion may take as much as an hour. In Shark Bay's subtropical environment dugongs may be metabolically stressed during the winter months. Harassment leading to high speed flight at any season may be energetically costly and may subject dugongs to damaging stress, affecting long term survival and/or reproduction.

2.2 - Feeding, Foods, and Habitat Utilization

Habitat quality is determined in part by the distribution and abundance of preferred foods. Unlike manatees, which ingest a wide variety of plant material throughout the water column, dugongs are diet specialists feeding only on or near the bottom. In any one region they may depend on two to four kinds of seagrasses. The preferred species are those that produce easily digestible material stored in underground stems (rhizomes). Dugongs also eat certain bottom dwelling invertebrates (sea pens, burrowing mussels, tunicates, annelid worms and possibly some sea cucumbers) and these foods may be important sources of protein.

Seagrass meadows are patchy. The most prominent species may be the least desirable. In Shark Bay the small pioneering seagrass species that dugongs prefer (the genera *Halodule* and *Halophila)* make up only a small portion of total seagrass material. Their availability is seasonal, local, and sometimes transient. Water temperature limits dugong distribution at some seasons and dugongs must seek out preferred foods where water is warmest. Water depth is likely to be an important variable in the food equation. Dugongs are restricted to foraging at depths where there is sufficient light for plants to grow, but the deeper the water the more time and energy dugongs must expend in travelling between their food and their air supply.

Shark Bay is unique in that in winter many (most?) dugongs feed extensively on leaf clusters of "wire weed," *Amphibolis antarctica*, a species found nowhere else in the dugong range. *Amphibolis* makes up 90% of the seagrass biomass in the Bay and dominates between the lower low tide level and the eight metre bottom contour. In winter, Shark Bay dugongs move to *Amphibolis*-dominated feeding areas when forced to leave other habitats by low temperatures. They abandon *Amphibolis*-dominated areas when higher temperatures allow. In some areas of the Bay and in some seasons some (or most) dugongs may also feed at depths of more than eight metres on rhizomes and/or entire plants of the seagrass *Halophila spinulosa*. The ecology of this deep water foraging has not been studied. In addition to time and travel costs in deep water there may be more wave action (thus higher energy cost in getting a breath), and there may be a higher risk of attack by large sharks or killer whales. Harassment in shallow water feeding areas could force dugongs to forage in deeper water, to the detriment of the population. Undisturbed access topreferrred, but uncommon, foods is an important management consideration.

Dugong viewing opportunities vary with habitat. When dugongs root into the bottom for the rhizomes of *Halodule uninervis* and *Halophila ovata* the activity raises clouds of fine mud that make dugongs easy to locate but less visible beneath the surface. In deep water dugong submerged times are long and movements while submerged are unpredictable. This handicap is only partially offset by longer time spent on the surface as animals recover from long dives. Dugongs excavating bottom dwelling and burrowing invertebrates on shallow (0.6 - 2 metres deep) banks of open sand may be relatively easy to locate and follow, but may be difficult to approach, either because of the draught of the vessel, or because when deep-water escape cover is not nearby dugongs panic and flee at high

speed when they become aware of an approaching vessel. Dugongs feeding in shallow water on *Amphibolis* leaf clusters are the most easily located and shown to tourists. Dives are short and animals are relatively visible beneath the surface because leaf cropping does not produce sediment clouds.

2.3 - Daily Activity Cycle

Because digestion takes place in the colon and is a continuous process dugongs do not have to interrupt feeding to digest their food. Just how much time a dugong needs to spend feeding is not clear. It may range from six to 18 hours or more. Dugongs are known to feed in darkness as well as during the day. When foraging time is restricted dugongs may lose condition, jeopardizing reproduction and survival.

When animals are clearly not feeding but remaining stationary just below the surface or on the bottom we assume they are resting. Resting, and even basking on the surface with the back exposed, is most likely in warm mid-day calms. Sunburn while basking may account for scar tissue commonly seen on the backs of large (presumably older) dugongs. We do not know how important resting may be. Sleep has not been demonstrated.

There is often a narrow "window" of favourable time in the day when dugong viewing is effective at any one location. Seeing dugongs is dependent on sun angle, wind, sea state, and dugong behaviour. Early and late in the day low sun angle makes dugongs difficult to see below the surface. Through much of the year winds increase in the afternoon. When winds are strong, waves make dugongs difficult to locate and difficult to keep in view once located, and a vessel becomes more difficult to manage. Dugong activity and accessibility may also vary with the tide. On the banks off Monkey Mia dugongs are excluded by low tides and are less easily located and viewed on such tides.

2.4 - Reproduction

The biology of dugong reproduction is understood principally as a result of carcass studies by Helene Marsh and her co-workers on the Australian east coast. There females are in reproductive condition between late August and January. The breeding season in Shark Bay is inferential but based on observation of male reproductive behaviour it may last from early September to early January.

The dugong reproductive rate is very low. Females become sexually mature at an age of 10-14 years and produce a single calf at intervals of from three to seven years. In males, mature sperm first appear in the testes in the 10-14 year age group but a male's tusks of males may not erupt until two to four years later. Assuming the tusks are required for successful mating (either in competition with other males, or in manipulating females) males may be unlikely to reproduce until they are up to 18 years of age. Although long lived (to 70 years) dugongs have low breeding rates, and populations may be sensitive to disturbance that affects reproduction. Significant population trends can develop without detection by an agency charged with dugong conservation.

Reproductive behaviour is of interest to viewers. Despite their long (possibly 40 million year) separate evolutionary paths it seemed logical that reproductive behaviour of manatees and dugongs would be somewhat similar. Manatee males cluster about potentially receptive females and pursue them actively for periods of up to a month. Clusters of dugongs in active physical contact, lasting one or two hours, have been observed in Queensland's Moreton Bay and interpreted as an equivalent of manatee mating. Despite many weeks spent on the water during the presumed mating season I have not encountered this mating-herd phenomenon in Shark Bay and it has not been reported by others. Instead a small aggregation of males holding and defending territories on which one-on-one

mating occurred was observed in the Gladstone region. The few matings seen there cannot account for the approximately 500 calves that must be born annually in Shark Bay and matings must occur somewhere else in great numbers.

Our information on birthing is even less complete. There are neither anecdotal accounts nor scientific observations of where, when, and how calves are born in the Bay. Very small, pale coloured, young are common in the Gladstone Area from mid-January until mid-March. A small, probably newborn, calf has been reported in the western Bay in July. A dead newborn washed up on the beach south of Monkey Mia in November. To date too little is known to make reproductive behaviour reliably accessible to viewing, or to risk disturbance of reproductive activities critical to the well being of Shark Bay's dugong population.

Young dugongs may remain in close contact with the maternal female for one to two years and the cow-calf bond is obviously very important for calf survival. Although calves may start to ingest seagrass within two weeks after birth, suckling may continue for as long as calves consort with their mothers and milk may be essential for rapid, normal, growth in the first years of life. The bond between a dugong cow and her calf may also provide protection from predators. Calves move over the back of the attending cow in the presence of an apparent threat. By doing this a calf may be less visible to a potential predator and/or protected there from attack from below. It is also carried along in the slipstream when the mother swims at speed.

A prolonged mother-young relationship is often associated with a requirement for prolonged learning. Extrapolation from other species suggests that young dugongs may have to acquire knowledge of food choices and locations, avoidance of danger, migratory requirements and routes, or other vital information through the mother-young association. There is no evidence that

a dependent dugong calf is ever cared for or suckled by other than its mother. Viewing that could cause separation of a cow and her calf should be avoided. With our limited knowledge we cannot make firm judgements as to where, when and how human activities might put dugong reproduction in the Shark Bay at risk.

2.5 - Dugong sensory abilities and communication

Dugongs and manatees appear to have underwater vision equivalent to that of a human diver wearing a mask. As dugongs sometimes lift their heads above the surface as if to look at a nearby vessel they also appear to have the ability to see in air. The acuity of the dugong eye in air is unknown.

Dugongs and manatees may had even longer than whales and dolphins to exploit the acoustic properties of the underwater environment. It should therefore be expected that they would have keen underwater hearing and make use of vocalizations for communication. Although they are active at night and in muddy water they apparently have not developed echolocation.

Manatee hearing appears to be good over a wide frequency range and dugong hearing should be as good. Dugongs respond to underwater sounds and produce vocalizations underwater. It follows that manmade underwater sounds may interfere with communication among dugongs (e.g. a cow and her calf) or cause dugongs to avoid important foraging grounds. Anecdotal observations suggest that dugongs can determine the direction from which a sound is coming."Sinus hairs" located in shallow pits scattered over a dugong's skin at intervals of about 2 cm may be a means of detecting water movement or changes in pressure, but the functions and sensitivities of these hairs are speculative.

2.6 - Short-term responses to disturbance

Dugongs may respond to a disturbance by vocalization,

investigation, or avoidance. In an underwater video recording that I made in 1989 a calf vocalized when it became aware of my presence and the cow responded by both vocalizing and swimming rapidly away. A territorial male on the Gladstone lek responded to the approach of our catamaran by emitting a series of loud barks that appeared to be aggressive, and may have been challenging or warning sounds.

Dugongs commonly approach and investigate a vessel or a swimmer, and often are apparently attracted from a distance of 100 metres or more. A typical investigation consists of approach to the limit of underwater visibility (usually 10 m or less in Shark Bay) and circling the intruding object in a manner that allows visual inspection from the side (i.e. with one eye). Visual inspections may last from a few seconds to 30 minutes but generally last for a few minutes only. Investigations are typically followed by departure from the area to a distance of greater than 100 metres ("avoidance"). Dugongs are particularly likely to investigate the sounds made when a vessel is anchoring.

Avoidance ranges from simply moving away as just described, moving off very surreptitiously (swimming longer distances below the surface with minimal emergence). More violent responses include panic dives with violent fluke slaps (in deep water) or panic swimming at maximum speed (in water less than two metres deep) to the point of exhaustion. The stimulus eliciting these responses may be acoustic (e.g. an engine, sound of an anchor chain over a bow roller, SCUBA, or splashing), sight of an underwater object, a rapid movement (including acceleration) by a human swimmer, sight of an above-water object, or the shadow of a mast or sail. The bottom line is that approach to a dugong by a vessel or swimmer almost invariably leads to interruption of previous activity and eventual departure from the immediate vicinity.

2.7 - Long term reactions to disturbance.

Where dugongs are hunted and/or subjected to frequent harassment major changes in behaviour may occur. In the Palau Islands and on the Kenyan coast where dugongs are hunted they are found only in deep water during the daytime and come inshore to forage only under cover of darkness. In Moreton Bay dugongs foraging over shallow seagrass banks react to engine sounds and flee to deeper water when vessels approach to within 1 km, and are reported to no longer utilize areas with the highest boat activity. Some dugongs that have been captured and tagged for research purposes are reported to have become extremely wary of vessels and difficult to approach. Too great pressure from dugong tourism could cause dugongs to change their habits in ways that interfere with efficient feeding or make them less approachable for viewing.

2.8 - Seasonal distribution in Shark Bay

Between mid May and mid August water temperatures are below minimal dugong preferences in eastern Shark Bay south of Guichenault Point. (25° 40' S) and west of the Peron Peninsula south of Useless Loop (26° 10' S). Dugongs become scarce or absent north of these boundaries between late October and mid May. The result of these shifts is that dugongs are difficult to locate from Monkey Mia in the May-August period, when the nearest site where dugongs can be confidently expected is off the Guichenault Spit approximately 13 nautical miles (two hours sailing time) to the north. The best opportunities for dugong viewing from Monkey Mia are in the August-November period, the poorest are between May through July. Dugongs do not frequent the western shore of the Peron Peninsula. To assuredly find dugongs between May and the end of October requires a two hour sail from Denham (Bar Flats, Heirisson-Bellafin Flats, and off the Dirk Hartog Homestead and Notch Point). Between mid November and the end of April sailing time from Denham for

assured dugong contact may be from three to six hours.

2.9 - Vulnerability to collisions with boats

Collisions with boats and laceration by propellars are frequent causes of manatee deaths in Florida, USA. Up to the present reports of death or injury to dugongs as a consequence of collisions with boats are rare, and scars characteristic of propeller wounds are unknown in Shark Bay. I suspect there may have been an average of one or two collisions annually in recent years. The explanation, other than open waters and a relatively small number of boats, may be that as bottom feeders dugongs spend more of their time out of danger while manatees may spend proportionately more of their foraging time near or at the surface. Dugongs take evasive action to approaching power boats in some, but not all, circumstances. When a power boat approaches at speeds of ten knots or more dugongs are unable to detect it in time and take evasive action to avoid collisions. Dugongs do not detect approaching sailboats acoustically. As sailboats generally travel at speeds below seven knots alert dugongs are probably capable of visually detecting their approach from most angles in time to avoid damaging collisions when subsurface visibility is good. Sailing vessels moving at higher speeds (e.g. windsurfers, sport catamarans) might not be noticed in time to take such action.

3.0 - Dugong Tourism

3.1 - Dugong viewing and dugong conservation

Why should viewing of an endangered and difficult to see species be allowed or encouraged? Dugongs are smaller and less impressive than the great whales and are less familiar to the public than dolphins. They spend less time at the surface than do dolphins and do not come to the beach to beg for fish. They have yet to be dramatized by the electronic media, have never

been stars of television serials, are less likely to attract advertising money, are rarely exhibited in aquaria, and have not been trained to leap through hoops or tow bathing beauties on surfboards. Despite these "deficiencies" dugong viewing should be encouraged. Public support of dugong conservation benefits from, and requires, an informed human constituency. It is important that society cherish a remarkable large mammal survivor from a distant past. Experiences that stimulate the human sense of wonder, and trusteeship must be fostered if we are to pull back from the destruction of the majority of our fellow travellers on the planet. Learning about species such as the dugong generates values required to keep the earth fascinating and human life rewarding and worth living. Last, and least, dugong watching can be a lucrative and sustainable local enterprise.

3.2 - Viewing dugongs from vessels

On a cloudless day with sea state less than Beaufort 3, dugongs can be sighted from a distance of 100 to 500 metres. For satisfactory viewing and photography by tourists sun angle should be above 45 degrees and the vessel must approach to within 30 metres. For interpretive commentary and discussion that proximity must be sustainable for five to twenty minutes without stimulating an avoidance response. Ideally, foraging and suckling of young can persist near a vessel long enough to be appreciated and discussed before dugongs respond by either investigating or leaving.

Good viewing requires that the approach is carried out at an angle relative to the sun that minimizes glare and maximizes subsurface visibility. Favourable conditions are likely to be limited to a few hours around the middle of the day. Viewing demands skilful and conscientious boat operation. Approach under sail is quiet and does not disturb dugongs at a distance. At closer quarters maneuverability under sail is limited by

wind, sea, and bottom contours, sail shadow may frighten dugongs, sudden appearance of a vessel nearby without warning may be disturbing, and sail handling can be noisy. A slow approach under power is often the most successful. Engine sounds and their impact vary with the vessel and engine type. Given a quiet engine with a sound spectrum that is not disturbing to dugongs and careful maneuvering, approaches under power can provide good viewing opportunities and minimize disturbance. Viewing is best of all when a vessel is drifting or at anchor. Anchoring and allowing dugongs to approach is good practice where time is available, but it is impractical on cruises lasting only one or two hours such as those from Monkey Mia.

3.3 Interaction Rules for Dugong Viewing.

3.3.1 The basis for interaction rules.

Herbivores need to spend large amounts of time feeding and frequent interruption reduces that time. A dugong will rarely be approached to within viewing distance without interrupting its feeding or other activity and causing it to eventually move away from the contact location. Dugongs may not get enough to eat if frequently disturbed. In response to disturbance animals may abandon preferred foraging areas, or forage on these areas only at night, but there are as yet no data to tell us what the critical limit of disturbance is at any place or season.Given that normal activity does not involve high-speed swimming and dugongs can be stressed if excessively disturbed, disturbance that has negative physiological consequences over the long term may appear innocuous at the time.

Dugongs sometimes respond to sounds at surprising distances, and may respond to engine sounds in some circumstances but not in others. Diesel engines with low speed propellers and above-water exhausts may be less disturbing to

dugongs than outboard engines with higher speed propellers and underwater exhaust. Sounds that increase in intensity (as when a vessel accelerates rapidly) may be interpreted as a rapidly approaching vessel and be highly disturbing. Any loud or continuous sound of the right frequency may interfere with communication between a cow and her calf or among adult dugongs in a group. Because consequences are not easily predicted management of human activities should always be conservative.

It is not appropriate to extrapolate whale and dolphin interaction rules to dugongs at Shark Bay. Interaction rules for dugongs must be designed specifically for dugongs and with the intention of limiting the impact of each contact and the frequency of contacts to which an individual is likely to be exposed at a particular location.

3.3.2 - Suggested interaction Rules for dugong viewing vessels

1. A vessel approaching under power or sail should go to "no-wake" speed (<5 knots) at 100 metres.
2. Vessels should not close under power or sail to less than 20 metres.
3. Within 20 metres the limits to all interactions should be set by the dugong(s).
    a. Once a dugong has detected and reacted to a vessel the distance between the vessel and the dugong should be left up to the dugong.
    b. Interactions with an individual dugong must end when that dugong moves away from the vessel.
    c. Departing dugongs should not to be followed, or approached again.
4. The same dugong is not to be knowingly approached repeatedly by the same or another vessel.
5. Dugongs are not to be pursued, herded, deliberately frightened, or run over.

6. If an interaction is not broken off by the dugong(s) vessels that are not drifting or anchored should break off the interaction after 30 minutes with a no-wake departure until 100 metres distant (if the vessel is suitably equipped departure under sail is preferable to power as the sound of an engine starting is often disturbing).
7. Visits to any dugong foraging area shall not knowingly exceed one vessel between sunrise and sunset on any given day, but a viewing vessel may remain at anchor in a dugong foraging area to a maximum of 24 hours.*
8. A vessel approaching or in interaction with a dugong should fly a signal flag indicating that an approach or interaction is in progress. When such a signal is flown no other vessel should approach closer than 500 metres.
9. No action shall be taken that threatens to separate a cow and her calf.

* Ideally an individual dugong should not be subjected to more than one interaction per day. If more than one vessel is licenced to interact with dugongs on a particular seagrass bank vessels should be assigned mutually exclusive interaction zones (or regulations should allow competing vessels to visit the area only on alternate days).

3.4 - Swimming with dugongs

Only when surfacing dugongs are visible from swimmer's eye-level (a nearly flat calm) can dugongs be easily located and approached. by a snorkeller. Splashing and/or breathing sounds alert dugongs to an approach. Dugongs respond to such sounds, or to sight of a swimmer by circling to investigate at about the limit of underwater visibility. or by moving away.

Over most of the Bay subsurface visibility is generally less than ten metres and views will not be very satisfactory and will be inadequate for photography.

Dugongs will flee if a swimmer moves rapidly towards them, or simply makes a quick movement. Swimmers need to approach with little splashing from directly behind a focal animal if they are to observe behaviour other than investigation or flight. Elsewhere, and in what appear to be special circumstances, dugongs have habituated to SCUBA . This has not been reported from Shark Bay.

Swimmers are unlikely to be in any danger from dugongs, but an early aerial survey recorded an association between large sharks and dugong concentrations. There is increasing evidence of shark predation on dugongs in Shark Bay. A swimmer could be interpreted by a shark as a partially incapacitated and vulnerable dugong. In my research swimmers have only twice encountered 2.5 to 3.5 metre tiger sharks. The sharks were not aggressive in these instances. Caution is advisable in any commercial swim-with-dugongs program, even when a shark was initially unaggressive, inexperienced or anxious swimmers might respond to an investigating shark in a manner that would invite attack.

Visibility in Shark Bay is rarely sufficient for good underwater photography of dugongs. In some years numbers of dugongs may move into South Passage in winter. Subsurface visibility may exceed 20 metres inshore of the Surf Point break. In this situation underwater dugong viewing and photographic opportunities may be excellent but the area is dangerous because sets of larger than average waves may pass over the reef causing steep breaking seas to appear with little warning in apparently safe water.

3.4.1 - Interaction rules for swimmers

As dugongs are so much more capable in the water than any

human swimmer, swimmers pose little risk to dugongs. For the would-be viewer or photographer the basic rules are to swim as quietly as possible, to float or swim slowly, to avoid quick motions, and to allow the dugong(s) to set the limits to the interaction. The number of persons entering the water at one time should be fewer than five. Viewing will be most successful when only a single swimmer is in the water. In order to limit impact on dugongs in any swim-with-dugongs operation the rules for vessels given above should be followed. Attempts to swim with any one group of dugongs should be limited to 30 minutes.

3.5 - Economic Geography of Dugong Viewing at Shark Bay

Local climate, docking facilities, dugong distribution, and local markets dictate the opportunities at any one operating base. Wildlife tours currently operating from Denham and Monkey Mia illustrate the extremes.

At Monkey Mia Docking facilities are limited. Wildlife cruises cater to the crowds that gather to view the beach dolphins and to bus tour groups making brief stays. Although longer tours (e.g to Guichenault, Herald Bight, Cape Peron) are possible the primary wildlife viewing areas are in a radius of 7.5 km (Red Cliff Bay and the seagrass banks east and west of Herald Gut). Only two species, dolphins and dugongs can be consistently located (sea turtles, small rays, sharks and sea snakes are sometimes seen). Interaction locations vary throughout the day and seasonally, but if dugongs are to be reliably encountered it is necessary to access seagrass banks and channels to a distance of four mile (7.5 km). Viewing benefits from the lee of the Peron Peninsula. With consistent offshore winds a vessel in transit can depend on sail, using power when docking, during calms, and when maneuvering near animals. Interaction is focused on small groups of dugongs and sites themselves are concentrated in very small "hot spots." The market is large, but if more than one vessel is licenced

mutual interference is inevitable at the dock and in the interaction localities and individual animals will be targeted repeatedly.

Denham caters to a much smaller market. Denham is on the windward side of the Peron Peninsula. Higher winds and rougher seas are to be expected in the immediate area. Protected interaction sites are in the lees of Dirk Hartog Island, Edel Land, and seagrass banks from eight to fifty miles distant. Potential destinations and wildlife viewing opportunities are numerous, diverse, and widely distributed. The viewing areas themselves are relatively spacious. Target wildlife sites in addition to dugong foraging areas include seagrass banks, osprey and sea eagle nests, gull, tern and cormorant colonies, and turtle nesting beaches. Large marine fauna include dugongs, dolphins, whales, manta rays, and whale sharks. Scenic and historical destinations include beaches, cliffs, headlands, Cape Inscription and the Gudrun wreck, islands, dune areas, spectacular surf, coral patches, and rock faces. There are numerous dive sites. Terrestrial and underwater adventure can be incorporated in the tours. Docking facilities are larger and sailing schedules can be readily adjusted to minimise conflict. For power-dependent vessels a limiting factor is the cost of fuel.

To summarize, Monkey Mia destinations are few, small in area and nearby and the wildlife tourism opportunity is a short-trip, large group, enterprise focused on two wildlife species. Restricted interaction and docking areas and concern for target wildlife dictate that there should be a single operator with an exclusive interaction zone extending over a radius of approximately four nautical miles. Conditions at Denham require long trips and catering to small groups. Denham destinations are numerous, diverse, and widely scattered. The number of licences at Monkey Mia must be set on the basis of impact on target wildlife. For the time being, at least, the

number of licences issued at Denham can be set primarily by the market.

4.0 - Observations on wildlife tourism in action at Monkey Mia and Denham in September-October 1997.

4.1 -Monkey Mia Wildlife Sailing Cruises

Dolphins usually arrived at the beach in the morning, between 0700 and 0900, drawing a crowd of more than one hundred viewers. "Shotover," a 19 metre LOA 9.5 metre beam open deck sailing catamaran with twin sail-drive diesels, moved to the jetty to load passengers for offshore dolphin-viewing in the immediate aftermath of a typical dolphin beach visit.

4.1.1 - The schedule

0900-1000 a short "wildlife cruise" taking advantage of relatively calm morning conditions and catering to bus passengers and others departing Monkey Mia early in the day. The cruise concentrated on offshore dolphin encounters, giving viewers an opportunity to see dolphins other than those that visit the beach, and observe dolphin activities in a less artificial situation.

10:30-12:30 a longer "dolphin cruise" - concentrating on dolphin activity in Red-Cliff Bay.

1300-1530 the "dugong cruise" to banks east and west of Herald Gut two to four miles to the NE.

1600/1700 (departure varies seasonally) "Sunset Cruise" directly north of Monkey Mia. This the dugong cruise takes advantage of lee provided by the Peron Peninsula for an evening "relaxation" and social sail. Wildlife viewing is not an objective. Although dolphins and dugongs may be encountered viewing conditions

are poor.

4.1.2 - The Vessel

"Shotover" is a superior vessel for wildlife viewing in the Monkey Mia environment. It is very stable, sails very fast, is quiet, can operate largely under sail in transit between the jetty and the viewing areas, and can carry approximately 49 guests in comfort and a blend of charisma and excitement. It provides a good platform for viewing and photography. It is expertly handled by a crew of three and can operate in depths to about one metre. Passengers are provided with polarized sunglasses that greatly enhance visibility into the water.

4.1.3 - The Interpretive Program

An introduction talk about dugongs takes place after the vessel got underway. A crew member gives a basic description of dugong morphology and natural history. Once an interaction is in progress further commentary is offered and passengers are encouraged to ask questions.

The management was concerned that information was accurate and requested that I spend an evening discussing dugong biology with crew members and answering their questions. When I provided plastic laminates with examples of sea grasses they were shown to illustrate what dugongs eat. When I joined cruises I was asked to participate in the interpretive comments and passengers were encouraged to ask me questions. Crew members were receptive to new information and to suggestions. Passengers were encouraged to ask questions throughout the cruise.

4.1.4 - Interactions

My notes are based on cruises on which I and/or my students were passengers and on occasions on which we were observing dugongs and "Shotover" operations from our own

vessel. Cruises in September and October were dependent on a favourable window of wind, light, and sea conditions, and on small areas of seagrass bank where dugongs could be reliably located and approached. During this season dugongs appeared to be migrating to the south, but small numbers could be reliably found foraging on *Amphibolis* in waters one to two metres deep east and west of Herald Gut. Rooting on the smaller seagrasses began only in early November. The largest dugong group reported was 30. In most cruises fewer than a dozen animals were located and dugongs were approached fewer than ten times. The interaction area was restricted by dugong distribution, by the lee provided by the banks in the stronger afternoon winds (quieter sea surface), by the necessity of positioning the vessel relative to the dugongs so that the sun angle was favourable for viewing, and by restrictions on maneuverability imposed by shoals. On the cruises I boarded the first dugong sighting took place 17 to 65 minutes into the cruise. Dugongs were most reliably found on the bank east of Herald Gut (four nautical miles from the Monkey Mia Jetty). At least one cow-calf pair was approached. Time spent in interaction (total) was 30-60 minutes. The sail back to the dock lasted 30 to 60 minutes depending on tide and wind and on opportunities to observe other animals (dolphins, turtles, sea snakes and rays). If no other wildlife were encountered on the return trip the guests relaxed, chatted, or asked questions of the crew. As the wind was usually increasing the return sail was exhilarating.

Shotover approached dugongs under power, sail, or by drifting. Dugongs were detected at distances of from 50 to 200 m. Effective observation by passengers required an approach to within 50 m. On the beam of the vessel viewing distances ranged from one metre to 50 metres. Photography required a distance of 30 metres or less. Dugongs occasionally found themselves between the hulls up to several metres back from the line

between the bows. Some approaches to these minimal distances did not evoke investigation, or even immediate avoidance. Suckling was observed at these minimal distances without disruption. On 03/11/97 a solitary dugong rooting into the substratum 15-20 metres ahead of Shotover's bows was followed under power for ten minutes without any sign that the dugong was aware of vessel.

My observations aboard Shotover indicated that approach under power had several real or possible advantages. In very light wind and sea conditions the vessel was more easily controlled. It also appeared that engine sounds may alert a dugong to a vessel so that a startle reaction and immediate flight are less likely. Under power there is not a massive sail shadow.

A very small portion of the total Shark Bay dugong population was exposed to contact with "Shotover". It was not clear whether the same individuals were contacted on succeeding days, but this seemed unlikely. Contacts with individual dugongs lasted from five to twenty minutes.

Although dugongs foraged or suckled young within a few metres of the vessel almost all approaches eventually induced interruption of the dugong's activity and displacement for a distance of 100 metres or more. The cost to each individual dugong appeared small, but this could and should be quantified.

5.2 - Observations on Denham-based Wildlife Tourism in Western Shark Bay:

5.2.1 - Shark Bay Explorer

In July of 1992 I was a guest on a typical tour on board the jet-driven power catamaran Shark Bay Explorer, operated by the Dysons. The tour lasted approximately seven hours. The final destination was the Indian Ocean off South Passage. A light lunch was provided. Stops en route were made to view dugongs on the Heirisson-Bellafin Flats and the osprey nest on

Sunday Island in Blind Strait. The explorer was able to locate dugongs while powering slowly along the channels in the Flats, and was positioned so as to drift to them and provide good views as the animals fed and investigated. The Dysons were eager to acquire and provide accurate information on the wildlife observed. Shark Bay Explorer has since been sold, reportedly because fuel costs made operation uneconomic unless a full load of passengers were aboard. As this was difficult to insure in advance trips were sometimes cancelled.

5.2.2- Research Catamaran James Scheerer

The motor-sailing catamaran ,James Scheerer, operated out of Denham by Craig and Jessie Shankland is a successful example of high-end ecotourism, offering day trips for up to 10 passengers, and trips lasting up to a week for smaller groups, usually one or two couples. As a motor-sailor James Scheerer can operate economically from Denham because it travels under sail in transit minimizing fuel costs. The Shanklands have accumulated a truly exceptional knowledge of the Bay and its natural history through cruises in the small sailboat that preceded the James Scheerer, cruises with the James Scheerer for personal pleasure and exploration, and charter of their vessel for scientific research and documentary filming. Resources aboard include an extensive reference library of illustrated natural history volumes available to guests and prominently displayed.

James Scheerer' day cruises last approximately eight hours. Morning and afternoon refreshments and a generous high quality lunch are served. There is no formal interpretive talk, but information is offered as animals are encountered and there is ample time for discussion in depth if clients are so motivated. Seagrass specimens are kept on board to illustrate dugong diets.

James Scheerer can reliably encounter dugongs during the winter months on the Heirisson-Bellafin flats, in Blind Strait, on the shoal off Notch Point, to the north along the eastern coastline of Dirk Hartog Island almost to Cape Inscription, and off Cape Leseuer. On a typical day cruise dugong are likely to be first encountered near the Eight Mile Beacon. Lunch is served at anchor off the Dirk Hartog homestead. If guests are so inclined there may be an opportunity snorkel to observe seagrass or coral patches or to swim with dugongs. The atmosphere is relaxed and social. Because discussion and interpretation are informal they are dependent in part on the interest expressed by guests. The Shanklands have maintained a conscientious log of all dugong sightings, with GPS location, depth, conditions, temperature, depth, approximate group size and notes on behaviour since 1995.

As is the case with the Shotover, James Scheerer can approach dugongs either under sail or power. Viewing under power has been generally the most satisfactory because the vessel can be positioned properly and maneuvered slowly under better control. Viewing is over the same range of distances, and as with Shotover dugongs may occasionally pass between James Scheerer's bows without panic reactions. On one occasion when a large herd of dugongs was foraging over open sand at a depth of around a metre and a distance of approximately 150 metres the sound of the anchor chain caused a panic reaction among some individuals, and rapid movement away by the rest.

Neither James Scheerer's day cruises, nor the longer cruises are "dugong cruises." Dugongs are merely one of the attractions which include other fauna, gourmet meals, scenery, and the pleasant social ambience that the Shanklands create.

5.2.3 - Potential for dugong tourism from other bases.

Dugongs can be found in the Freycinet Estuary near Three Bays, Baudin, Mary Anne and Salutation Islands only during the

summer. These areas can be reached within an hour's sailing time from Nanga, but there is no jetty and the beach is exposed to strong summer winds making loading and unloading of passengers difficult.

In the winter months dugongs are easily accessible under favourable conditions close inshore from the Dirk Hartog Homestead Resort and off Notch Point a few kilometres to the North. They can be observed from vantage points on land off the Shag Mia cliffs approximately 90 minutes drive away. I'm uninformed as to whether these options are being exploited at present.

6.0 - Critiques and recommendations

6.1 - Monkey Mia: The "Dolphin Information Centre"

There is at present no official recognition or emphasis on the dugong as a feature of tourism at Shark Bay. I am confident that Roxanne Shadboldt and other staff at the Information Centre would welcome and appreciate official support for a dugong emphasis.

The beach dolphin experience that draws tourists to Monkey Mia is precarious in its dependence on a few individual dolphins. The dolphins are at the beach for short periods only, and hold the attention of most tourists for less than an hour. In comparison, dugong tourism is a more secure enterprise and one that is unique to the Bay. Because seagrasses are readily shown the ecology of the Bay can be more readily addressed. At present the potential of the Information Centre is under-utilized. At the waterside the rangers have to be primarily concerned with crowd management and with selecting and involving a few visitors in feeding the dolphins. A few questions can be answered there, and although information is given readily in response to questions at the Information Centre desk the information provided to the average tourist is minimal. In the "vacuum" that follows the dolphin feeding only

a small fraction of the tourists avail themselves of videos or interpretive talks. The videos are presented with few or no introductory remarks and with little or no opportunity for follow-up discussion. Little use is made of the available collection of skeletal material. The collection lacks the most interesting materials such as sets of cervical vertebrae. Seagrass specimens were not available until I provided some. There are no videos on dugongs, seagrasses,, or on life on the intertidal flats to the south where interpretive trips could be offered at low tide. The only evening talks were those volunteered by the researchers.

Recommendation: I understand that Information Centre at Monkey MIA is due to be expanded. If this is done the Centre should be redesigned as a Wildlife Information Centre for the eastern Bay with emphasis (in the marine area) on dugongs, tiger sharks, intertidal flats, and seagrass banks as well as dolphins. Interpretive programs should be developed for each of these categories. Programs should emphasise habitat requirements and interactions. There should be a permanent hydrophone installation that would allow dolphin sounds to be monitored and a real time spectrogram of dolphin and engine sounds should be available for viewing. Dolphin wardens should have access to a patrol boat to monitor activity on the water.

6.2 CALM policy regarding licencing at Monkey MIA.

I have before me a copy of a letter on CALM stationary from Elena Anière to Mr. Harvey Raven regarding issuance of a wildlife interaction licence, and a copy of a licencing agreement (CLM 149/172). I am appalled by these documents. Despite the fact that Mia Wildlife Sailing has operated very successful "dugong cruises" for several years (usually filled to capacity while I was at the Bay), despite the fact that the dugong is an endangered species, despite the fact that the

Shark Bay dugong population is one of the largest known, and despite the fact that Shark Bay's dugong population was a major factor in the decision to grant World Heritage Status, the word dugong does not even appear in either document. Lack of attention to dugong tourism (or perhaps sheer ignorance) are attested to by establishment of an "exclusion zone" that does not extend to the seagrass banks where most of Monkey Mia Sailing's dugong viewing took place.

I understand that CALM currently proposes to licence two large tour boats, two sea kayak operations and a some sort of glass bottom dinghy concession at Monkey Mia. I have also learned that a helicopter concession has begun to operate at there (I presume this also is licenced by CALM). I also understand that CALM has again licenced the former operator of the second large wildlife touring vessel(Aristocat) in competition with Monkey Mia Wildlife Sailing. On the basis of the information to me this is puzzling. I have not seen this vessel nor met any of the operators, but accounts of the situation that existed when the two large vessels competed are consistently negative. It is clear that space limitations, both at sea and at the dock, put skippers and wildlife under pressure. Operation of the Aristocat is said to have been aggressive towards dolphins, dugongs, and the competing operation. The consensus is that dolphins and dugongs were harassed by Aristocat. The work of dolphin researchers is said to have been interfered with and made difficult. Given the consistency of these reports it is difficult to understand CALM's decision to offer Aristocat's operator another licence, or to recreate a competitive situation that seems to have been destructive to all concerned.

What could lead CALM to implement such a policy? In the documents referred to above CALM proposes to levy a fee of $1.00 per passenger on the wildlife tourism cruises, with the amount open to a (unilateral?) review on an annual basis.

Collection of per-capita fees puts CALM in a conflict-of-interest position. I estimate that in September-October 1997 Monkey Mia Wildlife Sailing, in its four cruises, carried a minimum of 150 passengers daily. At that level of activity CALM would recover $50,000 annually from this one entrepreneur. If a regulatory agency benefits from each tourist the motivation is to maximize the number of tourists, and the number of vessels. Unavoidably, this policy maximizes the number and intensity of interactions to which target wildlife are subjected. CALM becomes party to the overcapitalization of the eco-tourism undertaking.

In Ms Anière's letter the levy of $1 per head is justified as a contribution to the cost of a "research and monitoring program". As of November 1997 there was neither evidence of any CALM "research and monitoring", nor of any ability to conduct such a program in terms of staff or on-the-water capability (a CALM vessel of any sort) at Monkey Mia.

The evidence available to me is that CALM policy is motivated more by short-sighted greed than by either adequate knowledge or a commitment to conservation. As implemented at Monkey Mia it amounts to a destructive "experiment" designed to generate revenue for CALM while discovering how much it will take to destroy Monkey Mia's ecotourism carrying capacity. This "experiment" appears to be contrary to the views of CALM staff on the ground at Denham, to the views of visiting scientists engaged in dolphin research, to past experience, or even rudimentary common sense.

Approval of this policy by the recently constituted Marine Parks and Reserves Authority demonstrates in practice what is apparent from the membership of that Authority. Not one member has formal qualifications in marine mammalogy, animal behaviour, or even vertebrate zoology. Instead, expertise in the fishing and petroleum industries are apparently thought more appropriate! To my knowledge this lack of appropriately

qualified expertise applies to the entire CALM organization in that there is not a qualified marine mammalogist on staff anywhere. Until steps are taken to appoint a marine mammalogist to the Marine Branch and reconstitute the Marine Parks and Reserves Authority it seems likely that the current follies will be perpetuated.

I find no fault with CALM staff at Denham, and I appreciate the enthusiasm and dedication of the staff at the Monkey Mia Dolphin Information Centre. During my trips with them both Shotover and James Scheerer were operated with superb seamanship, concern for the wildlife, and a commitment to accurate interpretation. In contrast, my observation was that CALM was ineffective in monitoring and policing marine mammal interaction at sea. This was most obvious in that the Pearl Farm operators were tolerated in refusal to apply for marine mammal interaction licence and allowed to engage in marine mammal interactions in sight of the Dolphin Information Centre while intruding on Shotover-dolphin interaction space without any action being taken.

The scientific and economic values of the Monkey Mia beach population are significant but dolphins are not an endangered species. The dugong is endangered and the Shark Bay dugong population is likely to be critical to dugong survival over the next century. Unless a genuine "research and management program" is instituted I will be forced to conclude that CALM is subject to political interference and/or interested solely in money. Until recruits with formal marine mammalogy qualifications are brought into the CALM organization and the Marine Parks and Reserves Authority CALM will be on the scene primarily to protect economic interests, and CALM oversight of marine mammal tourism will be shabby and hypocritical.

The precautionary principle dictates that only a single licence should have been issued at Monkey Mia. The MSY (Maximum

Sustained Yield) approach has been a failure in fisheries management and it will not work any better here! Neglect and mismanagement of dugong tourism at Monkey Mia is not likely to have a major direct impact on the dugong population of Shark Bay. If harassment drives dugongs away from readily accessible viewing sites CALM's failures may well destroy a fledgling industry that could contribute significantly to the Shark Bay economy and to dugong conservation.

Recommendation: As an alternative to the present misguided and destructive "experiment" I recommend that dugong interaction at Monkey Mia be limited to a single operator for at least the next three years. Instead of a hypothetical and expensive "research and monitoring" program the operator should be required to submit a log for analysis by CALM staff at the end of each month with GPS fixes and number of unaccompanied adults or cow-calf pairs recorded for each contact. Data accumulated in this way would provide (without significant expense to CALM and/or the public, and no unacceptable risks to either the dugong population or the industry) the initial basis for formulation of a reasonable and responsible management policy for dugong tourism at Monkey Mi. In the meantime, CALM's inadequacy in the marine mammal area should be remedied by appointment of a marine mammalogist to CALM's Marine Branch and at least one equally qualified person to the Marine Parks and Reserves Authority.

Paul K. Anderson
Emeritus Professor