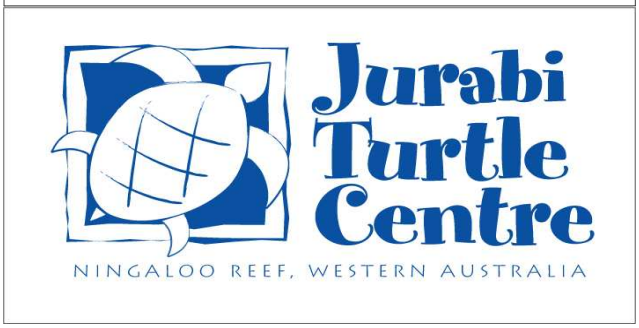
# Ningaloo Turtle Program

## Western Australia

# Annual Report 2004-2005

(Prepared July 2005)

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Department of Conservation and Land Management
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# Table of Contents

## List of Tables

**List of Figures**

# Executive Summary

The 2004/2005 Ningaloo Turtle Program (NTP) which includes the Ningaloo Community Turtle Monitoring Program (NCTMP) and the Jurabi Turtle Centre (JTC) resulted in an outstanding success. The program has expanded from previous seasons with increases in:

- the number of volunteers and volunteers' hours contributed;
- geographical areas monitored; and
- number of days monitored.

The Ningaloo Turtle Program has grown significantly with the inclusion of operations at the Jurabi Turtle Centre and the expansion of community turtle monitoring to other regions in the Pilbara,

The Ningaloo Community Turtle Monitoring Program has collected data over three successive turtle nesting seasons and obtained results indicating trends in turtle nesting activity on the North West Cape (Figure 1).

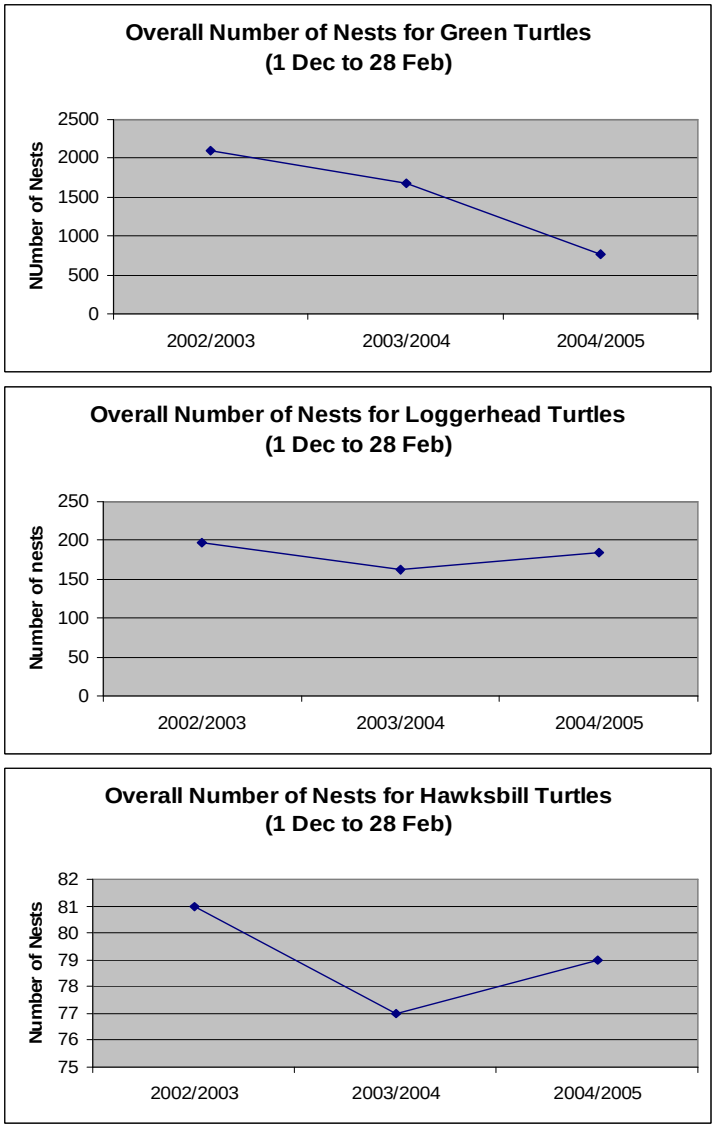



**Figure 1: Numbers of nests for Green Loggerhead and Hawksbill turtles on the North West Cape**

- The abundance of turtle nesting activities on specific sections of beach and the relative significance of specific sections to each species of turtle have been established.
- The abundance of turtle nesting activities over specified time intervals has been determined.
- A significant loggerhead turtle rookery on the mainland of the Ningaloo coast has been identified at Bungelup in the Cape Range National Park.
- Targeted fox baiting programs have resulted in the reduction of fox presence and predation along three important turtle rookeries along the Ningaloo coast.
- The rescue of 49 mature female turtles from stranding in the sand dunes over the duration of the program has provided an added benefit to populations of recovering marine turtles.

The Jurabi Turtle Centre commenced operations in 2004/2005. Education and interpretive information presented at the centre during turtle nesting season has provided a focus for turtle tourism along the Jurabi coast. It has been determined that education and interpretation alone has limited effectiveness and further development of the management of visitor-turtle interactions will be an outcome from this season.

The capacity building and outreach component has resulted in the identification of a flatback turtle rookery in Port Hedland not previously recorded. It has facilitated community turtle monitoring programs in the Pilbara and generated education and awareness towards marine turtle conservation in Pilbara communities.

As a result of the last three years of monitoring and data analysis and one season of operations at the JTC, the following recommendations can be made:

# Recommendations

The recommendations made by this report can be separated into several elements:

1. **Monitoring**

Continue to monitor nesting activity:

a. On the North West Cape to obtain long-term trends related to turtle populations, specifically in the Lighthouse, Hunters and Graveyards sections which are important rookeries.

b. Continue to monitor nesting activity in Bungelup section to indicate loggerhead nesting and population trends.

c. Continue to monitor nesting activity for a further 13 week period in the 2005/2006 season to further verify weeks 4-11 as being the period where 55% of the total nests are laid.

d. Consider reducing the monitoring season to define a cost effective and statistically rigorous program monitoring index beaches for an established index time period.

e. Develop data collection on turtle rescues, specifically the locations and consider rescues as a future objective of the NCTMP.

f. Review human impact data collection as an objective of the NCTMP.

## 2. Fox Control

Fox baiting and fox monitoring:

a. Maintain 1080 fox baiting on Five Mile section and continue to monitor for fox presence and predation in all sections of the North West Cape Division.

b. Implement a targeted fox baiting program in the Bundera Coastal Park and Bungelup section in the Cape Range National Park and monitor fox presence and predation.

c. Continue 1080 fox baiting in the Batemans Bay section and monitor for fox presence and predation in all sections of the in Coral Bay Division.

d. Continue with and urgently upgrade the current 1080 fox baiting program to include the whole coastal strip adjacent to Janes Bay.

## 3. Human Impacts and Recreation

a. Continue to manage visitor-turtle interactions through education and interpretive activities at the Jurabi Turtle Centre and nearby nesting beaches in collaboration with all stakeholders.

b. Refine and develop the visitor impact monitoring method used at the Jurabi Turtle Centre to obtain information on human disturbance.

c. Support the development of a sustainable turtle ecotourism industry of the North West Cape.

d. Review car park locations at Jacobz, Jansz, Wobiri and Five Mile to consider the impacts of car headlights on turtle nesting activities.

## 4. Research

Encourage further research projects into:

a. Impacts and compliance of human activities on turtle nesting beaches of the North West Cape

b. Comparisons between nesting success and environmental data.

c. Migration and foraging habits of turtles nesting on the North West Cape by facilitating a satellite tagging program in conjunction with the NCTMP.

d. Accuracy of differentiation of Loggerhead and Hawksbill tracks.

# 1.0 Background

## 1.1 Ningaloo Region

Ningaloo Reef, which stretches approximately 260km along the Ningaloo Carnarvon Coast, is Australia's largest fringing reef system. Over 250 species of coral form a complex coral ecosystem which provides habitat for over 500 species of fish and 600 species of molluscs and many other species of organisms. The diversity of fish and colourful coral, combined with the accessibility of the coral reef system, make Ningaloo Marine Park a prime tourism location. The presence of charismatic mega-fauna such as the world's largest fish, the elusive whale shark, as well as whales, dugongs, turtles and manta rays provides prime conservation and tourism opportunities.

The Ningaloo Region encompasses a gulf system, a range, cave systems, a wetland, and an extensive coastline adjacent to the Ningaloo Marine Park which provides a plethora of habitats for globally significant species and communities.

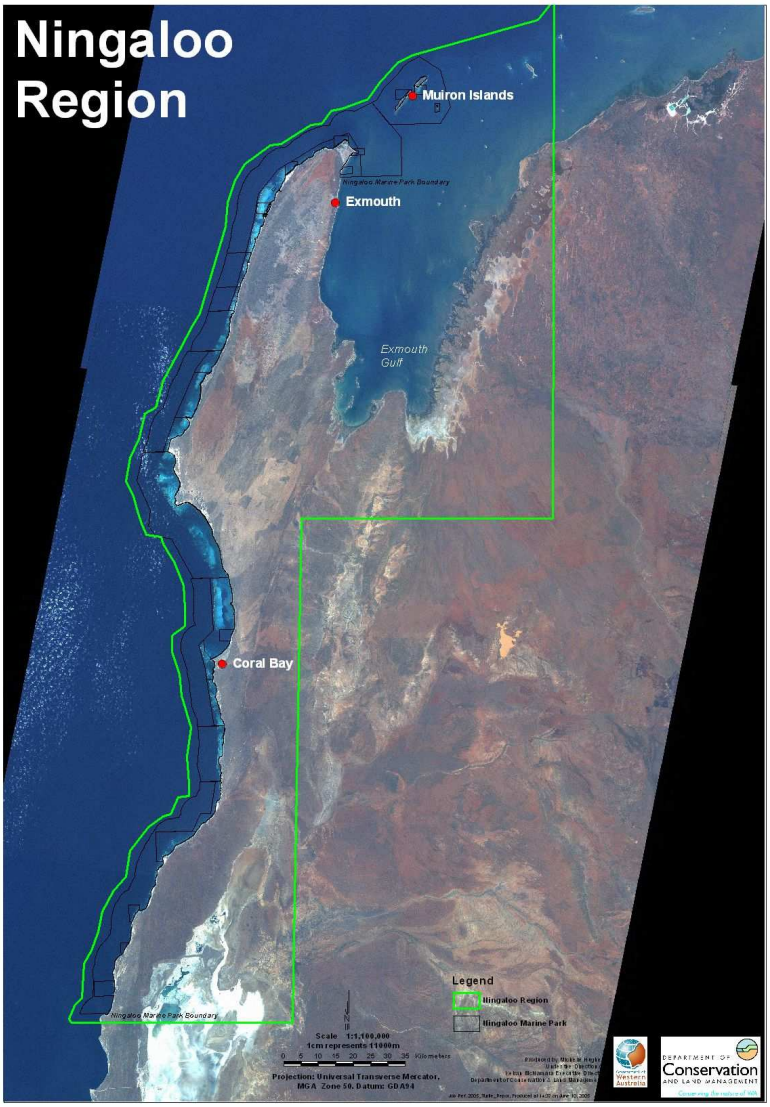



**Figure 2: Ningaloo Region**

It is imperative that local communities in the Ningaloo Region work in collaboration with management agencies, scientists, conservation organisations and industries to bring about coordinated and effective measures for the conservation of the values that make the Ningaloo Region so highly valued by the general public and local communities.

## 1.2 Marine turtles of the Ningaloo Region

The Ningaloo Region has been identified as having significant beaches for turtle nesting (Prince 1990). Three main species of marine turtles nest on the Ningaloo Coast:

- Green turtle *(Chelonia mydas*)
- Loggerhead turtle (*Carretta carretta*)
- Hawksbill turtle (*Eretmochelys imbricata*)

All are listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* as "threatened" and are listed on the IUCN Redlist. All three species of turtles are also scheduled as "rare or likely to become extinct" and considered in need of special protection under the *Western Australian Wildlife Conservation Act 1950 (Wildlife Conservation Notice 2003)*

Green turtles tagged in the Ningaloo region are known to migrate to the Lacepede islands, and loggerhead turtles tagged on the North West Cape have been recorded off the coast of Java, in Indonesia and within the Gulf of Carpentaria (Prince 2003). This indicates that that the conservation of marine turtles in the Ningaloo Region will contribute to marine turtle global conservation efforts. Internationally, marine turtles are under immense pressure from a range of activities including illegal trade and harvest; unsustainable harvest; some forms of commercial fishing such as trawling and long-lining; and loss of habitat such as seagrass beds, coral reef ecosystems and intact coastlines. In the Ningaloo regions specifically, marine turtles face the following pressures:

- fox predation;
- inappropriate recreational and tourism activities such as disturbance and four-wheel driving on nesting beaches;
- boat strikes;
- specific fishing practices, such as long lining and
- light pollution from developments both marine and land based.

In an attempt to provide a coordinated and concerted effort in the conservation and management of marine turtles and their associated habitats, the local conservation group – the Cape Conservation Group (CCG), the Department of Conservation and Land Management (CALM), Murdoch University and WWF Australia have worked towards the development and implementation of the Ningaloo Turtle Program (NTP).

## 1.3 The Ningaloo Turtle Program

At present, there are three main components to the Ningaloo Turtle Program which include:

- Implementation and refinement of the Ningaloo Community Turtle Monitoring Program (NCTMP);
- Developing community awareness and education programmes along with appropriate turtle interaction protocols at the Jurabi Turtle Centre (JTC)
- Capacity building and outreach to other community groups involved in turtle conservation.

### Purpose and objectives

The principal aim and goals of the Ningaloo Turtle Program are:

***Aim:*** To promote the long-term survival of turtle populations.

***Overarching goals***:

- Identify key nesting beaches.
- Monitor populations and assess trends at key index sites.
- Identify the level of feral predation threats on nests
- Implement effective protection of important nesting beaches in cooperation with the management agency.
- Generate and maintain community support for the program and for the conservation of marine turtles and their habitats.
- Educate visitors and the community about marine turtles.
- Manage visitor turtle interactions through education and interpretation and by promoting sustainable ecotourism.

This report has been prepared with a focus on the Ningaloo Community Turtle Monitoring Program, and the inaugural year of operations at the Jurabi Turtle Centre. There is an overview of the results of three years of turtle monitoring and a set of recommendations for the improvement and enhancement of both the NCTMP and JTC for turtle nesting season 2005/2006.

## 1.4 Ningaloo Community Turtle Monitoring Program

### Background

The Cape Conservation Group (CCG), Department of Conservation and Land Management (CALM) Exmouth District and David Waayers, PhD Candidate, Murdoch University (MU) formally established the Ningaloo Community Turtle Monitoring Program in 2002, with the assistance of a Threatened Species Network[1] Grant. Since then, it has grown with a high level of interest not only from the local community of Exmouth, Western Australia, but within Australia and overseas. The Program has become an excellent example of a collaborative conservation initiative driven by the local community.

### Purpose and objectives

The principal aim and objectives of the Program are:

***Aim:*** To promote the long-term survival of turtle populations.

***Core monitoring objectives***:

- Determine the abundance of nests on specific sections of beach over specified time intervals for each species.
- Identify the relative significance of nesting beaches to each species.
- Establish the level of predation on nests.
- Determine the impact of human interaction on the nesting activities of each species.

A key component of the NCTMP is the collection of data (identifying key nesting habitats for turtles and their relative significance) on which future management planning and development can be based. It also provides the necessary data that allows the management agency to address and manage potential threats such as fox predation, beach access management and turtle tourism, and provide turtle interpretation/education.

[1] The Threatened Species Network is a joint program between WWF Australia and the Australian Government's Natural Heritage Trust

## 1.5 Jurabi Turtle Centre

### Background

A significant threat faced by marine turtles on the North West Cape is disturbance during the nesting process by people seeking a turtle viewing opportunity. This has been demonstrated in two separate studies. Osborne (1995) found that 33% of people who had contact with turtles disturbed them. Waayers (2004) during a study from 2001 – 2003, found that 33% of people shone torches at nesting female turtles, prior to egg laying, and 60% of these torch interactions disturbed the turtles, which returned to the water. Unfortunately, 13% of these people knew they were acting inappropriately.

The number of visitors is increasing annually, with records showing a 27,000 visitor increase between 2001 and 2003 and significantly higher visitation specifically during the low season from November to March (see Figure 3), which corresponds to turtle nesting season. As eco-tourism is the fastest growing sector, the increased visitation means increasing numbers of tourists will frequent turtle rookeries along the Ningaloo Coast in search of nesting and hatching turtles.

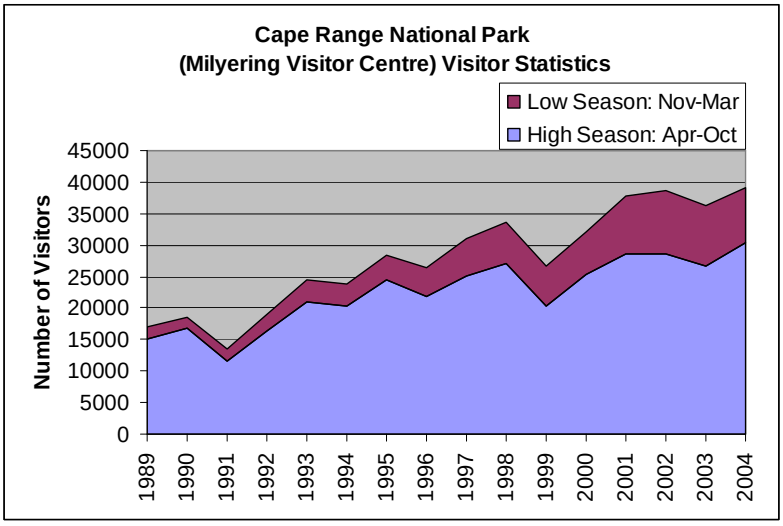



**Figure 3: Milyering Visitor Centre visitor numbers for sixteen years including high and low seasons.**

As turtles are highly vulnerable to disturbance during certain stages of the nesting process and hatching, it is important to manage and educate the increasing number of visitors seeking nature based experiences with turtles to minimise any negative impacts these interactions may have. CALM introduced turtle interaction licensing in 2002/2003 to initiate management of this developing ecotourism industry. It was acknowledged that turtle tourism was and still is underdeveloped, with an urgent need to develop management plans and education programmes that ensure visitor behaviour adheres to interaction protocols designed to protect the turtles.

In recognition of this problem, a recommendation was made (by the Jurabi and Bundegi Coastal Parks and Muiron Islands Management Committee) to construct an educational facility within the Jurabi coastal area, where there are significant turtle rookeries. The Jurabi Turtle Centre (JTC) was constructed in 2003. It is a small-scale, shade-sail structure approximately 18 kms from Exmouth. The project is a joint venture between the Shire of Exmouth and Dept of CALM with funding and "in-kind" contributions for the centre being provided by CALM, Shire of Exmouth, Woodside Energy, the Commonwealth Government

Assistance Scheme, WA Tourism Commission, MG Kailis Group, Coastwest and the Ningaloo Turtle Program.

**Purpose**

The purpose of the Jurabi Turtle Centre venture is to work in collaboration with stakeholders and the community to promote conservation of marine turtles and protect biodiversity values while providing access to an informative and enriching wildlife experience.

This is provided through:

- Static interpretive and educational material providing information about turtle biology, threats, appropriate observation techniques and conservation strategies through a variety of interpretive media. This material is accessible to the public at all times.
- Volunteers participating in a training program coordinated by CALM. They educate the public through "turtle talks" which outline the Turtle Watcher's Code of Conduct, monitor turtle-visitor interactions on the adjacent beach and assist visitors to follow the interaction guidelines.
- Visitors to the centre being encouraged to participate in a commercial, guided tour with licensed operators. Volunteers assist commercial operators to locate turtles for their tour.
- Commercial operators visiting the centre and attending turtle talks as a regular component of their turtle tour. Operators can also collect additional clients at the centre who have participated in a turtle talk.
- JTC operating in consultation with a range of stakeholders who form the Turtle Interpretation Facility Advisory Committee.

These features enable JTC to play a prominent, localized role in:

- protecting threatened species and conserving biodiversity;
- advocating and facilitating sustainable tourism;
- promoting and maintaining community participation and stewardship for coastal management; and
- integrating the interests of conservation and recreation.

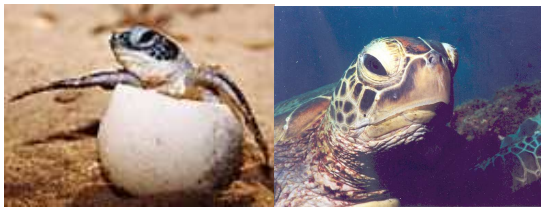
## 1.6 Community Monitoring Expansion and Outreach.

The Ningaloo Turtle Program involves a training component in both methodology used for monitoring, and the delivery of interpretation at the Jurabi Turtle Centre, and is being provided to other groups in the Pilbara to allow capacity building in this region. It will also facilitate the development of further community monitoring programs in remote locations on the Pilbara coast and encourage community education and awareness of marine turtle conservation

# 2.0 **The Ningaloo Community Turtle Monitoring Program**

NINGALOO COMMUNITY TURTLE MONITORING PROGRAM

## Annual Report 2004/2005



## 2.1 Introduction

The Ningaloo Community Turtle Monitoring Program involves the recruitment of committed volunteers to take part in a program to monitor the nesting beaches of the Ningaloo Coast. The program largely focuses its efforts on monitoring nesting success, turtle species and evidence of threats such as human disturbances or fox predation of nests. Over time, the program will be able to identify population changes and trends and allow CALM and the community to keep track of the marine turtle population changes in this region.

## 2.2 Methods

The following steps outline the general protocol used to ensure that sufficient data of high quality is collected and analysed. For more information on the beach nest monitoring method which is based on Eckert *et al*, 1999, please see www.ningalooturtles.org.au.

***Volunteer recruitment***
Volunteers are vital to the successful implementation of the NCTMP. These include local and non-local volunteers. Volunteers were recruited through the Cape Conservation Group (local membership), local media including newspaper articles, posters and through workshops and information days. Volunteers have also been recruited through universities (in particular Murdoch University), websites and newsletters.

***Volunteer Training***
New volunteers participate in a robust training and competency assessment, including provision of a field guide, training video and field based training. Once certified, volunteers were able to undertake beach monitoring without supervision. (See Turtle Monitoring Field Guide, Training CD/DVD available at www.ningalooturtles.org.au).

***Data collection***
Data collection has occurred along specified beaches. The Ningaloo region has been previously identified as a significant area for turtle nesting activities along the West Australian coastline. Aerial surveys were conducted along the Ningaloo Coast in 2001/2002 and 2002/2003 to establish the abundance of emerging turtles along all these beaches (Waayers 2003). These surveys were conducted as part of a PhD project and were supported through funding from the Australian Governments Natural Heritage Trust (NHT).

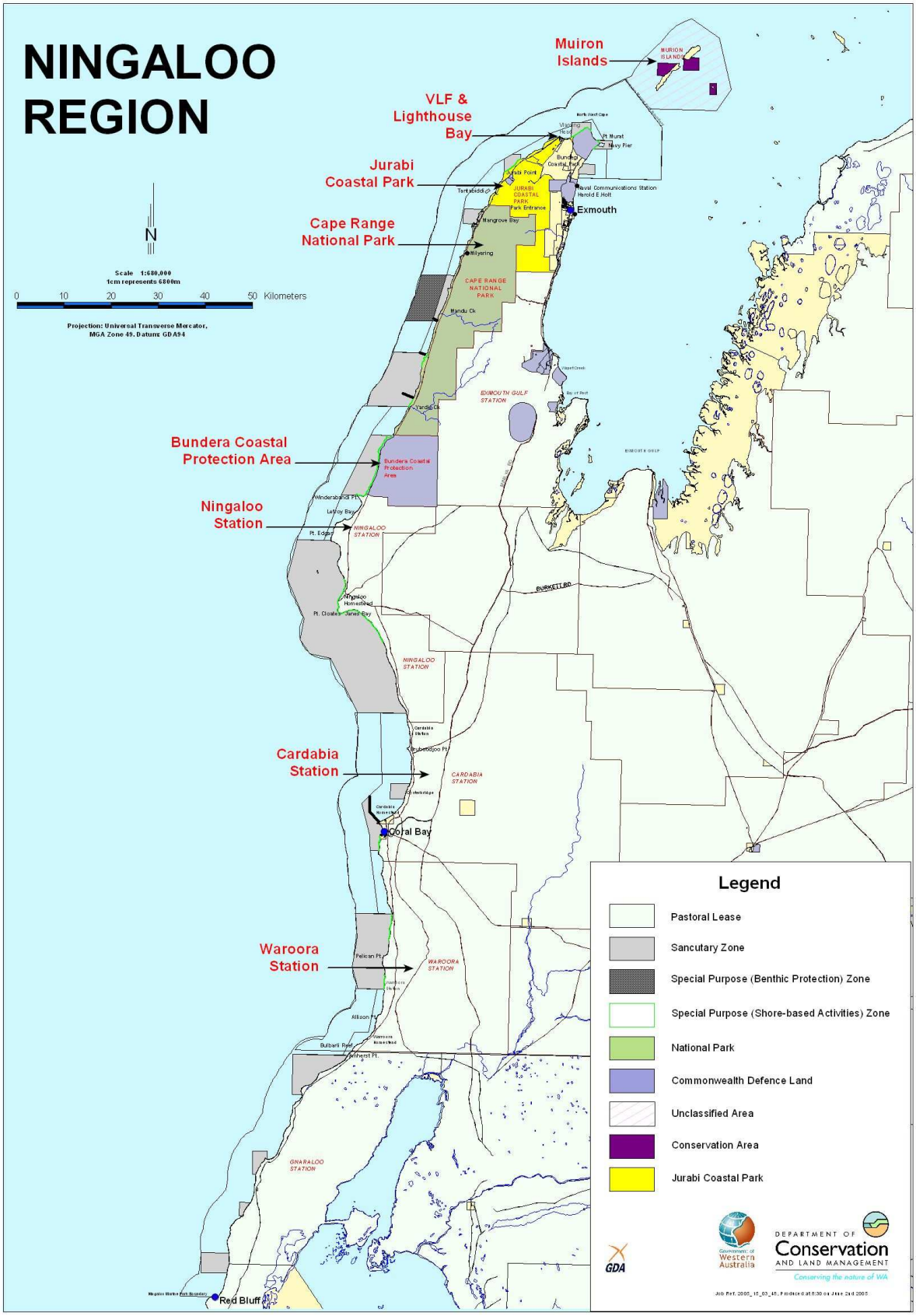



**Figure 4: Tenure map of the Ningaloo coast**

The results of these aerial surveys indicate areas that have a high density of turtle emergence tracks per km of beach (Figure 5) and beaches with aggregations of turtle activity (Figure 6). These findings indicate that the Murion Islands are a very significant area of activity, while mainland beaches with significant aggregations include Lighthouse, Hunters, Graveyards, Bungelup and Janes Bay. These results were used as an indication of areas to concentrate ground surveys in.

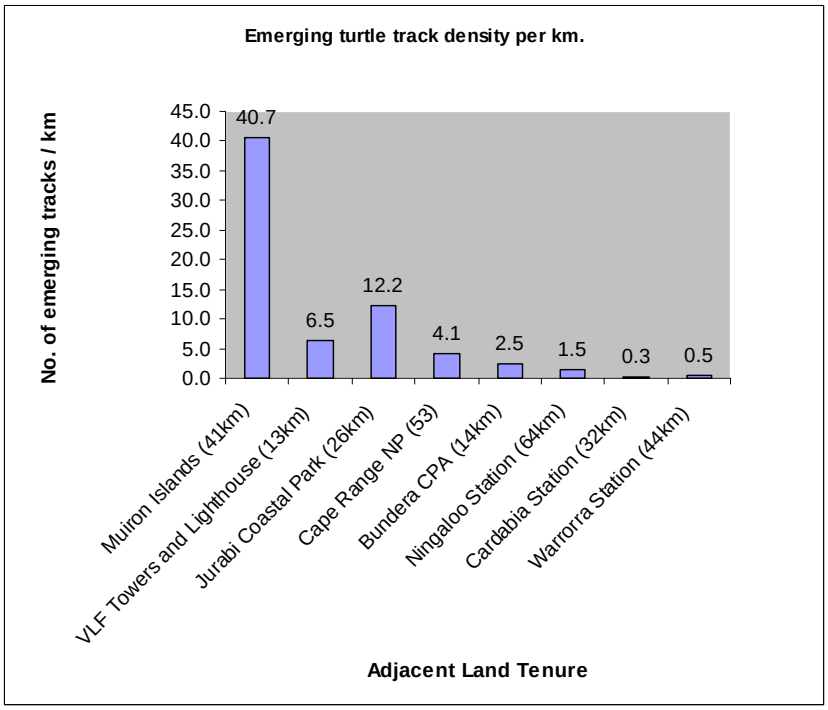



**Figure 5: Density of emerging tracks per kilometre of beach, recorded over 6 flying days sorted geographically according to adjacent land tenure. (Note: This does not account for the actual areas of suitable nesting beach within the land tenure)**

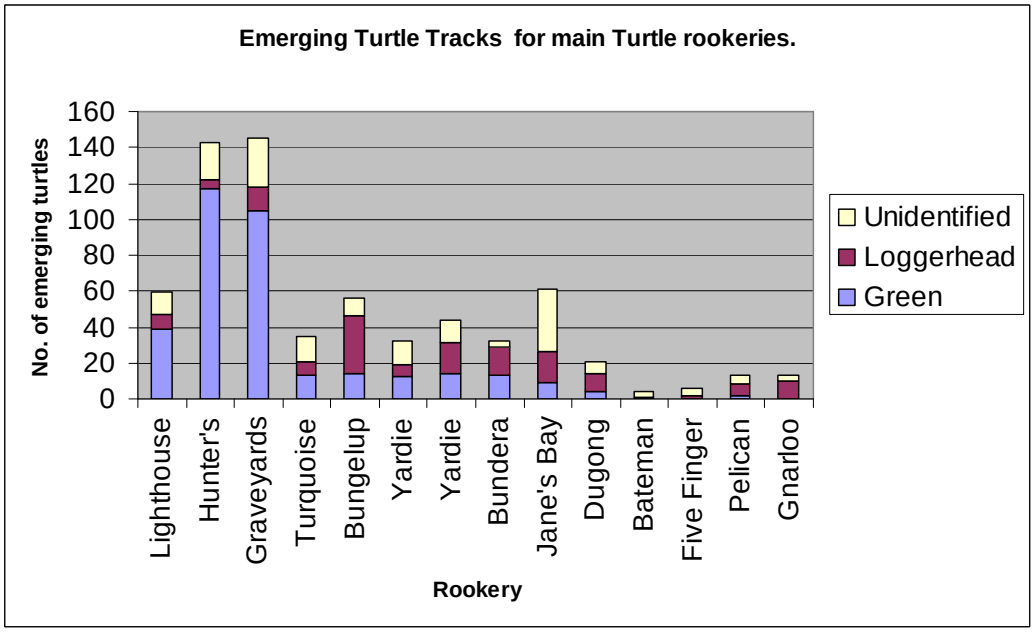



**Figure 6: Number of emerging tracks recorded over 6 flying days sorted geographically according significant mainland aggregations.**

Based on the information collected in these aerial surveys, the Ningaloo region is divided into a spatial hierarchy of Divisions, Sections and sub-Sections to assist in the management and distribution of volunteer effort (see Figure 7 and Figure 8 below).

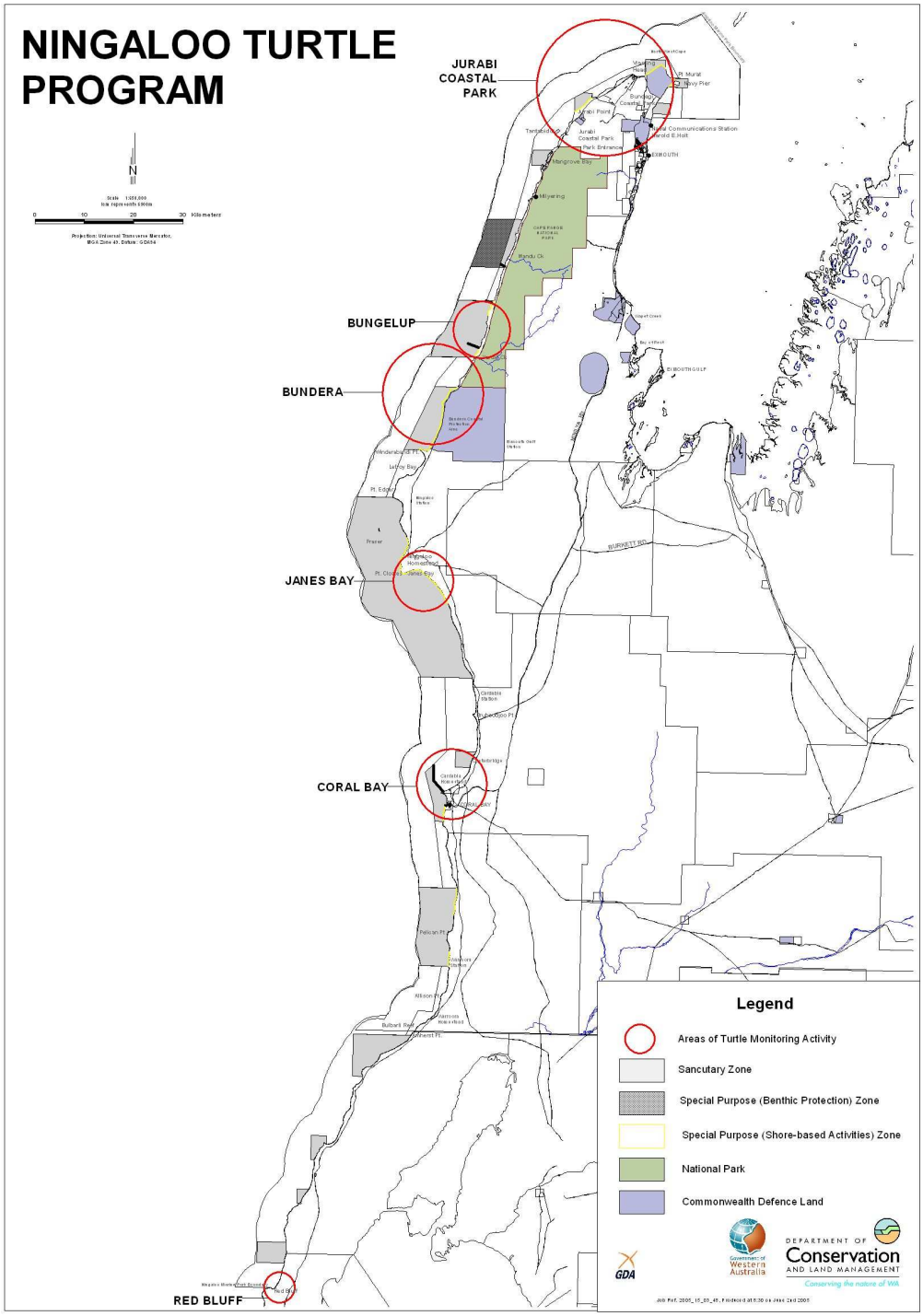



**Figure 7: Area of monitoring activities in the Ningaloo region.**

These sections were defined, divided into subsections (see Figure 8 and Appendix 11.2) and have been monitored for three consecutive seasons. Beaches were divided up predominantly based on pragmatic considerations such as geographical barriers that separate beaches, the location of carparks and the time required to monitor a section of beach.

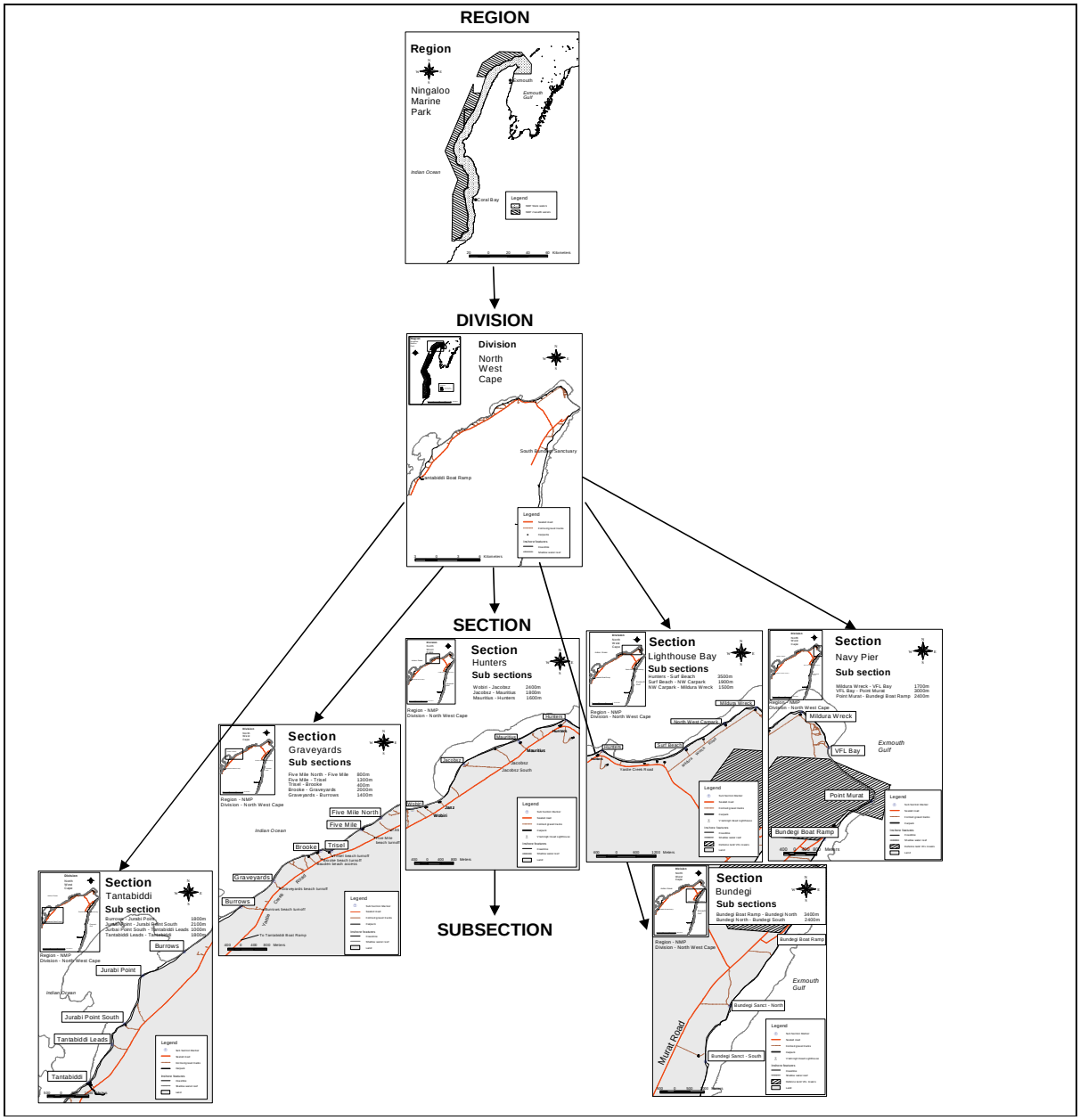



**Figure 8: Sections and Subsections of the North West Cape Division**

Volunteers were rostered for each morning and allocated sections of beach to be monitored based on the number of volunteers and vehicle availability. Volunteers were required to meet at a central nominated location each morning for a briefing session from a team leader.

Once at the designated Section, competent volunteers followed the standard monitoring methodology as per the field manual to collect data. Once sections had been completed, volunteers returned to Exmouth and submitted monitoring forms to Coordinator for data entry.

***Data entry***
Data is stored on a central Microsoft Access database hosted by the Department of CALM Exmouth District. The database allows for standard queries and the output of report summaries to improve the ease and efficiency of data analysis.

Data was entered under the following categories on data sheets and in the data base. These categories and their definitions are outlined below:

**Species type** – Green (G), Loggerhead (L), Hawksbill (H), Unidentified (U)
**GPS Position** – the longitudinal and latitudinal coordinates for the position of a successful nest only (note: successful nest refers to a successful emergence of adult turtle in laying nets and does not refer to the success of hatchling emergence from nests)
**Fresh/old nest**: Fresh (F), Old (O)
**Position of nests –** Intertidal (I) – nests found in the intertidal zone – high risk of inundation, High (H) – nests found between High tide mark and the edge of vegetation, Edge (E) - nests found between the edge of vegetation and the base of dune, Dune (D) nests found between the base of the dune and beyond.
**Prints** - refers the presence of prints within the vicinity of a successful nest. Prints can be categorised into Fox (F), Human (H), Vehicle (V), Dog (D), Cat (C) and Goanna (G).
**False Crawls (FC**) refers to a non nesting emergence. No GPS coordinates are taken for false crawls.

All data forms are entered into the database, within one week of acquisition.
Data was recorded in sub-sections for the convenience of volunteers; however the results for overall sections for the North West Cape, Bundera, Ningaloo, Coral Bay and Red Bluff Divisions are the focus of this report.

***Data analysis***

***Number of nests for each species***
In order to analyse data and provide results that reflect the nesting success of each subsection, it was important that data for each sub-section was adjusted for effort. A moving average statistical approach was used to fill in the few gaps that existed on sections on the North West Cape. A moving average projects values in the forecast period, based on the average value of nests over a specific number of preceding and subsequent periods. A moving average provides trend information useful for temporal distributions that a simple average of all historical data would mask.

When considering the spatial distribution of successful turtle nests some subsections with low effort were compared relative to other subsections using a nests per week average. A t-test comparing a random sample mean to total mean was conducted on known data to validate this method and averaging to a weekly period can be conducted with a 95% confidence interval. This method allows an indication of the relative significance of a geographical area and can be used to demonstrate low nesting activity areas.

Some sections along the southern region of the Ningaloo Coast in the Red Bluff division were monitored for intermittent time periods and with inconsistent effort. This information is presented as a total number of nests recorded. No valid comparisons can be made using this data however total number of nests can be indicative of nesting activity in a particular area.

***Nesting Success (Percentage of successful nests of total emergence)***
To determine the nesting ratios, successful emergences to false crawls, a percentage was used which was calculated based on the number of days monitored and the number of false crawls to successful nests of non-adjusted data. This provided ratios of successful nests to false crawls. **% Nesting success = successful emergences/total emergences x 100**

**Abbreviations and definitions for the purposes of this report:**

**G** = Green
**L** = Loggerhead
**H** = Hawksbill
**U** = Unidentified/unknown
**Successful nest**: an emergence that has resulted in a nest
**False crawl**: an emergence that has not resulted in a nest
**Successful nesting**: the number of successful nests as a percentage of total emergences
**Effort:** the number of days or percentage of days monitored throughout the duration of the program
**Actual disturbance:** Nests that show evidence of physical disturbance
**Potential disturbance:** areas that exhibit evidence of potential disturbances such as the presence of fox and human prints around nests, not necessarily physically disturbed.

**Table 1: Turtle Monitoring season dates for 2002/2003, 2003/2004, 2004/2005**

**2002/2003 Turtle Monitoring Season**

| Week 1 | Week 2 | Week 3 | Week 4 | Week 5 | Week 6 | Week 7 | Week 8 | Week 9 | Week 10 | Week 11 | Week 12 | Week 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2/12/02<br>8/12/02 | 9/12/02<br>15/12/02 | 16/12/02<br>22/12/02 | 23/12/02<br>29/12/02 | 30/12/02<br>5/1/03 | 6/1/03<br>12/1/03 | 13/1/03<br>19/1/03 | 20/1/03<br>26/1/03 | 27/1/03<br>2/2/03 | 3/2/03<br>9/2/03 | 10/2/03<br>16/2/03 | 17/2/03<br>23/2/03 | 24/2/03<br>28/2/03 |

**2003/2004 Turtle Monitoring Season**

| Week 1 | Week 2 | Week 3 | Week 4 | Week 5 | Week 6 | Week 7 | Week 8 | Week 9 | Wee k 10 | Week 11 | Week 12 | Week 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/12/03<br>7/12/03 | 8/12/03<br>14/12/03 | 15/12/03<br>21/12/03 | 22/12/03<br>28/12/03 | 29/12/03<br>4/1/04 | 5/1/04<br>11/1/04 | 12/1/04<br>18/1/04 | 19/1/04<br>25/1/04 | 26/1/04<br>1/2/04 | 2/2/04<br>8/2/04 | 9/2/04<br>16//2/04 | 17/2/04<br>23/2/04 | 24/2/04<br>29/2/04 |

**2004/2005 Turtle Monitoring Season**

| Week 1 | Week 2 | Week 3 | Week 4 | Week 5 | Week 6 | Week 7 | Week 8 | Week 9 | Week 10 | Week 11 | Week 12 | Week 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29/11/04<br>5/12/04 | 6/12/04<br>12/12/04 | 13/12/04<br>19/12/04 | 20/12/04<br>26/12/04 | 27/12/04<br>2/1/05 | 3/1/05<br>9/1/05 | 10/1/05<br>16/1/05 | 17/1/05<br>23/1/05 | 24/1/05<br>30/1/05 | 31/1/05<br>6/2/05 | 7/2/05<br>13/2/05 | 14/2/05<br>20/2/05 | 21/2/05<br>28/2/05 |

## 2.2 Results

### 1. The abundance of turtle nesting activities on specific sections of beach and the relative significance of specific sections to each species of turtle.

The Ningaloo Community Turtle Monitoring Program has been conducted over three successive turtle nesting seasons from 2002 to 2005. Turtle monitoring occurs from December to February each year. Using community groups in identified areas, together with available resources and volunteers during each turtle nesting season, several previously identified areas of the Ningaloo region have been monitored to determine their significance as turtle nesting rookeries.

***North West Cape Division***

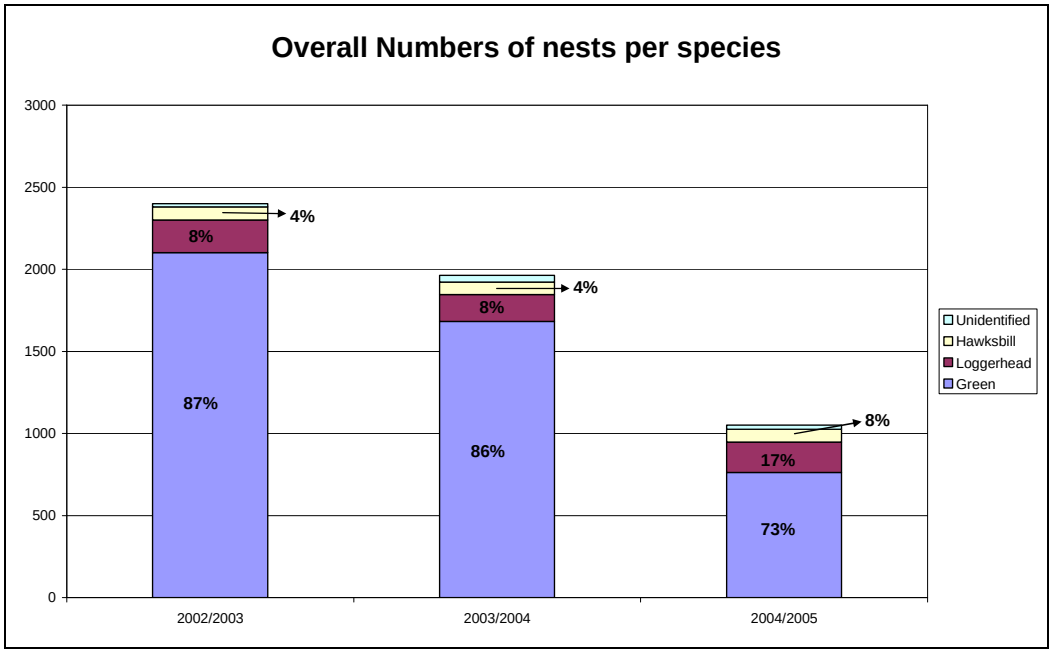



**Figure 9: Overall Number of nests per species for North West Cape Division**

Figure 9 indicates the overall nest numbers for all three species of turtles over the past three monitoring seasons for Lighthouse, Hunters and Graveyards sections in the North West Cape Division.

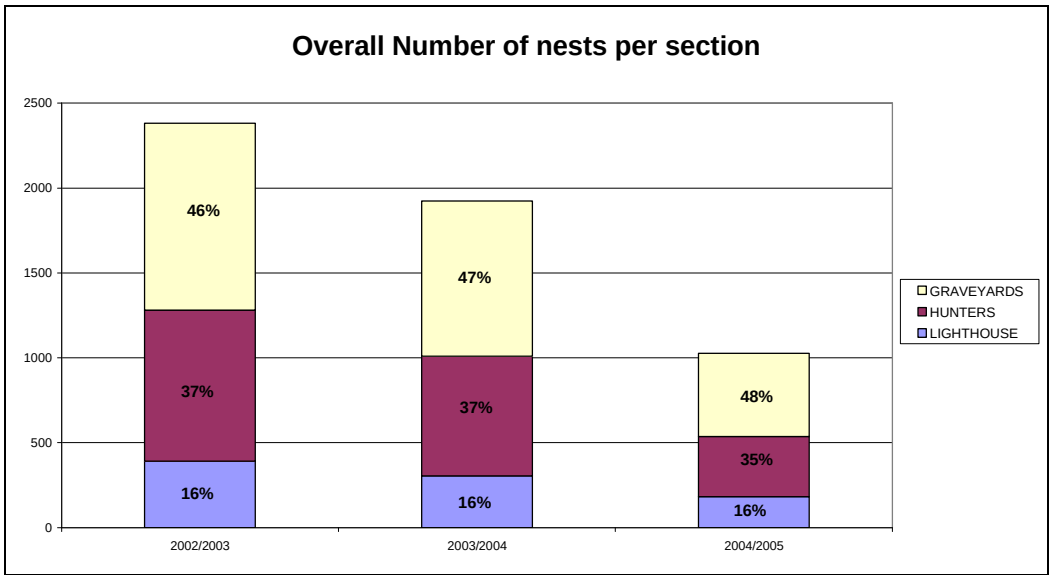



**Figure 10: Overall Numbers of nests per section for North West Cape Division**

Figure 10 indicates the overall nest numbers for all three species of turtles in the identified sections of Graveyards, Hunters and Lighthouse sections over the past three monitoring seasons. The ratio of abundance in each section remains consistent over three years irrespective of the decreasing abundance of successful nests.

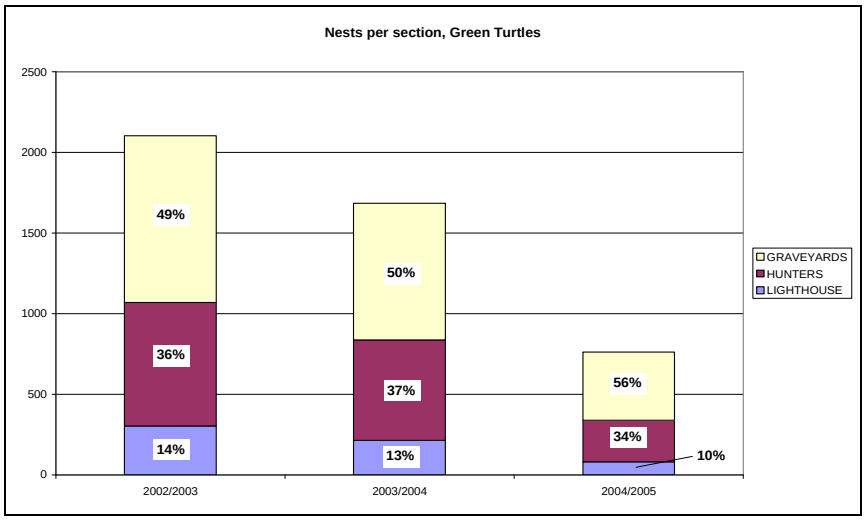



**Figure 11: Nest Numbers per section for Green Turtles**

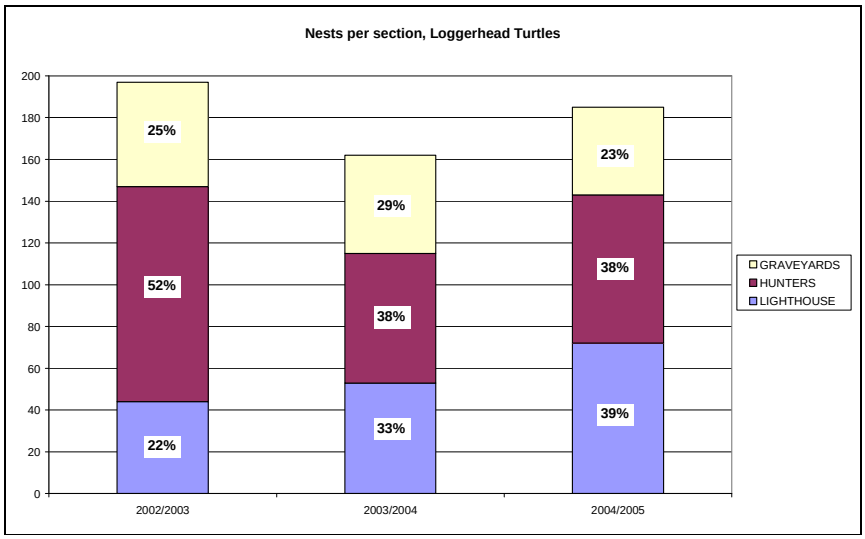



**Figure 12: Nest Numbers per section for Loggerhead turtles.**

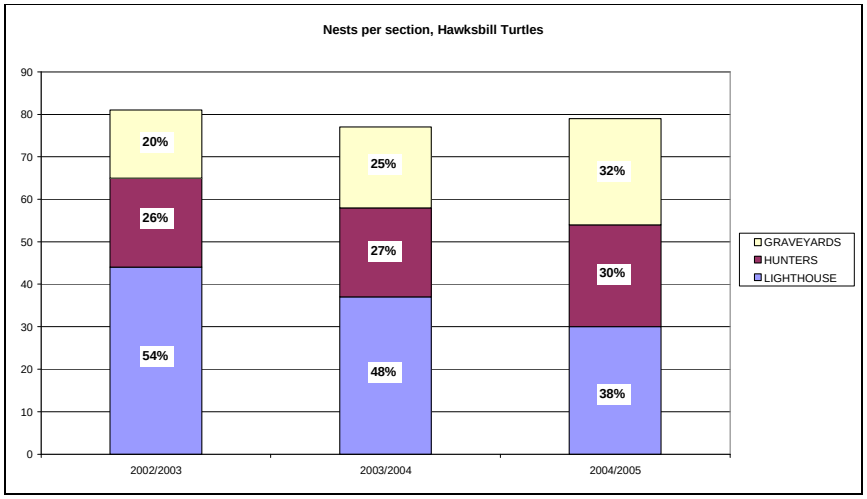



**Figure 13: Nest Numbers per section for Hawksbill Turtles.**

Figure 11, to Figure 13 indicate the abundance of nests in each section for the individual species of turtle. Graveyards section is significant to Green turtles with around 50% of green turtle nests are laid in this section. 40 -50 % of Loggerhead nests were located in Hunters section while Lighthouse Bay appears to be significant to Hawksbill turtles. All three species of turtles are found to nest on the three identified sections of the North West Cape Division.

Sections were monitored from Lighthouse to Tantabiddi (see Figure 8) in season 2002/2003 to establish the significance of the Tantabiddi section. Figure 14 demonstrates the number of nests per week based on collected data from the subsections.

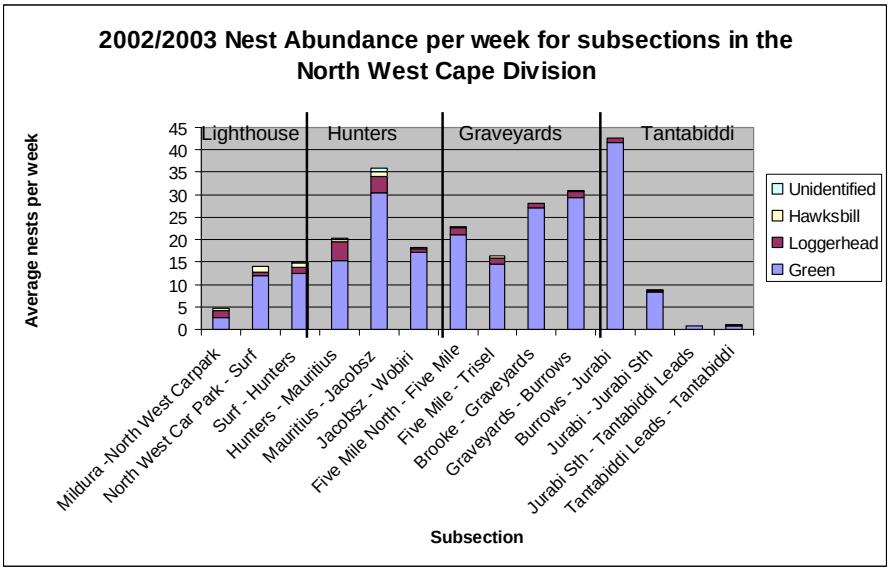



**Figure 14: 2002/2003 Nest Abundance per week for subsections in the North West Cape Division.**

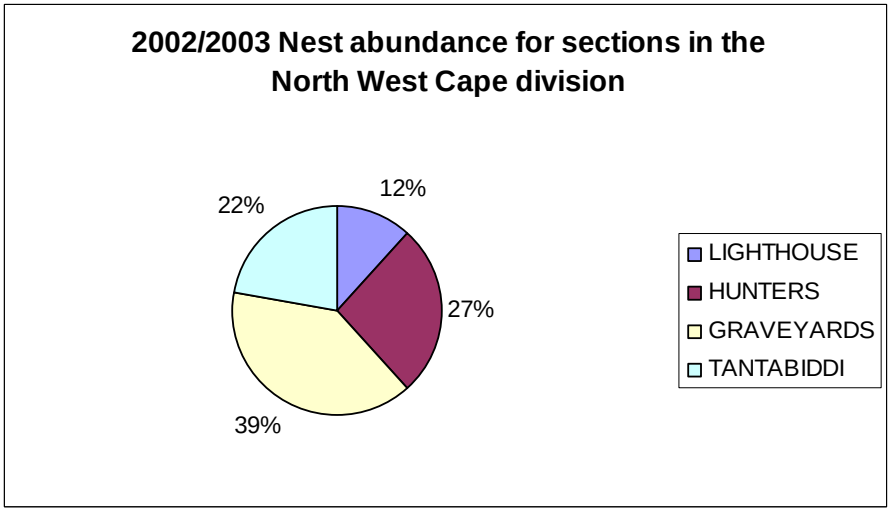



**Figure 15: 2002/2003 Nest Abundance for sections in the North West Cape**

These results indicate low abundance of nests in the Jurabi South to Tantabiddi Leads and Tantabiddi Leads to Tantabiddi subsections, however there is a significant abundance of nests in the Burrows to Jurabi Pt subsection. Figure 15 reflects the abundance of Burrows to Jurabi Pt. subsection by showing the Tantabiddi section accounting for 22% of successful nests in 2003/2004.

Sections were monitored from Navy Pier to Graveyards (see Figure 8) in season 2003/2004 to establish the significance of the Navy pier section for nesting turtles.
Figure 16 shows the number of nests per week based on collected data from the subsections.

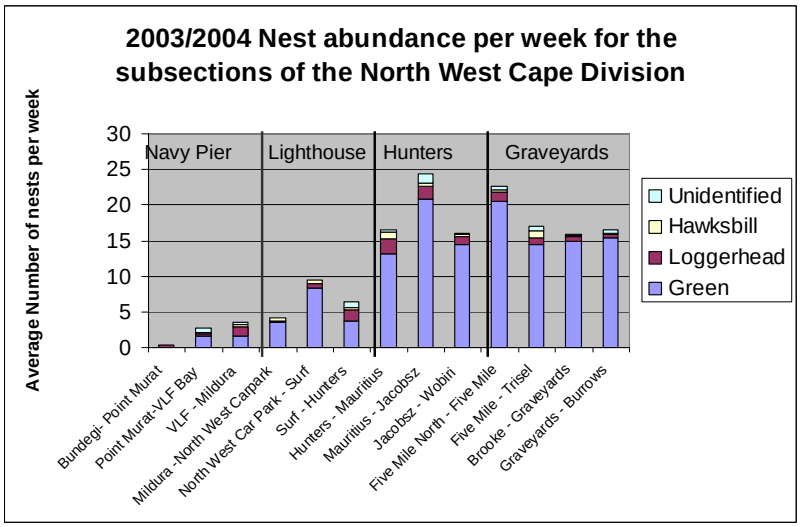



**Figure 16: 2003/2004 nest abundance per week for the subsections of the North West Cape**

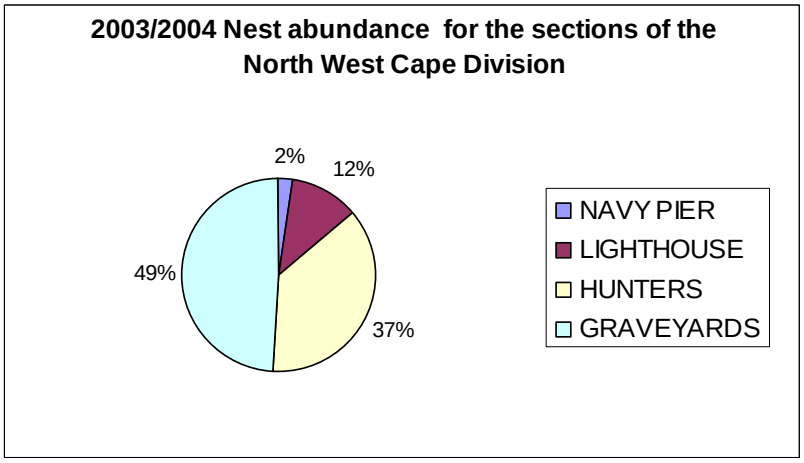



**Figure 17 : 2003/2004 Nest abundance for the sections of the North West Cape.**

These results indicate low abundance of nests in the Navy Pier section. Figure 17 demonstrates that 2% of nests in 2003/2004 were located in the Navy pier section in comparison to 12% in Lighthouse, 37% in Hunters and 49% in Graveyards sections. The Navy Pier section was insignificant compared to other sections monitored in the North West Cape Division.

***Determining an index beach section to monitor overall turtle activity on the North West Cape.***

To further refine the monitoring program to conserve resources such as, numbers of volunteers and vehicles used, in the future and still gain valid information on overall trends, the data can be analysed to determine on which sections peak nesting activity occurs. Over three years of data, the ratio in nesting abundance in each section has remained relatively similar. (See Figure 8) If it is assumed that the abundance ratios will remain relatively constant in all of the sections, (See Figure 18) an overall ratio can be obtained for each section (see Figure 19). 39% of nesting activity occurs in Graveyards section and 28% in Hunters section with a combined ratio of 67% of the nesting abundance. Graveyards and Hunters sections can be described as index beaches for turtle nesting activity on the North West Cape.

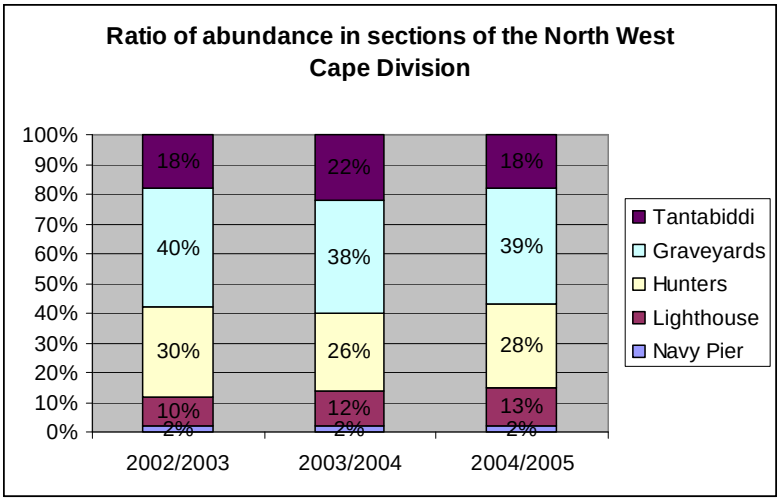



**Figure 18: Ratio of Nest Abundance in the North West Cape Division**

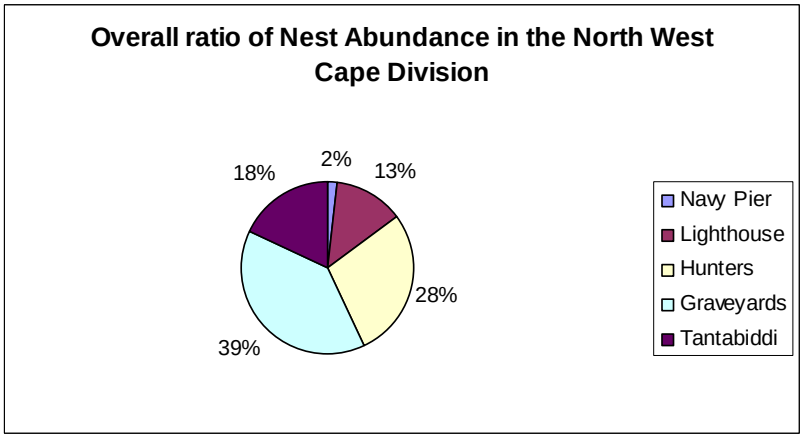



**Figure 19: Overall ratio of nest Abundance in the North West Cape Division**

However given the reduced effort in earlier years, it is recommended that a further 13 week season be monitored to improve the confidence in the ratios these index beaches represent.

***Bundera Division***

The Bundera and Bungelup areas on the Ningaloo coast (see Figure 7) had been identified as an indicative turtle nesting rookery for loggerhead turtles on the mainland coast of North Western Australia. This is based on anecdotal reports and short monitoring surveys conducted in January 2004. These sections were identified and marked relative to access points and were monitored as the Bundera Division (see Appendix 11.3) in season 2004/2005 to establish the significance of this area for nesting turtles.

Figure 20 shows the number of nests per week based on collected data from the subsections and indicates the prevalence of loggerhead turtles nesting in these sections. Figure 21 indicates that the Bungelup section accounts for 70% of nests in the Bundera Division.

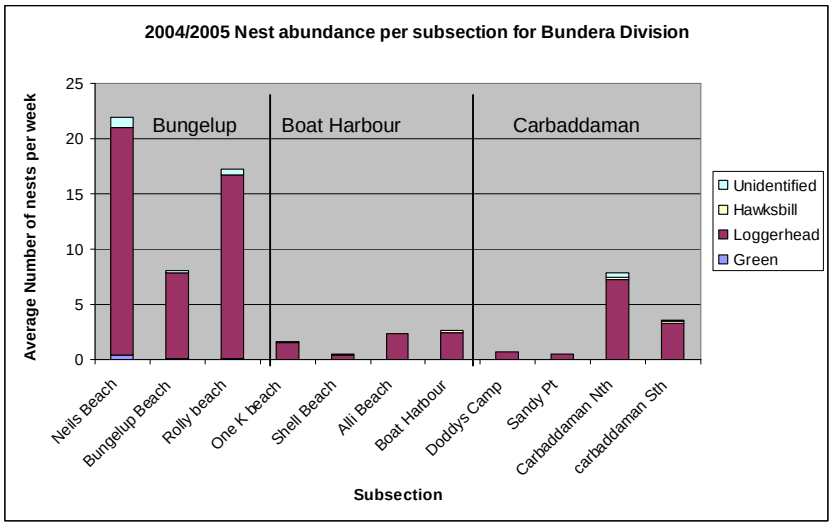



**Figure 20: 2004/2005 Nest abundance per subsection for Bundera Division**

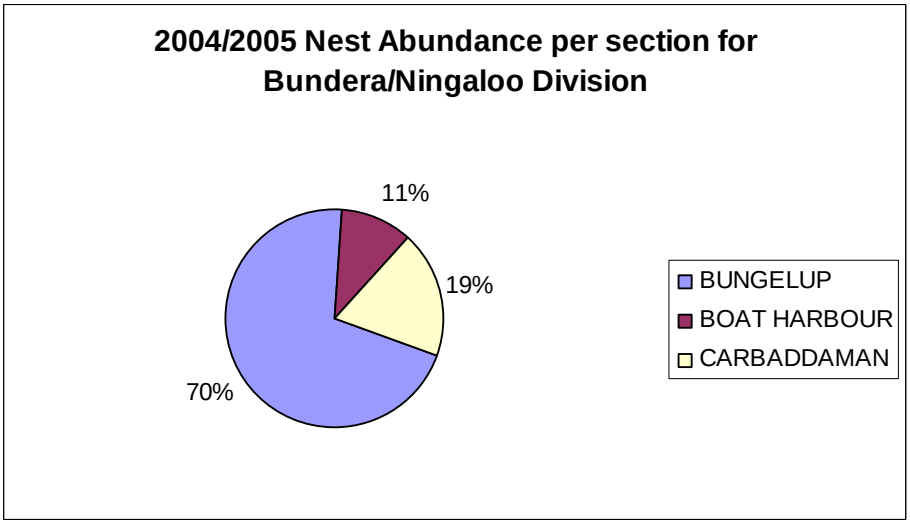



**Figure 21: 2004/2005 Nest abundance per section for Bundera Division.**

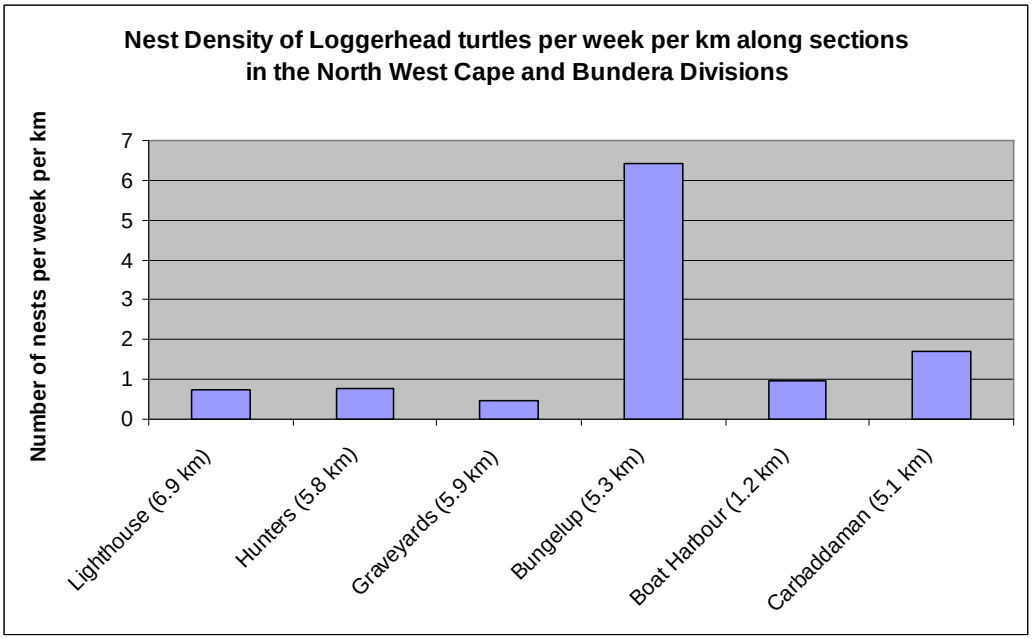



**Figure 22: 2004/2004 Nest Density of Loggerhead Turtles in the North West Cape Division compared to Bundera Division.**

Figure 22 indicates the density of loggerhead nests per km of beach monitored. These results indicate that Bungelup section, which is similar in length to sections in the North West Cape Division, is a significant turtle nesting rookery for loggerhead turtles and the density of loggerhead nests at Bungelup is far greater than the density of loggerhead nests found in Lighthouse, Hunters and Graveyards sections.

***Coral Bay Division***

The Bateman's Bay section of the Ningaloo Coast (Appendix 11.5) is close to the Coral Bay settlement. It has been monitored over three consecutive turtle seasons prompted by historical evidence of turtle nesting activity in the area (Mack 2003). Figure 23 demonstrates the number of nests from the data collected over three turtle nesting seasons.

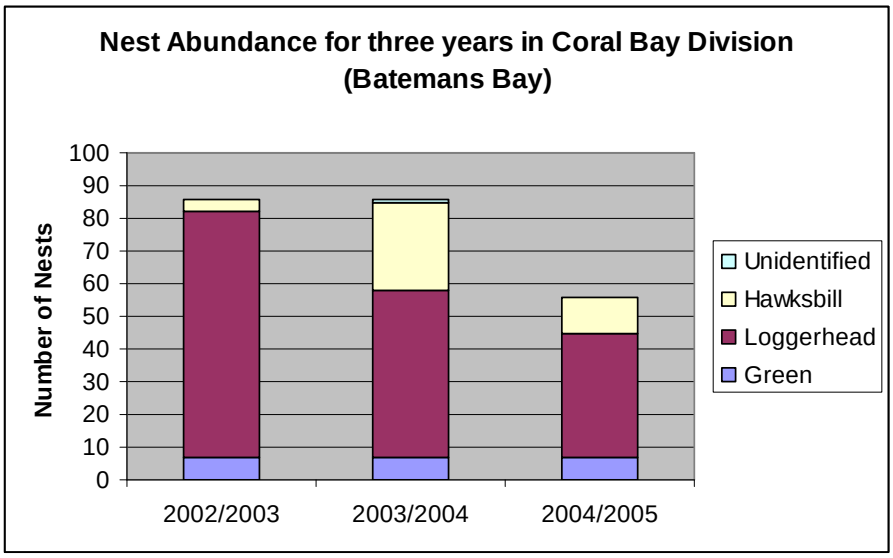



**Figure 23: Number of nests over three years in the Coral Bay Division (Batemans Bay)**

***Red Bluff Division***

The Red Bluff section on the Ningaloo coast (see Figure 7) has been identified as possible turtle nesting rookeries for turtles. This is based on anecdotal reports by long term residents in the area. The 300 metre section of beach (See Appendix 11.6) was monitored in 2003/2004 for 15 days out of 90. The total number of nests recorded in this period is recorded in Figure 24. Anecdotal evidence from 2004/2005 suggests a similar pattern however further data is not available for comparison. Trends cannot be detected due to the limited effort however; the total number of nests recorded during these surveys is presented.

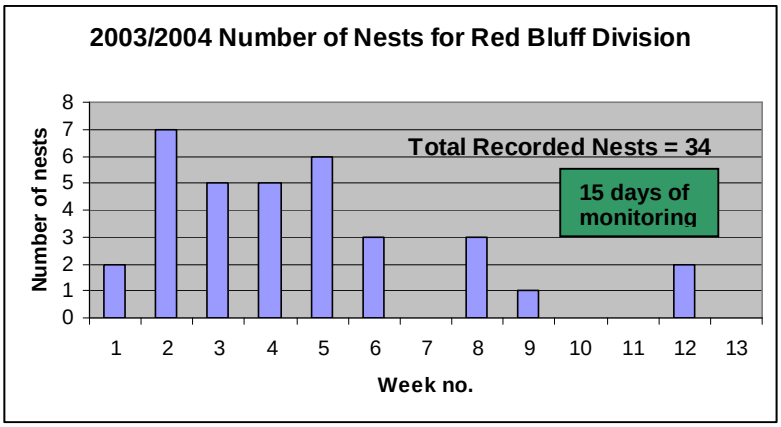



**Figure 24: Number of Nests recorded at Red Bluff during 2003/2004**

***Ningaloo Division***

Janes Bay adjacent to Ningaloo Station (Figure 7 and Appendix 11.4) was identified by the aerial surveys (Figure 6) as a possibly a significant turtle rookery along the Ningaloo Coast. This area has been monitored intermittently over three turtle seasons due to limited resources along this isolated section of the coast. The results of these surveys can be used as an indication of the relative significance of this turtle rookery for turtles compared to other sections along this coast (Figure 25).

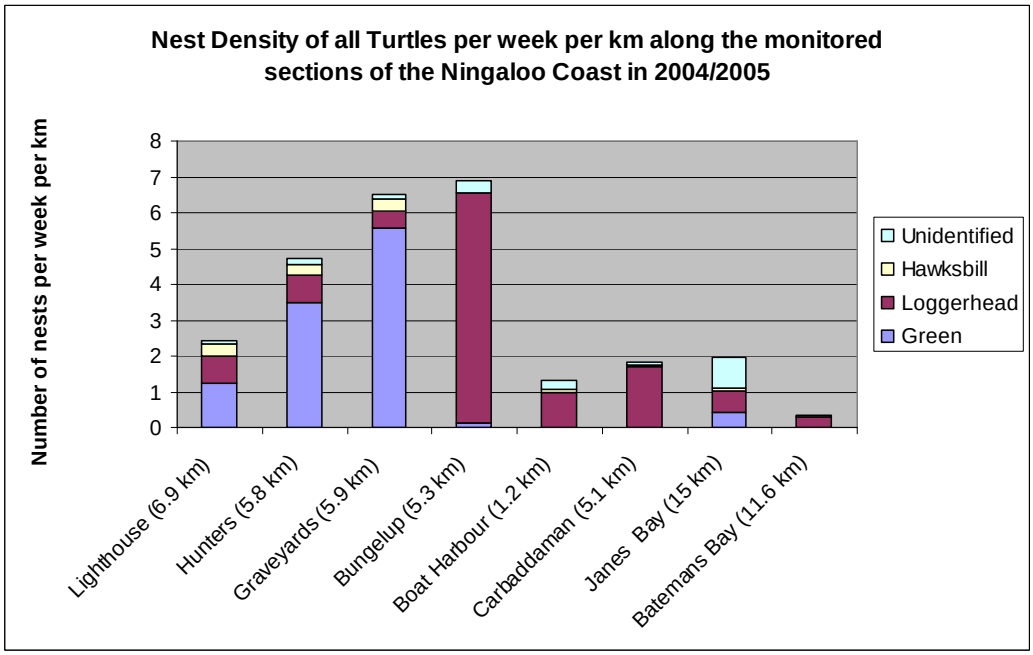



**Figure 25: Nest Density of all turtles per week per km along the monitored sections of the Ningaloo Coast in 2004/2005**

## 2. The abundance of turtle nesting activities over specified time intervals

***North West Cape Division***

The Ningaloo Community Turtle Monitoring Program has been conducted over three successive turtle nesting seasons including 2002/2003, 2003/2004, and 2004/2005. Using available resources and volunteers several areas of the Ningaloo region have been monitored relatively consistently over a 13 week time period from the start of December to the end of February to determine peak nesting periods for all three species of marine turtles.

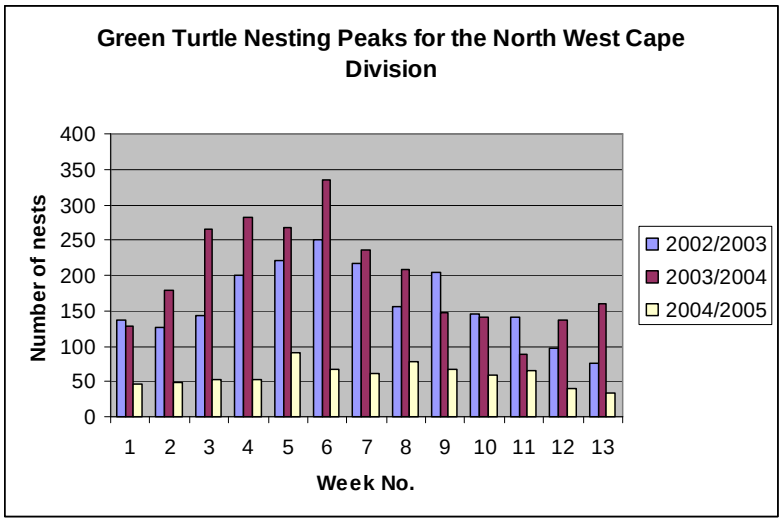



**Figure 26: Green turtle nesting peaks for the North West Cape Division**

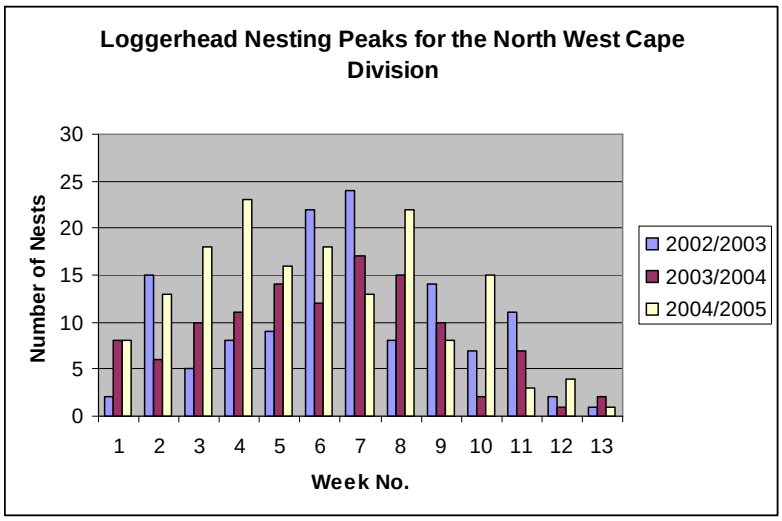



**Figure 27: Loggerhead turtle nesting peaks for the North West Cape Division**

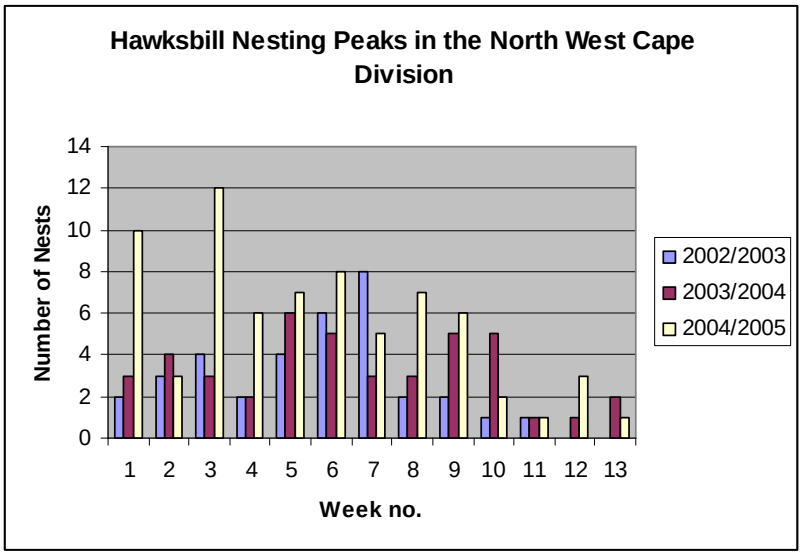



**Figure 28: Hawksbill turtle nesting peaks for the North West Cape Division**

Figure 26 to Figure 28 indicate the nesting peaks for each species over three years. The numbers of nests for loggerhead and hawksbill turtles are insufficient to detect any trends in peak nesting periods.

Green turtle nesting patterns do appear to follow a normal distribution over the study period (See Figure 29). Green turtle nesting peaks can be recognised over the three years to be fairly consistent irrespective of a decrease in overall numbers of nests.

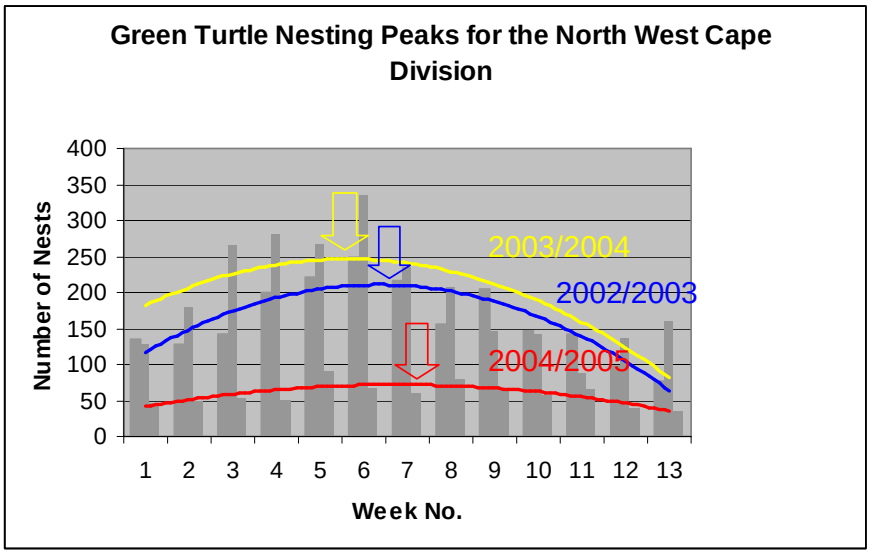



**Figure 29: Green Turtle Nesting Peaks for the North West Cape Division**

Sections were monitored over a 20 week period from November to March in season 2002/2003 in the Hunters section and in 2003/2004 in Graveyards section. This data can be analysed to establish that peak nesting periods are found in the 13 week period.

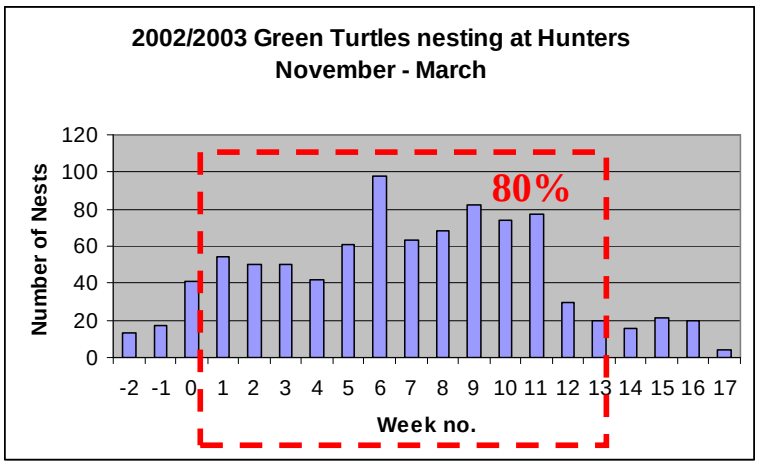



**Figure 30: 2002/2003 Green Turtles nesting at Hunters. November-March**

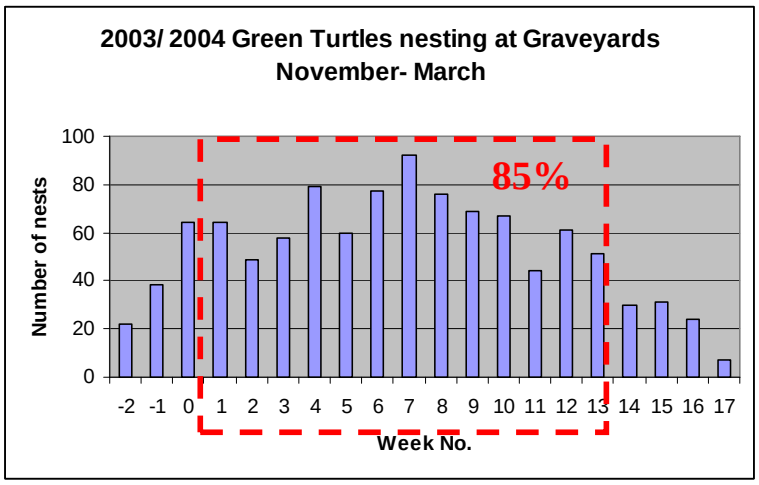



**Figure 31: 2003/2004 Green Turtles nesting at Graveyards. November –March**

Figure 30 demonstrates that 80% of all green turtle nests at Hunters section in 2002/2003 were recorded in the 13 week period from the start of December to the end of February. Figure 31 demonstrates that 85% of all green turtle nests at Graveyards section in 2003/2004 were recorded in the 13 week period from the start of December to the end of February.

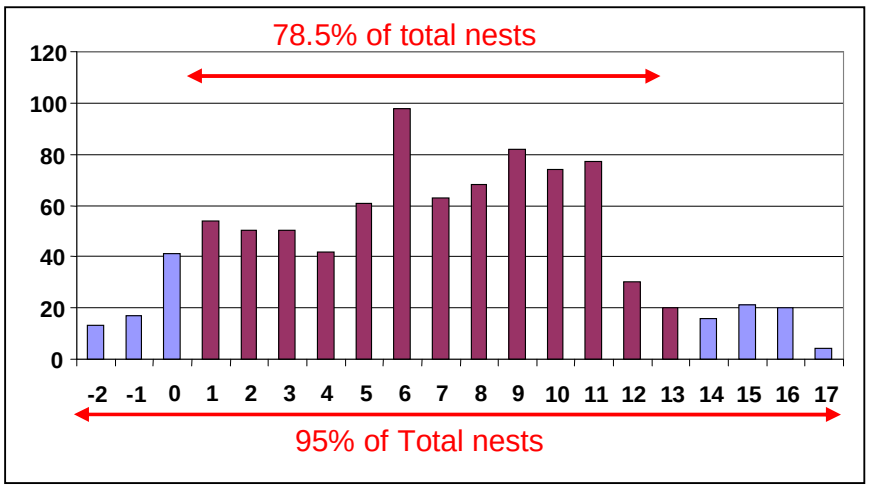



**Figure 32: Percentage of Nests in 13 week period**

Assuming a normal distribution of nests over the whole year, 95 % of all successful nests in the North West Cape Section occur in the 20 week period between the months of November to March, and 82.5% of monitored nests occur in the 13 week period, then 78.5% of total nests are observed from December to February.

***Determining an index time period to monitor overall turtle activity on the North West Cape***

To further refine the monitoring time period to conserve resources in the future and still gain valid information on overall trends, the data was analysed to determine when approximately 50 % of the nesting activity is occurring. Assuming a normal distribution of nests over time, 95% of all nests occur in the 20 week period and 78.5% (Figure 32) of total nests are observed in a 13 week period, several trials using different time scales and different time periods have been applied to the data. (See Figure 33, to Figure 36 )

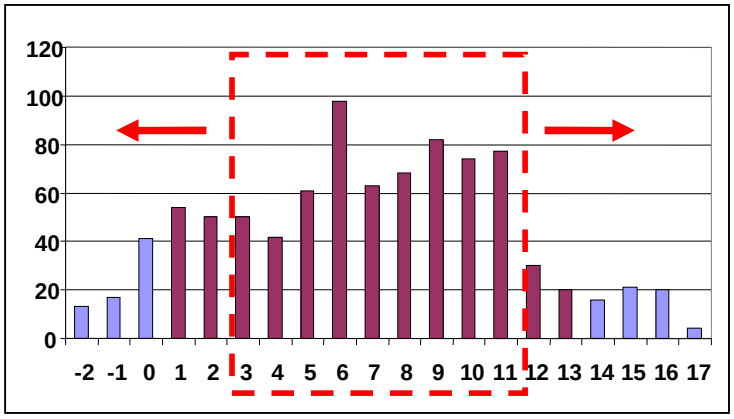



**Figure 33: Trial and Error with different lengths and starting dates**

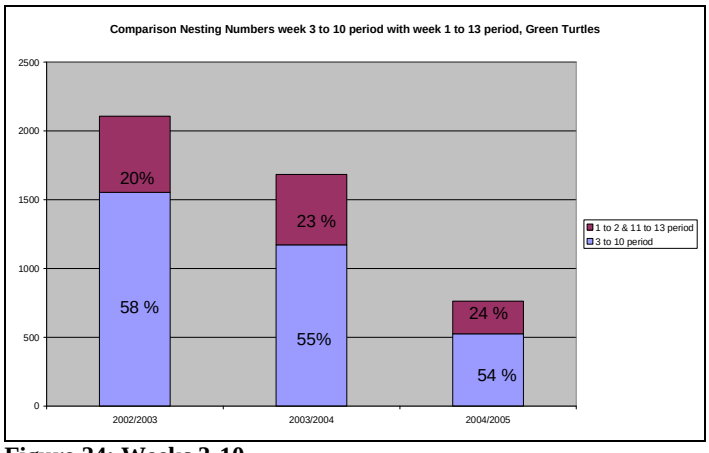



**Figure 34: Weeks 3-10**

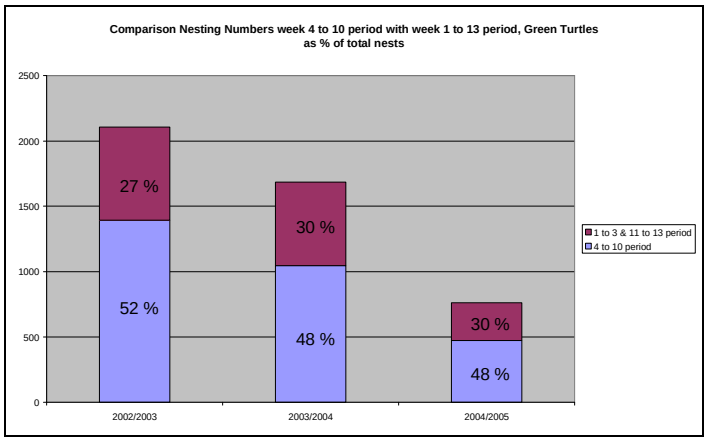



**Figure 35: Week 4-10**

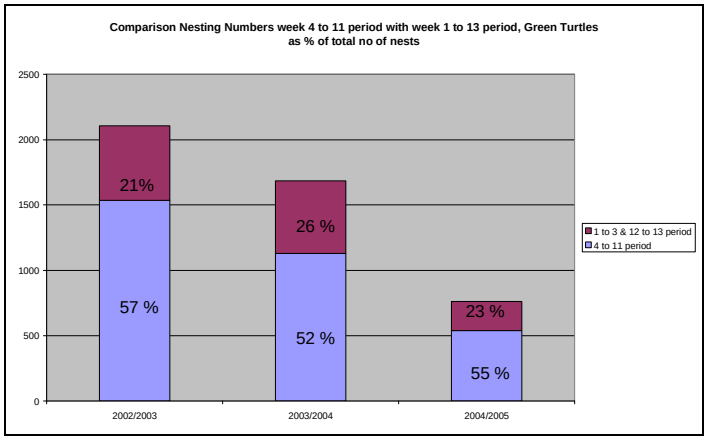



**Figure 36: Week 4-11**

From Figure 34, to Figure 36 it can be seen that:

- Weeks 3 to 10 covers 56 ± 2% of total nests
- Weeks 4 to 11 covers 55 ± 2.5% of total nests
- Weeks 4 to 10 covers 50 ± 2% of total nests

Thus an 8 week index time period monitoring will yield a range of between 48-58% of total nests. Moving the 8 week window by a week either way has little impact on monitored numbers.
However given the reduced effort in earlier years, it is recommended that a further 13 week season be monitored to improve the confidence in the ratio this index time period represents.

***Bundera Division***

Data from the Bundera Division in season 2004/2005 was analysed to establish the peak nesting period for nesting turtles in the division. Due to logistical and training constraints monitoring was conducted over an 8 week period from the 17$^{th}$ of December to the 9$^{th}$ of February.

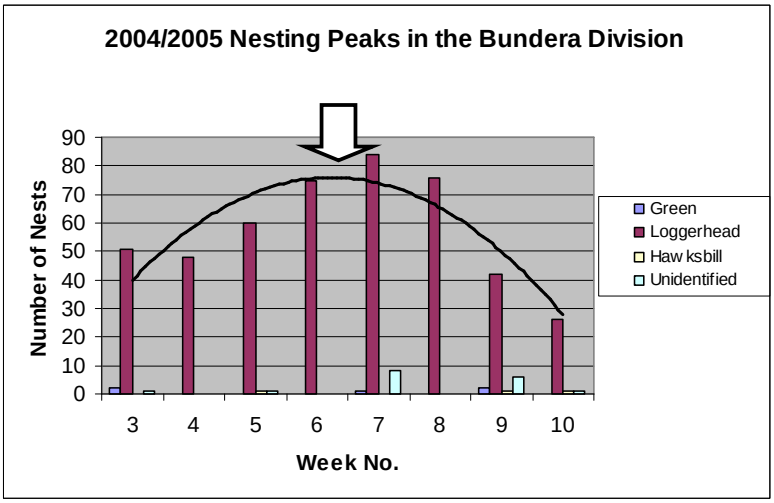



**Figure 37: 2004/2005 Nesting Peaks in the Bundera Division**

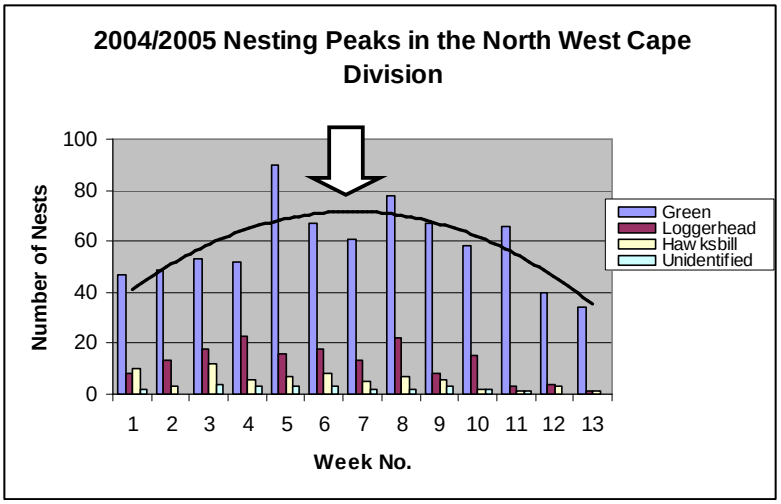



**Figure 38: 2004/2005 Nesting Peaks in the North West Cape Division**

The nesting trendline appears to indicate that the peak occurs in Week 6-7 in the Bundera Division. (See Figure 37) This is consistent with nesting peaks in the North West Cape Division. (See Figure 38)

***Coral Bay Division***

Data from the Coral Bay Division was analysed to establish the peak nesting period for nesting turtles in the division. Loggerhead turtle nests were used as an indicator of temporal distribution due to the fact that this species is the most abundant in the Coral Bay Division (See Figure 23). Figure 39 indicates low weekly nesting numbers providing insufficient information to indicate overall peak nesting times.

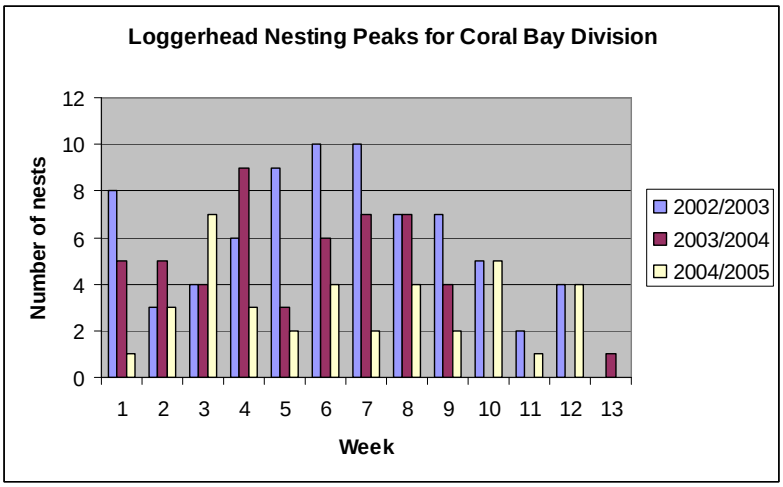



**Figure 39: Loggerhead Turtle nesting peaks for the Coral Bay Division.**

## 3. Nesting Success

*North West Cape Division*

The high numbers of green turtles nesting in this division (see Figure 9) allows an analysis of nesting success (ratio of successful nests to false crawls) over weeks for the three years of data (see Figure 40, to Figure 42).

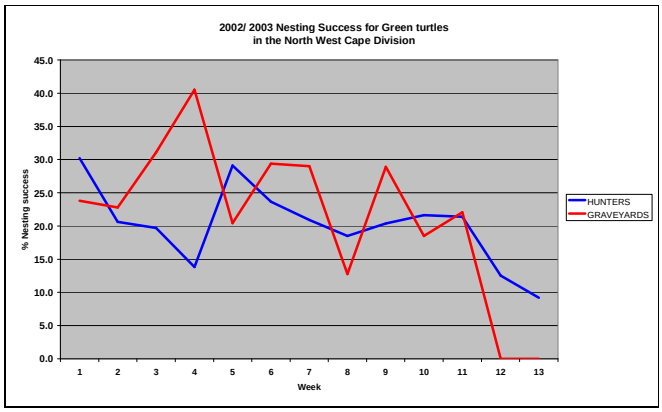



**Figure 40: 2002/2003 Nesting success for Green turtles**

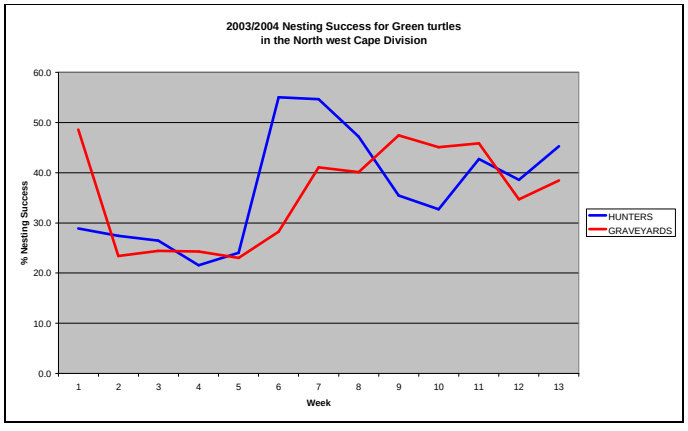



**Figure 41: 2003/2004 Nesting success for Green turtles**

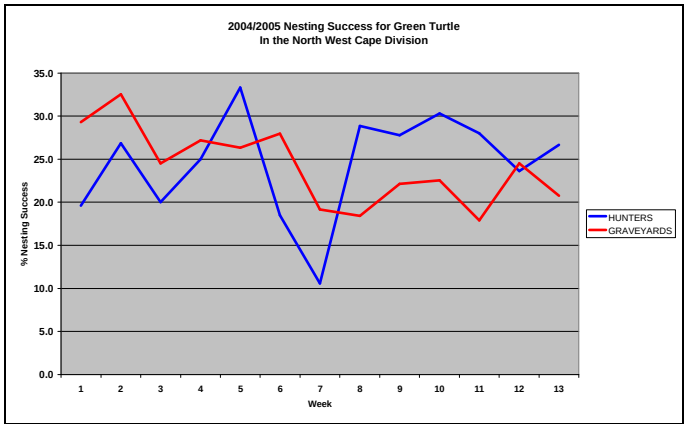



**Figure 42: 2004/2005 Nesting success for Green turtles**

### *Bundera Division*

Sections were monitored in the Bundera Division in season 2004/2005 to establish the significance of this area for nesting turtles. The high density of loggerhead turtles nesting in this division (see Figure 22) allowed an analysis of nesting success over the 8 weeks of data (see Figure 43).

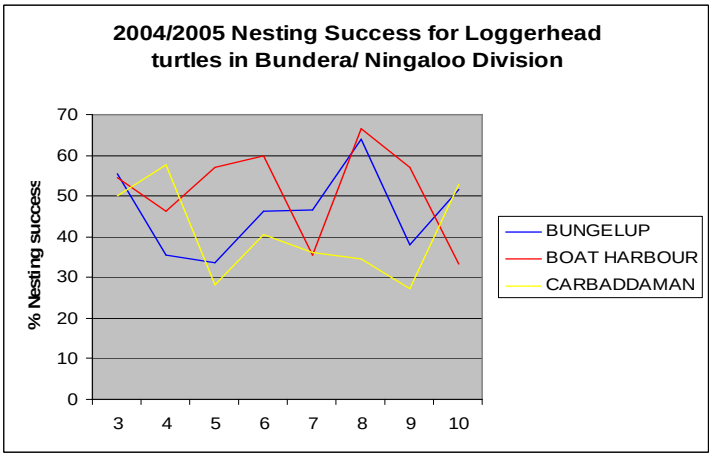



**Figure 43: 2004/2005 Nesting Success for Loggerhead Turtles in the Bundera Division.**

## 4. The level of presence and predation by the European fox *(Vulpes vulpes)*

Predation of sea turtle eggs and hatchlings by the European red fox *(Vulpes vulpes)* has been identified by the Department of Environment and Heritage in their *Recovery Plan for Marine Turtles of Australia*, as being a key threat to the recovery of threatened turtle populations. This has been noted by anecdotal evidence of fox predation on turtle nests and hatchlings on the North West Cape from as early as the late 1970's (Kinnear, 1995) and in the early 1990's (Mack, 2003).

### *North West Cape Division*

Foxes have been recorded in all sections of the North West Cape division over the three turtle nesting seasons (see Figure 44). Actual fox predation rates are demonstrated in Figure 45.

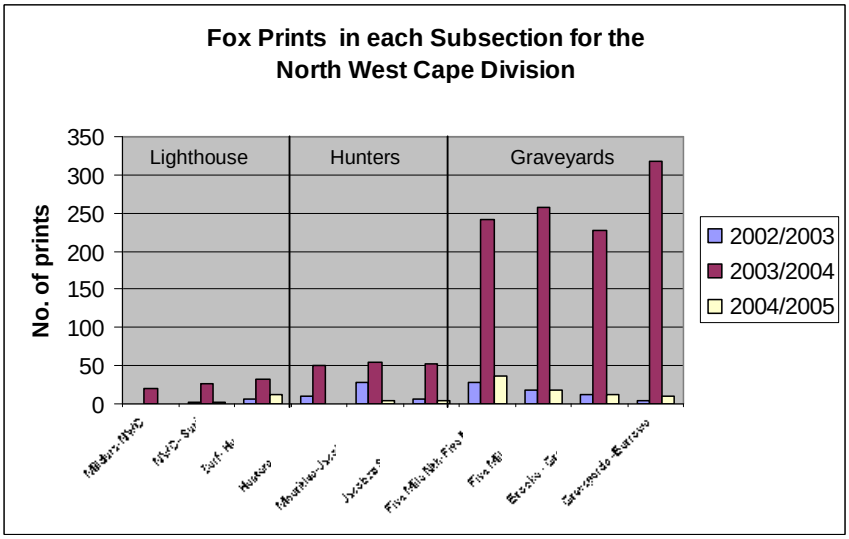



**Figure 44: Fox prints in each subsection of the North West Cape Division**

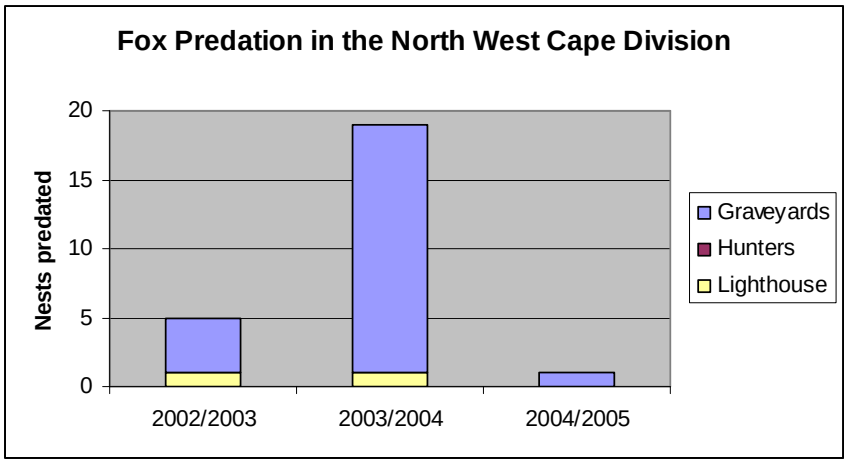



**Figure 45: Fox predation in the North West Cape Division**

A targeted 1080 (sodium fluoroacetate) fox baiting program was introduced on recommendations made from the results obtained in the 2003/2004 nesting season. The baiting program commenced in the beginning of the 2004/2005 nesting season and was located along Five Mile Beach. Figure 46 demonstrates the fox presence on this beach for the three years of monitoring.

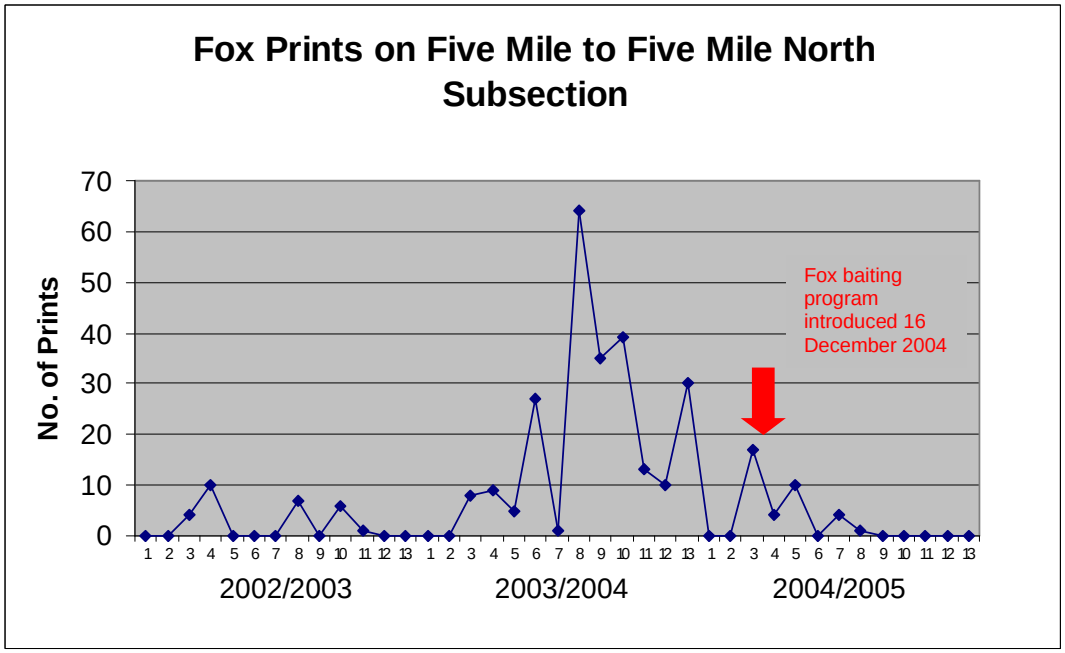



**Figure 46: Fox Prints on Five Mile Beach**

### *Bundera Division*

Sections were monitored in the Bundera Division in season 2004/2005 to establish the presence of foxes along this stretch of coastline. A total of 266 fox tracks were recorded in the Bundera Division with 135 tracks identified in Bundera Coastal Park and 131 tracks recorded in the southern Cape Range National Park in an 8 week period. The number of tracks in individual subsections is recorded in Figure 47. Fox prints were concentrated in areas with high nesting abundance (See Figure 48).

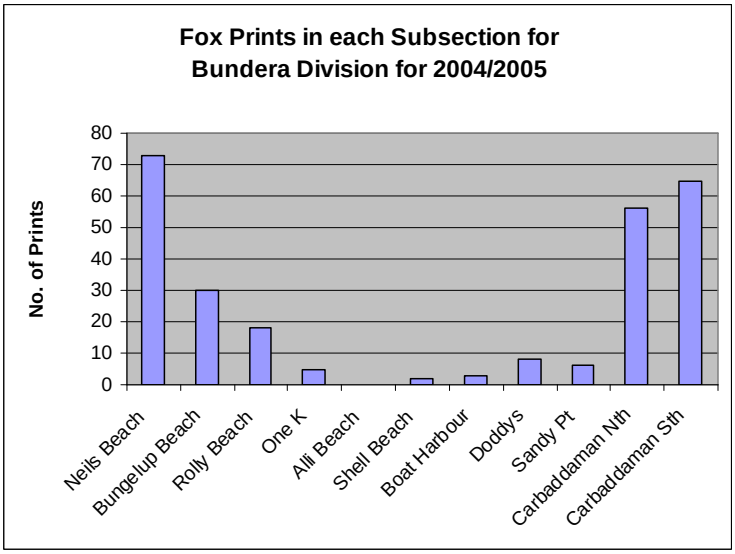



**Figure 47: Fox Prints in Bundera Division for 2004/2005**

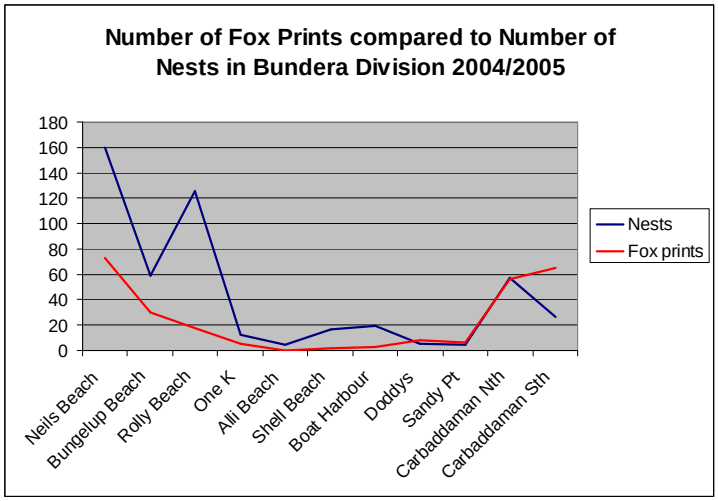



**Figure 48: Number of Fox Prints compared to Number of Nests in Bundera Division 2004/2005**

## *Coral Bay Division*

Sections were monitored in Batemans Bay to establish the presence of foxes along this stretch of coastline. The number of tracks and predated nests observed over three years is recorded in Figure 49. The predation rates of observed nests are displayed in Figure 50. Fox baiting was introduced in Batemans Bay on the 16th of October 2003.

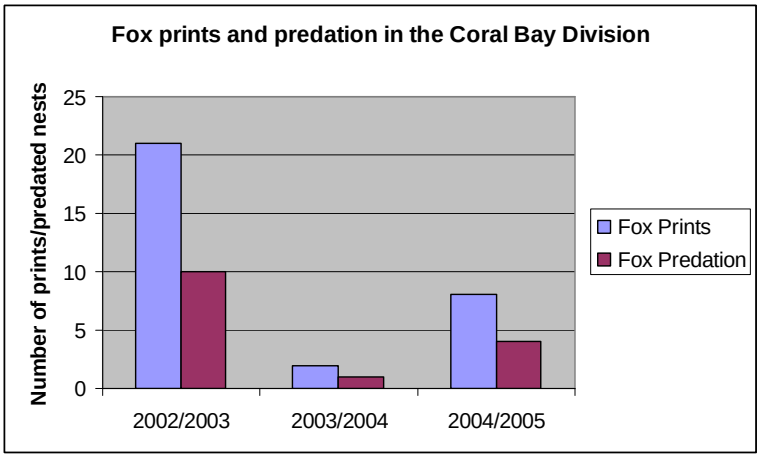



**Figure 49: Fox prints and predation in the Coral Bay Division**

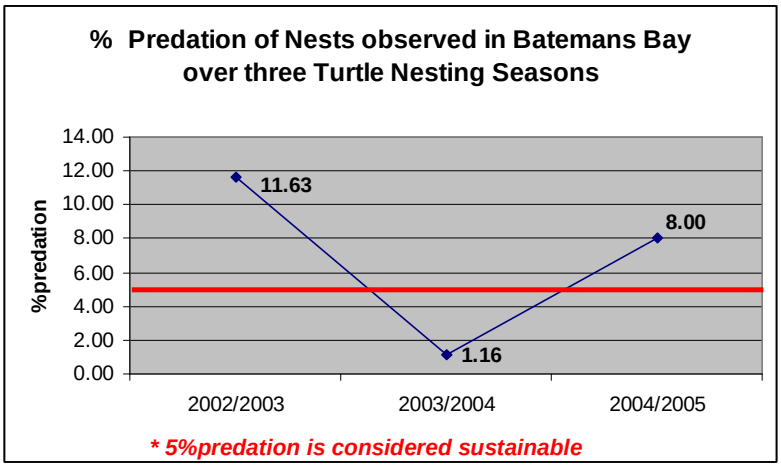



**Figure 50: % Predation of nests observed in Batemans Bay over three Turtle nesting seasons**

### *Ningaloo Division*

Sections were monitored in Janes Bay to establish the presence of foxes in this area. The number of tracks and predated nests observed over three years is recorded in Figure 51. Predation rates can also be expressed as a percentage of observed nests predated per overall nests observed during surveys during each year (See Figure 52). A restricted baiting program was introduced in Janes Bay on the 16th of January 2004.

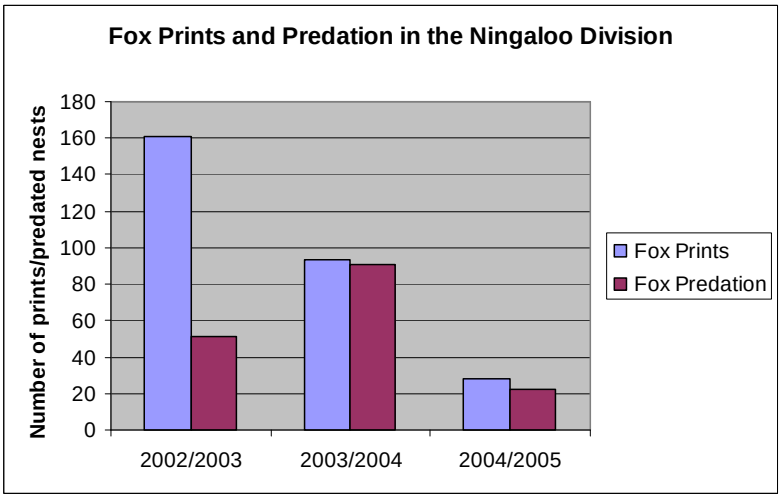



**Figure 51: Fox Prints and Predation in the Ningaloo Division**

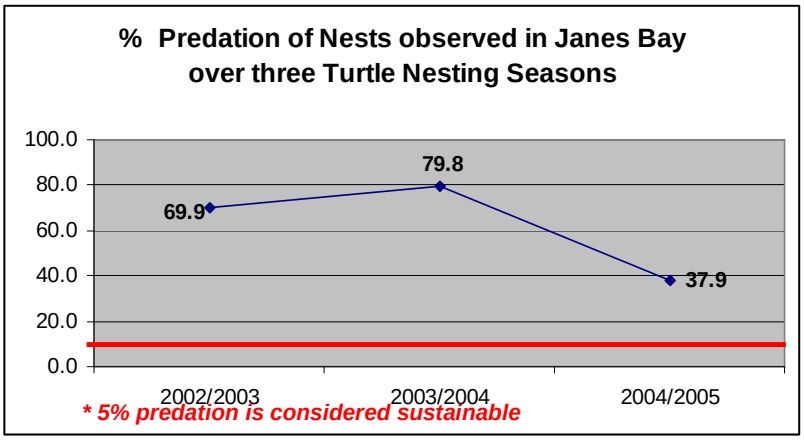



**Figure 52: %Predation of nests observed in Janes Bay.**

## 5. The impacts of human interaction on turtle nesting activity

One of the most significant threats faced by marine turtles on the North West Cape is disturbance during the nesting process by people seeking a turtle viewing opportunity (Osborne 1995, Waayers 2004). The presence of human prints around nests and turtle tracks indicates the potential disturbance that has occurred and the beaches where human interactions may be a problem.

### *North West Cape Division*

The Hunters to Mauritius and Mauritius to Jacobz South subsections are the beaches where potential disturbance to turtles have been identified (see Figure 53).

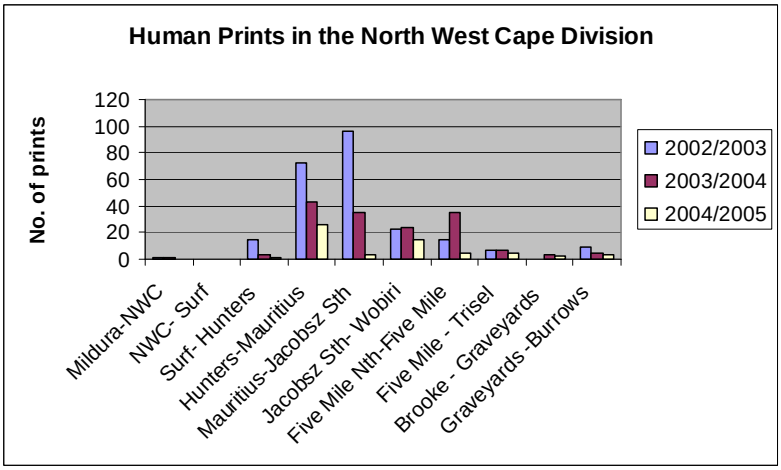



**Figure 53: Human Presence on the subsections of the North West Cape Division**

### *Bundera Division*

There was no potential or physical disturbance from humans to turtle nests recorded in the Bundera Division in season 2004/2005.

## 6. Turtle Rescues

There were 24 successful turtle rescues from stranding in the dunes (see Appendix 11.8) during the 2004/2005 season, 15 rescues in the 2003/2004 season and approximately 10 rescues achieved in the 2002/2003 turtle nesting season.

## 7. Stochastic Events

A "Category 3" cyclone passed within 450km of the North West Cape on the 12$^{th}$ of March 2005. The swell and weather conditions associated with this cyclone resulted in very high storm surge that inundated the turtle nesting beach areas well above the high tide line. This inundation would have affected several of the incubating nests laid up to 60 days prior to the event. Following visual inspection of a number of nesting beaches and consideration of differing beach topography along the various sections of coast, it can be estimated that in total between 50-80% of nests were lost to storm surge. Thus out of the 305 nests laid in all divisions in the Intertidal zone and High tide to edge of vegetation zone, it was estimated that between approximately 77 and 244 nests were lost to inundation from storm surge associated with Cyclone Willy.

## 2.3 Discussion

The Ningaloo region is an important nesting site for three species of turtle. Green turtles in Western Australia have been recorded nesting from the Lacepede Islands (Kimberley) in the north to the beaches of the Ningaloo region while Loggerhead turtles frequent nesting beaches which extend from Shark Bay to the south to as far north as Varanus Island off the Pilbara coast. Hawksbill turtles nesting beaches in Western Australia are centred in the Dampier Archipelago and extend south to the Ningaloo coast (Prince, 1990). Green turtle nesting activities in the Ningaloo region are concentrated along the northern mainland beaches of the North West Cape, while Loggerhead nests are more prevalent along the southern mainland beaches of the Ningaloo coast. Hawksbill nests are relatively small in numbers along the Ningaloo coast and are scattered along the coast with some concentrations on the northern beaches of the North West Cape.

The Muiron Islands are considered part of the Ningaloo region and are recognised as a significant rookery in the region for both Green and Loggerhead turtles (Prince 1990). Tagging and monitoring studies were previously carried out as part of the Western Australian Marine Turtle Project from 1986-1990. Monitoring activities on the Muiron islands as part of the NTP to date have been limited by available resources and community capacity. There has been a low degree of focus on monitoring the Muiron Islands as the beaches are considered to be of low risk for threats to turtle populations. The islands are not inhabited by foxes and human visitation to the islands is restricted over the turtle nesting period. Monitoring activities have been concentrated on mainland beaches.

Monitoring results over three turtle nesting seasons from 2002 to 2005 in the North West Cape Division have indicated a decline in the overall numbers of turtle nests observed (Figure 9). Loggerhead turtle and hawksbill turtle nest numbers have remained relatively consistent over the three years (Figure 1).The decline in overall nests can be attributed to a decline in green turtles visiting this section of coast to nest. Green turtles have well documented large levels of inter-annual variation in the numbers of nesting females (Broderick *et al*, 2003). This has been linked to natural long term breeding cycles and to complex environmental conditions. It has been demonstrated that there is a correlation between the numbers of green turtles nesting at Eastern Australian rookeries and the meteorological variations involved with the El Nino Southern Oscillation two years prior to breeding and nesting. This can effect the foraging and nutritional preparation of green turtles and the numbers of females able to breed in that year (Limpus and Nicholls, 1988). There is likely to be a similar effect on green turtles visiting Western Australian rookeries, which needs to be monitored over time. Decline in numbers of nesting females can also be the result of negative impacts and harvesting of the turtles in their foraging grounds and in the open ocean (Limpus, 2002b)

Turtle nesting populations can be approximately estimated from the number of nests each season. Turtles will lay anywhere from 1 to 12 clutches of eggs per season, with and average of 3 to 6 clutches (Gulko and Eckert, 2003). This means that approximately 400-800 turtles nested in the 2002/2003 season, 330-650 turtles nested in the 2003/2004 season and 175 -350 turtles nested in the 2004/2005 season in the North West Cape Division. This method of estimating nesting populations is limited by intermittent remigration intervals, clutch frequency and nesting site fidelity for each different species and often results in overestimates of the abundance of nesting females (Schroeder *et al*, 2003). To establish whether the declining trend is of concern, monitoring of turtle nesting activities needs to continue in order to obtain meaningful information. Considering the high variability of inter-annual nesting and typical remigration intervals of between 2 and 8 years for green turtles (Limpus 2002c), monitoring beach nesting activities to establish population trends should continue for at least 2 complete remigration cycles. This suggests at least 16 years or more to establish indicative population trends. Similar beach monitoring programs in Florida and in Hawaii for 16 years and 30 years respectively, have successfully demonstrated recovering populations through similar methods. (Balazs and Chaloupka 2004, FWRI 2004)

**Recommendation**: Continue to monitor nesting activity on the North West Cape to obtain long-term trends related to turtle populations.

### 1. The abundance of turtle nesting activities on specific sections of beach and the relative significance of specific sections to each species of turtle.

The spatial distribution of overall turtle nesting activities in the North West Cape Division is concentrated in the Hunters and Graveyards sections with Lighthouse and Tantabiddi sections retaining relative significance. This is based on three years of monitoring Lighthouse, Hunters and Graveyards sections and expanding monitoring in specific seasons to establish the significance of adjacent sections. Over three years of data, the ratio in nesting abundance in each section has remained relatively constant for Lighthouse, Hunters and Graveyards (Figure 10). If it is assumed that the abundance ratios will remain constant in all of the sections then an overall indication of spatial distribution of nesting activity can be determined. These overall ratios indicate that 28% of nesting activity occurs in Hunters section and 39% in Graveyards section and identifies these sections as index beaches to continue monitoring in order to obtain trends in turtle nesting activities (Figure 19).

The spatial distribution of the three individual species of turtles over three years indicate that Graveyards section is significant to Green turtles (Figure 11) with 52% of green turtle nests laid in this section. 40-50% of Loggerhead nests were located in Hunters section (Figure 12), while Lighthouse section is where 40-50% of Hawksbill nests are located (Figure 13). This indicates that Lighthouse section although, not as significant in total numbers of nests is significant for the nesting preferences of Hawksbill turtles and should continue to be monitored for trends in nesting activities. It should be noted that the identification of Hawksbill tracks can often be mistaken for Loggerhead tracks when the size ranges overlap. Further studies into the accuracy of Loggerhead/ Hawksbill species identification through track observation should be conducted as a possible honours project.

**Recommendation**: Continue to monitor nesting activity in the Lighthouse, Hunters and Graveyards sections which are important rookeries.
**Recommendation**: Encourage further study into the accuracy of differentiation of Loggerhead and Hawksbill tracks.

Turtle nesting activities in the Bundera Division is concentrated in the Bungelup section (70% of the total -see Figure 21) which is located in the southern Cape Range National Park and a smaller concentration in Carbaddaman section (19%) located in the Bundera Coastal Park. The high density of loggerhead turtle nests (Figure 22) in the Bungelup section suggests that this is the most significant rookery for loggerhead turtles on the mainland coast of the Ningaloo Region.

**Recommendation**: Continue to monitor nesting activity in Bungelup section to indicate loggerhead nesting and population trends.

The nest distribution in the southern divisions of Ningaloo, Coral Bay and Red Bluff were monitored with varying degrees of consistency over three nesting seasons. The results obtained indicate that mainly loggerhead turtles frequent these nesting beaches, with small numbers of green turtles evident. The results can be used to indicate the relative significance of these nesting beaches to other rookeries along the Ningaloo Coast. Figure 25 demonstrates

the numbers of nests per week per kilometre of beach and indicates that the sections of Janes Bay and Batemans Bay have a comparatively low density of nesting activity and establishes the North West Cape and Bundera sections as significant to nesting turtles along the Ningaloo coast. It should be noted that, this trend could be the result of unmanaged fox predation along the southern rookeries of the Ningaloo coast for most of the last 50 years (See section 4 below).

## 2. The abundance of turtle nesting activities over specified time intervals

The temporal trends of turtle nesting activities in the North West Cape Division vary between the three turtle species. Loggerhead and Hawksbill turtles show considerable differences in nesting peaks within nesting seasons and the numbers of nests for these two species are insufficient to detect any valid trends. Green turtles do appear to follow a normal distribution from year to year and nesting peaks can be recognised to be fairly consistent irrespective of a decrease in overall numbers of nests. Nesting peaks for all three years occur between week six and week seven of the 13 week period from December to February (Figure 29).

Monitoring of a 20 week period in 2002/2003 and 2003/2004 helped to establish that 82.5% of nests are laid in a 13 week period. If it is assumed that 95% of all nests throughout the year are observed within that 20 week period then 78.5 % of the total number of nests can be observed in the 13 week period from December to February. This can be further analysed to establish that weeks 4-11 is an index period where 48-58% of all nests are observed (Figure 36).

> **Recommendation**: Continue to monitor nesting activity for a further 13 week period in the 2005/2006 season to further verify weeks 4-11 as being the period where 55% of the total nests are laid.
> **Recommendation**: Consider reducing the monitoring season to define a cost effective and statistically rigorous program monitoring index beaches for an established index time period.

The temporal trends of the loggerhead turtle nesting activities in the Bundera Division over an eight week period showed a peak occurring in between week six and week seven (Figure 37). This represents a strong parallel with the nesting patterns of green turtles in the North West Cape Division and suggests a similar temporal dispersal. Continued monitoring of this significant loggerhead rookery should be carried out for a minimum eight week period from mid December to mid February to obtain further trend information regarding the temporal distribution of nesting activities in this division.

## 3. Nesting Success

The nesting success rates for both the North West Cape Division and Bundera Divisions (Figure 40 and Figure 43) do not display any obvious trends over the three years of data. Nesting success can possibly be related to environmental factors such as tide, moon phase, wind, ocean currents and other environmental conditions. Nesting success can also be related to social factors including visitor disturbance potentially occurring early in the evening and then discontinuing after 11pm. Social factors are hard to quantify and relate directly to nesting success however the number of nests, nesting success and emergences should all be compared with environmental data to determine if these factors affect the nesting success of the three species of turtles.

> **Recommendation:** Comparisons between nesting success and environmental data are undertaken as a further research project.

## 4. The level of presence and predation by the European fox *(Vulpes vulpes)*

Fox predation of turtle nests is an introduced threat to nesting turtle populations along the Ningaloo coast. Previous studies of eastern Australian turtle populations indicate that small long term increases in annual mortality from introduced sources above natural mortality levels will cause population declines. Increases in turtle mortality of more than a few percent are considered unsustainable (Limpus 2002a). 5% has been identified as a sustainable fox predation level for the Ningaloo region (pers comm. Limpus 2002).

Over three turtle nesting season's foxes have been recorded on all sections of the North West Cape Division. Research conducted at Five Mile Beach from January to April found that nest predation occurred on 52% of the nights foxes were present on the beach. It was concluded that predation of sea turtle nests along this stretch of beach had reached an estimated 10.1% of all nests laid. (McKinna-Jones 2005)This study noted that the greatest predation activity on turtle nests occurred in March of the study year.

Predation levels in the North West Cape Division were relatively low in relation to overall nests laid, however this data was collected between December to February. Predation levels are expected to be much higher than reported as much of the predation may have occurred in March and not been recorded.

A targeted 1080 (sodium fluoroacetate) fox baiting program was introduced at the beginning of the 2004/2005 nesting season and was located along Five Mile Beach. This beach was targeted as foxes tend to travel along multiple sections of beach and Five Mile beach has a high density of nests and high incidence of fox presence. A decrease in the number of fox prints recorded along this beach in comparison to the previous year demonstrates that the baiting program produced an overall effect The decrease in fox presence on the beaches (Figure 46) would have dramatically decreased predation rates and only one predation event was actually recorded up to February in the 2004/2005 season.

> **Recommendation:** Maintain 1080 fox baiting on Five Mile section and continue to monitor for fox presence and predation in all sections of the North West Cape Division.

A total of 266 fox tracks were recorded in the Bundera Division with 135 tracks identified in Bundera Coastal Park and 131 tracks recorded in the southern Cape Range National Park in an 8 week period. These results indicate a relatively high presence of foxes in this area. Four nests were recorded as dug up by foxes during the season but as monitoring ended mid February many of the predation events may not have been recorded and actual predation levels are expected to be much higher than reported.

If Five Mile beach as mentioned above is an example of fox activities on the Ningaloo coast, then 52% of nights that foxes are present, turtle nests are subject to predation (McKinna-Jones 2005). This would indicate that predation levels on turtle nests in the Bundera Division are relatively high and require the implementation of a targeted baiting program to reduce fox presence and decrease the impacts of foxes on threatened loggerhead turtles. This is making a quantitative assumption, however as foxes are feral and any threats to loggerhead turtles must be minimized, immediate threat abatement measures are required.

> **Recommendation:** Implement a targeted fox baiting program in the Bundera Coastal Park and Bungelup section in the Cape Range National Park and monitor fox presence and predation.

Fox presence and predation in the Coral Bay Division has been monitored over three turtle nesting seasons. Predation of the nests observed indicated that a fox baiting program was required along this section and was introduced on the 16th October 2003. This baiting program reduced the number of predations during the 2003/2004 nesting season (Figure 50) but predation levels have risen again during the 2004/2005. Methods of distributing and tethering the baits are currently under review.

> **Recommendation:** Continue 1080 fox baiting in the Batemans Bay section and monitor for fox presence and predation in all sections of the in Coral Bay Division.

Fox predation levels of observed nests along the isolated section of Ningaloo Marine Park known as Jane's Bay are very high (Figure 52). A trapping and shooting program had been conducted during the 2002/2003 season and early in the 2003/2004 nesting season by lease holders on Ningaloo Station. Continual monitoring of predation levels has shown no decrease in the percentage of nests predated on during this time (Figure 52). A limited 1080 fox baiting program began on the 16th of January 2004 and has continued until the end of the 2004/2005 season. There has been a significant decrease in the percentage of nests predated in this season. This evidence indicated that 1080 baiting of the coastal strip reduced fox predation events. The predation levels could be reduced further by a comprehensive and unrestricted baiting program being implemented along this section of coast to reduce fox predation impacts to below the sustainable level of 5%. Loggerhead turtles are endangered and immediate action to reduce this significant threat is required.

> **Recommendation**: Continue with and urgently upgrade the current 1080 fox baiting program to include the whole coastal strip adjacent to Janes Bay.

## 5. The impacts of human interaction on turtle nesting activity

The potential and actual human impacts recorded on the beaches of the North West Cape are based on footprints, digging and vehicle tracks on and around successful turtle nests. It does not reflect the disturbance caused by humans that occurs before turtles emerge from the water or disturbance that may cause turtles to abort nesting once on the beach. This information is difficult to measure and cannot be obtained by monitoring tracks alone. Human impacts must be measured by recording the numbers of visitors on the beaches, amount of time visitors spend on the beach and detailed compliance studies regarding torch use and the behaviours of humans on turtle nesting beaches.

The Jurabi Turtle Centre was built in 2004 and began operations in 2004/2005 with the purpose of managing visitor–turtle interactions and minimising the disturbance to turtles during the nesting process. The 2004/2005 season report for the Jurabi Turtle Centre is included in Section 3.

A further negative human impact on nesting turtles and hatchlings observed is the light pollution emitted from car headlights arriving and departing from four specific carparks along the Jurabi Coastal Park. Car headlights have been observed disturbing nesting turtles and disorientating emerging hatchlings. The Jacobz, Jansz, Wobiri and Five Mile carparks are located within a few metres of the beach and several turtle nests in the 2004/2005 nesting season were located directly beside and behind the Five Mile carpark (see Appendix 11.3).

Relocating these identified carparks back from the beach to suitable areas behind the dunes will significantly reduce the impacts of car headlights on the adjacent nesting beaches.

> **Recommendation:** Refine and develop the visitor impact monitoring method used at the Jurabi Turtle Centre to obtain information on human disturbance.
> **Recommendation:** Review human impact data collection as an objective of the NCTMP.
> **Recommendation:** Review car park locations at Jacobz, Jansz, Wobiri and Five Mile to consider the impacts of car headlights on turtle nesting activities.

## 6. Turtle Rescues

24 rescues of turtles stranded behind sand dunes were achieved in the 2004/2005 nesting season. Nesting females can often become disorientated after scaling large sand dunes that occur along certain sections of the coast. The turtles are unable to find their way back to the ocean before suffering fatal exhaustion and dehydration in the summer heat. Although this is a natural event, all intervention on behalf of breeding females in a threatened species can have a significant impact on recovering populations. Volunteers who encounter stranded turtles report back and a rescue team sets out to assist the turtle back into the water prior to distress and dehydration occurs in the heat of the day. Assisting turtles in this situation is an unexpected added benefit to the program and information regarding high risk beaches should be collected in future seasons and reviewed in relation to the refinement of index beaches and index time periods.

> **Recommendation:** Develop data collection on turtle rescues, specifically the locations and consider rescues as a future objective of the NCTMP.

## 7. Stochastic Events

The loss of an estimated 50-80% (77 to 244) of turtle nests laid 60 days prior to the cyclone event demonstrates that turtle nests are susceptible to the effects of naturally occurring storms and extreme weather conditions. This reinforces the need to minimise the losses incurred from non-natural sources, such as fox predation, tourism and recreation in order to assist recovering turtle populations.

## 2.4 Conclusions

The objectives of the Ningaloo Community Turtle Monitoring Program for the past three turtle nesting seasons have been achieved.

The abundance of nests on specific sections of beach over specified time intervals for three seasons for each of the three species has been determined. This has allowed the identification of the key nesting beaches located in Bungelup, Graveyards, Hunters and Lighthouse sections. The relative significance of each of these sections to the three species has been established. Hawksbill turtles nest sporadically along coast of the North West Cape with a peak in Lighthouse section. Green turtles nest in high numbers along all beaches of the North West Cape but are mainly concentrated in the Hunters and Graveyards sections.

Bungelup section has been established as a significant loggerhead turtle rookery along the mainland coast of the Ningaloo region.

It has been determined that 78.5 % of all turtle nesting activity occurs in a 13 week period from the start of December to the end of February. Loggerhead and Hawksbill turtles display differences in nesting peaks however green turtles appear to follow a normal distribution from year to year. Nesting peaks occur between week six and week seven of the 13 week period from December to February.

The levels of potential and physical predation of the European fox *(Vulpes vulpes)* were established as high in the 2003/ 2004 season. The program assisted the managing agency CALM to implement and monitor a targeted baiting to address the predation rates and monitoring in 2004/2005 indicated the success of this baiting with only one predation event and a dramatic decrease in fox presence recorded.

The high incidence of fox tracks in the Bundera coastal Park and the southern Cape Range National Park has been identified as a significant potential threat to turtle nesting and hatching along these sections and requires the immediate implementation of a fox baiting program.

The significant levels of fox predation in Janes Bay and to a lesser degree in Batemans Bay led to the implementation of limited 1080 baiting programs along both sections. This has resulted in a decrease in observed predation events along these sections; however predation rates are still well above the 5% rate for unnatural causes. To reduce this predation rate to sustainable levels, a comprehensive and improved program is urgently required.

Human interaction and impacts on nesting marine turtles have been determined to be beyond the scope of the monitoring program and visitor impact monitoring should be integrated into the operations of the Jurabi Turtle Centre.

Turtle rescues are a significant added benefit to the program and should be included as an objective of the monitoring program.

Inundation of turtle nests from increased storm surge associated with cyclone events is a natural occurrence. This loss can affect the recovery of turtle populations. If species populations continue to decrease over time, nest relocation may be an option to reduce losses from these types of events.

Overall numbers of successful green turtle nests has decreased over the three years of data collection. Loggerhead and Hawksbill turtle nest numbers have remained relatively consistent. Further monitoring of nesting activities is essential to determine cyclical trends and the use of nesting abundance as an indication of overall population trends.

## 2.5 Recommendations

### 1. Monitoring

Continue to monitor nesting activity:

a. On the North West Cape to obtain long-term trends related to turtle populations, specifically in the Lighthouse, Hunters and Graveyards sections which are important rookeries.

b. Continue to monitor nesting activity in Bungelup section to indicate loggerhead nesting and population trends.

c. Continue to monitor nesting activity for a further 13 week period in the 2005/2006 season to further verify weeks 4-11 as being the period where 55% of the total nests are laid.

d. Consider reducing the monitoring season to define a cost effective and statistically rigorous program monitoring index beaches for an established index time period.

e. Develop data collection on turtle rescues, specifically the locations and consider rescues as a future objective of the NCTMP.

f. Review human impact data collection as an objective of the NCTMP.

### 2. Fox Control

Fox baiting and fox monitoring:

a. Maintain 1080 fox baiting on Five Mile section and continue to monitor for fox presence and predation in all sections of the North West Cape Division.

b. Implement a targeted fox baiting program in the Bundera Coastal Park and Bungelup section in the Cape Range National Park and monitor fox presence and predation.

c. Continue 1080 fox baiting in the Batemans Bay section and monitor for fox presence and predation in all sections of the in Coral Bay Division.

d. Continue with and urgently upgrade the current 1080 fox baiting program to include the whole coastal strip adjacent to Janes Bay.

### 3. Human Impacts and Recreation

a. Continue to manage visitor-turtle interactions through education and interpretive activities at the Jurabi Turtle Centre and nearby nesting beaches in collaboration with all stakeholders.

b. Refine and develop the visitor impact monitoring method used at the Jurabi Turtle Centre to obtain information on human disturbance.

c. Support the development of a sustainable turtle ecotourism industry of the North West Cape.

d. Review car park locations at Jacobz, Jansz, Wobiri and Five Mile to consider the impacts of car headlights on turtle nesting activities

## 4. Research

Encourage further research projects into:

a. Impacts and compliance of human activities on turtle nesting beaches of the North West Cape

b. Comparisons between nesting success and environmental data.

c. Migration and foraging habits of turtles nesting on the North West Cape by facilitating a satellite tagging program in conjunction with the NCTMP.

d. Accuracy of Loggerhead/Hawksbill species identification through track observation.

# 3.0 JURABI TURTLE CENTRE

## SEASON REPORT
## (Interim Version)

## 2004 – 2005

DEPARTMENT OF
Conservation
AND LAND MANAGEMENT
*Conserving the nature of WA*

# Table of Contents



# List of Figures

## 1.0 Introduction

The Jurabi Turtle Centre (JTC) is an interpretive centre located on the North West Cape in the Jurabi Coastal Park. It is situated between Hunters and Mauritius beaches, adjacent to a popular rookery for three threatened species of marine turtles –Green (*Chelonia mydas*), Loggerhead (*Caretta caretta*) and Hawksbill (*Eretmochelys imbricata*).

JTC is a joint venture between the Shire of Exmouth and the Department of Conservation and Land Management (CALM). The mission of the centre is defined in the *Jurabi Turtle Centre Draft Business and Operational Plan* (JTC Draft Plan) (CALM, 2004):

> ***The purpose of the Jurabi Turtle Centre venture is to work in collaboration with stakeholders and the community to promote conservation of marine turtles and protect biodiversity values while providing access to an informative and enriching wildlife experience.***

The 2004 – 2005 turtle breeding period comprised the first season that JTC operated. Operational guidelines were provided in the JTC Draft Plan, which also identified this season as a pilot program for future operations. This report, the *Jurabi Turtle Centre 2004-2005 Season Report*, provides information about the centre's activities, assesses the effectiveness of operations and makes recommendations to assist development of the project so that it may meet its goals in the future.

## 2.0 Operations

Operations at the centre closely followed those suggested in the JTC Draft Plan.

The centre was run by volunteers from the Ningaloo Turtle Program (NTP) from 18th December 2004 to 12th February 2005. Two presentations were delivered each Monday, Wednesday, Friday and Saturday evening, with the exception of Christmas Eve, Christmas Day and New Year's Eve.

The first presentation commenced at 8:00 pm and the second at 9:00 pm, each with a duration of approximately 20 minutes. Between presentations, volunteers interacted with visitors, answered questions and provided further information with the assistance of artefacts and props relating to marine turtles.

### 2.1 Volunteer roles

The roles that were undertaken by volunteers and the related training is summarised in Table 2.1 below:

*Table 2.1: Volunteer roles at JTC*

| Role title | Tasks | Training |
|---|---|---|
| Team Leader | Centre co-ordination, delivering talks, liaising with Commercial operators and Turtle Scouts | Completion of Turtle Tour Guide Training Course, on-the-job training at JTC |
| Information Officers | Delivering talks, liaising with Commercial operators and Turtle Scouts | Completion of Turtle Tour Guide Training Course, on-the-job training at JTC |
| Assistant Information Officers | Greeting visitors, issuing tickets, informal interaction with visitors, distribution of feedback forms | Competent volunteer NTP, on-the-job training |
| Turtle Scouts | Scouting beaches for turtle activity, monitoring visitor-turtle interaction, liaising with Team Leader and commercial tour operators, data collection | Completion of Turtle Tour Guide Training Course and on-the-job training OR Competent volunteer NTP, completion of Turtle Scout Training Workshop and on- |

| | | |
|---|---|---|
| | | the-job training. |
| Assistant Turtle Scouts | Assisting Turtle Scouts | Volunteer NTP, community member. |

The JTC was overseen and supervised by an Officer from the Department of Conservation and Land Management.

The centre was able to operate with a minimum of two volunteers in the centre itself. Up to two pairs of Turtle Scouts worked on the beaches when sufficient numbers of suitably trained volunteers were available.

### 2.2 Volunteer effort

Forty one volunteers contributed 363.75 hours at JTC during this season. This represents 50% of the total volunteers involved in the NTP. The smaller number of volunteers participating in the JTC venture appears to be a consequence of the centre being perceived as a separate entity to the NTP and the greater emphasis placed on the monitoring component of the program, which is more soundly established (having run since 2001/02).

While a minimum number of two volunteers each evening ensured presentations were delivered on each designated evening, beach patrols by Turtle Scouts were limited due to low numbers of adequately trained people. Consequently, more volunteers need to be engaged at JTC.

Future promotion of the NTP should more fully incorporate the JTC and clearly outline opportunities available for volunteers. This could be achieved by:

- Promoting the monitoring and education components of the program equally under the umbrella of the NTP;
- Volunteers attending at least one information evening at JTC as a prerequisite for obtaining their monitoring competency (this would also provide a valuable information and education about marine turtles).

### 2.3 Volunteer training

As volunteers are providing information for the public and supervising interactions with marine turtles, they require a thorough understanding of marine turtle interaction protocol. This high level of competency is also a legislative requirement under the *Wildlife Conservation Act (1950)*. Consequently, training for volunteers is vital and training requirements are comprehensive.

During the 2004/05 season, one 8 hour Turtle Scout Training Workshop was conducted on 13th January to coincide with an influx of new volunteers (11 attended). To promote greater presence on the beach at night by Turtle Scouts:

- more volunteers should be engaged at JTC (see section 2.2).
- additional training workshops could be marketed and conducted – one early in the season and two others that coincide with major influxes of volunteers

One of the major issues with the provision of training is the time investment required by qualified CALM staff. A large portion of training for this season was undertaken by staff in a voluntary capacity, which does not accurately reflect the resource demands of JTC and is not necessarily sustainable.

- Additional budgetary resources and/or external funding are required for training volunteers.

### 2.4 Visitor-turtle interaction

One of the duties of Turtle Scouts was to monitor and supervise visitor-turtle interaction on the beach. To avoid potential conflict with commercial tour operators by providing "free" guided interactions, Turtle Scouts endeavoured to provide guidance without providing a tour.

This strategy, however, proved difficult to implement, and it appears virtually impossible to eliminate the role of tour guide from managed interactions. Advising visitors how to behave inevitably entails providing explanations and information. Furthermore, to actually prevent disturbance when turtles were encountered, Scouts found that they needed to maintain a presence and assist visitors to prevent them from inappropriately approaching the animals, irrespective of the visitors familiarity with interaction guidelines.

Solutions to this issue should be discussed with commercial tour operators. Possible resolutions include:

- Access to Hunters/Mauritius beaches incurs a fee and all turtle encounters are supervised by Turtle Scouts, who provide a tour;
- Access to Hunters/Mauritius beaches can only be undertaken by visitors joining a commercial tour (operators may choose to use the services of Turtle Scouts to locate turtles);
- Turtle Scouts provide tours at Hunters/Mauritius (optional for visitors, paid viewing has priority over non-paid viewing) and operators provide tours exclusively at other locations;
- Some of these alternatives may require limiting access to nearby rookeries.

Several other visitor-turtle interaction issues were encountered on the beach during presentation evenings. These are summarised in Table 2.2 below:

*Table 2.2: Visitor-turtle interaction issues*

| Event | Problem | Possible resolution/s |
|---|---|---|
| Overcrowding of nesting turtles, therefore increasing chance of disturbance | Limited nesting events and too many visitors | Limit number of visitors on the beach at one time;<br>Scouts/tour guides manage all interactions; |
| Emerging turtles disturbed | Visitors walking along high tide mark as advised | All visitors participate in a guided experience with qualified personnel;<br>Visitors wait while a guide scouts alone; |
| Preferential turtle viewing for paying tourists with commercial operators | Dissatisfied members of the public, unfair alienation from turtle viewing | All visitors participate in guided tours;<br>Commercial operators use different beaches;<br>Advise visitors of this philosophy at JTC; |

## 3.0 Commercial Tour Operators

The commercial tour operators running tours through the JTC comprised Neil McLeod's Ningaloo Safari Tours and Ningaloo Reef Retreat's Turtle Tours. These two companies were the only licensed operators for this turtle season. Operators were anticipated to contribute to JTC's goals by providing controlled and supervised guided tours.

Neil McLeod's tour attended JTC presentations twice throughout the period of operations. This business brought a total of eleven participants through the centre, collecting no further

tourists at JTC on either occasion. Ningaloo Reef Retreat commenced operations on 17th January in response to an apparent demand for guided turtle tours which was not being met at the centre. This business brought seven tours through the centre over two weeks, taking a total of 63 tourists on guided tours. Fifty percent of these tourists were recruited at JTC following the presentation by volunteers.

There is a strong case for tours being available at the centre during each night of operations. Most visitors cited the main reason that they did not join a commercial tour was a shortage of time (the majority of visitors were only in Exmouth for one or two days) (see Figure 3.1). Being able to join a tour at the centre would address this issue. Furthermore, discussions with visitors indicate a large proportion believed that the JTC experience included a turtle tour, not just a talk.

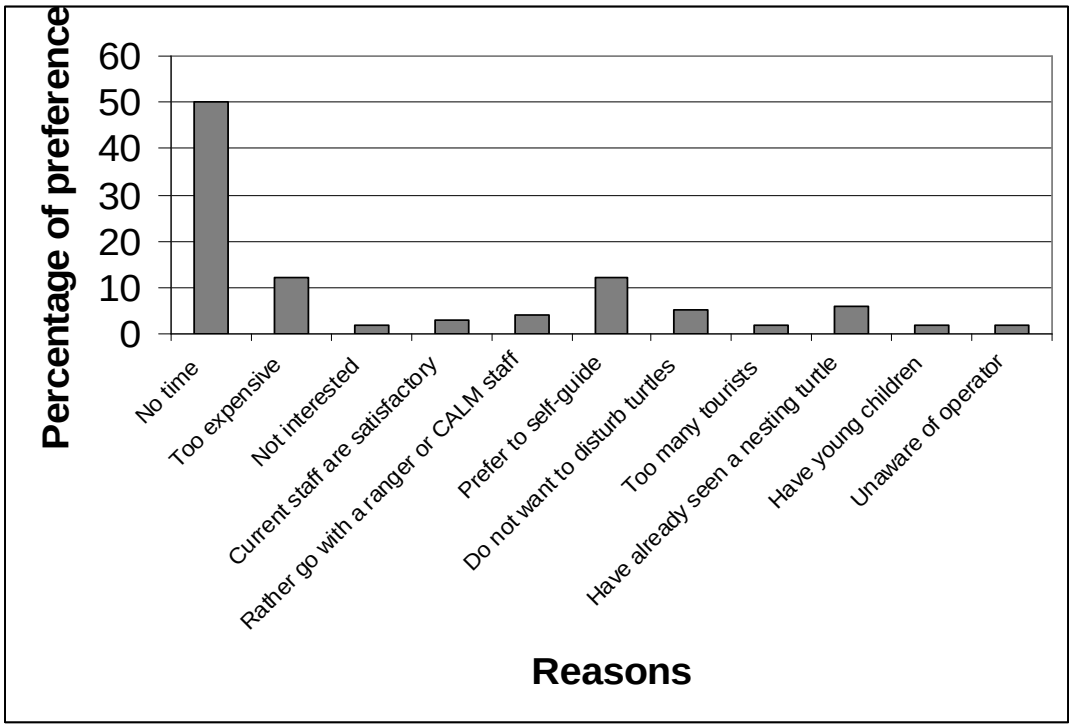



*Fig. 3.1 Bar graph showing the most frequently given reasons for not participating in a commercial tour.*

The fact that Ningaloo Reef Retreat collected an additional 31 clients at JTC over seven nights suggests that a suitable tour product effectively marketed has the potential to attract sufficient clients. This will benefit visitors by meeting their expectations about the JTC product, enhance turtle ecotourism and reduce turtle disturbance.

The second most prevalent reason for not joining a guided tour by visitors was that they were perceived as being too expensive (Figure 3.1). Tours were priced at $45 and $30 leaving from Exmouth, or $20 departing from the centre after the presentation. It should be noted that the $30 and $20 tours were only available between 17th and 31st January, which may have skewed this result, giving it greater emphasis if people believed the only available product cost $45.

Visitors generally indicated in feedback surveys that they would prefer to pay between $10 and $25 (see Figure 3.2), with approximately 27% indicating a preference for $10 tours.

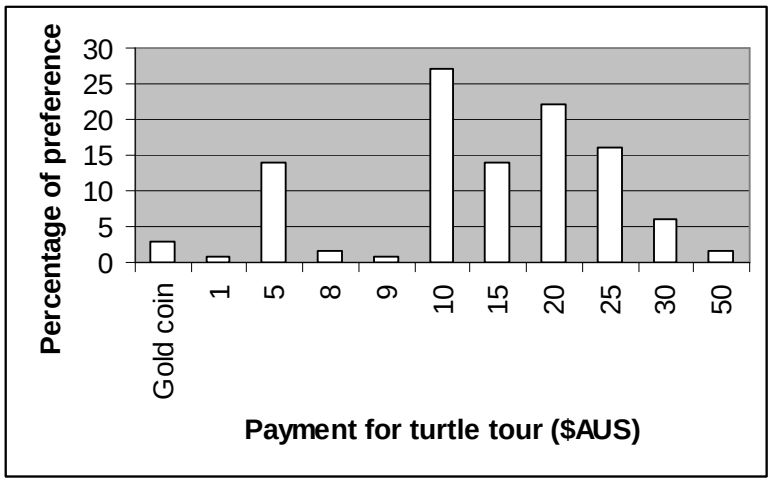



*Fig. 3.2 Bar graph showing the choice of payment for a commercial tour by visitors*

As a result, it is recommended that:

- Guided turtle tours operate from JTC each night of operations.
- Tours from the centre cost between $10 and $25.

A significant problem encountered by both commercial tour operators was a lack of qualified Turtle Tour Guides. This issue was probably amplified this season for the following reasons:

a) the Turtle Tour Industry is a relatively new and underdeveloped industry, hence experienced personnel are rare;
b) the Turtle Tour Guide Training Course is a pre-requisite for Guides but only commenced in 2004, resulting in a limited pool of qualified candidates;
c) of the 14 students enrolled in the course, few demonstrated interest in working as a guide, despite being aware of opportunities available with both Exmouth operators.

The vehicles used by each business to transport tourists to JTC and the beaches provide a critical service for Exmouth-based visitors but also demanded special requirements of guides. These included physical strength (eg: to change a flat tyre on an Okka) and an MR licence with an F class endorsement. Securing staff with these qualifications, particularly at relatively short notice, proved problematic.

- Discussions with commercial operators about the qualifications necessary for guides and the workability of the Turtle Tour Guide Training Course should be implemented.

## 4.0 Visitor data and analysis

Tickets issued to each adult and child throughout the period of operations show that the total number of visitors attending presentations was 834. Of these, 85% (708) were adults (over the age of 16).

Figure 4.1 shows a clear increase in visitor numbers after Christmas, with steady attendance during January. Visitor numbers decline towards the end of the season in February. This pattern may be related to the Christmas holiday period, with the February decline due to visitors returning to work commitments and children to school. It is unlikely that low visitor numbers are related to a decline in turtle activity in February, as most people would be unaware of this detail of local turtle behaviour.

Low attendance at the beginning of operations is probably attributed to the absence of road-side signage and marketing during the first two weeks and the fact people were unaware that the centre was active (see section 7.0). Australia Day (January 26$^{th}$) was also poorly attended.

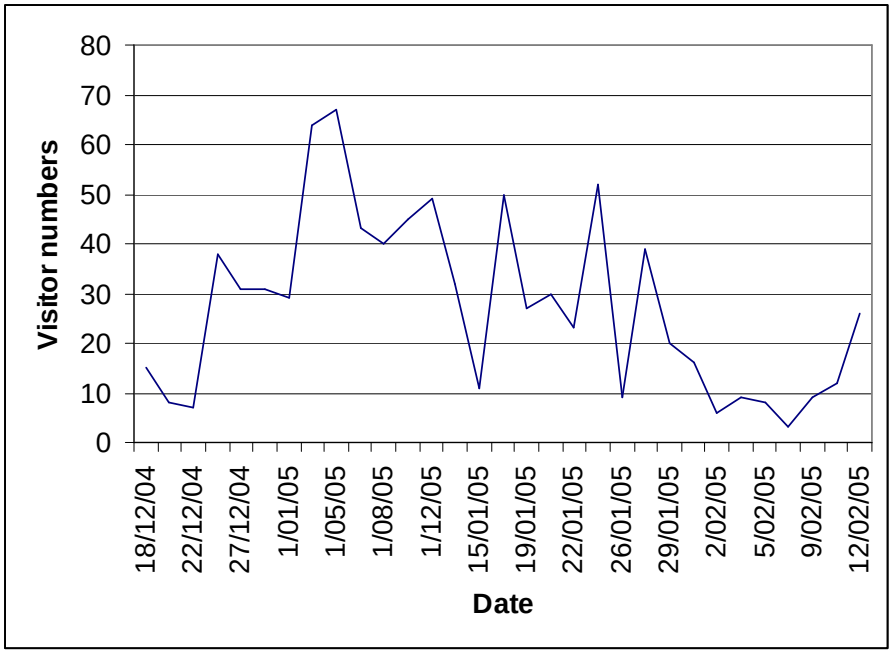



*Fig 4.1 Line graph demonstrating visitor numbers to JTC during the period of operations.*

Eighty percent of visitors were present for the first presentation, indicating that the 8:00 pm timeslot was preferred.

Offering a single presentation on four nights may be problematic for large numbers of people given the limited space and seating at the centre and frequent occurrence of strong winds at this time of the year, which make it difficult for presenters to be heard. Furthermore, this could concentrate visitors on the beach at one time, which may be difficult to manage. A single presentation each night could counter this if they were conducted more frequently.

The maximum number of people attending a presentation at one time was 54 people (5$^{th}$ January, 2005) and the average number of visitors each night was 27 people. To cater for a 50% increase in visitor numbers next season (1,251) and retain an average of 27 people per presentation, recommendations for 2005/06 are to:

- hold one presentation per night at 8:00 pm;
- increase the number of information evenings to six nights a week (Monday to Saturday);
- retain a similar operational period to cater for a potential increase in attendance;
- continue to monitor visitor attendance

Visitors completed a total of 180 feedback forms (Appendix 1). These show a “high” to “very high” level of satisfaction with the interpretive material, the services provided by volunteers, the facilities offered and road access and conditions. Visitors were most satisfied with the facilities available at the centre. This is surprising given that toilet facilities were incomplete, there was an obvious lack of lighting and seating is basic and limited. Visitor satisfaction could reflect the type of people who visit JTC; they are interested in a nature-based experience and are predominantly campers or caravaners (see figure 4.2), so may be content with relatively rustic, natural surroundings.

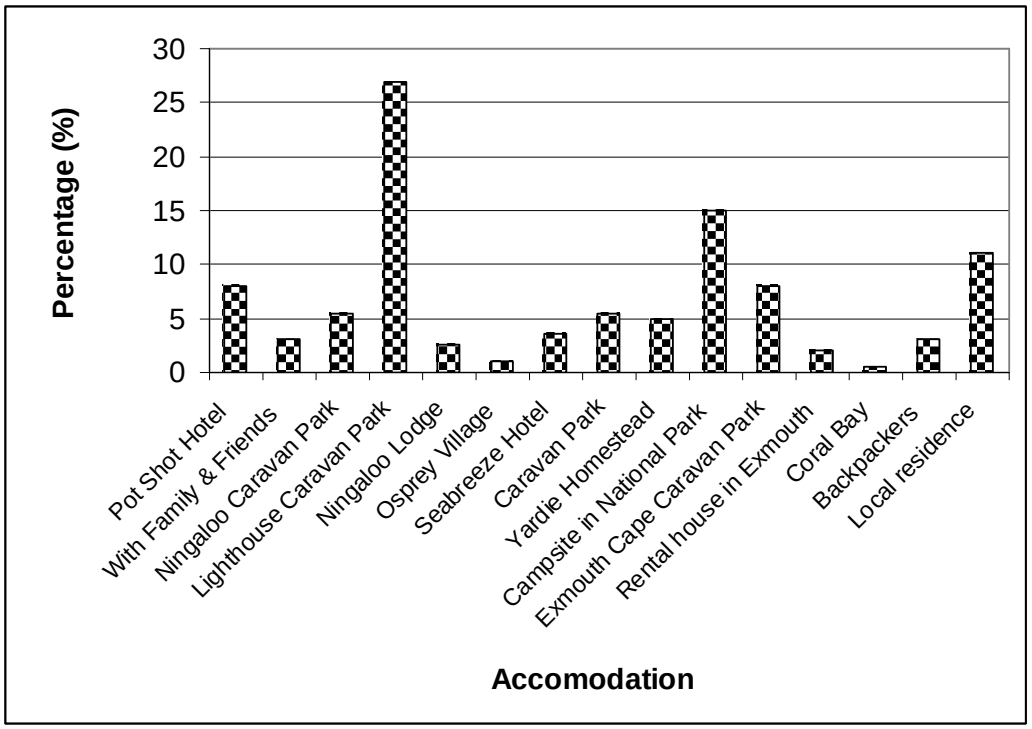



*Fig 4.2. Bar graph showing the accommodation of JTC visitors*

Figure 4.2 demonstrates that the approximately 27% of visitors to JTC were staying at the Lighthouse Caravan Park. This caravan park is located about 1.5 kms from JTC, hence the centre is readily accessible.

Visitors staying in Exmouth, especially those without independent transport, have limited opportunities to access the centre at night time and this factor may partially account for the comparatively low attendance by this visitor group.

A surprisingly high portion (15%) of visitors drove to JTC from campsites in Cape Range National Park. This may be because campers are more attracted to nature-based wildlife viewing and information about native fauna. The lack of evening entertainment options at both Lighthouse Caravan Park and campers in Cape Range NP compared to all other accommodation venues (which are located in Exmouth) could also be a factor contributing to the hight representation of visitors from these two locations.

Figure 4.3 shows that over 60% of adult visitors to JTC are between the ages of 25 and 39 years old, 25% are 40 or over and less than 20% are below the age of 25.

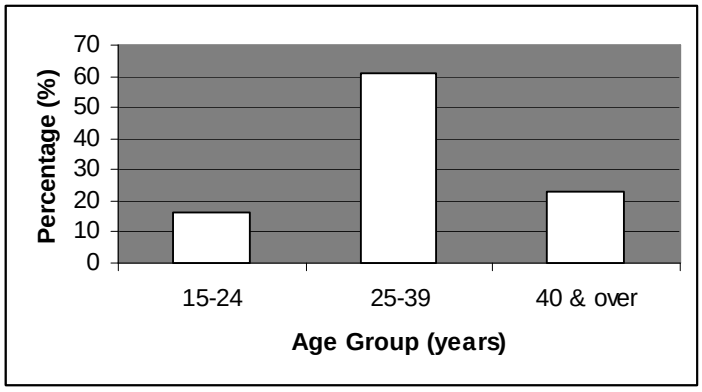



*Fig 4.3 Bar graph of the age groups of visitors to JTC*

Over 50% of visitors to JTC are international visitors. Even though half of the international visitors were from the UK (Figure 4.4), it could be alleged that 25% of JTC visitors do necessarily use English as their first language. This is important when preparing interpretation that is understandable for the audience. The existing pictorial signage at JTC that informs people how to observe turtles includes cartoons that are not sufficiently explicit for those who have limited understanding of English. Furthermore, volunteers at the centre should be aware of this significant client group and instructed how to meet their needs.

- Signage and brochures relating to JTC should include unambiguous, simple pictures that clearly demonstrate turtle observation techniques.
- Volunteer training will address how the needs of non-English speaking visitors can be met.

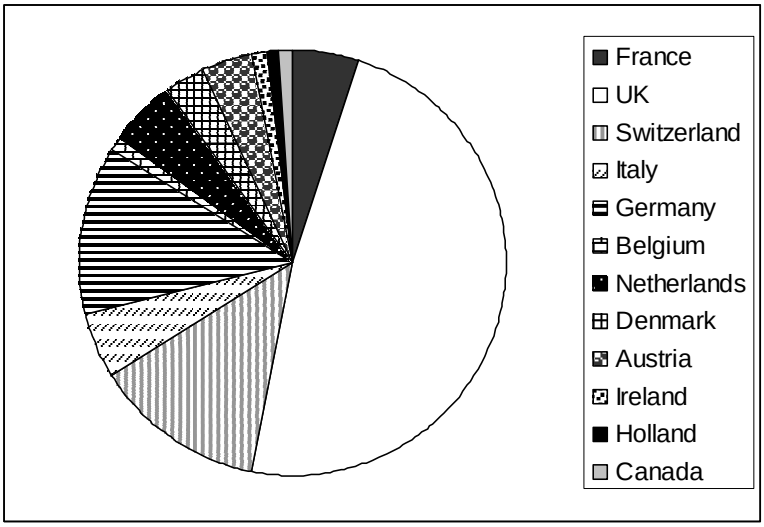



*Fig 4.4. Pie chart presenting the differing percentages of international visitors*

Local visitors to JTC comprise the smallest visitor group (less than 5%). Figure 4.5 also shows that the majority of Australian visitors are from Perth (20%).

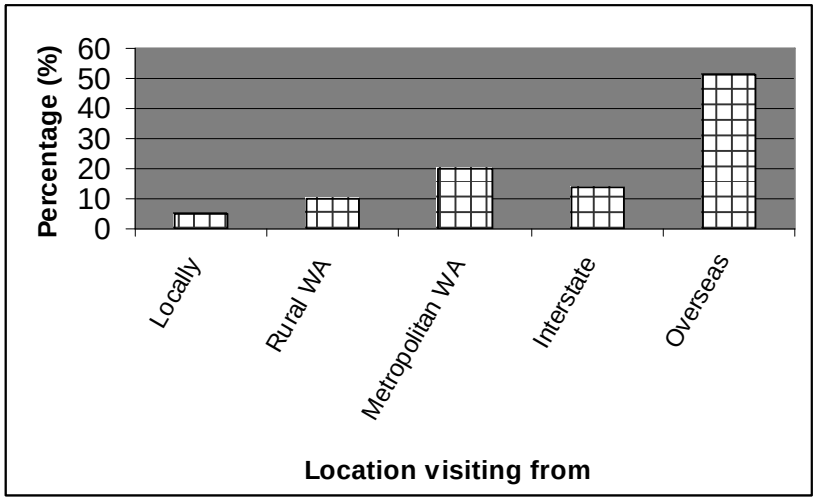



*Fig 4.5. Bar graph showing the percentage of visitors from differing locations*

## 5.0 Effectiveness of Education at JTC

One of the key goals of JTC is to reduce disturbance to nesting marine turtles by providing education about turtle behaviour and turtle observation techniques.

Data collected by Turtle Scouts on the beach demonstrate the effectiveness of the information provided at JTC in terms of reducing human disturbance on turtle activity. Of the total 36 groups of visitors surveyed on the beach, 80% had visited JTC and 65% were present for a presentation. Of the groups that had visited the centre, but not listened to a talk, 65% were not complying with the code of conduct. Of visitors that had not called into the centre or been present for the presentation, 90% were not adhering to the code of conduct.

55% of visitors who had been to the centre and heard the talk were following the code of conduct. While this visitor group demonstrated the greatest degree of compliance with the code of conduct, it is still relatively low considering these people should have been aware of how to behave. A proposed study of the "Effectiveness of the Jurabi Turtle Centre interpretation facility, Ningaloo Reef" by Honours student Leanne Smith should be encouraged to examine the reasons for this lack of compliance and consider remedial strategies.

- Recommend that Leanne Smith examines reasons for lack of compliance as part of her Honours project

When a group of beach visitors were noted to disturb a turtle, 70% of the time they were unaware of the code of conduct and had not been to the centre or the presentation.

These figures demonstrate that visitor attendance at JTC increases compliance with the code of conduct. While the static interpretation at the centre appears to mitigate turtle disturbance, the presentation is a more effective method. Most effective of all were supervised interaction on the beach, which recorded no disturbance to turtle activity.

- All future marketing of turtle encounters in the Exmouth area should endeavour to channel turtle watchers to JTC, preferably to a presentation, prior to their beach experience; and
- All turtle watchers should continue to be encouraged to participate in a supervised interaction by every Exmouth business or information source that provides details about turtle watching (eg: Visitor Centres, local information sources, local tour and accommodation businesses, CALM); or

- All turtle watchers on Hunters/Mauritius beaches must experience marine turtles with supervision by qualified personnel; and
- Access to nearby turtle rookeries is restricted (particularly during emergence periods around high tide).

The most frequent visitor behaviour that contravened the code of conduct was visitors not walking along the high tide line as they searched for turtles (Figure 5.1). While any movement may potentially disrupt turtle activity, turtles encountered and disturbed on the beach have invested considerably more energy in their nesting attempt than those who do not emerge from the water if they detect people walking along the high tide line.

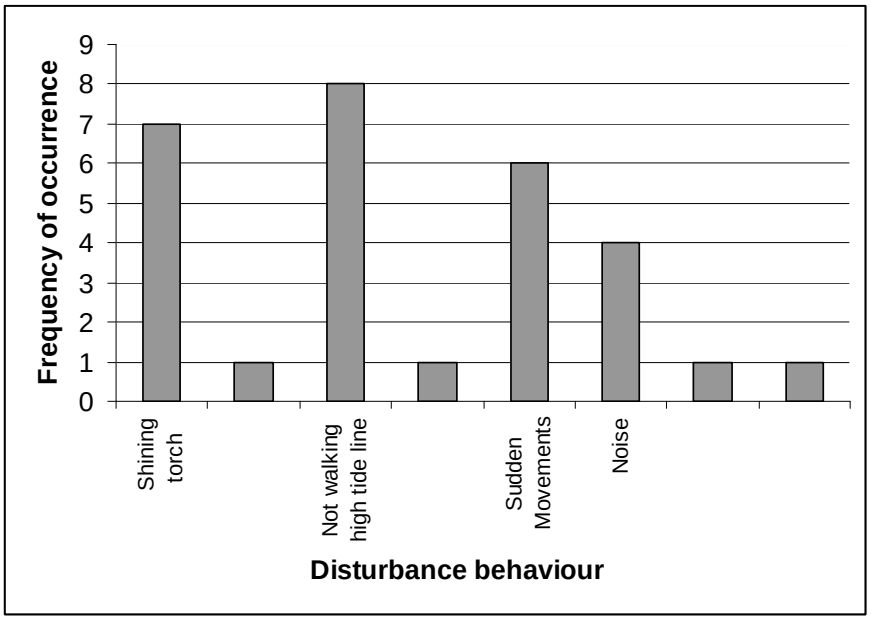



*Fig 5.1. Bar graph illustrating disturbance behaviour on nesting turtles on Hunters/Mauritius beach and their frequency of incidence.*

The high frequency of this tourist behaviour is probably due to the lack of interpretation about this activity at JTC. This message is delivered during the presentation but is not included in signage or written material, so is only apparent to a limited group of turtle watchers who have remembered the message from the turtle talk.

The next most frequent breach of the code of conduct was shining of torches (Figure 5.1). Considerable emphasis is placed on this disturbance factor in the interpretation at the centre and during the presentation. The high incidence of this conduct appears partly due to the conflicting information provided in signage at JTC and at the beach accesses to turtle rookeries, as well as on Turtle Watching brochures. Both forms of material recommend that turtle watchers reduce (rather than eliminate) the use of light on the beach. Eighty percent of visitors encountered using torches and questioned about their use of light claimed to have read the interpretation at the centre and assumed that excessive use of light was not condoned but a small amount was still acceptable.

The common feature for both of these breaches of the code of conduct is the provision of inconsistent information. To maximise compliance with the code of conduct:

- interaction guidelines, particularly those relating to walking along the high tide line and acceptable use of lights, must be consistent and reiterated in all forms of information about turtle watching techniques (static interpretation, presentations, brochures etc).

## 6.0 Occupational Health and Safety and Visitor Risk Management

### 6.1 OH & S

Occupational Health and Safety guidelines for JTC are detailed in the Operational Procedures for Interpretation Officers and Turtle Scouts. All volunteers are formally briefed about OH & S issues are required to register as a CALM volunteer. No OH & S incidents or issues were recorded this season.

### 6.2 VRM

VRM issues and remedial actions were identified in the JTC Draft Plan. Inadequate lighting along the walkway was temporarily addressed by installing solar lights prior to presentations. The lack of sufficient lighting in the car park, along walkways and in the centre itself continues to expose visitors to risk of injury. This issue will be resolved once the permanent lighting has been installed (scheduled for July/August 2005).

Bollards located at the pathway entrance which prevent vehicle access also need to be clearly demarcated at night time. The toilet has now been completed.

## 7.0 Marketing

Since this season was conducted as a pilot program, the JTC Draft Plan recommended that marketing target existing visitors to the area by advertising locally.

Marketing consisted of the following:

- A letter detailing operational information was sent to over 40 tourism related business in and around Exmouth, including all of the major bus charters that visit Exmouth on a regular basis. A full colour A4 promotional poster was included with the letter;
- 15 full colour A3 size laminated promotional posters were delivered to local accommodation suppliers, Exmouth Visitors Centre, Milyering Visitor Centre, Coral Bay and Exmouth Community and CALM notice boards;
- Signage on the Yardie Creek Road opposite the centre advertised "Turtle Talks, 8:00 pm and 9:00 pm" (delivered during week 3 of operations);
- An article was published in the local newspaper, "The Northern Guardian", midway through the season (19th January).

Figure 7.0 below shows a significant proportion of visitors found out about the centre by driving past and seeing the road signage. The late delivery of the signs may therefore account for low attendance in the first few weeks of operations.

Exmouth Visitor Centre (and possible Milyering Visitor Centre given the high attendance of people staying in Cape Range NP) and word of mouth were the second largest source of information about JTC.

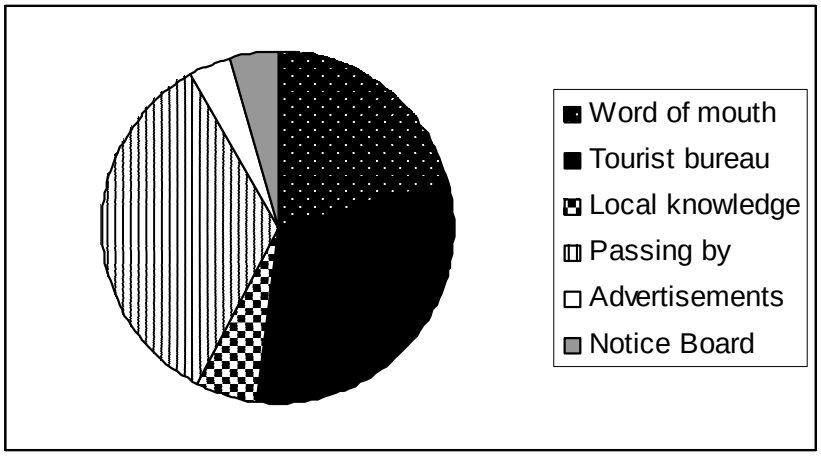



*Fig. 7.0. Pie chart illustrating source of information on JTC operations.*

Discussions with visitors at the centre indicated that a large proportion felt misinformed of what was involved at JTC. They believed a turtle tour was a component of the JTC experience, even though it was specifically promoted as a "talk" rather than a "tour". Visitor disappointment could be mitigated next season by

- joint marketing with turtle tour businesses (providing turtle tours are available every night when the centre is operating);

- providing a guided tour as part of the visit to JTC.

As recommended in the JTC Draft Plan, marketing for next season should not be significantly expanded until operation issues, such as regular provision of guided tours and adequate supervision of visitors on the beach, are resolved.

## 8.0 Finance

The revenue produced through donations at JTC totalled $573.15. One commercial tour operator donated a gold coin for each tour member to attend JTC and the other contributed $5 per participant for the use of the Turtle Scouts. This raised an additional $315 (63 @ $5).

Advertising posters and signage requested a "gold coin donation" from visitors attending talks. 771 visitors (excluding Ningaloo Reef Retreat clients) should therefore have contributed at least $771.00. The shortfall of $198.00 indicates that at least 25% of people attending the talk did not pay.

Any revenue raised by the centre will assist covering operational costs, which are presently absorbed by CALM (and indirectly the Shire of Exmouth). Next year, it is recommended that:

- a set fee is charged for attendance at JTC. Presence at a talk only should incur a fee of at least $1 for children and $2 for adults.

The JTC Draft Plan identified a revenue objective of cost recovery for CALM's vehicle running expenses associated with the centre. The total revenue raised of $888 is almost identical to vehicle running costs (excluding training) ($868 = 31 nights @ 40kms x $0.70).

## 9.0 Visitor Impact on Turtle Activity

A positive association between peaks of high visitor numbers and a high incidence of false crawls is apparent in Figure 9.0. This suggests that human presence on the beach increases disturbance of the nesting process.

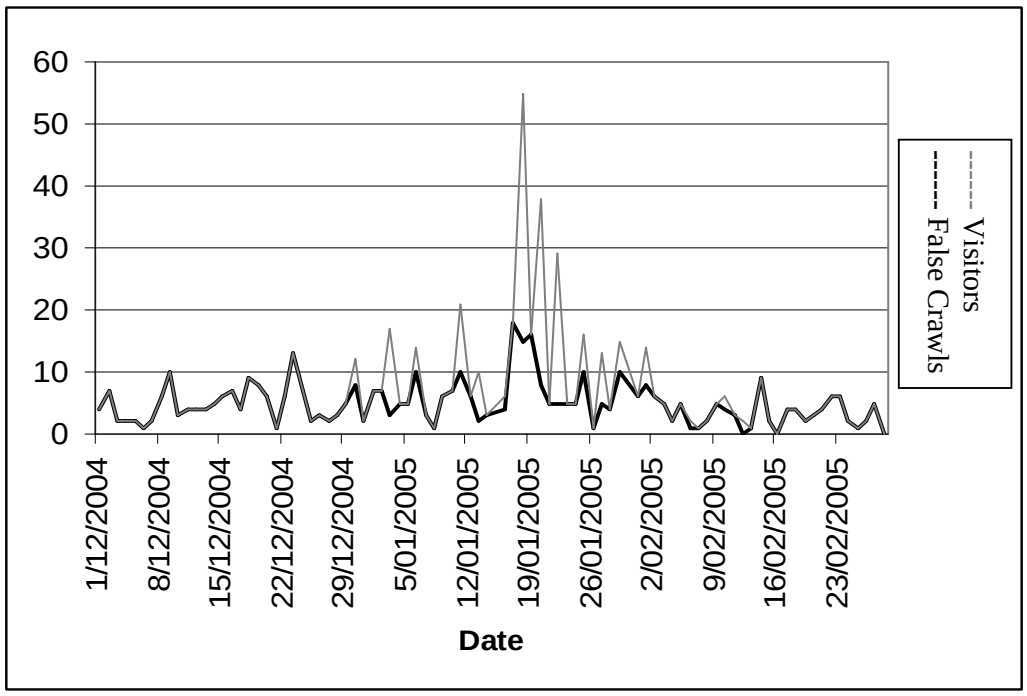



*Fig 9.0. Line graph showing the relationship between number of visitors on the beach the previous night, and number of false crawls on Hunters/Mauritius beach.*

However, even if visitors are disturbing turtles and increasing the incidence of false crawls, this does not necessarily preclude a negative impact on nesting success. For example, turtles that abort nesting attempts due to disturbance may still emerge later and successfully nest.

Data analysis conducted by Mattias Schneider (2005) compared the nesting success (the ratio of emergences to nests) at Hunters beach and Graveyards. The decline in nesting success at Hunters in January 2005 (Figure 9.1) could be attributed to the peak in tourists on the beach, or numerous other factors, such as environmental conditions. These figures overall, however, show a small difference in nesting success (about 2%) between Hunters beach where visitor numbers were high, and Graveyards, which would have had comparatively low numbers of turtle watchers.

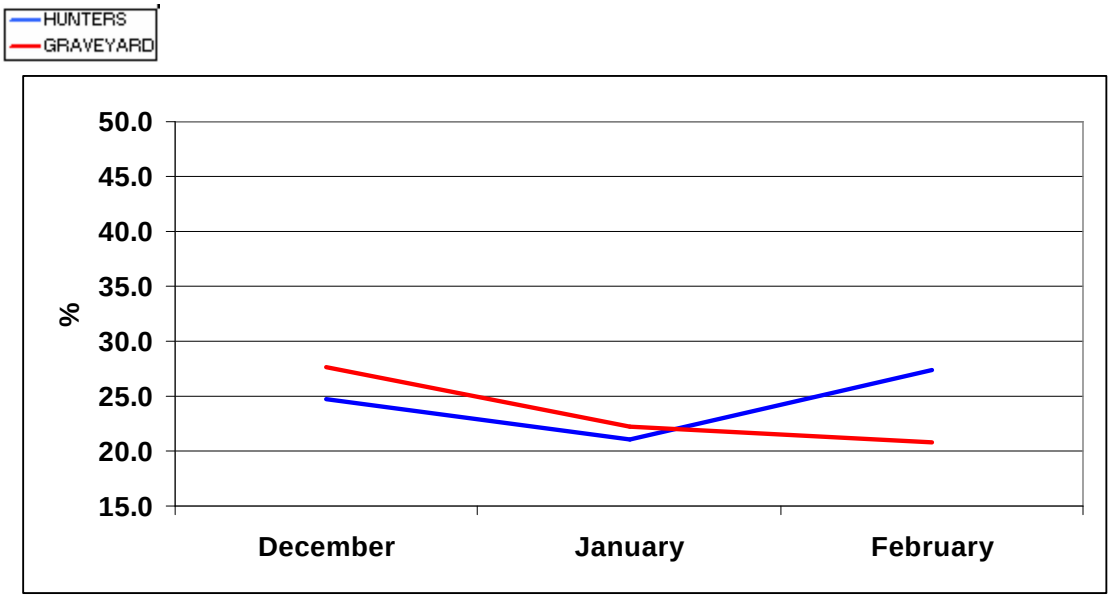



*Figure 9.1: Monthly Nesting Success – Green Turtles in 2004/05*

This indicates that despite evidence that visitors are disturbing turtles, turtles are still nesting. However, this conclusion and it's implications should be viewed cautiously. Turtle behaviour is impacted by a wide range of factors, including a suite of environmental conditions, and the data collected represents only one year.

Female marine turtles do not feed during the months that they mate and nest, relying on fat reserves accumulated during the previous year/s. Nesting on the beach uses an enormous quantity of valuable energy reserves, hence continued disturbance that results in aborted (and therefore repeated) nesting attempts may still have serious negative repercussions for marine turtles. This is potentially exacerbated by the specific requirements of nesting beaches and the predisposition of marine turtles to nest on their natal (birth) beach.

Visitor numbers on the Hunters/Mauritius beach section will continue to be high as the centre attracts more visitors. Consequently:

- every endeavour should continue to be made by management agencies to minimise turtle disturbance during nesting;
- continual monitoring of the impact of visitors on disturbance and nesting success is essential.

## 10.0 Conclusion

The goals projected for JTC during the centre's inaugural operating season were mostly achieved.

The effectiveness of interpretation in positively influencing the behaviour of tourists is apparent. The presentation appears to be the most informative method of encouraging compliance with the turtle watchers code. However, compliance with the code of conduct is still relatively low, even among visitors who have attended presentations at JTC. The reasons for this require examination in order for the JTC product to be adjusted accordingly.

Visitation this season was predicted to be 900 people during the eight week period of operations in the JTC Draft Plan. 834 recorded visitors is therefore a satisfactory result. More visitors to the centre should be encouraged in future, as long as adequate beach management strategies are in place.
Financial objectives were adequately met for the first season of operations. While JTC is not expected to cover its operational costs, a greater financial contribution by users will assist managers to maintain the centre. Revenue can be increased immediately by implementing a small fee for attendance.

The number of volunteers at JTC was satisfactory, however, needs to be increased in order to more effectively supervise and monitor visitor-turtle interaction on the beaches. Additional resources are required to meet training requirements.

Visitor-turtle interaction on the beaches remains one of the greatest issues at JTC that requires resolution prior to next season. The recommended procedure that will most effectively meet the needs of tourists, commercial operators and turtle conservation appears to be including guided tours as a component of the JTC experience by providing affordable tours after the presentation. This can be facilitated by using volunteer Turtle Scouts in the role of Guides, or by working collaboratively with a commercial operator(s) and retaining Scouts to identify turtle activity. Given the comprehensive legal training requirements for Guides, the limited resources that CALM and the Shire of Exmouth have available for the project and the restricted capacity of volunteers, the preferred option is to encourage and support commercial operators to provide this service.

To assist visitor management, channelling visitors to JTC is highly desirable. Closing access to nearby turtle rookeries will assist this process, although will most likely encounter resistance from local users and result in conflict with other user groups (eg fisher people). All brochures and literature relating to turtle watching should refer people to JTC and Hunters/Mauritius beaches, so that self-guided viewing elsewhere on the Jurabi Coast is not encouraged.

The issue of visitor-turtle management potentially impacts a range of stakeholders and should be discussed by the Turtle Interpretation Facility Advisory Committee.

The activities at JTC, visitor feedback and surveys conducted by volunteers on the beach during the 2004/05 breeding season have all provided valuable information that will direct and assist the Turtle Interpretive Facility Advisory Committee to develop the centre. The successes of the centre during the 2004/05 season are largely due to the commitment of volunteers, the NTP, TAFE instructors, CALM and a suite of supporters in Exmouth, including local businesses, the Exmouth Visitors Centre, commercial operators and the Shire of Exmouth. Collaboration among stakeholders continues to contribute to the spirit of this project.

The following table summarises issues and recommendations based on the 2004/05 Turtle Breeding Season:

*Table 10.1 Summary of issues and recommendations*

| Issue | Recommendation |
|---|---|
| Beaches were not consistently monitored due to an insufficient number of volunteers. | ➢ Engage more volunteers, both within the Exmouth Community and through the NTP |
| Poor volunteer representation from the NTP. | ➢ Promote JTC and the monitoring component of the NTP equally;<br>➢ Stipulate that all NTP volunteers must attend at least one information evening at JTC as a prerequisite for obtaining their monitoring competency. |
| Training for volunteers is essential and demands considerable time by qualified personnel. | ➢ Seek additional budgetary and/or external funding to train volunteers.<br>➢ Conduct additional training workshops for Turtle Scouts<br>➢ Encourage volunteers to complete the Turtle Tour Guide Training Course |
| Volunteer Turtle Scouts are unable to provide adequate supervision of visitor-turtle encounters without providing a guided tour, which potentially competes with commercial operators. | ➢ Implement a compulsory fee for access to Hunters/Mauritius beaches where visitors are taken on tours by volunteer Turtle Scouts;<br>➢ Limit access to Hunters/Mauritius beaches to visitors who are part of a commercial tour (operators may choose to use the services of Turtle Scouts to locate turtles);<br>➢ Tours are provided by Turtle Scouts at Hunters/Mauritius (optional participation by visitors, paid viewing has priority over non-paid viewing) and operators provide tours exclusively at other locations;<br>➢ Some of these alternatives may require limiting access to nearby rookeries. |
| Overcrowding of nesting turtles | ➢ Limit the number of visitors on the beach at one time;<br>➢ All turtle interactions are managed by Scouts/Tour Guides. |
| Emerging turtles are disturbed by visitors walking along the high tide mark as advised | ➢ Encourage or ensure that all visitors participate in a guided experience with qualified personnel;<br>➢ Visitors wait while a guide scouts for turtle activity alone. |
| Member of the public are disgruntled as they are excluded from turtle viewing opportunities by preferential treatment for paying customers | ➢ Stipulate that all visitors must participate in a guided tour;<br>➢ Commercial operators use beaches other than Hunters/Mauritius;<br>➢ Advise visitors of this philosophy at JTC. |
| Visitors are not joining tours because they have limited time. Visitors expect a guided tour as part of the JTC product. | ➢ Visitors are able to join guided tours at JTC each night of operations. |
| Visitors indicate willingness to pay between $10 and $25 for a guided turtle encounter. | ➢ Price tours at the centre between $10 and $25. |
| Commercial tour operators had difficulty sourcing suitably qualified tour guides. | ➢ Undertake discussions with commercial operators about the qualifications necessary for guides and the workability of the Turtle Tour Guide Training Course. |
| 80% of visitors attended the 8:00 pm presentation four nights a week. | ➢ Offer a single presentation at 8:00 pm six nights per week over a similar operational period;<br>➢ Continue to monitor visitor attendance |

| Issue | Recommendation |
|---|---|
| Approximately 25% of visitors to JTC do not speak English as a first language. | ➢ Signage and brochures relating to JTC should include unambiguous, simple pictures that clearly demonstrate turtle observation techniques;<br>➢ Volunteer training will address how the needs of non-English speaking visitors can be met. |
| Despite attending presentations at JTC, 45% of turtle observers did not follow the code of conduct. | ➢ Encourage Leanne Smith to examine reasons for lack of compliance with the code of conduct as part of her Honours project. |
| Information at JTC and attendance at presentations increases compliance by turtle observers with the code of conduct | ➢ All future marketing of turtle encounters in the Exmouth area should endeavour to channel turtle watchers to JTC, preferably to a presentation, prior to their beach experience; and<br>➢ All turtle watchers should continue to be encouraged to participate in a supervised interaction by every Exmouth business or information source that provides details about turtle watching (eg: Visitor Centres, local information sources, local tour and accommodation businesses, CALM); or<br>➢ All turtle watchers on Hunters/Mauritius beaches must experience marine turtles with supervision by qualified personnel; and<br>➢ Access to nearby turtle rookeries is restricted (particularly during emergence periods around high tide). |
| The most frequent breaches of the turtle watcher's code appears to be a consequence of inconsistent information. | ➢ Interaction guidelines must be consistent and reiterated in all forms of information about turtle watching techniques. |
| Most visitors believe that a turtle tour was included as part of the JTC product | ➢ Undertake joint marketing with turtle tour businesses (providing turtle tours are available every night when the centre is operating);<br>➢ Provide a guided tour as part of the JTC experience. |
| At least 25% of people attending the talk did not make a gold coin donation. | ➢ Implement a set fee for attendance at JTC. For a talk only, this should be at least $1 for children and $2 for adults. |
| Despite a positive correlation between visitor numbers and the incidence of false crawls, there is no certain evidence from the 2004/05 season to indicate that visitors are reducing the nesting success of turtles at Hunters/Mauritius. | ➢ Every endeavour should continue to be made by management agencies to minimise turtle disturbance during nesting;<br>➢ Continue monitoring of the impact of visitors on disturbance and nesting success is essential. |

This report was prepared by:

Jess Silva – JTC Team Leader, 2004/05
Kate Macgregor – Project Officer, CALM Exmouth

# 4.0 Community Monitoring Expansion and Outreach

Community monitoring of turtle nesting activities were expanded in 2004/2005 to communities in Port Hedland and Cape Lambert, near Wickham. The participation of the Care for Hedland Group in Port Hedland and the Cape Lambert Eco Action Network, in workshops in early 2003 demonstrated their interest in participating in community turtle monitoring and in the methodology used by the Ningaloo Turtle Program.

A training and community education workshop was held in Port Hedland at the end of October 2004 to introduce volunteers to the turtle monitoring methodologies used and provide training and assessment to enable members of Care for Hedland to become trainers.
Monitoring commenced on the 24th of October 2004 and continued until the 31st of January 2005. There was no turtle activity recorded after the 14th of January and the results are only considered for the 12 weeks up to this date (see Table 2). Monitoring was conducted on Cemetery Beach with the help of 45 volunteers contributing 650 hours.

**Table 2: Monitoring weeks in Port Hedland**

| Week 1 | Week 2 | Week 3 | Week 4 | Week 5 | Week 6 | Week 7 | Week 8 | Week 9 | Week 10 | Week 11 | Week 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 24/10/04<br>31/10/04 | 1/11/04<br>7/11/04 | 8/11/04<br>14/11/04 | 15/11/04<br>21/11/04 | 22/11/04<br>28/11/04 | 29/11/04<br>5/12/04 | 6/12/04<br>12/12/04 | 13/12/04<br>19/12/04 | 20/12/04<br>26/12/04 | 27/12/04<br>2/1/05 | 3/1/05<br>9/1//05 | 10/1/05<br>16/1/05 |

363 nests were recorded in a 12 week period with a nesting peak in weeks 6-7 (Figure 54). Flatback turtles *(Natator depressus)* were the only species of marine turtle to nest on Cemetery Beach.

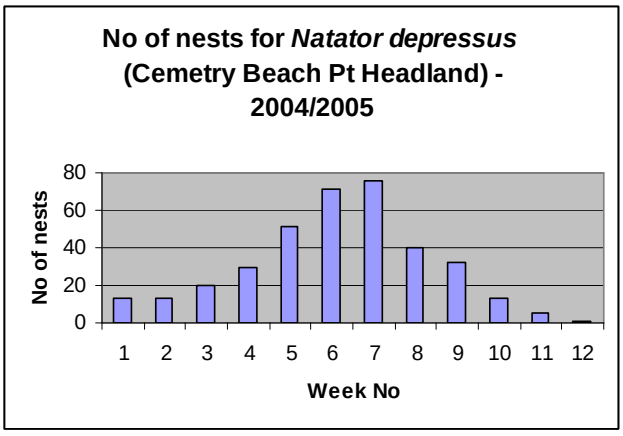



**Figure 54: Numbers of nests for Flatback Turtles at Cemetery Beach, Port Hedland**

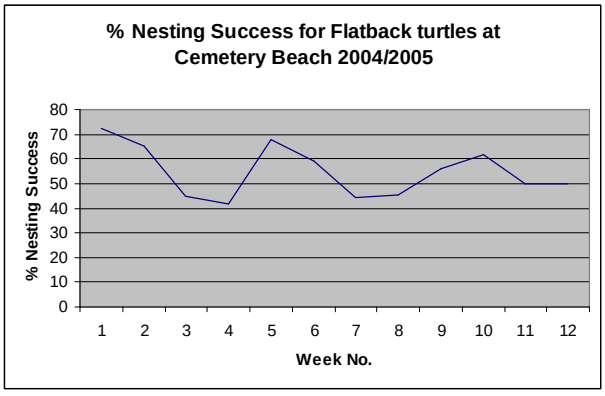



**Figure 55: % nesting success for flatback turtle on Cemetery Beach in 2004/2005.**

These results indicate that Cemetery Beach in Port Hedland is a nesting rookery for Flatback turtles *(Natator depressus)* not previously recorded. Nesting occurred from October to January in 2004/2005 with a peak nesting period in the first two weeks of December. This nesting activity should continue to be monitored over time and analysed to determine its significance as a nesting site to the flatback populations along the North West coast of Australia.

> **Recommendation:** Continue to monitor Cemetery Beach in season 2005/2006 to obtain long term trends related to flatback turtle populations.

Monitoring activities were conducted at Bells Beach on Cape Lambert from the start of December 2004 to the middle of February 2005. Green, Hawksbill and Flatback turtles were recorded as nesting on Bells Beach during the 2004/2005 season. 165 nests were recorded over the season, however, due to inconsistencies in data collection and limited effort obtaining the data no conclusions can be drawn from the information provided. Total numbers recorded do indicate that Bells beach is potentially an important turtle rookery and should be monitored in the future. Further training and field based workshops regarding monitoring methodologies and additional capacity building is required within the Cape Lambert Eco Action Network to facilitate an effective monitoring effort in this region of the Pilbara.

> **Recommendation:** Develop and extend training and capacity building in Cape Lambert and build on efforts in Port Hedland in the Pilbara to facilitate effective community monitoring of turtle nesting activity in these areas.

# 5.0 Ningaloo Turtle Program - Volunteers and Coordination 2004/2005

The 2004/2005 turtle program was a great success for volunteers, coordinator and trainers who were facilitating, recruiting and training volunteers. The introduction of three volunteer team leaders responsible for the monitoring program, Jurabi Turtle Centre and operations at Bundera remote camp greatly improved the organisation of the overall program and created new opportunities for volunteers to engage in a wider range of activities.

During the 2004/ 2005 volunteers engaged in the following activities:

- "Turtle tracking" – ie beach monitoring;
- data entry;
- remote camping on the Ningaloo Reef monitoring beaches;
- educational activities and interpretive talks at the newly established Jurabi Turtle Centre;
- assisting with Turtle Rescues;
- completing a TAFE certified Turtle Tour Guiding Course;
- supervision of turtle-visitor interactions on the beaches at night;
- regular social events;
- leadership and organizational role as a team leader and
- field methodology trainers.

## 5.1 Volunteer numbers and hours

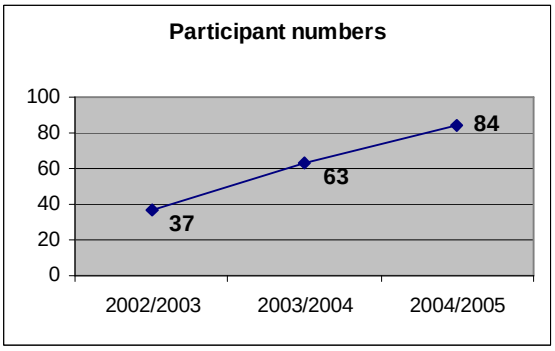



**Figure 56: Participant numbers over three years of the Ningaloo Turtle Program.**

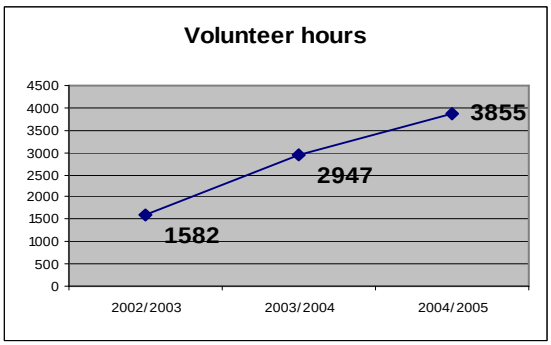



**Figure 57: Volunteer hours over three years of the Ningaloo Turtle Program.**

A total of 84 registered volunteers participated in the Ningaloo Turtle Program in 2004/2005. These volunteers contributed 3855 total volunteer hours to the program. 3306 hours were spent walking 1871 kilometres of beach along the Ningaloo coast (the equivalent of walking

from Exmouth to Albany!). Volunteers covered 255kms on quad bike and contributed 108 hours to data entry. Volunteers donated 441 hours towards educational and interpretive talks at the JTC and also assisted with scouting the beaches for nesting turtles. Enough volunteers over the season ensured that a 100% monitoring effort was achieved in the Hunters and Graveyards sections and a 90% effort in the Lighthouse section. 100% effort was achieved in Bundera Coastal Park and 90% in the southern Cape Range National Park. The program could not have taken place without the enthusiastic efforts of these dedicated volunteers.

## 5.2 Volunteer demographics

Volunteer enquiries were received from all over rural and metropolitan WA, Eastern Australia, USA, UK, New Zealand, Canada, Italy, France, Hong Kong and Japan.
19 volunteers were from the local community, while 35 volunteers were enrolled students at various universities in Perth and around Australia. 30 participants were travellers originating from Sydney, Melbourne, the Gold Coast, Darwin, the UK, Germany, France and Japan. The youngest participant was seven years old and accompanied his mother. The oldest participant was 74 years of age.

> **Recommendation:** Continue to recruit volunteers through websites, advertisements and media opportunities. Concentrate on increasing local participation and conduct targeted recruitment at universities in Perth to ensure high numbers of participants in the program.

## 5.3 Volunteer training

In mid-November a two day training workshop was conducted, followed by three days field training in monitoring activities. Monitoring training was ongoing throughout the season and was generously provided by Susie Bedford (Cape Conservation Group), Roland Mau (CALM) and three newly certified trainers; Allison Richards (WWF), Mistral Dodson (Murdoch University) and Jessica Silva (Murdoch University). Training was based on the methodology stated in the NCTMP field guide and was supplemented with a training DVD and field based experience. Nearly all the 84 volunteers achieved competency and received certificates of competency. Issues arose for trainers because of a continual supply of new volunteers requiring training on most mornings of the week. This placed a strain on those providing training and conducting competency assessments.

> **Recommendation:** Streamline monitoring training procedures to provide definitive start dates to provide a formalised roster for trainers and volunteers and limit the strain on experienced trainers donating their expertise.

Training was provided at the Jurabi Turtle Centre for volunteers assisting information officers and as Turtle Scouts. As volunteers provided information for the public and supervised interactions with marine turtles, they required a thorough understanding of the marine turtle interaction protocols. This high level of competency is also a legislative requirement under the *Wildlife Conservation Act (1950)*. Consequently, training for volunteers is vital and training requirements are comprehensive. During the 2004/05 season, one 8 hour Turtle Scout Training Workshop was conducted on 13$^{th}$ January to coincide with an influx of new volunteers (11 attended).

**Recommendation:** To promote greater presence on the beach at night by Turtle Scouts, the Turtle Scout training workshops could be marketed and conducted at the beginning in the season and two others to coincide with major influxes of volunteers

One of the major issues with the provision of training at the JTC is the time investment required by qualified CALM staff and/or suitably qualified volunteers. A large portion of training for this season was undertaken by staff in a voluntary capacity, which does not accurately reflect the resource demands of JTC and is not necessarily sustainable.

**Recommendation:** Additional budgetary resources and/or external funding are required to provide high quality training for volunteers at the JTC.

## 5.4 Volunteer accommodation

In the 2004/2005 season, Ningaloo Turtle Program participants, who committed for a minimum of four weeks with the program, were provided with subsidised accommodation ($70/week) at one of two rented Exmouth villas. Feedback indicated this was a very satisfactory arrangement and it enabled many volunteers to participate and remain with the program longer than they would have otherwise been able. Volunteers made bookings with the coordinator, who did weekly inspections and rent collection. Volunteer arrivals out of hours, on weekends and at unorthodox times caused unnecessary strain on the coordinator. This can be better managed by allowing subsidised accommodation through one of the local accommodation providers in town thus removing day to day accommodation duties from the coordinator. Issues arose at the beginning of the season with regards to insurance for volunteers residing in the accommodation. These issues were resolved at the time but should be considered in future seasons.

**Recommendation:** Consider subsidising volunteer accommodation through a local provider to facilitate day to day duties and resolve insurance and duty of care issues by engaging an established business. This also alleviates the need for accommodation inspections and rent collection.

## 5.5 Volunteer transport

Car pooling of volunteer vehicles was the means by which volunteers were transported to monitoring beaches daily. Reimbursement for vehicle use was 30 cents/km, which was sufficient to cover fuel costs. A lack of available private transport often placed limits on numbers of volunteers who could participate each morning and sometimes made organising vehicles a logistical problem.

For evening activities at JTC, a CALM vehicle was used for the volunteers. This arrangement was satisfactory however it relied on the in-kind support of CALM.

**Recommendation:** Consider the use of a dedicated vehicle to transport volunteers for the morning monitoring and evening educational activities for the duration of the program, to overcome the identified transport problems

## 5.6 Volunteer Social Events

Social activities were organised for volunteers on a weekly basis in addition to weekly get togethers at the pub for certificate presentations. Social activities ranged from BBQs at various locations to Pool competitions, beach parties, breakfast at JTC, attendance at the local street party, several do it yourself pizza nights and a big Christmas lunch. Social interaction between volunteers was great and helped maintain morale and create a sense of community with the program. The organisation of social events once a week should continue.

## 5.7 Bundera Remote Camp

The Bundera Remote Camp was run from the 16th of December 2004 to the 10th of February 2005 as part of the Ningaloo Community Turtle Monitoring Program for the 2004 – 2005 turtle season. The camp was situated at the Bungelup Rangers Camp, 6km north of Yardie Creek. The area monitored covered sections from Neil's Beach just to the north of camp, to Carbaddaman Beach – approximately 20km south of Yardie Creek.
The camps were mostly run over a period of 5 days, the last day being a changeover of volunteers and supplies for the next camp. Two to four volunteers attended each camp, as well as a Team Leader. Monitoring was carried out each morning from a 4WD vehicle as well as a quad bike.
The aims of the camp included monitoring turtle activity in the Cape Range National Park and in the Bundera Protection Area to establish if there were any significant turtle rookeries in these areas. During the monitoring season, there were significant observations of feral animals both in the Cape Range National Park and in the Bundera Protection Area.

The setup of the camp involved organising / purchasing camping, safety and 4WD equipment, and the actual set up of this equipment on site. It was also necessary to plan menus for the volunteers and to mark out the monitoring sections.
The menus were planned by the team leaders and revised before the first camp to reflect the budget per camp for food expenses.
The camping equipment was partly supplied by CALM Exmouth, and the remainder was purchased from the local camping store with funds provided to the program by the Department of Defence. The CALM equipment was sorted, repaired and cleaned prior to the first camp by the Team Leaders.
The majority of the camping equipment was taken to Bungelup prior to the first camp. On this trip the campsite was cleaned, shade cloths set up and BBQ equipment, camp beds, chairs and swags installed at the camp. Section markers for the monitoring sections were set up with the assistance of CALM staff and a 4WD vehicle.
The camp protocols and procedures were determined by the program coordinator, in consultation with CALM staff. Each group of volunteers was briefed on arrival at camp.
Daily monitoring started from 5:30am, and took anywhere from 3 to 6 hours to complete. The 4WD vehicle was used for the Boat Harbour and Carbaddaman subsections, and the Quad Bike was used for the Bungelup sections on the beach in front of camp.
The monitoring seemed to be at its most efficient with at least 4 volunteers on the camp, including the Team Leader. This ensured that the southern sections did not take too long to monitor, and the Quad Bike sections could be done before the day got too hot.
The new model GPS units were very useful for the camp monitoring as the sections were not clearly signposted with actual names. These GPS units could be used to determine which section you were at very easily. They also had a straightforward waypoint system. Results obtained from monitoring activities at Bundera are contained in section 2 of this report.

Basic food supplies for each camp were funded by the Department of Defence, whilst transport and other costs were provided by the NTP.

28 different volunteers participated in camps at Bundera and found it to be a rewarding experience and a welcome break from the activities in Exmouth. The atmosphere of the camp was very relaxed, so people interacted well.

Feedback from volunteers indicated the remote camp experience was a success and it facilitated important monitoring of turtle activities in a remote area in difficult weather conditions. This monitoring identified a significant loggerhead rookery on the mainland coast of this region.

## 5.8 Coordination of the Ningaloo Turtle Program

A full time coordinator of the NTP was employed by WWF Australia (on behalf of CCG) in season 2004/2005. The coordinator is hosted in the CALM Exmouth office and this facilitates the role with access to valuable advice and resources. The employment of a coordinator allowed for an increase focus on volunteer recruitment, training, accommodation, transport, data collection and the day to day running of the program including coordination of the remote camp. The coordinator is also responsible for budgeting, marketing, promotion, reporting and fundraising for the Ningaloo Turtle Program. The progression from a part time to full time position has proven successful. The provision of a team leader to help the coordinator has enabled a more sustained monitoring effort with positive feedback being received.

An education officer was employed by CALM to oversee operations at the Jurabi Turtle Centre during season 2004/2005. This part time position facilitated the running of the centre during this first year of operation. Subsequent familiarity with the centre requirements and effective procedures endorses reviewing the roles of the coordinator and education officer at the JTC.

> **Recommendation:** The coordinator is responsible for overseeing the day-to day operations of volunteers at the centre. The education officer manages the overall operation of the JTC, including training, meeting the needs of stakeholders and accomplishing operational goals.

The coordinator was assisted in the physical day to day running of the program by three university students completing internships with the program. The interns were known as Team Leaders and were responsible for the three different aspects of the program; the morning community monitoring, JTC operations and Bundera remote camp. For JTC activities the team leaders worked under the guidance of both the coordinator and the education officer. The internships were invaluable for both the NTP and the students involved. New skills, knowledge and experience were gained by the students and the program benefited greatly from the enthusiasm, dedication and organisation contributed by the students.

> **Recommendation:** Continue to develop the internship program as an excellent opportunity for students to gain field experience in a conservation program.
> **Recommendation:** Introduce an indigenous internship opportunity into the program to encourage indigenous involvement and capacity building in local communities.

# 6.0 Communication

Communication and promotion of the program has taken the form of newsletters and several newspaper articles in the Cape Connection, Exmouth Expression, Northern Guardian, The Courier Mail, Waves newsletter and several online newsletters. A total of five radio interviews were conducted during the turtle nesting season with various local and state radio programs. 2000 brochures and several posters were distributed locally and in Perth to provide information about and encourage participation in the program. Two training workshops were held at the beginning and during the turtle nesting season to educate and inform local residents and visitors about turtle conservation and the efforts of the program, as was a training DVD.

Communication has also been undertaken through email networking, particularly via the coordinator during volunteer recruitment and answering enquiries from all over the world. Complete volunteer packages, containing educational materials and program information were distributed to over 200 volunteers enquiring about the program.

A website containing comprehensive information about the program and educational information regarding turtle biology and ecology has been produced this season and will go online in July 2005.

With the anticipated streamlining of training schedules and the possibilities of introducing a charge for the training provided, recruitment and promotion will require a more directed approach in the future. Recruitment seminars at Perth universities and for any other relevant groups or organisations will assist in directing recruitment towards specific groups in order to promote the training opportunities available.

> **Recommendation:** Conduct targeted recruitment seminars to encourage participation from relevant groups.

# 7.0 Finance

The 2004/2005 Ningaloo Turtle Program was funded by the following organisations:

- Coastwest
- Department of Defence
- Tony and Lissette Lewis Foundation-Wildlife Link

In-kind support was provided by the Cape Conservation Group, CALM, WWF Australia and the Shire of Exmouth

**Table 3: Income received and Expenditure of the Ningaloo Community Turtle Monitoring Program for the 2004/2005 financial year.**

| Project Activity | Funds Budgeted | Funds Spent | Balance |
|---|---|---|---|
| Salaries, wages and superannuation | 30,416 | 30,416 | 0.00 |
| Data analysis and consultants | 3,000 | 2,655 | 345.00 |
| Volunteer Travel | 8,000 | 7,403 | 597.00 |
| Coordinator Travel | 5,859 | 4,265 | 1,594.00 |
| Volunteer accommodation | 6,500 | 6,500 | 0.00 |
| Training | 4,000 | 3,646 | 354.00 |
| Communication | 7,000 | 4,535 | 2,465.00 |
| Printing | 4,263 | 3,971 | 292.00 |
| Office Expenses | 4,240 | 4,240 | 0.00 |
| Bundera Camp Purchases, 4WD hire, OH+S and all expenses | 11,000 | 10,485 | 515.00 |
| Monitoring expenses | 1,400 | 14,000 | 0.00 |
| **TOTALS** | **85,678** | **79,516** | **6,162** |

The balance of $6,162 will be carried forward to the next financial year to continue recruitment, report writing, communications and support for the coordinator. These carry forward funds received from the Tony & Lissette Lewis Foundation are part of ongoing funding agreements and will be spent in the Ningaloo Turtle Program in the 2005/2006 financial year.

Difficulties obtaining ongoing funding to continue the Ningaloo Turtle Program have been encountered. Seed grants from funding bodies are not sustainable and longer term funding from other institutions has been difficult to obtain. Long term funding is a priority for the continuation of this project.

> **Recommendation:** Investigate self funding options by introducing a minimal charge to volunteers for participation in the program and training received.

# 8.0 Summary

The Ningaloo Turtle Program has resulted in significant capacity building, management and scientific outcomes that will aid in the long-term conservation and management of the Ningaloo Coast. Volunteers and the local community are vital to the longevity and effectiveness of this anticipated long-term program.

Overall, the NTP has been very successful by covering a large geographical area of nesting habitats and in the collection of data and provision of information that will be useful for managing agencies in the context of coastal planning and development and conservation management. The program has successfully introduced educational and interpretive information at the JTC through which it is developing management of visitor-turtle interactions. The capacity building and training component has facilitated the expansion of community turtle monitoring to other centres in the Pilbara, including Port Hedland.

The Ningaloo Community Turtle Monitoring Program has collected data over three successive turtle nesting seasons and obtained results indicating trends in turtle nesting activity on the North West Cape. The spatial and temporal distributions of nesting activities have been established along with predation impacts and human disturbance information. A significant loggerhead turtle rookery on the mainland of the Ningaloo coast has been identified at Bungelup. A targeted fox baiting program has resulted in the reduction of fox presence and predation along important turtle rookeries along the North West Cape. Monitoring of fox presence and predation along Janes Bay and Batemans Bay has identified a significant threat to endangered loggerhead turtles and established that a limited baiting program has had an effect. The need to now implement a comprehensive baiting program has been confirmed. The rescue of 49 mature female turtles from stranding in the sand dunes over the duration of the program has provided an added benefit to populations of recovering marine turtles.

The Jurabi Turtle Centre commenced operations in 2004/2005. Education and interpretive information presented at the centre during turtle nesting season has provided a focus for turtle tourism along the Jurabi coast. It has been determined that education and interpretation alone does not change human behaviour and further development of the management of visitor-turtle interactions will be an outcome from this season.

The capacity building and outreach component has resulted in the identification of a flatback turtle rookery in Port Hedland not previously recorded. It has facilitated community turtle monitoring programs in the Pilbara and generated education and awareness towards marine turtle conservation in Pilbara communities.

The partnership between Cape Conservation Group, Department of Conservation and Land Management and WWF has been strengthened further and has provided a model in demonstrating the importance of partnerships in the area of biodiversity conservation and management and the effectiveness in community monitoring. Long-term commitments from funding bodies, agencies and the community will be crucial to the overall long-term success of the NTP.

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# 10.0 Glossary

| | |
|---|---|
| Anecdotal | Consisting of or based on second hand accounts rather than scientific investigation. |
| CALM | Department of Conservation and Land Management, Western Australia |
| CCG | Cape Conservation Group, Exmouth Western Australia |
| Effort | The number of days and sections monitored throughout the identified days of the program |
| False Crawl | An emergence that has not resulted in a nest. |
| Hatchling | Newly hatched turtle; yolk sac or umbilical cord still visible. |
| Index | To be a sign or indicator of trends |
| IUCN | World Conservation Union |
| JTC | Jurabi Turtle Centre |
| MU | Murdoch University |
| Nesting success | The number of successful nests as a percentage of total emergences |
| NHT | Natural Heritage Trust |
| NMP | Ningaloo Marine Park |
| NTP | Ningaloo Turtle Program |
| NCTMP | Ningaloo Community Turtle Monitoring Program |
| OHS | Occupational Health and Safety |
| Rookery | A breeding area for a large number of animals |
| Successful nest | An emergence that has resulted in a nest |
| Spatial distribution | Geographical location of turtle nesting activities |
| Stochastic | Involving or showing random behaviour |
| Temporal trend | Time periods and shifts demonstrating when nesting activities take place. |
| Threatened species | Any species likely to become an endangered species within the near future throughout all or a significant portion of its range. |
| VRM | Visitor Risk Management |
| WWF | WWF Australia |

# 11.0 Appendices

## 11.1 Summary of all Recommendations

**Ningaloo Community Turtle Monitoring Program**

### 1. Monitoring

Continue to monitor nesting activity:

a. On the North West Cape to obtain long-term trends related to turtle populations, specifically in the Lighthouse, Hunters and Graveyards sections which are important rookeries.

b. Continue to monitor nesting activity in Bungelup section to indicate loggerhead nesting and population trends.

c. Continue to monitor nesting activity for a further 13 week period in the 2005/2006 season to further verify weeks 4-11 as being the period where 55% of the total nests are laid.

d. Consider reducing the monitoring season to define a cost effective and statistically rigorous program monitoring index beaches for an established index time period.

e. Develop data collection on turtle rescues, specifically the locations and consider rescues as a future objective of the NCTMP.

f. Review human impact data collection as an objective of the NCTMP.

### 2. Fox Control

Fox baiting and fox monitoring:

a. Maintain 1080 fox baiting on Five Mile section and continue to monitor for fox presence and predation in all sections of the North West Cape Division.

b. Implement a targeted fox baiting program in the Bundera Coastal Park and Bungelup section in the Cape Range National Park and monitor fox presence and predation.

c. Continue 1080 fox baiting in the Batemans Bay section and monitor for fox presence and predation in all sections of the in Coral Bay Division.

d. Continue with and urgently upgrade the current 1080 fox baiting program to include the whole coastal strip adjacent to Janes Bay.

### 5. Human Impacts and Recreation

a. Continue to manage visitor-turtle interactions through education and interpretive activities at the Jurabi Turtle Centre and nearby nesting beaches in collaboration with all stakeholders.

b. Refine and develop the visitor impact monitoring method used at the Jurabi Turtle Centre to obtain information on human disturbance.

c. Support the development of a sustainable turtle ecotourism industry of the North West Cape.

d. Review car park locations at Jacobz, Jansz, Wobiri and Five Mile to consider the impacts of car headlights on turtle nesting activities.

### 3. Research

Encourage further research projects into:

a. Impacts and compliance of human activities on turtle nesting beaches of the North West Cape

b. Comparisons between nesting success and environmental data.

c. Migration and foraging habits of turtles nesting on the North West Cape by facilitating a satellite tagging program in conjunction with the NCTMP.

d. Accuracy of differentiation of Loggerhead and Hawksbill tracks.

## Jurabi Turtle Centre

(These recommendations are based on outcomes and recommendations made in the JTC Season Report 2004/2005 and are to be interpreted in conjunction with the centre's overall goals as detailed in the JTC Draft Business and Operational Plan, 2004-2009):

1. In consultation with commercial tour operators, modify the delivery and content of the JTC product to maximise the value of interpretation and education for visitors and effectively manage visitor- turtle interactions on beaches adjacent to JTC.
2. Develop methods to assess non-compliance with the turtle watcher's code of conduct and examine options to reduce turtle disturbance by turtle watchers.
3. Continue to monitor the effectiveness of education at the centre, the impact of turtle observations on nesting turtles, the needs of visitors and the requirements of volunteers to promote turtle conservation and turtle ecotourism on the North West Cape.

## Community Monitoring Expansion and Outreach

1. Continue to monitor Cemetery Beach in season 2005/2006 to obtain long term trends related to flatback turtle populations.
2. Develop and extend training and capacity building in Cape Lambert and build on efforts in Port Hedland in the Pilbara to facilitate effective community monitoring of turtle nesting activity in these areas.

## Ningaloo Volunteers and Coordination

1. Continue to recruit volunteers through websites, advertisements and media opportunities. Concentrate on increasing local participation and conduct targeted recruitment at universities in Perth to ensure high numbers of participants in the program.
2. Streamline monitoring training procedures to provide definitive start dates to provide a formalised roster for trainers and volunteers and limit the strain on individuals donating their expertise.
3. To promote greater presence on the beach at night by Turtle Scouts, the Turtle Scout training workshops could be marketed and conducted at the beginning in the season and two others to coincide with major influxes of volunteers

4. Additional budgetary resources and/or external funding are required to provide high quality training for volunteers at the JTC.
5. Consider subsidising volunteer accommodation through a local provider to facilitate day to day duties and resolve insurance and duty of care issues by engaging an established business. This also alleviates the need for accommodation inspections and rent collection.
6. Consider the use of a dedicated vehicle to transport volunteers for the morning monitoring and evening educational activities for the duration of the program, to overcome the identified transport problems
7. Transfer all coordination of volunteers and the day to day operations of the Jurabi Turtle Centre to the turtle coordinator and rely on the education officer to oversee the overall running of the JTC and facilitate training.
8. Continue to develop the internship program as an excellent opportunity for students to gain field experience in a conservation program.
9. Introduce an indigenous internship opportunity into the program to encourage indigenous involvement and capacity building in local communities.

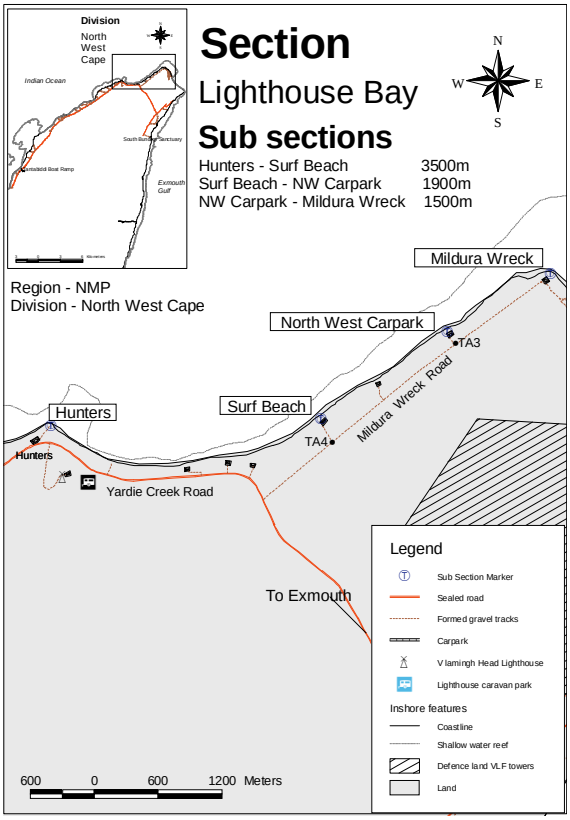
**Communication**

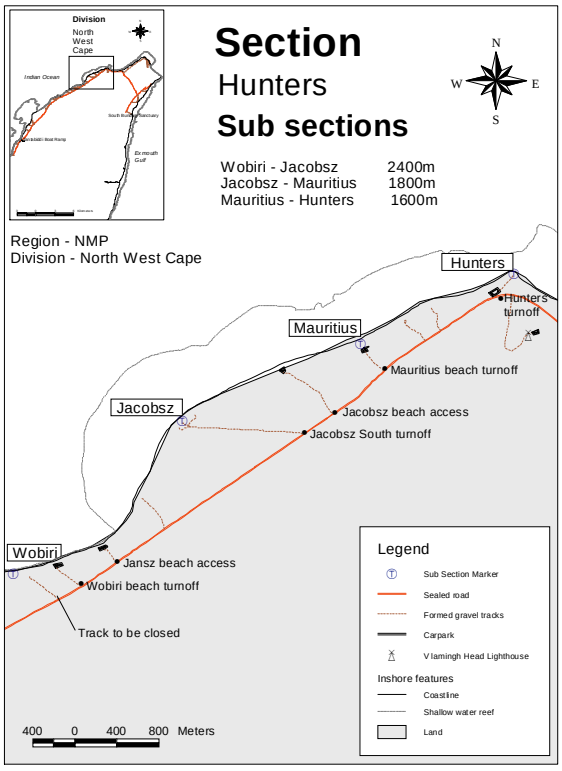
1. Conduct targeted recruitment seminars to encourage participation from relevant groups.

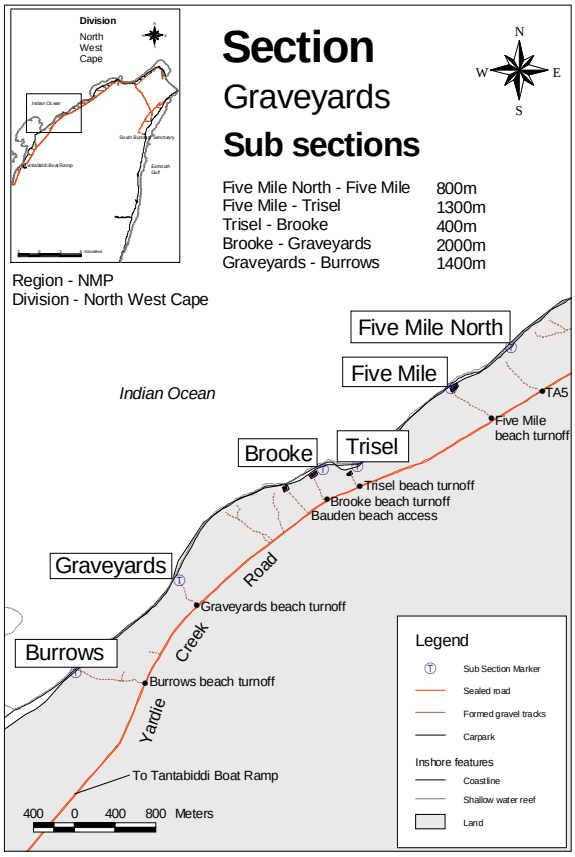
**Finance**

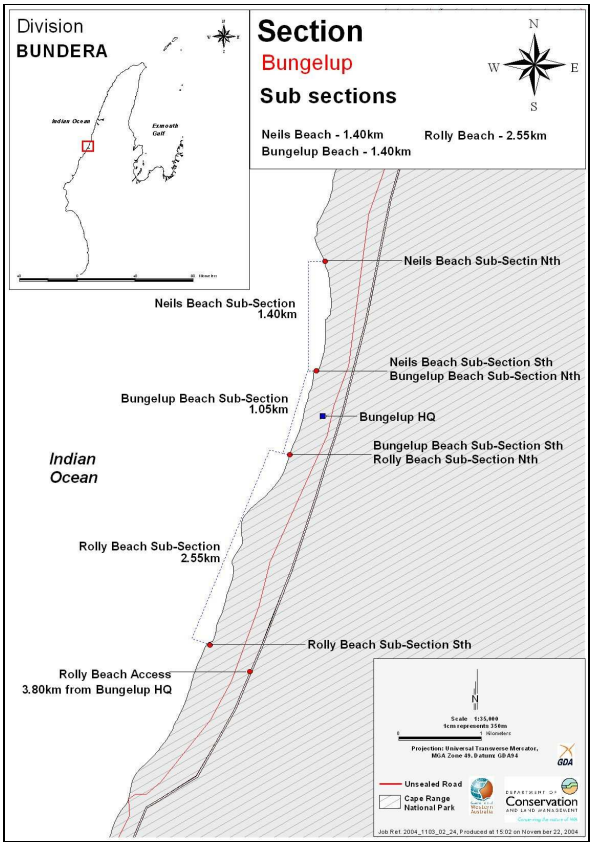
1. Investigate self funding options by introducing a minimal charge to volunteers for participation in the program and training received.

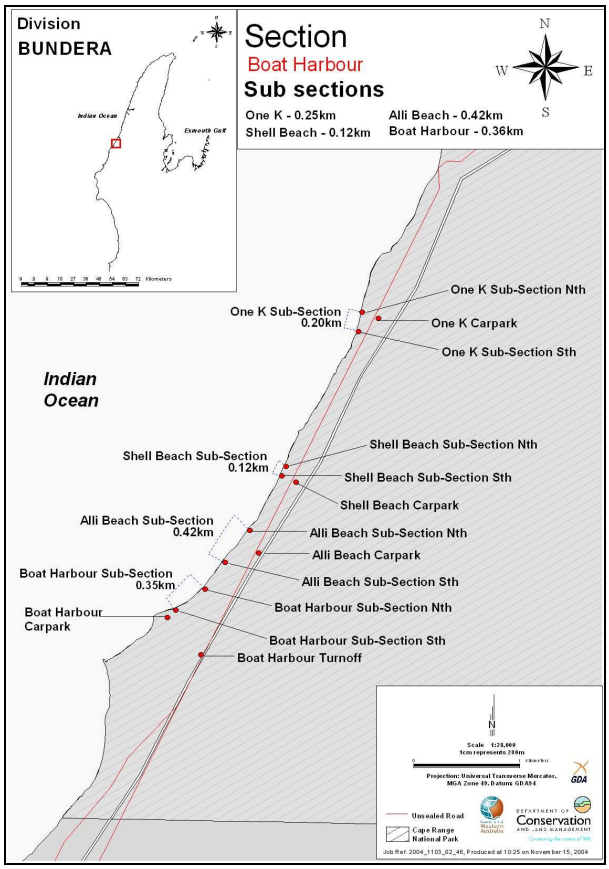
## 11.2 Maps of Sections and Subsections monitored in the North West Cape and Bundera Divisions in 2004/2005.

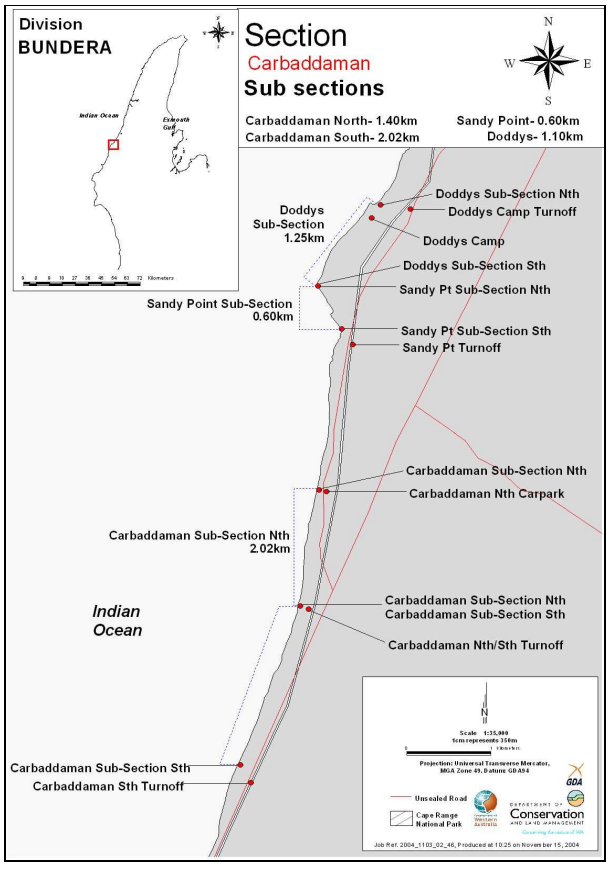


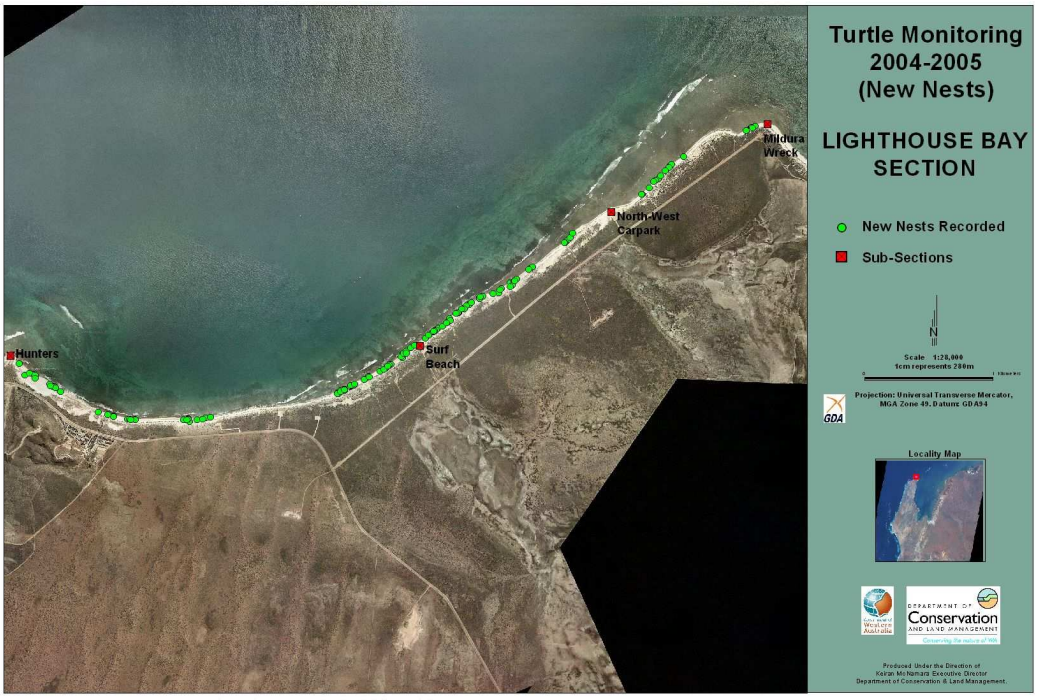

Division
North West Cape
Section
Graveyards
Sub sections
Five Mile North - Five Mile 800m
Five Mile - Trisel 1300m
Trisel - Brooke 400m
Brooke - Graveyards 2000m
Graveyards - Burrows 1400m
N
W
E
S
Region - NMP
Division - North West Cape
Five Mile North
Five Mile
Indian Ocean
TA5
Five Mile beach turnoff
Brooke
Trisel
Trisel beach turnoff
Brooke beach turnoff
Bauden beach access
Graveyards
Road
Graveyards beach turnoff
Creek
Burrows
Burrows beach turnoff
Yardie
To Tantabiddi Boat Ramp
400 0 400 800 Meters
Legend
Sub Section Marker
Sealed road
Formed gravel tracks
Carpark
Inshore features
Coastline
Shallow water reef
Land

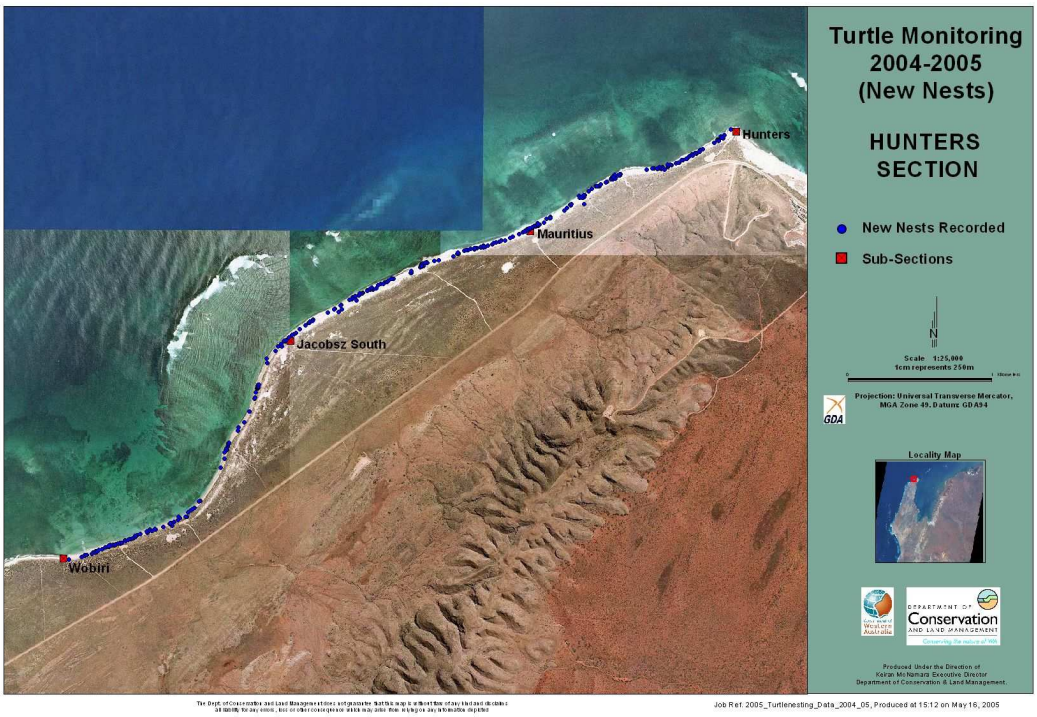

Division
BUNDERA
Section
Bungelup
Sub sections
Neils Beach - 1.40km
Bungelup Beach - 1.40km
Rolly Beach - 2.55km
N
W
E
S
Neils Beach Sub-Sectin Nth
Neils Beach Sub-Section 1.40km
Neils Beach Sub-Section Sth
Bungelup Beach Sub-Section Nth
Bungelup Beach Sub-Section 1.05km
Bungelup HQ
Bungelup Beach Sub-Section Sth
Rolly Beach Sub-Section Nth
Indian Ocean
Rolly Beach Sub-Section 2.55km
Rolly Beach Sub-Section Sth
Rolly Beach Access 3.80km from Bungelup HQ
Unsealed Road
Cape Range National Park
Conservation

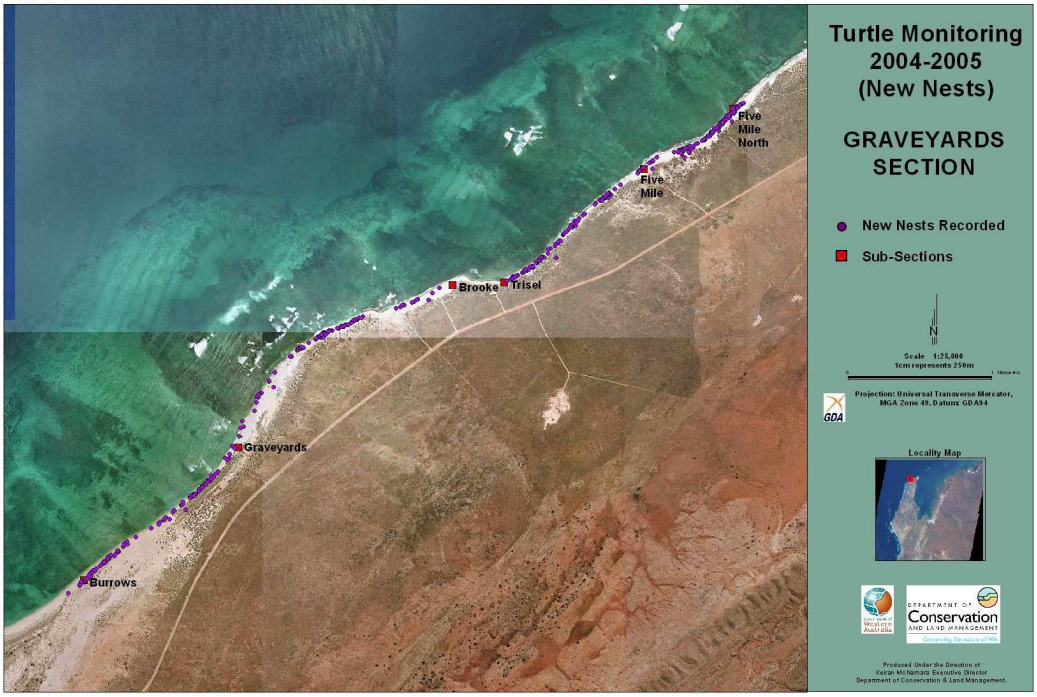

Division
BUNDERA
Indian Ocean
Exmouth Gulf
Section
Boat Harbour
Sub sections
One K - 0.25km
Shell Beach - 0.12km
Alli Beach - 0.42km
Boat Harbour - 0.36km
N
W
E
S
One K Sub-Section Nth
One K Sub-Section
0.20km
One K Carpark
One K Sub-Section Sth
Indian
Ocean
Shell Beach Sub-Section Nth
Shell Beach Sub-Section
0.12km
Shell Beach Sub-Section Sth
Shell Beach Carpark
Alli Beach Sub-Section
0.42km
Alli Beach Sub-Section Nth
Alli Beach Carpark
Boat Harbour Sub-Section
0.35km
Alli Beach Sub-Section Sth
Boat Harbour Sub-Section Nth
Boat Harbour
Carpark
Boat Harbour Sub-Section Sth
Boat Harbour Turnoff
Scale 1:25,000
1cm represents 250m
Projection: Universal Transverse Mercator,
MGA Zone 49, Datum: GDA94
GDA
Unsealed Road
Cape Range
National Park
Conservation
Job Ref: 2004_1103_02_46, Produced at 10:25 on November 15, 2004


Division
BUNDERA
Indian Ocean
Exmouth Gulf
Section
Carbaddaman
Sub sections
Carbaddaman North- 1.40km
Carbaddaman South- 2.02km
Sandy Point- 0.60km
Doddys- 1.10km
N
W
E
S
Doddys Sub-Section Nth
Doddys
Sub-Section
1.25km
Doddys Camp Turnoff
Doddys Camp
Doddys Sub-Section Sth
Sandy Pt Sub-Section Nth
Sandy Point Sub-Section
0.60km
Sandy Pt Sub-Section Sth
Sandy Pt Turnoff
Carbaddaman Sub-Section Nth
Carbaddaman Nth Carpark
Carbaddaman Sub-Section Nth
2.02km
Indian
Ocean
Carbaddaman Sub-Section Nth
Carbaddaman Sub-Section Sth
Carbaddaman Nth/Sth Turnoff
Carbaddaman Sub-Section Sth
Carbaddaman Sth Turnoff
Scale 1:35,000
1cm represents 350m
Projection: Universal Transverse Mercator,
MGA Zone 49, Datum: GDA94
GDA
Unsealed Road
Cape Range
National Park
Conservation
Job Ref: 2004_1103_02_46, Produced at 10:25 on November 15, 2004

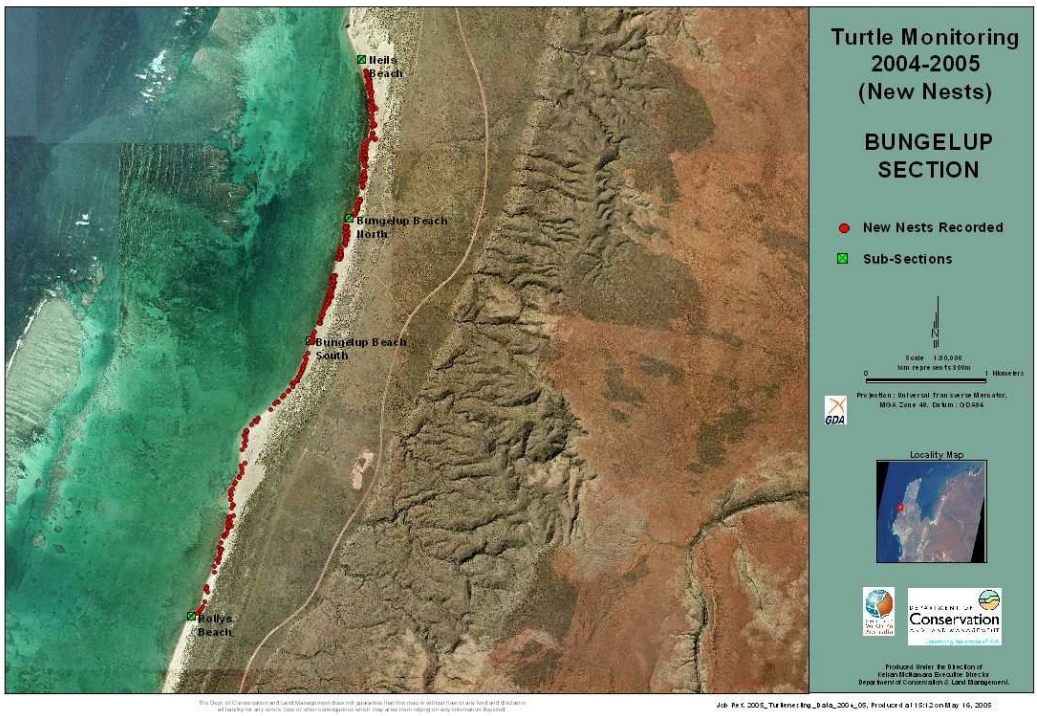
## 11.3 GIS maps of New Nests in the sections of the North West Cape Division in 2004/2005

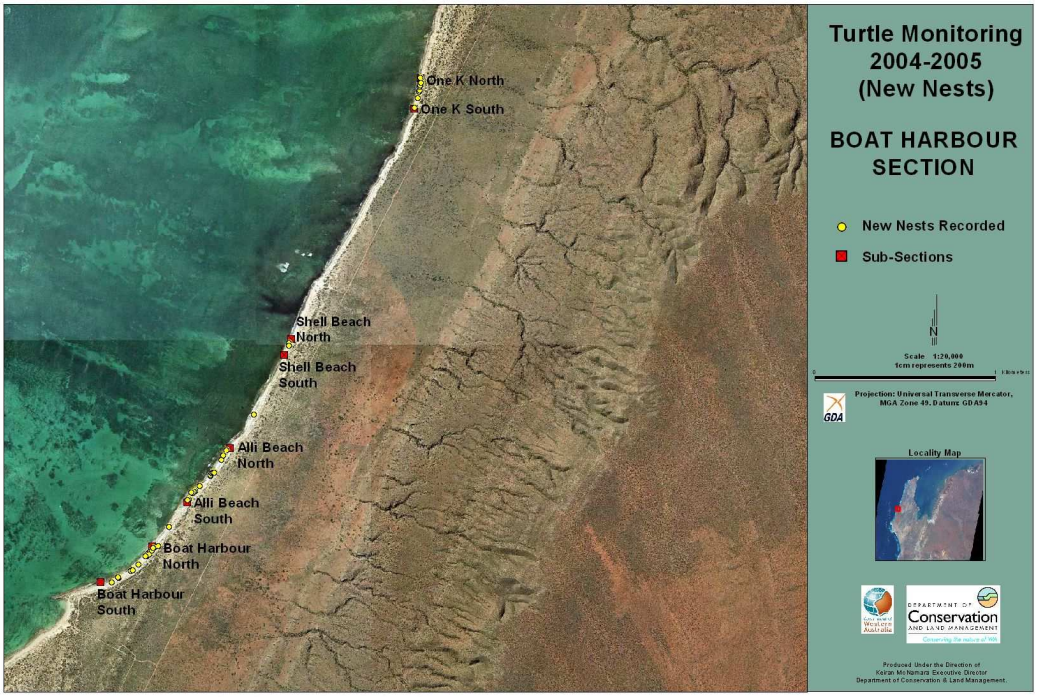


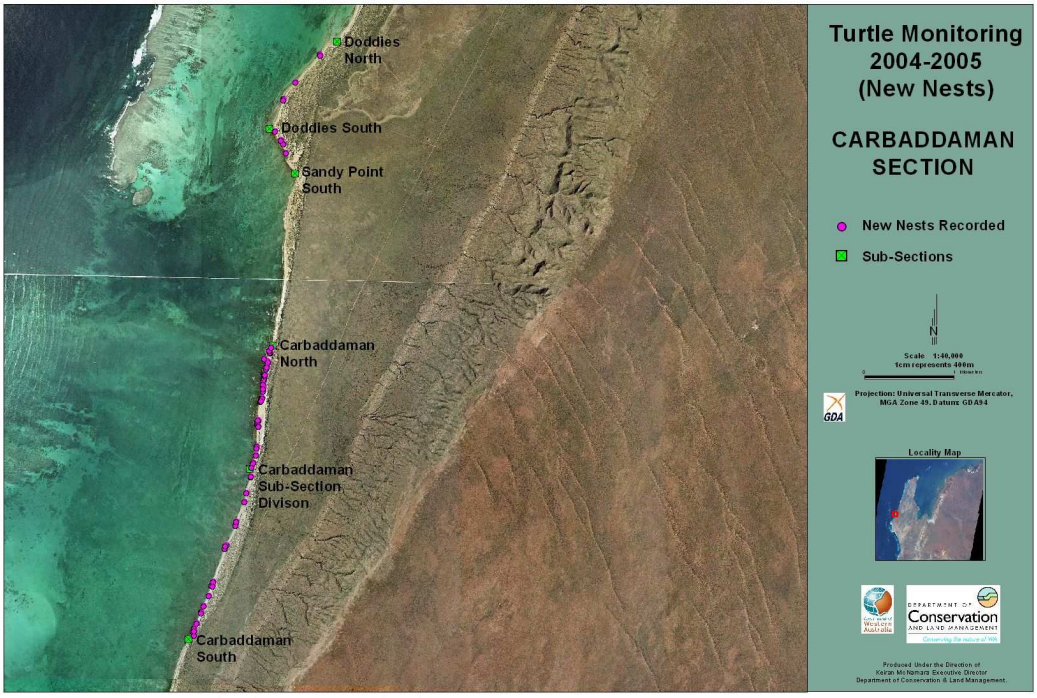





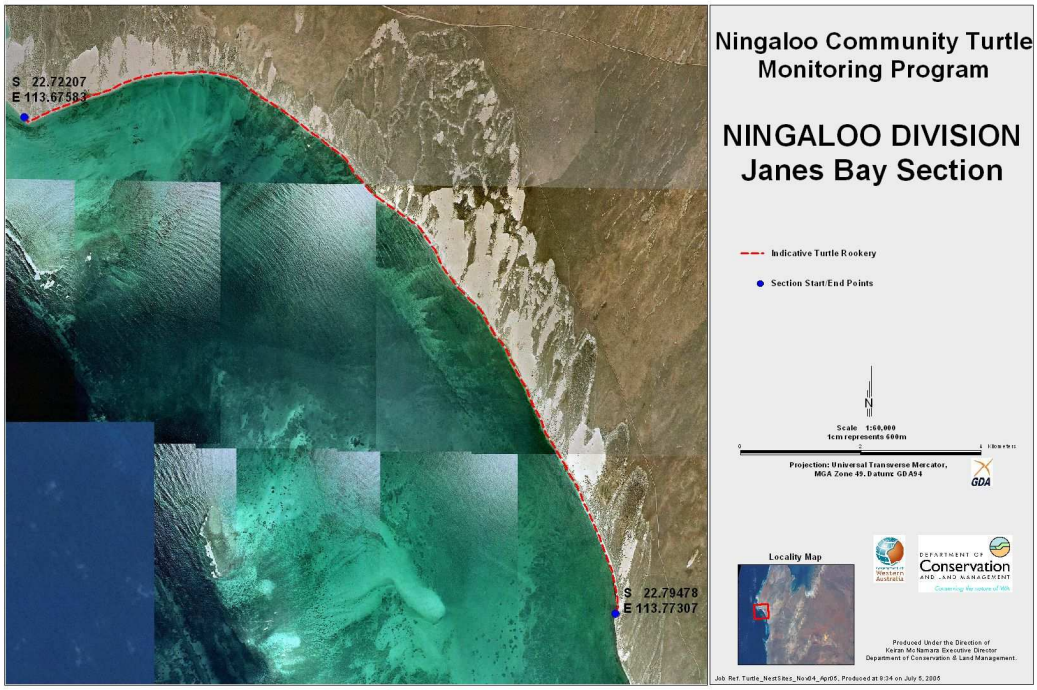

## 11.4 GIS maps of New Nests in the sections of the Bundera Division in 2004/2005



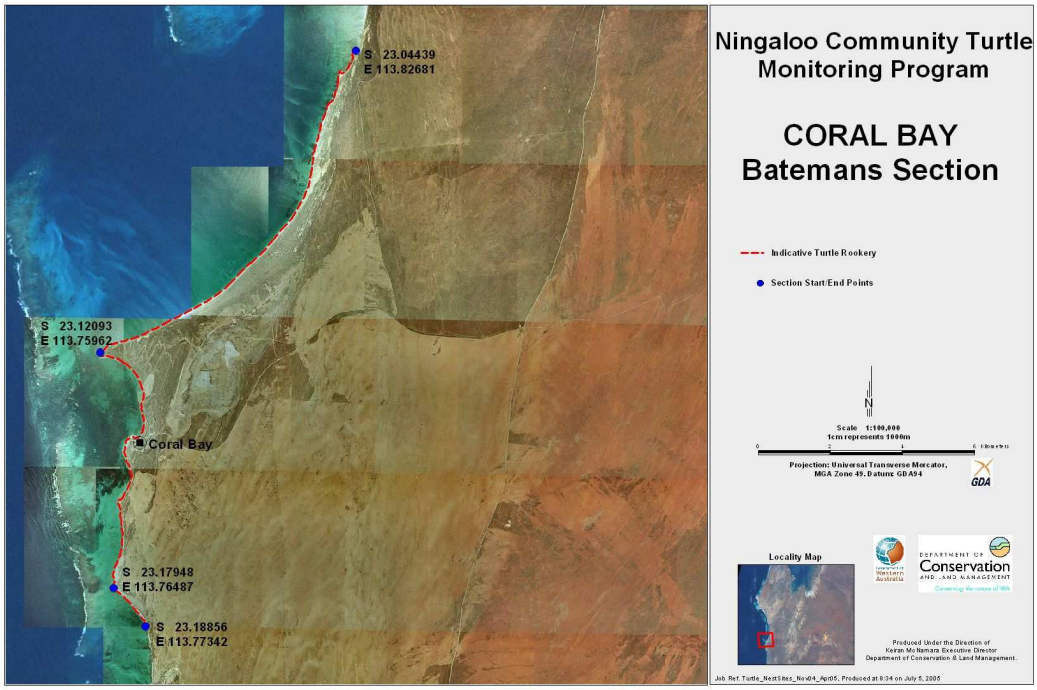

One K North
One K South
Shell Beach North
Shell Beach South
Alli Beach North
Alli Beach South
Boat Harbour North
Boat Harbour South
Turtle Monitoring 2004-2005 (New Nests)
BOAT HARBOUR SECTION
New Nests Recorded
Sub-Sections
N
Scale 1:20,000
1cm represents 200m
Projection: Universal Transverse Mercator, MGA Zone 49, Datum: GDA94
GDA
Locality Map
Conservation
AND LAND MANAGEMENT
Produced Under the Direction of
Keiran McNamara Executive Director
Department of Conservation & Land Management.
Job Ref: 2005_Turtlenesting_Data_2004_05, Produced at 15:12 on May 16, 2005


Doddies North
Doddies South
Sandy Point South
Carbaddaman North
Carbaddaman Sub-Section Divison
Carbaddaman South
Turtle Monitoring 2004-2005 (New Nests)
CARBADDAMAN SECTION
New Nests Recorded
Sub-Sections
N
Scale 1:40,000
1cm represents 400m
Projection: Universal Transverse Mercator, MGA Zone 49, Datum: GDA94
GDA
Locality Map
Conservation
AND LAND MANAGEMENT
Produced Under the Direction of
Keiran McNamara Executive Director
Department of Conservation & Land Management.
Job Ref: 2005_Turtlenesting_Data_2004_05, Produced at 15:12 on May 16, 2005

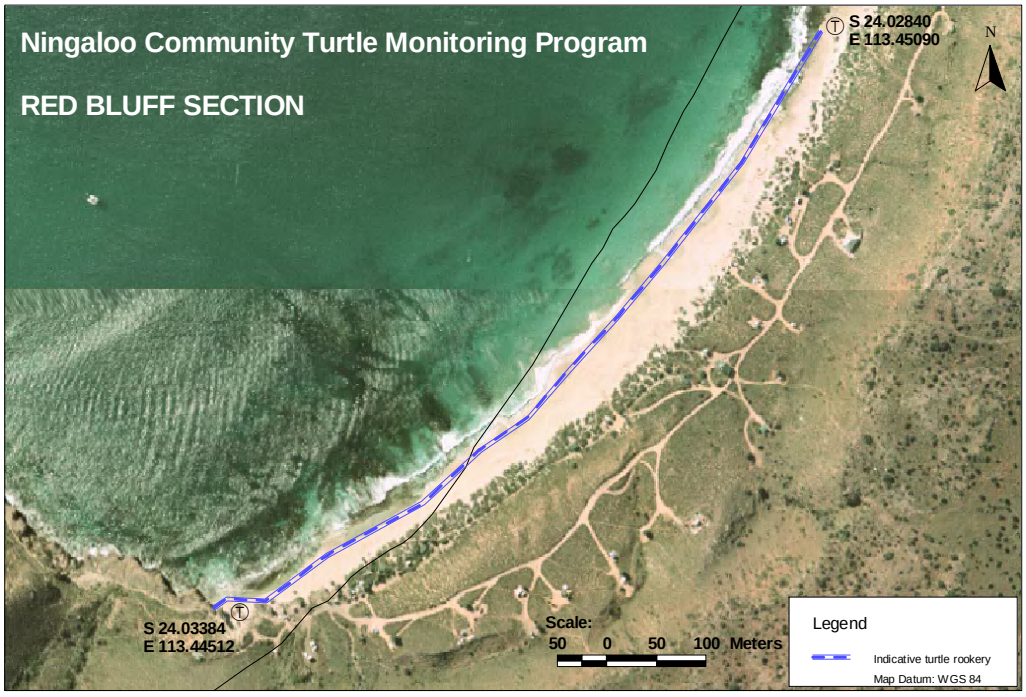
## 11.5 GIS map of the boundaries of the Janes Bay Section




## 11.6 GIS map of sections of the Coral Bay Division



## 11.7 GIS map of boundaries of the Red Bluff Division



## 11.8 Photos of Threats to Turtles

**Figure 58: Stomach contents of a trapped European Fox in the Pilbara Photo: Courtesy Mike Butcher, Animal Pest Management Services**

**Figure 59: Turtle fatally disorientated and stranded in the dunes.**