'Giving them a hand' – Insights into turtle conservation initiatives at Coral Bay, Ningaloo Marine Park in 2002/2003

Department of Conservation and Land Management
Exmouth District

Acknowledgements
This report was prepared by Linda Reinhold with input and editing by Roland Mau. The outcomes of this work would have not been possible without the support of Gordon Wyre, and Exmouth District CALM staff especially Shaun Thomas and Bruce Bond. I would also like to thank Dave Waayers for making available his aerial survey data for reference.

Cover picture: *Hand next to fox track on the Jurabi Coast, Ningaloo Marine Park.*

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Executive summary

Three species of turtles nest on the coastline of Ningaloo Marine Park. The loggerhead (*Caretta caretta*) is endangered, and green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) turtles are vulnerable. The main human-induced threats to sea turtles on marine park beaches appear to be fox predation on eggs and hatchlings and beach usage by four wheel drive vehicles. The potential of nesting turtle disturbance by tourists may also be an increasingly significant threat.

Foxes are a major predator of sea turtle eggs and hatchlings. Dogs and cats are also potential predators, but probably negligible compared to foxes. Foxes dig away large amounts of sand to get to the eggs. Even if they do not eat all of the eggs, the remaining eggs are exposed to high temperature fluctuations. Foxes also eat hatchlings as they emerge from the nest and run down the beach.

1080 Baiting Program

The fox predation levels and baiting regime of each stretch of coastline within Ningaloo Marine Park are as follows:

- The Jurabi coastal strip is not baited, but fox predation is negligible presumably due to the baiting of surrounding lands at adjacent Defence land and Cape Range National Park.
- Cape Range National Park is baited every three-month. Reports from Ningaloo Reef Retreat suggest that foxes dig up turtle nests in this area, but data is anecdotal.
- The Bundera Coastal Protection Area is not baited, but the inland bombing range is baited every 3-month. Some fox predation occurs at the Bundera beaches, but this must be interpreted with caution as these beaches were not surveyed through the peak of the nesting season.
- Jane's Bay (adjacent to Ningaloo Station) has the worst fox problem in the Marine Park. About 70% of nests are destroyed within a few days of being laid, and many more are dug into later in development.
- Bateman Bay has had an unofficial fox control regime in place for at least seven years. A retired school teacher, Peter Mack, used traps and strychnine poison to control foxes at this section of beach. A CALM baiting program was commenced in November 2002 using buried and tethered 1080 dried meat baits on the 40 metre coastal strip in Ningaloo Marine Park. Bateman Bay had a fox predation rate of about six per cent (all on nests in advanced development or upon emergence) at the conclusion of the baiting program. 67 baits were taken.
- At beaches to the south of Coral Bay, fox predation occurred on turtle nests at Five Mile and Turtle Beach. These are unbaited areas of Coral Bay with relatively low numbers of turtle nests.

Baiting is the most efficient, effective method for reducing fox predation. However, it has been suggested that an alternative to removing the threat of foxes is to let foxes continue to inhabit the area and instead protect each individual turtle nest from their digging. Fox excluder devices only protect hatchlings while they are in the nest. Nest protection devices are potentially very damaging to hatchlings. If not placed in exactly the right position, they can trap hatchlings trying to emerge. Licences to install such devices should not be issued without proven competence of the licensee. Additionally, the devices do not stop foxes from digging up nests. A suitable structure has not yet been found.

Nest protection devices cannot be made of metal because they may shield the developing hatchlings from the ambient electro-magnetic field. They cannot shade the nest because this produces a lower proportion of female hatchlings. Tepees of sticks are also ineffective because they do not stop foxes digging in. Flat meshes do not stop foxes from digging into eggs, and they can trap emerging hatchlings.

Vehicles on beaches

Four wheel drives can create deep wheel ruts in sand, making it difficult for emerged hatchlings to orient to the sea. Hatchlings may follow these ruts along parallel to the shore, making them prone to dehydration and predation. Vehicles driving on beaches at night may disturb turtles with their headlights, and may hit or run over turtles.

Turtle nesting beaches along the Jurabi Coastal Park are closed to vehicles. Beaches in Cape Range National Park are closed to vehicles. Vehicular traffic on beaches was significant at Bateman Bay. Bateman Bay beach had a voluntary seasonal closure for the 2002/2003 nesting season which reduced the usage but did not eliminate the problem.

Recommendations

If fox baiting is increased and beaches are seasonally closed to vehicles, the threat to future of the sea turtle nesting from these sources should be abated in Ningaloo Marine Park. The following recommendations should ensure that this will occur:

Nest Protection

- ***Devices to protect individual nests from fox predation are not to be used as an alternative to baiting. If the threat of foxes is removed, the best management for the turtle nests is to leave them to incubate naturally.***
- ***Careful consideration should be given to the level of skill of the applicant(s) when a research license is sought involving the use of FED's, as these may interfere with emerging hatchlings.***
- ***Meshes have not been proven to be effective, and need to be checked regularly to ensure that hatchlings do not get trapped. It is recommended that a larger mesh size (7-10cm) be used if nest meshing is to be continued.***

1080 baiting

- ***Predation levels at Jane's Bay are the highest along the Ningaloo Marine Park coastline. Baiting should commence as a priority***
- ***Predation levels at Bateman Bay were reduced to about 6% for the 2003/4 season. The existing monthly re-baiting interval at Bateman Bay should be intensified to a fortnightly schedule to further reduce nest loss from predation.***
- ***Gnarloo Bay showed no signs of fox predation probably due to the past 1080 program that had been conducted on the adjacent Gnarloo Station. Baiting should be recommenced to secure the nesting population at Gnaraloo Bay.***
- ***The density of loggerheads nesting at the Blowholes, Quobba Station, indicates that a monitoring program in association with a 1080 fox baiting program may be worthwhile.***
- ***Fox predation in Bundera Coastal Protection Area should be more intensely monitored, and if necessary, coastal baiting increased to target the beaches.***
- ***An integrated 1080 baiting program should be implemented at all significant turtle rookeries including the coastal strip and areas inland of the Ningaloo Marine Park.***

Vehicle beach access and community monitoring

- ***Restricted vehicular access to significant nesting beaches, especially at Bateman Bay and Jane's Bay, should be made compulsory.***
- ***Bateman Bay has a very low nesting density, and poor accessibility without a licensed ATV. No residents participated in the Ningaloo Marine Park Community Turtle Monitoring Program. There is therefore limited scope for a community program in Coral Bay.***

OVERVIEW

Three species of turtles nest on the coastline of Ningaloo Marine Park. The loggerhead (*Caretta caretta*) is endangered, and green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) turtles are vulnerable. Globally, loggerheads are threatened by incidental fisheries captures and coastal development, greens are threatened by being hunted for food, and hawksbills are threatened by being hunted for their shells. The main human-induced threats to sea turtles on marine park beaches appear to be fox predation on eggs and hatchlings and beach usage by four wheel drive vehicles. The potential of nesting turtle disturbance by tourists may also be an increasingly significant threat.

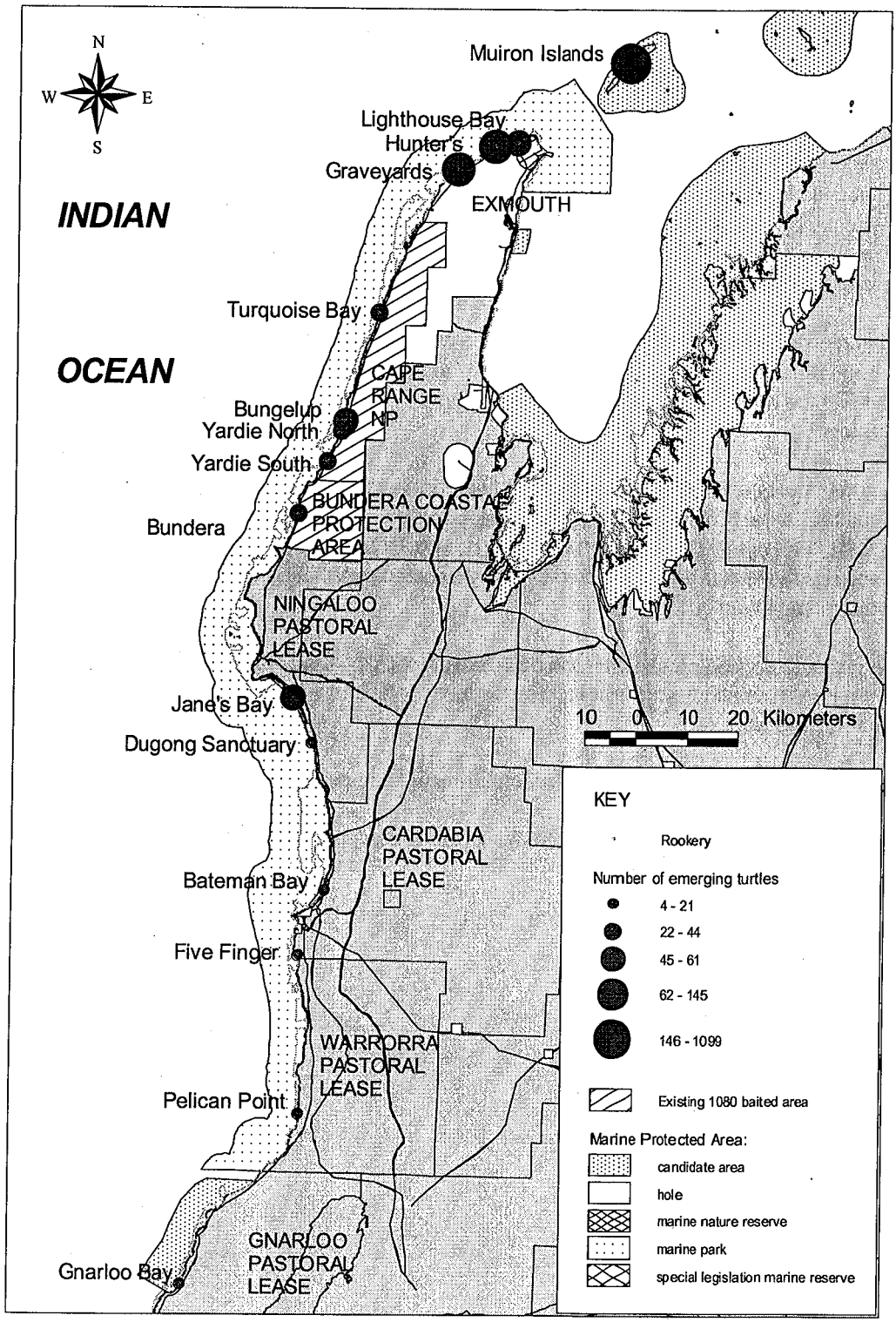
This report is intended as a summary of activities and outcomes achieved by CALM staff focussing on the area around Coral Bay over the 2002/2003 turtle nesting season. The report has been divided into four sections focussing on monitoring, research, public participation, and a summary.

The monitoring section focuses on nesting activity and impacts at Bateman Bay, Jane's Bay and Bundera Coastal Protection Area and Gnarloo (Figure 1), effectiveness of fox exclusion devices, and 1080 bait uptake. Resources availability restricted methods applied and results obtained. Hence conclusions drawn for the areas vary to some degree but should be sufficient to guide future management of these areas.

The research section presents results on comparisons of various turtle rookeries, the effects of shading on incubation temperature, temperature profiles of nesting beaches, and a brief turtle standing summary.

In section three, results of public participation and education efforts are presented.

The reports findings are summarised in section 4 with some recommendations.



(Source: Prepared by Roland Mau, 23/0703, CALM Exmouth, from 6 days of aerial survey data provided by Dave Waayers)

Figure 1: Map of indicative locations of marine turtle rookeries in the Ningaloo Marine Park and proposed extensions

1. Monitoring

1.1 Coral Bay sea turtle nesting

Introduction

The main turtle nesting areas around Coral Bay (Figure 2) anecdotally are said to be at Bateman Bay (from Mauds Landing to the Lagoon) and Turtle Beach south of Five Fingers. Occasional nesting has also been reported between Coral Bay and Mauds Landing, Coral Bay and Five Fingers and at Five Mile beach. However, these areas were not included in the survey. The area surrounding Coral Bay is primarily a small nesting ground for loggerhead turtles, but smaller numbers of hawksbills and greens also come to nest here (Peter Mack, unpublished data.).

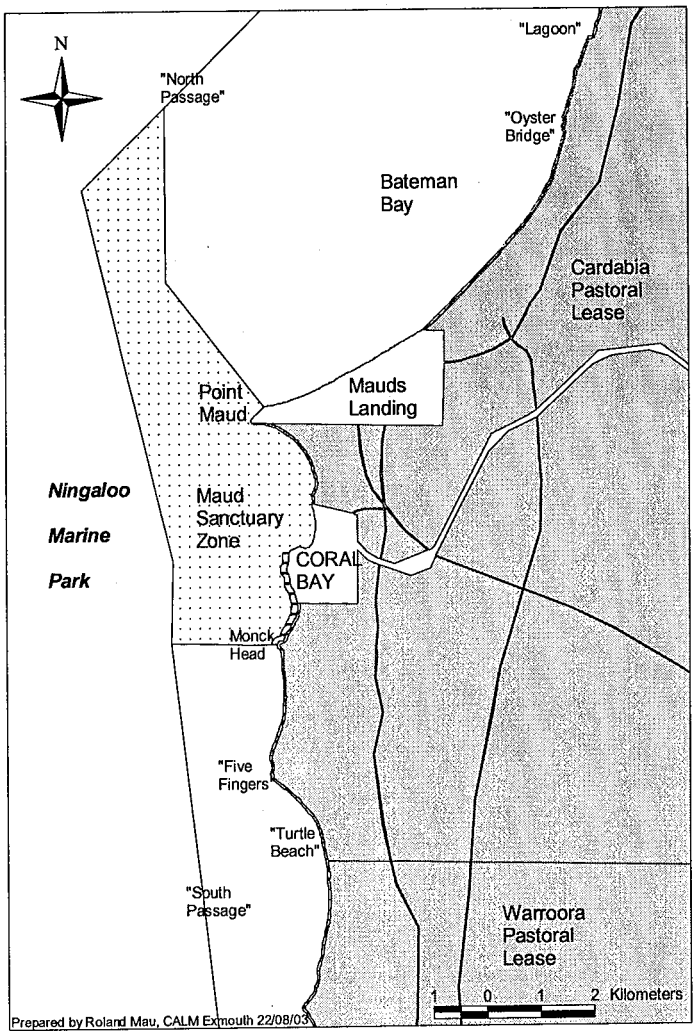


Figure 2: Map of Coral Bay localities

Methods

Monitoring of nesting turtle tracks in 2002/3 followed the methodology of the Ningaloo Marine Park Turtle Monitoring Program (Appendix C). At dawn, Bateman Bay beach between Point Maud and the Lagoon (83 days; 20 Nov – 16 Apr), and Turtle Beach between Five Fingers and the south passage (53 days; 10 Dec – 16 Apr), were surveyed. Each nesting turtle track encountered was identified and recorded, with the location of the nest or nesting attempt. Incidences of fox disturbance on turtle nests were also recorded. Occasionally, a number of tracks

and nests were not identified as staff with limited competencies conducted the surveys at these times.

Results

Numbers of nests laid on the Coral Bay beaches averaged one per night over the nesting season (83 known nests laid over 83 survey days). Most nests at Bateman Bay were loggerheads, with a few hawksbills (Table 1). The majority of nesting occurred at the northern end of Bateman Bay. Most nests at Five Fingers and Turtle Beach were greens, with a couple of loggerheads.

Table 1: *Numbers of tracks, nests laid and unknown lay/no lay for loggerhead, hawksbill, green and unidentified turtles on Bateman Bay and Five Fingers beaches.*

	logg track	logg nest	logg ?nest	hbill track	hbill nest	hbill ?nest	green track	green nest	green ?nest	un-id track	un-id nest	unid ?nest
Bateman	101	50	9	9	6	1	9	0	2	21	18	0
5 Finger	6	2	0	0	0	0	12	7	0	3	0	0

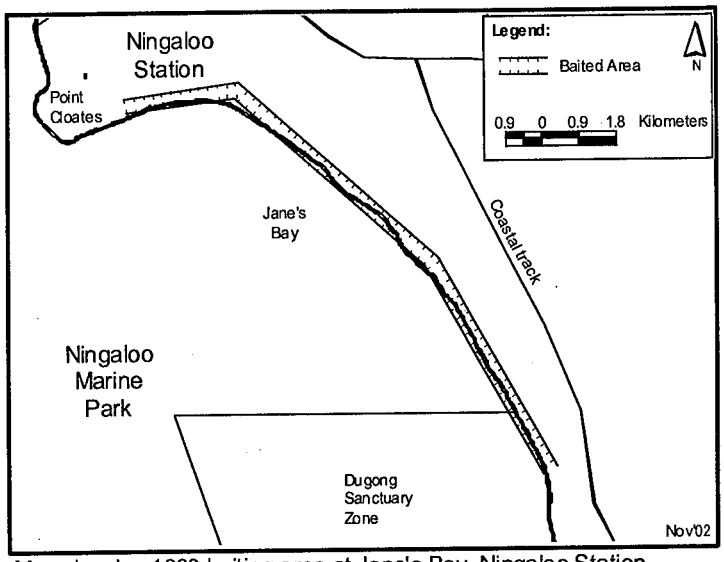
Discussion

Foxes did not dig up any nests in the few days following laying. There were no signs of fox predation until late January. There have been 10 instances of foxes digging up nests at Bateman Bay late in incubation and upon hatching. Five of these were nests that had already run. Foxes dug right through the nest protection tepees of sticks in place around the nests. There was evidence of fox predation at the Five Mile, but this was not included in the survey. Bateman Bay has been baited monthly from November 2002 to April 2003. It is recommended that fox baiting is continued and increased so that predation levels next season are further reduced.

1.2 Jane's Bay sea turtle nesting

Introduction

Jane's Bay (adjacent to Ningaloo Station) is a nesting ground for loggerhead, green and hawksbill sea turtles (Figure 3). This beach had traditionally not been recognised as a rookery, however, anecdotal reports suggested that there were considerable number of turtles emerging to nest and fox predation was high. It was surveyed for nesting turtle tracks during the 2001/02 and 2002/03 season with a specific focus to monitor the proportion of nests being disturbed by foxes.



Map showing 1080 baiting area at Jane's Bay, Ningaloo Station

***Figure 3:** Map of Jane's Bay localities*

When foxes dig into nests, they not only eat the eggs from the top, but any eggs left in the nest are then subjected to high fluctuations in sand temperature as a result of being exposed. Goannas dig tunnels leading down to the eggs, whereas fox predation is evidenced by a large amount of sand dug out from above the eggs.

Although a baiting program has been approved for Jane's Bay (following a risk assessment), it was not implemented due to requests of the neighbouring property holder to allow their new shooting and trapping regime to take effect. This season's activities were therefore limited to monitoring only.

Methods

2001/2002 season

Jane's Bay/Norwegian Bay was surveyed for turtle tracks five times during the 2001/2002 turtle season, fortnightly from 24 December 2001 to 13 March 2002. Turtle tracks were not identified to species level as staff with limited competencies conducted the surveys. Out of 33 nesting turtle tracks, six resulted in nests, five were not nests and 22 were unknown. There were seven accounts of foxes digging up nests, but only three of these were known nests. Fifteen of the 33 tracks also had fox prints nearby.

2002/2003 season

Jane's Bay was surveyed for turtle tracks weekly for eight weeks (10 December 2002 to 04 February 2003), then twice a week for two weeks (28 Feb to 14 March 2003). For the first eight survey days, the monitoring area extended from the rocky cliffs at the south end of Jane's Bay to

the beach rocks beyond the shearing sheds to the north. The last five survey days were primarily to monitor fox predation on emergences of hatchlings from nests. On these days the survey area covered the south end of Jane's Bay to Point Cloates.

The tracks of nesting sea turtles, both from the previous night and those still recognisable as turtle tracks from the past few nights, were counted. Since the beach was only monitored for turtle nesting once a week, including old tracks in the counts increased the data gathered. It was noted whether tracks were fresh from the night before so that the data can be compared with that of the Ningaloo Marine Park Turtle Monitoring Program.

The location, species and presence of a nest were recorded for each track. Tracks of dogs, foxes, goannas and humans were recorded if they occurred within 5 metres of the turtles' diggings. If the turtle tracks resulted in a nest, disturbance to that nest was also recorded. If eaten-out eggshells were strewn around the top of the nest, these were counted.

Results

Out of a total of 68 sea turtle nests recorded, 54 were loggerheads, eight were greens and six were hawksbills (Table 2).

This meant a nesting success of about 50% for loggerheads, 10% for greens and 60% for hawksbills.

Table 2: *Turtle nesting tracks, turtle nests laid and disturbed by foxes within a few days of being laid, recorded on Jane's Bay beach.*

	Loggerhead	Green	Hawksbill	Total
Tracks	110	90	10	210
Nests	54	8	6	68
Nests disturbed	40	3	0	43

Foxes dug up the majority (63%) of turtle nests within a few days of them being laid. All three species are pooled in Table 3 which also shows the numbers of nests disturbed (and eggs found destroyed) out of numbers of nests laid within a few nights of being surveyed. The right side of the table shows nests laid fresh the night before, divided into species.

Table 3: *Jane's Bay sea turtle nests – numbers of nests disturbed*

Date	Nests laid	Nests disturbed	Eggshells found	New logger	New green	New hawksbill
10 Dec 2002	9	5	55	2	-	1
17 Dec 2002	13	10	297	1	-	-
24 Dec 2002	12	9	333	1	-	-
31 Dec 2002	6	4	27	2	2	-
07 Jan 2003	3	3	98	-	-	-
15 Jan 2003	14	7	94	8	1	-
21 Jan 2003	6	4	90	-	-	-
04 Feb 2003	1	0	0	1	-	-
28 Feb 2003	2	1	0	-	-	-
04 Mar 2003	0	0	0	-	-	-
07 Mar 2003	1	0	0	-	-	-
11 Mar 2003	0	0	0	-	-	-
14 Mar 2003	1	0	0	-	1	-
Total	**68**	**43**	**994**	**15**	**4**	**1**

"Nests disturbed" only counts damage to those nests with still recognisable turtle tracks leading to them. Therefore, nests more than a few days old, or which were disturbed after their initial recording, are not counted. Two marked nests were dug up by foxes several weeks later. "Eggshells found" means the number of eggshells found strewn around the top of the nest, although this is not a complete count of the eggs killed by a fox. Out of a total of 210 turtle tracks counted, fox tracks were also present (within five metres) at 168. Dog tracks and goanna tracks were noted at one nest each. Most fox tracks were on the southern end of the beach, as were most turtle tracks.

No hatchling tracks were found during the five days of monitoring for fox predation on emerging hatchlings. However, it is unlikely that hatchling tracks would have been visible due to the debris and seaweed on the beach and the time of survey. During this time, there were six instances of fresh fox disturbance at older, developed nests (with 75 eggshells plus one yolkless at the surface). Instances of fox attack on older nests were not noted during the first eight survey days.

Discussion and Conclusion

Jane's Bay has a low nesting density of sea turtles, mostly loggerheads. Unfortunately, statistically valid estimations of the size of the nesting population cannot be made on the limited data available. However, the focus of this survey was to ascertain the levels of fox predation on nests as they are laid. Most of the sea turtle nests laid at Jane's Bay were disturbed by foxes. Foxes were occasionally seen on the beach during the day, and fox tracks were numerous, both around nest diggings and along the beach. Predation levels at Jane's Bay are the highest along the Ningaloo Marine Park coastline. It appeared that the fox control program carried out by Ningaloo Station had not been effective in reducing fox predation on nests at Jane's Bay.

1.3 Bundera Coastal Protection Area sea turtle nesting

Introduction

The Bundera Coastal Protection Area is the coastal portion within the Learmonth Air Weapons Range that is used by the public for camping (Figure 1). Areas to the east of the coastal access road are 1080 baited, mainly to assist in the conservation of the black footed rock wallaby. Anecdotally, the area has been recognised as a turtle nesting area. However, no quantitative data was available to evaluate its significance as a turtle rookery or the effectiveness of the existing 1080 baiting program in preventing fox predation on turtle nests.

Methodology

For three days during February/March, the beaches of the Bundera Coastal Protection Area (adjacent to the Bombing Range, between Ningaloo Station and Cape Range National Park) were surveyed for nesting turtle tracks. On 11th February, the survey covered the two southern sandy beaches. On 24th February and 5th March, all four stretches of sandy beach at Bundera were surveyed.

Results and Discussion

On the first survey day, 19 nesting turtle tracks were counted on the southern two beaches. Eight of these were fresh from the previous night. On the second survey day, seven nesting turtle tracks were counted on all sandy beaches. None of these were fresh from the previous night. On the third survey day, two turtle tracks were counted on all sandy beaches, both fresh from the previous night. All tracks from the previous few nights are included in Table 4.

Table 4: *Nesting turtle tracks (from previous few nights) counted at Bundera beaches (numbers in parentheses are nests laid)*

Survey date	Beaches surveyed	loggerhead	green	hawksbill	total
11 Feb	2 (south)	12 (4)	4 (1)	3 (2)	19 (7)
24 Feb	4 (all)	4 (1)	1 (0)	2 (1)	7 (2)
05 Mar	4 (all)	2 (2)	0	0	2 (2)

One loggerhead hatchling emergence was recorded on the third survey day. There were about 20 tracks going to the water, and no signs of predation.

Fox tracks were recorded in proximity to six of the 28 turtle tracks. On the second survey day there were reasonably fresh dog tracks along the southern sandy beach. On the third survey day there was a fresh fox track all along the second sandy beach from the south. There was no destruction of new nests.

Two very old nests had been dug into on the northern sandy beach. The first of these had six eggshells nearby, and a goanna (*Varanus gouldii*) sniffing around in the middle (Figure 4). The second of these had goanna tracks down to a nest with yellow shells, but no eggshells strewn around the top. There were no goanna tunnels leading down to the nest – it is probable that the nests were dug into by foxes, and secondarily predated on by goannas.

It appears that the Bundera Coastal Protection Area has a significant level of turtle nesting activity. The adjacent baiting regime may account for the low level of fox predation. Further monitoring may be warranted to establish both the significance of this location as a rookery and to quantify the level of predation.

Figure 4: *Varanus gouldii* sniffing around in old dug-into nest, northern sandy beach of Bombing Range, 24 February 2003.

1.4 Gnaraloo Bay sea turtle nesting

Introduction

Gnarloo Bay lies outside the administrative boundary of the Exmouth District but the area is proposed as a southern extension to the Ningaloo Marine Park in the current management review process (Figure 1). Loggerhead nesting is known to occur on many of the beaches along the Ningaloo-Carnarvon coast. The following is an account of observations made during a two-day fieldtrip in February 2003.

Beach survey

Gnaraloo Bay, from the southern end to "Nine Mile", was surveyed for turtle nesting on 19th February only. There were 15 fresh and old nesting turtle tracks, most leading to nests. Most of these were at the northern end of the beach. All tracks were from loggerheads. One emerged loggerhead nest was found. Only one dog/fox track was found at the southern access to the beach. That night, a loggerhead turtle was tagged (WA28341).

Marked nests

For a couple of weeks earlier in the season, turtle nests had been marked with sticks and aluminium cans (Brett Fitzgerald, pers Comm.). Along the 8 km stretch of beach at Gnaraloo Bay, 194 marked nests were counted on the day. Most of these nests were at the northern end of the beach.

Nest protection devices

Three nests with protection devices placed around them were found (Figure 5). The first was a section of plastic mesh laid over the top of the sand and weighted down along the edges by coral stones. Another section of plastic mesh (1.25m x 1.5m) was laid flat on top of the sand and staked down with sticks. Neither had holes cut in the middle to facilitate hatchling escape. There was also a vertical cylinder of mesh (45cm in diameter) protruding from the sand. Half the cylinder was single plastic mesh, and half was doubled.

Management

The beach at Gnaraloo Bay is managed by Gnaraloo Station. There are signs at the beach access asking people not to drive (four wheel drive or quad bike) on the beach. There is also extensive signage about the 1080 fox baiting program which was carried out until a few months ago.

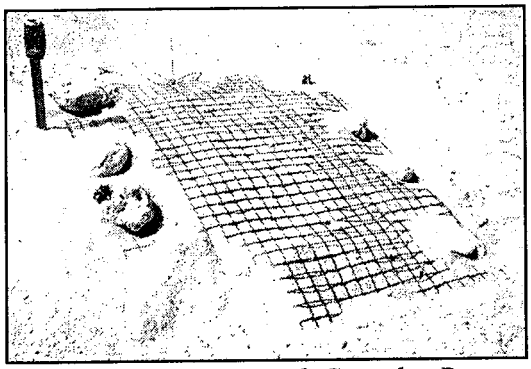
Blowholes (south of Gnarloo Station)

During a 15 minute walk along the beach south of the Blowholes settlement on 20th February, seven loggerhead nesting tracks from the previous few days were counted, four nests dug into with eggshells strewn around and three nests dug into without eggshells strewn around (Figure 5). There were fox and dog tracks all along the beach.

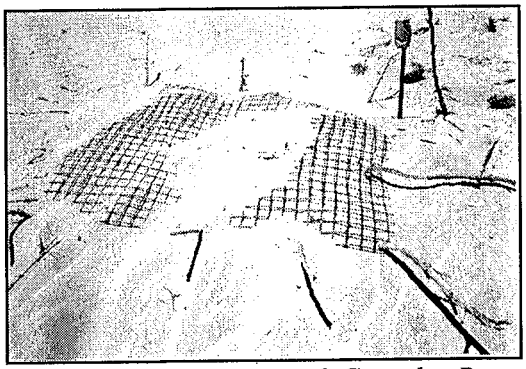
Discussion and Conclusion

With nearly 200 nests marked in a couple of weeks, and loggerhead nesting continuing at a greater density than at the northern rookeries, Gnaraloo Bay appears to be a more significant loggerhead rookery than either Coral Bay or the Exmouth beaches. There are likely to be several hundred loggerhead nests laid along the 8 km of Gnaraloo Bay per season. Fox predation levels appear to be negligible following the recent 1080 baiting program.

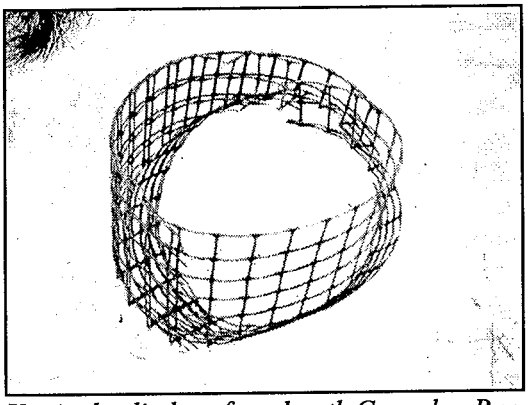
The density of loggerhead nesting at the Blowholes indicates that this site may be a significant loggerhead rookery. Furthermore, if this site is a significant rookery, the level of fox predation is of concern. Further investigation is recommended.



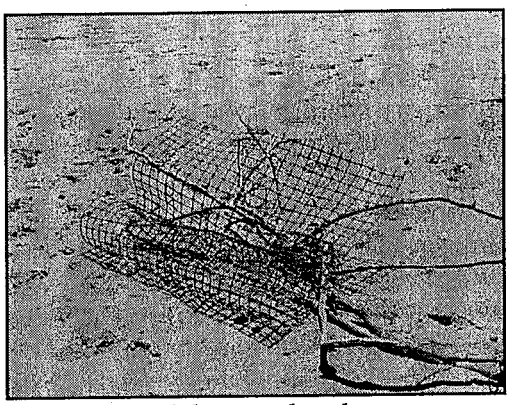
Plastic mesh over nest, sth Gnaraloo Bay



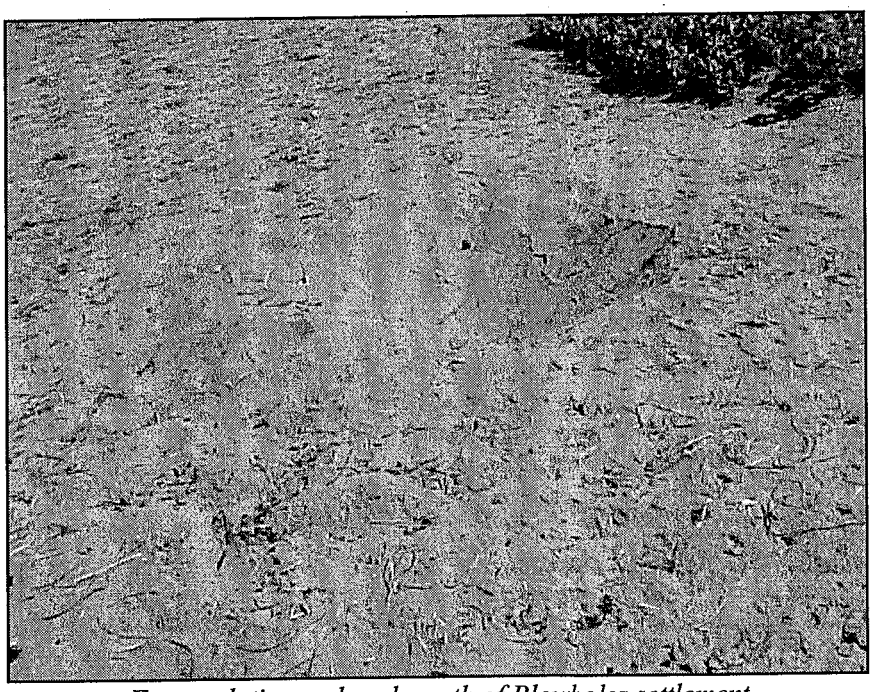
Plastic mesh over nest, nth Gnaraloo Bay



Vertical cylinder of mesh, nth Gnaraloo Bay



Plastic mesh littering beach



Fox predation on beach south of Blowholes settlement

Figure 5: *Series of images depicting nest protection and predation activity*

1.5 Comparison of loggerhead sea turtle rookeries – Jurabi to Gnaraloo

Introduction

Mainland beaches in the Exmouth/Carnarvon region are used as nesting grounds by the endangered loggerhead sea turtle. Figure 1 shows the indicative nesting areas of all turtles found in the Ningaloo Marine Park and proposed extensions. All identified rookeries include nesting loggerhead turtles. This report compares the significance of some of the rookeries for numbers of nests laid and proportion of nests being destroyed by foxes, success or otherwise of nest protection efforts, and preliminary monitoring results. Although the methodologies used to gather the data varied to some degree for the different rookeries, an attempt is made here to compare them quantitatively. More expansive surveys on the relative significance of all rookeries, including for green and hawksbill turtles, was undertaken by David Waayers in 2001/02/03 (unpublished data).

Methods

In 2002-2003, three stretches of beach, from North-West Cape to Gnaraloo Bay, were surveyed simultaneously during the loggerhead nesting season. Sea turtle nests at Gnaraloo Bay had been marked by Peter Mack working under a Coast West grant from 27th December 2002 to 14th January, 2003. Out of 94 nests marked, it its estimated that about 90 of them were from loggerheads (NB: Departmental staff surveyed this beach on 19th February, and found evidence of only loggerhead nesting.) Nesting loggerhead numbers were extracted from the data gathered for the other areas during this same time period. Nesting details at Bateman Bay were recorded daily by Departmental staff. Nesting details at the Jurabi Coastal Park beaches were recorded daily by volunteers as part of the Ningaloo Marine Park Community Turtle Monitoring Program. The beaches from Lighthoue Bay through Hunters to Graveyards were surveyed every day during this time, so are combined as the 'Jurabi beaches'. A fourth stretch of beach, Jane's Bay, was surveyed for turtle nests at the beginning, middle and day after this period. The numbers of loggerhead nests for these dates were averaged and approximated for the whole period. A separate report on this monitoring program will be prepared.

Results

During the survey period, there were 90 loggerhead nests laid on 8km of beach at Gnaraloo Bay, 22 nests on 11km at Bateman Bay, an estimated 48 nests on 13km at Jane's Bay and 18 nests on 5.7km at the Jurabi beaches. The nests laid per kilometre for the survey period are given in Table 5.

Table 5: *Density of loggerhead sea turtle nests for four rookeries from 27th December to 14th January. Fox predation levels are estimates for the season.*

Rookery	Length of beach	Nests per km	Fox predation	Coastal baiting	Inland baiting
Gnaraloo Bay	8 km	11	~nil	Stopped in Nov.	Stopped in Nov.
Bateman Bay	11 km	2	~6%	Started in Nov.	Never baited
Jane's Bay	13 km	4	~75%	Never baited	Never baited
Jurabi beaches	5.7 km	3	nil	Never baited	Never baited*

*There are strong suspicions that the Jurabi beaches benefit from the baiting of the adjacent Cape Range National Park and surrounding Commonwealth lands.

The loggerhead season starting dates for Gnaraloo, Jane's Bay and the Jurabi beaches were not established for this season. The finishing date for the season at Gnaraloo is not known, but nesting was still considerable on 19th February. The last loggerhead laid eggs at Bateman Bay on 22nd February, at Jane's Bay on 28th February, and at the Jurabi beaches on 12th March.

Fox predation
During a one day survey of Gnaraloo Bay in February 2003, Departmental staff found no evidence of fox predation. Departmental staff recorded five nests out of approximately 80 laid at Bateman Bay that had been destroyed by foxes. Two-thirds of new nests laid at Jane's Bay had been dug into by foxes, with more nests dug into later in development. It is estimated that about 75% of all nests at Jane's Bay were dug into by foxes. No fox predation was recorded at the Jurabi beaches during the volunteer community monitoring in 2002/03 although some predation was recorded in the 2001/02 season.

From July 2001 to November 2002, 1700 baits were used at Gnaraloo Bay. Baiting was ceased at the beginning of the current turtle season. Bateman Bay has been baited (monthly, with 53 bait stations) since November 2002. Jane's Bay has never been baited. The Jurabi Coastal Park has never been baited, however, the Cape Range National Park, Defence land at North-West Cape and Bundera Bombing Range to the south has been baited for sometime.

Conclusion
Out of the four loggerhead rookeries surveyed, Gnaraloo Bay was the most significant, followed by Jane's Bay, the Jurabi beaches and Bateman Bay. It should be a priority for baiting to be recommenced at the entrances to Gnaraloo Bay to retain the high productivity of this beach. Jane's Bay has approximately twice the nesting density and 10 times the fox predation of Bateman Bay. This means that this beach has the potential to produce more hatchlings than Bateman Bay or the Jurabi beaches, but it is currently producing less because of its fox problem. The number of nests successfully incubated at Jane's Bay could be increased significantly if baiting reduced fox predation to the levels occurring at Bateman Bay.

1.6 Marine turtle "Fox Exclusion Devices"

Introduction
Predation on turtle nests by introduced species such as foxes is a significant threat to turtle populations around the State especially on the mainland coast of the Ningaloo Marine Park. Conservation efforts have included shooting, the use of baits, traps and Fox Exclusion Devices (FED). The purpose of FED's is to stop foxes from digging up eggs, while allowing the hatchlings to emerge. Several types of devices have been trialled and assessed this season.

Peter Mack Turtle Conservation Foundation (PMTCF)
At Jane's Bay, double cylinders of plastic mesh dug in around the eggs, with wire mesh over and around this were used. At Gnaraloo Bay, both cylinders of plastic mesh and flat sections (1.25 x 1.5 m) laid over the top of the sand, held down by either wooden sticks or lumps of coral were applied. The nest protection devices used at Coral Bay during the season have consisted of several wooden sticks (either driftwood or slats) stuck in the sand around the top of the nest.

Departmental staff expressed concern about the use of metal mesh over developing turtle eggs because of the potential negative effects of interference with surrounding electro-magnetic field during the imprint phase of hatchling development.

Sea turtle hatchlings use magnetic imprinting to be able to navigate. This imprint may be critical for turtles to return to their natal beaches. If the ambient electro-magnetic field is disturbed during embryonic development, it could affect the imprinting process (C. Limpus, pers. Comm.). The individuals involved were informed about these concerns and requested to apply for a research licence to apply FED's to allow their impact to be objectively assessed.

Departmental staff facilitated the use of specially prepared plastic garden mesh (1.2 m wide, 5 cm mesh diameter) as recommended by Col Limpus, to overcome the concerns of electro-magnetic shielding and shading from inappropriate FED's (Figure 6).

Several nests were left unmarked, and many were marked with sticks or Spinifex, but not protected. On 16 February 2003, the day after three nests had been dug into by a fox, cylinders of plastic mesh appeared around several nests at Bateman Bay. Two of these cylinders appeared around nests that had already been dug into. The cylinders looked like the 1.2 m sq template, but instead of being laid flat were dug in shallow around the nest, so that most of the mesh stuck up above. They were held in place by two wooden stakes.

Effectiveness of sticks

Foxes had not attempted to dig into nests at Bateman Bay until late January 2003. Foxes did not dig into new nests, but into post-hatched nests. It was found that three nests that had been dug into by foxes in the second week of February. At one of these nests, foxes had done damage to the eggs/hatchlings. The other two instances were of a nest that had already emerged.

The first of these nests was on the dune towards the northern end of Bateman Bay. There were two successful hatchling tracks coming out of the nest. There were fox prints around the nest and the rest of the nest had been dug up. Departmental staff counted 73 eggshells and four unhatched/undeveloped eggs for this clutch. Foxes had dug in between the nest protection sticks, leaving the sticks standing.

The second nest was on the beach at Oyster Bridge, Bateman Bay. There were many hatchling tracks coming from the nest. There were 12 hatchlings still alive on the beach, but they were weak and hardly moving. There were 33 dead hatchlings out on the beach, 10 with their heads missing. Six eggshells had been dug up, but the rest of the nest was still there. There were fox prints around the nest, and only two of the nest protection sticks were left standing.

The third nest was just to the north of the second one. There was one dead hatchling on the beach. There were fox prints around the nest. The nest was dug into but the nest protection sticks were still standing.

Departmental staff found a nest dug into by foxes on 7th March. The nest was unprotected, although there was a tepee of sticks close to it.

Effectiveness of mesh

The mesh prepared by Departmental staff has the middle nine squares cut out, and several rows of every second square cut out. It is laid flat over the eggs at a depth of 10 cm below the surface of the sand and staked down at each corner with a paint-tipped wooden stake.

On three nests found with FED's at Jane's Bay, metal mesh was replaced with plastic mesh (5 cm diameter, 1.2 m sq), laid flat and buried 10 cm below the surface. These nests also had doubled plastic mesh in a cylinder buried around the eggs. Foxes dug under the seaward side of one of the meshes, also digging out the cylinder of mesh buried around the eggs (Figure 7). Foxes did not attempt to dig into the other two nests.

Plastic mesh, however, was also reported as having been damaged. Peter Mack reported that the owner of the kiosk at Red Bluff "*has had foxes chew straight through it* [plastic mesh] *to eat the eggs beneath*".

The three meshes from Jane's Bay were retrieved and placed over three marked, unprotected nests at Five Fingers/Turtle Beach on 17 February 2003. One of these nests emerged without incidence, and the mesh was removed. The remaining two meshes were removed before

emergence on 25th March. Ten more meshes (doubled and held together with cable ties) were placed over nests at Bateman Bay from Mauds Landing to south of the Lagoon from 21 to 25 February, 2003. Nine of these were placed over marked, unprotected nests. One was placed over a hawksbill nest that was protected by a tepee of sticks, and the sticks put back in place in conjunction with the mesh. Eight of these nests emerged without incidence, and the meshes were removed. The remaining two meshes were removed before emergence on 25th March. No foxes attempted to dig into the trial mesh-covered nests at Coral Bay, although the day after installation, there were fox prints (and human prints) around one of the meshes at Bateman Bay. On 24th March there were fox prints over the southern meshed nest at Turtle Beach.

On the morning of 25th March, there were two dead loggerhead hatchlings on top of a mesh protected nest at the middle of Bateman Bay. They were at the top of a crab hole to the side of the nest. The nest was full of dead hatchlings (Figure 8). None had emerged. One hatchling at the top had a strand of mesh over its shoulders. The mesh had distorted the hatchling's shape as it was pressed against the mesh. The mesh in the middle was distorted and partially broken from the pressure of hatchlings trying to get out. The hatchlings were under the large square cut in the centre of the mesh, with no other obstructions above them. It appears that it only takes a small obstruction to trap an emerging patch of hatchlings. For instance, several batches of hatchlings were found at Jurabi beaches, where the pivotal hatchling had a grass root jammed across its front body. This appeared to be stopping the other hatchlings from emerging, even though when their heads and front flippers were visible above the sand. In one instance, once the obstruction was removed by Departmental staff, 10 hatchlings emerged.

Competency

Volunteers have been assisting the Department over the past nine years to protect turtle nests from fox predation using a range of methods. More recently, the use of "sticks" has become more prevalent and Departmental staff have noticed that these were placed incorrectly at times.

This was first recorded when Departmental staff attempted to relocate a nest that was in highly likely to be eroded. It was found that the eggs were not in the centre of the tepee of sticks, but 25 cm to the side, so that the sticks on the seaward side were right over the top of the eggs (Figure 9). This applied to a further eight nests where either the point of emergence was under or between sticks, or outside the sticks (Figure 10 and Figure 11). On three occasions sticks were found pointing down into the emergence crater. One emergence from a cylinder of mesh occurred directly under the mesh instead of in the middle.

Marking of nests

The marking of nests attracted people to tamper with them. Although nest sites are obvious once the hatchlings have emerged, people disturbed nests before and after emergence. People may have be digging into nests to find hatchlings. For instance, on 1st February, there were ATV tracks along the beach pre-dawn. The tracks went to several nests, with footprints going up to the nests and handprints at the nest sites where the nests had been dug into. There have been numerous instances of nests being disturbed or dug out, with human handprints over the site. Seven unmarked, unprotected nests emerged at Bateman Bay without incidence.

Comparison of nest protection devices

At Bateman Bay, no unprotected or meshed nests were attacked by foxes. Six per cent of stick-protected nests were dug into by foxes. At Jane's Bay, an estimated three quarters of unprotected nests were dug into by foxes, and 33 % (one of three) of mesh-protected nests were dug into by foxes. These results cannot be compared statistically because no foxes attempted to dig into 15 of the 16 trial meshes. That is, neither the sticks nor the meshes were proven to stop foxes from digging into nests.

Conclusion

Nest protection sticks are no barrier to foxes that want to dig into nests (Figure 12). They can dig up the nest by putting their paws between the sticks, or knock out the sticks entirely. Therefore, putting tepees of sticks around nests to protect them from foxes does not appear to be effective.

The primary advantage of using sticks is that they protrude from the ground therefore making the location of a nest visible to 4WD's using the area. However, there is not proof that existing FED design's applied in Ningaloo Marine Park decrease predation rates on baited beaches. Unfortunately, their incorrect application may cause more harm than good. Given the difficulty of correctly locating nest chambers to avoid damage to nests when placing "sticks", future licensing of volunteers for this task will need to consider the level of skill required to safely conduct this activity.

The design of the current meshes is a compromise between allowing hatchlings to escape and not allowing foxes to dig in. If the hole cut in the centre was bigger, foxes may be able to dig in. Meshes need to be checked regularly to ensure that hatchlings do not get trapped. The mesh used by Queensland Turtle Research is 7 to 10 cm diameter (C. Limpus, pers. Comm.). It is recommended that this larger mesh size be used if nest meshing is to be continued.

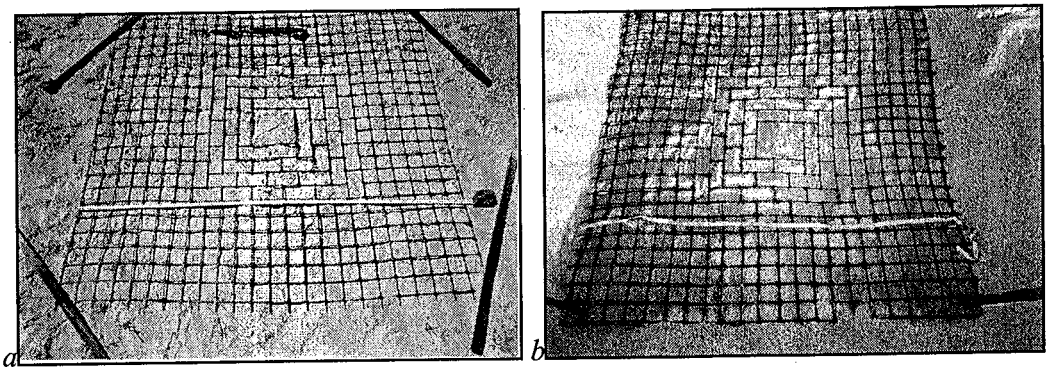


Figure 6(a) *Plastic mesh template, supplied with 90m mesh, stakes and sidecutters to P.M.T.C.F. on 28 Dec. 2002;* ***(b)*** *Double-thick plastic mesh, 10 installed at Bateman Bay by D.C.L.M. in February 2003.*

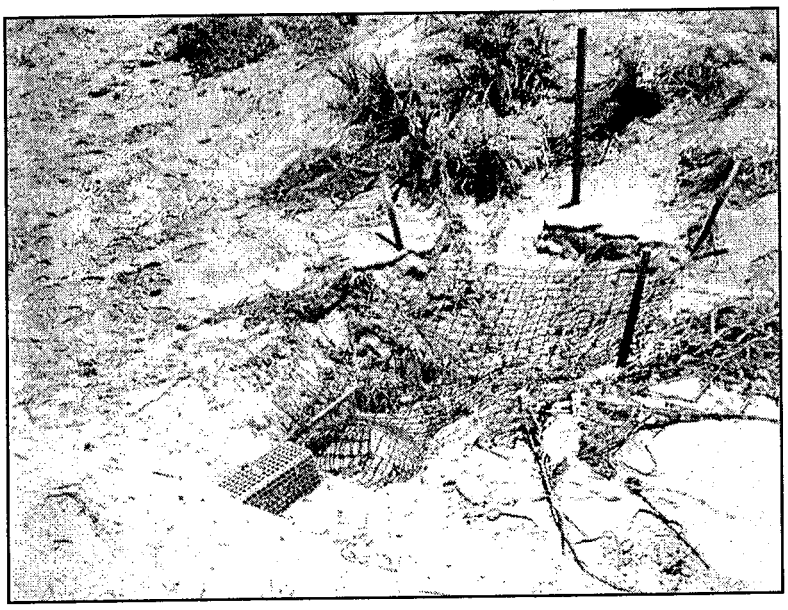


Figure 7: *Meshed nest dug up by foxes, Janes Bay, 7 January 2003.*

Figure 8: *Clutch of dead loggerhead hatchlings under mesh put down by P.M.T.C.F., Bateman Bay, 25 March 2003.*

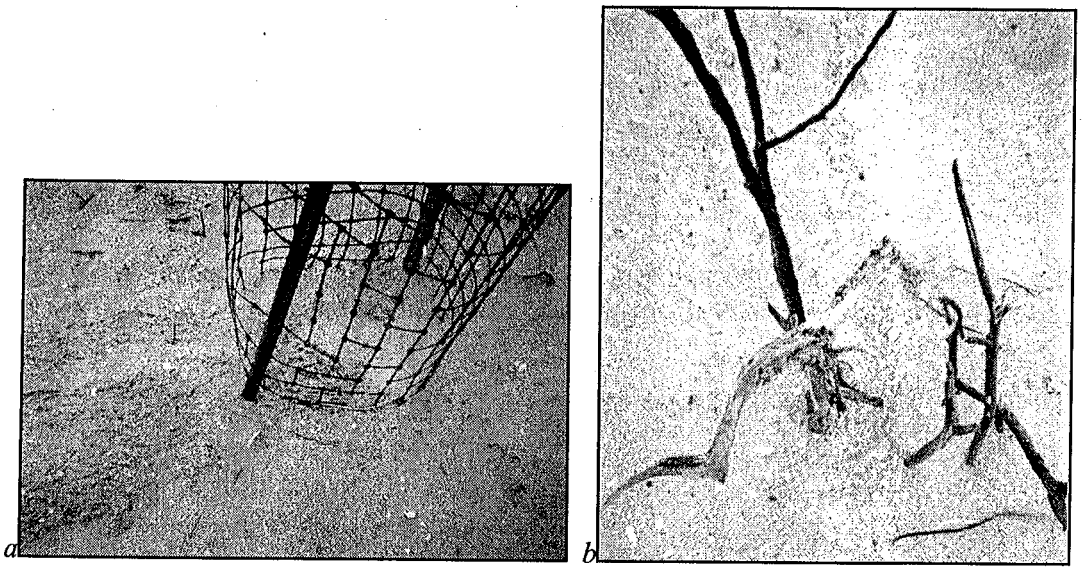


Figure 9:(a) Emergence under edge of cylinder of mesh, Bateman Bay (middle), 22 February 2003;(b) Emergence just outside sticks, Bateman Bay (cove north of Oyster Bridge), 9 February 2003.

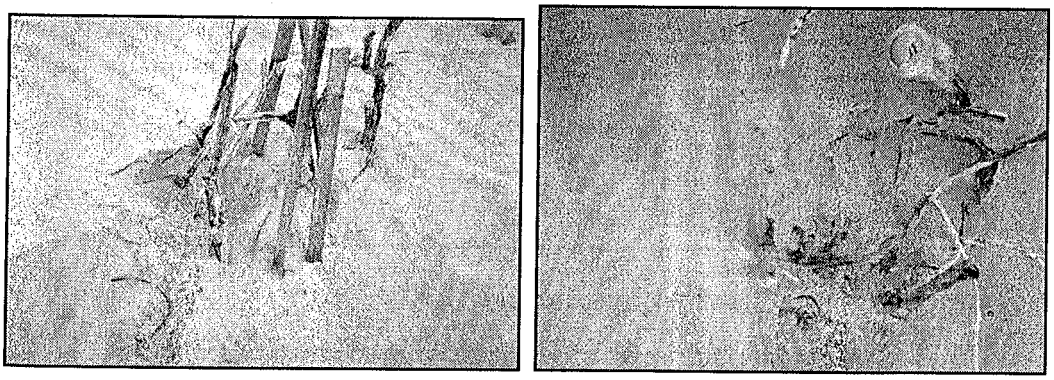


Figure 10: *Emergences under sticks, Bateman Bay (nests 4 and 11), 2 and 8 February 2003.*

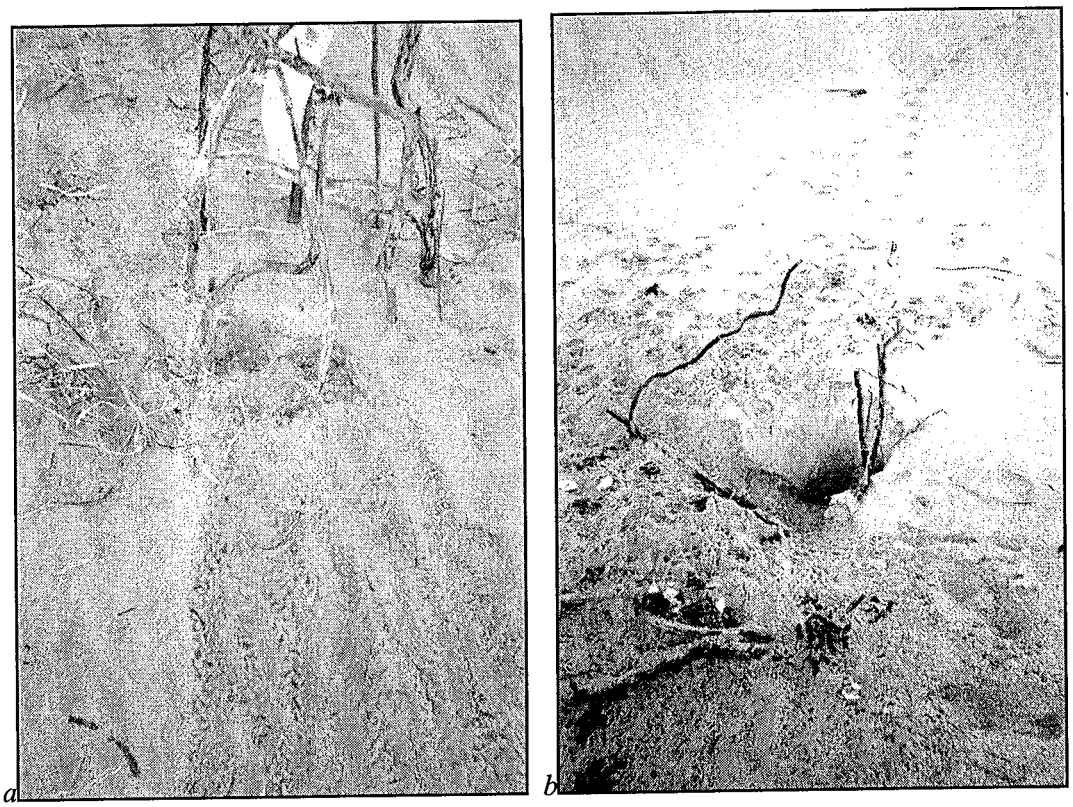


Figure 11:*(a) Two sticks directly over crater of emergence, Bateman Bay (nest 5), 4 February 2003;(b) Fox predation, Bateman Bay (Oyster Bridge), 15 February 2003.*

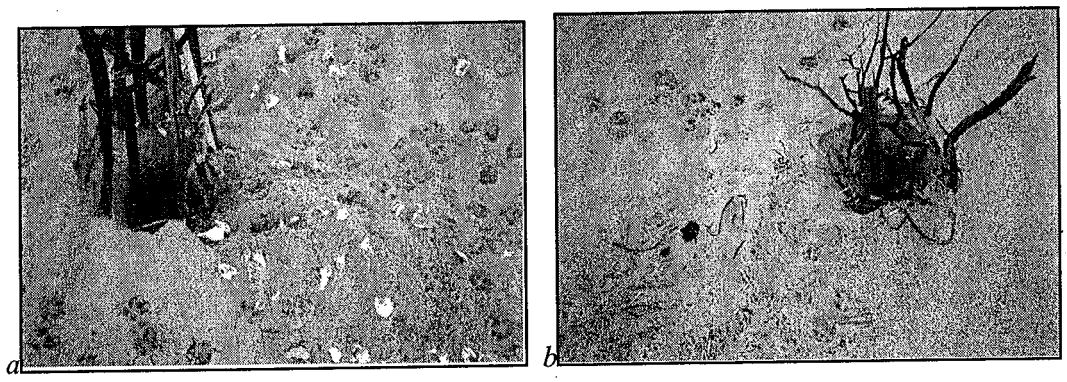


Figure 12:*(a) Fox predation, Bateman Bay (nest towards northern end), 15 February 2003;(b) Fox predation, Bateman Bay (second nest at Oyster Bridge) 15 February 2003.*

1.7 '1080' bait uptake at Bateman Bay

Introduction

Nesting sea turtles come ashore to lay their eggs in buried chambers above the high water mark on suitable beaches. The eggs are the natural food of goannas, and, when exposed, birds such as seagulls. On the coast of North-West Cape, sea turtle eggs are eaten predominantly by introduced foxes. Foxes predate both on nests and hatchlings. When foxes dig into nests, they not only eat the eggs from the top, but any eggs left in the nest are then subjected to high fluctuations in sand temperature as a result of being exposed. A 1080 baiting program was initiated at Bateman Bay in November 2002 (Figure 12).

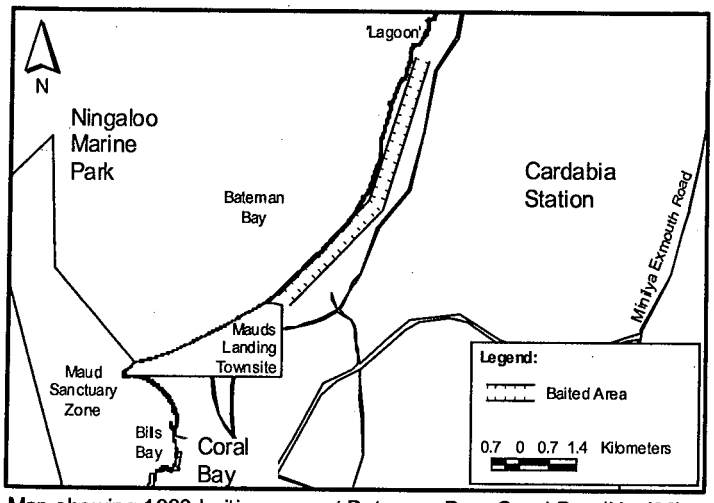


Figure 13: *Map showing the baited area at Bateman Bay*

Methodology

The 1080 fox baiting program was implemented at Bateman Bay, Coral Bay, on 14 November 2002. At 100 metre intervals on fifty-three sites, dried meat baits were tethered to plastic tent pegs with fishing line, and buried. Baits were laid over the first dune with 250 metre exclusion zones around recreation areas to reduce the risk to the visitors. Baits were checked weekly, and taken baits replaced monthly. Sixteen baits were taken in the first month, and 18 in the second month. By then end of the season's program in April 2003, a total of 67 baits were taken.

Results

Baits were taken on a regular basis. Table 6 summarises the bait uptake for the first 3 months of the program.

Table 6: *Bait uptake at Bateman Bay over 6 months in 2002/2003 (from 53 stations)*

Baiting period	**Total no. of baits taken**
Nov'02 – Dec'02	16
Dec'02 – Jan'03	18
Jan'03 – Feb'03	14
Feb'03 – Mar'03	11
Mar'03 – Apr'03	5
Apr'03 – May'03	3
Total	**67**

Discussion

Although very labour intensive, the tethering and burial of baits minimises the risks of accidental uptake by native fauna. No baits were found in the area outside of the baiting stations. No incidents of accidental uptake or finding of individual baits by the public was reported. CALM staff involved in baiting suggested the use of wire rather than nylon fishing line would lead to a more time efficient bait replacement regime.

It is not possible to exactly specify the number of foxes eliminated as no fox carcasses were found. However, nest predation was reduced significantly from previous years. Peter Mack eliminated foxes in previous years using traps and the numbers caught varied annually but were generally in the vicinity of 50-60. This season, 67 baits were taken. Assuming some double take (i.e. one fox ate more than one bait before succumbing to its effects), the number of foxes eliminated this season using 1080 was between 50-60.

It was found that foxes were using some tracks on a regular basis. It is suggested that by targeting the baiting at these locations in future, foxes could eliminated quicker. Monthly re-baiting also proved to be inefficient as this left gaps in the baiting line after take. It is recommended that re-baiting of baiting stations occur on a fortnightly basis during routine monitoring.

2. RESEARCH

2.1 Effects of shading sea turtle nests on incubation temperatures at Bateman Bay

Introduction

The large loggerhead sea turtle nesting ground on Dirk Hartog Island has a sand temperature about 3^0C lower than that of the mainland beaches of North-West Cape (C. Limpus, pers. Comm.). This means that even the very small mainland loggerhead rookeries may have an important function in increasing the proportion of females in the total population (warmer sand temperatures being responsible for a female-biased sex ratio). During November and December 2002, sticks have been put in a cone around each turtle nest at Bateman Bay. These stick cages have been put in place by a volunteer group to protect the nests from the potential of fox predation. However, as they shade the nests to varying degrees throughout the day, concerns were raised about the effect of shading on incubation temperature (Figure 14 and Figure 15).

Methods

Sand temperatures were measured at five nests along Bateman Bay during the afternoon of 28th December, 2002. Nests that were spatially in the middle of clusters of nests were chosen. Two "Technitherm" thermometers were used, and calibrated before and after the readings were taken. Temperatures were measured simultaneously in the centre of the cone of sticks surrounding the nest, and in a patch of sand adjacent to the nest (Figure 16). Sand surface temperatures were measured first, then sand temperatures at a depth of 10cm (the length of the thermometers)(Figure 17). Thermometers were left in place for five minutes before readings were taken.

Results

Sand surface temperatures directly over the nest varied between being the same as, and being 8^0C cooler than, the adjacent sand (Table 6). These differences translated to a cooling effect at a depth of 10cm. The temperatures at depth over the nests were consistently 2 to 3^0C cooler than the temperatures at depth of sand outside the nests (Table 7).

Table 7: Sand temperatures on the surface and at 10cm depth for five nests at Bateman Bay.

Lat.	Long.	Time	Temp outside surface ^{0}C	Temp nest surface ^{0}C	Temp outside depth ^{0}C	Temp nest depth ^{0}C	Location
23.06782	113.81691	14:45	35	27	31	28	2 coves north of Oyster Bridge (middle of 3)
23.07048	113.81625	15:03	36	30	31	29	1 cove north of Oyster Bridge (middle of 5)
23.07933	113.81462	15:23	35	33	32	30	Northern Bateman Bay (middle of 7)
23.11260	113.77967	15:45	39	32	34	31	Southern Bateman Bay (middle of 5)
23.12068	113.76066	16:08	38	38	34	32	Within sanctuary zone at Mauds Landing

Discussion/Conclusion

Even if the 2 to 3^0C difference at a depth of 10cm equates to a 1 to 1.5^0C difference at nest depth, it is possible to have an effect on the sex ratio of the hatchlings. The shading of the nests in a

nesting population in which it is important to produce female hatchlings could be turning more hatchlings male, than under natural conditions without nest interference. However, more extensive studies are required to confirm this hypothesis.

Figure 14: Sign shading nest, south Bateman Bay, 27 December 2002.

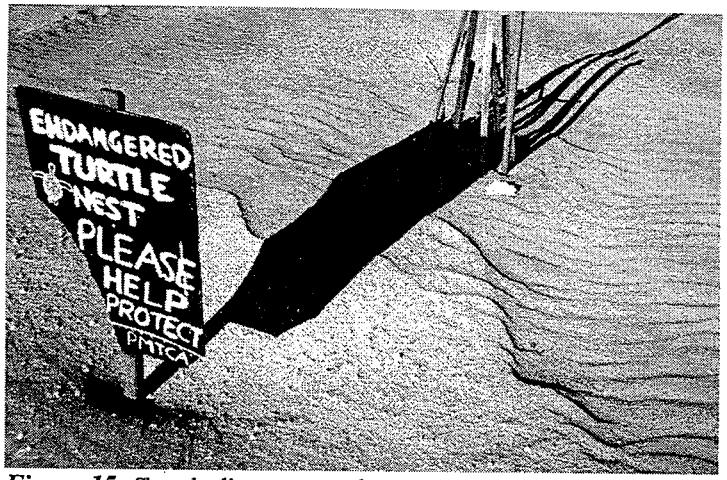


Figure 15: Sign shading nest, south Bateman Bay, 27 December 2002.

Figure 16: Nest temperature testing – surface – Bateman Bay, 28 Dec 2002.

Figure 17: Nest temperature testing – 10cm depth – Bateman Bay, 28 Dec 2002.

2.2 Temperature profiles of three loggerhead sea turtle nesting beaches

Introduction

The sex of sea turtle hatchlings is determined by the temperature of the developing eggs during the middle third of incubation period. Warmer incubation temperatures produce more female hatchlings, and cooler incubation temperatures produce more male hatchlings. A temperature change of only one or two degrees away from the pivotal temperature can have a significant effect on clutch sex ratio. Sand temperatures at the large loggerhead rookery on Dirk Hartog Island are approximately 3^0C lower than that of the mainland beaches of North-West Cape (C. Limpus, pers. Comm.). Therefore, the mainland beaches, although small rookeries, may be important in increasing the ratio of females in the population. This report makes a preliminary comparison of sand temperatures between three loggerhead nesting beaches along the Ningaloo Marine Park coastline.

Methods

Three temperature data loggers were calibrated and deployed at each of three beaches in the Ningaloo Marine Park. They were positioned in areas of relatively similar topography on representative loggerhead rookeries. All beaches faced west. Each data logger was attached (by a cable tie) to a wooden board positioned on a plastic star picket (Figure 1). The star pickets were buried so that the data logger resided at a depth of 50cm below the surface of the sand (i.e. the approximate depth at which turtle nests incubate). The depth markings on the pickets were checked periodically to ensure that there was still 50cm of sand covering the data loggers. Location details are listed below.

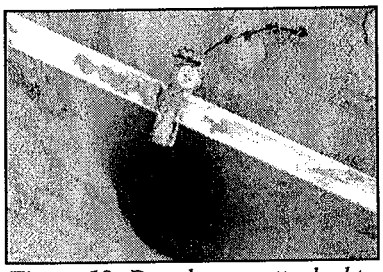


Figure 18: *Data logger attached to wooden platform at 0.5m depth on plastic star picket*

Jurabi Beaches (Five Mile)
Datalogger 298514/2199; Middle of sandy stretch to north. Mid-dune area, 10 metres in from start of grass. Deployed at 14:45 on 17 February 2003. Sand dry – very difficult to dig into without collapsing.

Jane's Bay
Datalogger 304286/0699; About 150 metres north of the dugong sanctuary sign. On dune slope, 2 metres up from start of grass. Deployed at 12:00 on 28 February 2003. Sand moist – very easy to dig a chamber.

Bateman Bay
Datalogger 299261/2199; North end, near nest 3, a few metres north of BB35. Two metres in from start of grass, one metre perpendicular south of CALM post. Deployed at 15:05 on 16 February 2003. Sand moist – easy to dig a chamber.

Results

The data were downloaded and corrected from calibration measures. Average daily temperatures were obtained from the Australian Institute of Marine Science Weather Station at Milyering, Cape Range National Park.

The dataloggers were retrieved as follows:
Jane's Bay (304286/0699) – 29/04/03
Jurabi Beaches (298514/2199) – 29/04/03
Bateman Bay (299261/2199) – 16/04/03

The half-hour interval temperature recordings were averaged for each day and the results plotted in Figure 19.

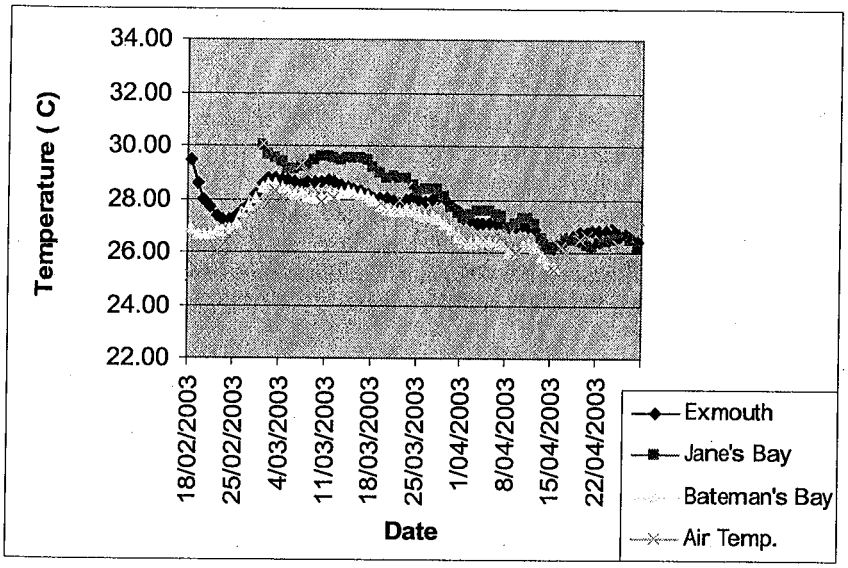


Figure 19: Graph showing average daily sand temperatures at 0.5m depth at three locations

Discussion

These temperature data loggers were deployed on an opportunistic basis. Incubation temperatures vary due to latitudinal gradient, beach sand colour, texture and moisture content, aspect and effects of shading from vegetation or closeness to dunes. Knowledge of temperature at incubation depth is necessary to allow estimation of male to female ratio. An understanding of spatial variation of nesting beach temperatures at incubation depths will assist in the identification of the relative importance of beaches for female production. It will be necessary to determine the pivotal temperature, i.e. the temperature at that moment in time when the sex of a developing embryo is determined, for the West coast loggerhead population.

2.3 Sea turtle stranding summary - Coral Bay and Janes Bay

Introduction

Dead turtles or washed up sick turtles are regularly reported to the District Office throughout the season. District staff respond to these on an opportunistic basis. Assessments of the cause of death or injury are made and incident forms are completed to maintain quantitative records.

Results and Discussion

During December to March 2002/2003, 15 green sea turtles were found washed up at Coral Bay and Jane's Bay, North-West Cape. Ten of these were autopsied. Most turtles seemed to have died of cachetic myopathy (general wasting caused by non-feeding and/or parasitism). Without sending samples away for pathology, specific diseases and/or parasites were not able to be identified. No turtles had any artificial material in their mouths, throats or guts. No turtles had signs of rope, trawler deck or harpoon damage. Only one turtle died from other causes (cut throat).

3 Public participation

3.1 Public education – Coral Bay

Introduction

Managing threats to nesting sea turtles involves a component of educating the community about what is happening, why it is necessary, what can be done, and how they can help. This was critical at Coral Bay as there were a range of established use patterns such as driving vehicles on beaches and interfering with hatching nests, activities which were identified as threats to turtle conservation.

Methods

A range of means were used to educate and involve the community. This included placing signs in strategic locations, public contact, establishing working relationships with existing community groups, and seeking assistance from volunteers.

Results

Signage

A voluntary seasonal closure of the beach to vehicles was in place from 15th October to 30th April. The closure applied to Bateman Bay beach north of the baiting sign. A number of signs were placed around the settlement of Coral Bay to ask people not to take four wheel drive vehicles onto the beach (Figure 20). A large Coastcare "Make the cost of your 4wd the only cost poster" was put up at the petrol station early in the season. This sign disappeared on 26th January. Several A3 and A4 posters were put up on 31st December, at the petrol station, Peoples and Bayview caravan parks, the shopping centre and the backpackers (Appendix A). Two temporary signs were put on the beach – one tied to the turtle rookery sign post at the access to Mauds Landing, and one tacked to a pole and board at the start of the exclusion zone (Figure 20). The sign on the pole on the beach was pulled out and put behind the dune within a few days of placement. A second temporary sign was erected in the same place some time later, and remained untouched. The permanent "colonial information shelter" was erected at the end of March (Figure 20). This sign was put on the main entrance track to the beach at the old jetty pylons.

Flyers were put up around the settlement asking for public participation in the Ningaloo Marine Park Community Turtle Monitoring Program. An article was also published in the local paper asking for volunteers. Unfortunately, no Coral Bay locals joined the program – only some volunteers from the Peter Mack Turtle Conservation Foundation early in the season.

Handouts

Early in the season, discussions were held with the Peter Mack Turtle Conservation Foundation (PMTCF) about producing a joint brochure about vehicles on beaches. At the end of December, 500 flyers were handed to the PMTCF for distribution (Appendix A). Volunteers of the PMTCF handed out these flyers to four wheel drive owners. An additional 500 flyers were distributed to information centres (i.e. the pub, caravan parks, backpackers and the Coral Coast information centre). The park note "The turtles of Coral Bay" was also distributed to these centres (Appendix B). This note gave information on turtle watching as well as driving on beaches.

Public contact

Numerous local people were approached about their views on turtle management around the area with mixed responses. Concerns were expressed about the effect of not allowing turtle

hatchlings to be dug up by tourism operators. In the 2002-2003 turtle nesting season, tourism operators did not to conduct turtle nesting tours because they believed that the tours with the CALM modified code of conduct were not commercially viable. CALM stopped unlicensed turtle interaction activity at the end of the 2001/02 season due to concerns about the level of interference with natural hatching processes. Some local individuals believed that tourists needed to be at hatchling emergence events otherwise foxes would eat the hatchlings as they ran down the beach. Other operators understood the changes and were only unhappy about the financial implications on their business.

Most shop owners, residents and tourists in the Coral Bay area that were spoken to about turtles seemed surprised that CALM had let people dig up turtle nests in the past, and were happy that this practice was being stopped. In summary, tourists who had heard about seeing turtle hatchlings that had been 'dug up' could be made to understand why such tourism was detrimental.

Conclusion

Education is an important component of the management strategy to minimise impacts from locals and visitors.

Posters and brochures were received well by establishment owners, especially by the caravan parks and the backbackers who agreed that four wheel drives should not be on the beach. The park notes were also popular.

Vehicles on the beach were not a problem earlier in the season and windy weather often made the beach smooth. However, four wheel drive traffic in April caused deep ruts on the beach. Beach closure at Bateman Bay beach should become compulsory at the next nesting season.

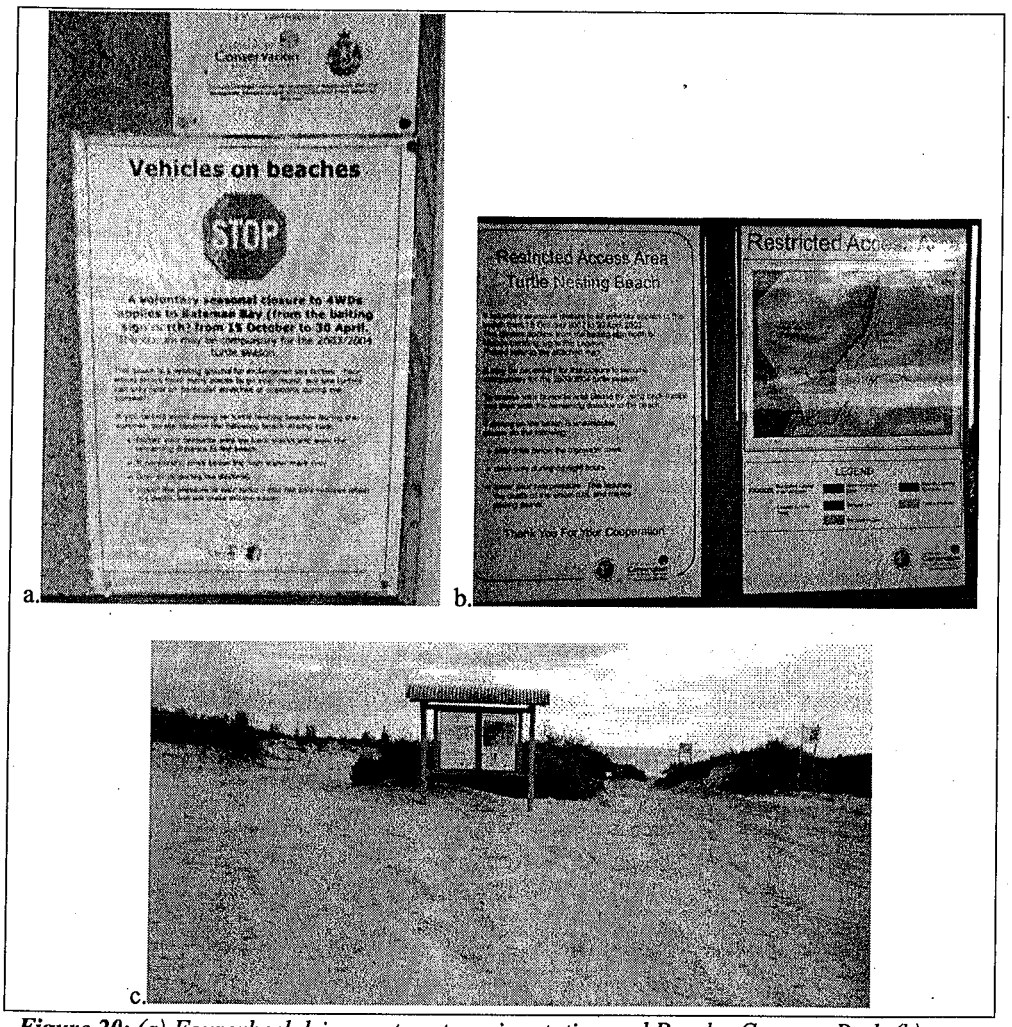


Figure 20: *(a) Four wheel drive poster at service station and Peoples Caravan Park;(b) new signs advising visitors about 4WD access restrictions and code of conduct; and (c) new sign shelter at the beach access to the old jetty pylons, Mauds Landing.*

4. In summary

This report is a summary of activities undertaken by Linda Reinhold while employed in the capacity of Turtle Conservation Officer by the Department of Conservation and Land Management Exmouth District based at Coral Bay. Her main responsibility included monitoring nesting beaches, supervising volunteers and researchers and implementing vehicle beach closures and 1080 fox baiting programs. The following outcomes were achieved:

Significant loggerhead rookeries

- Out of four *loggerhead* rookeries surveyed by the author from Coral Bay, Ningaloo Marine Park, Gnaraloo Bay was the most significant, followed by Jane's Bay, the Jurabi beaches and Bateman Bay.
- Jane's Bay has approximately twice the nesting density and 10 times the fox predation of Bateman Bay.

Nest Protection

- The shading of the nests when nest protection sticks in a tee-pee formation are used has a potential of changing nest chamber temperature, increasing the nest male to female ratio.
- Nest protection sticks are no barrier to foxes that want to dig into nests. Therefore, putting tepees of sticks around nests to protect them from foxes does not appear to be effective.
- Meshes have not been proven to be effective, and need to be checked regularly to ensure that hatchlings do not get trapped. It is recommended that a larger mesh size be used if nest meshing is to be continued.
- There is not proof that existing FED design's applied in Ningaloo Marine Park decrease predation rates on nests at baited beaches. In fact, their application may cause more harm than good.
- Careful consideration should be given when a research license is sought involving the use of FED's which may interfere with emerging hatchlings. If the threat of foxes is removed, the best management for the turtle nests is to leave them to incubate naturally.

1080 baiting

- 67 baits were taken. Assuming some double take (i.e. one fox ate more than one bait before succumbing to its effects), the number of foxes eliminated this season using 1080 was between 50-60.
- Predation levels at Jane's Bay are the highest along the Ningaloo Marine Park coastline. Baiting should commence as a priority
- Baiting should be intensified at Bateman Bay for the 2003/4 season to further reduce nest loss from predation. The existing monthly re-baiting interval at Bateman Bay and Jane's Bay should be intensified to a fortnightly schedule.
- The past baiting on Gnarloo Station resulted in no losses of turtle nests from fox predation. Baiting should be recommenced at Gnaraloo Bay as a priority.
- The density of loggerhead nesting at the Blowholes, Quobba Station, indicates that a fox baiting program at this beach would be worthwhile.
- Fox predation in Cape Range National Park should be quantified, and if necessary, coastal baiting increased to target the beaches.

Vehicle beach access and community monitoring

- Restricted vehicular access to nesting beaches, especially at Bateman Bay, should be made compulsory.
- Bateman Bay has a very low nesting density, and poor accessibility without a licensed ATV. No residents joined the Ningaloo Marine Park Community Turtle Monitoring Program. There is therefore limited scope for a community program in Coral Bay.

The Turtle Watching Code of Conduct:

a) Try to avoid the use of lights, but if necessary use only a low light intensity torch (less than 3V bulb). Avoid the use of flash photography while on nesting beaches. Avoid sudden movement at all times.

b) Letting you eyes adjust to the dark, carefully walk along the beach at high tide mark looking for tracks. If you see a turtle emerging, stay very still until she has passed you up the beach.

c) Only approach nesting turtles directly from behind, and stay low.

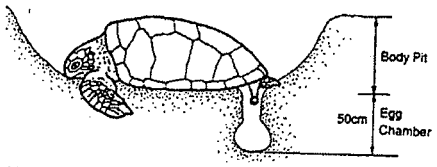
d) Position yourself behind the turtle, staying well away and out of her field of vision. If you are getting covered in sand as she digs you are too close!

e) Be patient. She may abandon the nest and dig another one for a variety of reasons including hitting an obstacle or the sand being too dry.

f) Wait until she is settled into laying before moving closer or shining your torch. Disturbance before and during laying can lead to nest abandonment. A turtle has usually commenced laying when she is sitting still after digging a deep hole with her back flippers.

g) Give her enough space to cover up the nest and let her return to the ocean without blocking her path.

h) Leave by 11pm, giving the beach to the turtles for the rest of the night.



Turtle nest profile

Hatchlings

During hatchling emergence you should:

- Stand back from the nest – do not compact the sand.
- Don't use lights.
- Let the hatchlings make their own way down the beach. Hatchlings can get stuck in footprints so stand to the side rather than crossing their path.

Research Projects

There are several programs planned for this summer :

- Western Shield '1080' Fox baiting programs.
- Ningaloo Marine Park (community) Turtle Monitoring Program.
- A study developing a management framework for the endangered marine turtles.

To find out more about these projects or information about how to identify different species of turtles please visit either the Milyering Information Centre or the Exmouth DCLM Office in Nimitz St on 9949 1676 during office hours.

Strandings can be reported to the ranger at Coral Bay on 0429 49 16

Appendix C

Checklist of Monitoring Procedures

HAVE YOU:

- ❑ Verified that you are at the correct starting bollard?
- ❑ Entered all details on the top of the data sheet?
- ❑ Located the latest high tide mark?

. . . . . .

- ❑ Identified a fresh track?
- ❑ Identified the turtle species or taken a photograph if unable to?
- ❑ Identified the emerging and returning track?
- ❑ Determined the crawl time?
- ❑ Determined if nest is successful or a body pit?
- ❑ Determined how many body pits?
- ❑ Recorded GPS coordinates for the last body pit or nest?
- ❑ Recorded all necessary details in all columns of data sheet?
- ❑ **Marked the track?**

. . . . . .

- ❑ Identified the end bollard and entered the identification details on the data sheet?
- ❑ Entered the finish time of the survey on the data sheet?
- ❑ Entered all page numbers on data sheets and stapled them together?
- ❑ Turned off the GPS?
- ❑ Checked that all the contents of the kit are present?
- ❑ Picked up fellow volunteers travelling with you?
- ❑ Returned the monitoring kit to the DCLM office?