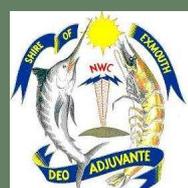


Ningaloo Turtle Program Western Australia

Annual Report 2005-2006

(Prepared June 2006)



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Executive Summary

The 2005/2006 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 again expanded from previous seasons with further increases in:

- the number of volunteers' hours contributed;
- geographical areas monitored;
- number of days monitored; and
- number of nights of educational activities were held at the JTC.

The Ningaloo Turtle Program has continued to grow with the expansion of community turtle monitoring to other regions in the Pilbara.

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

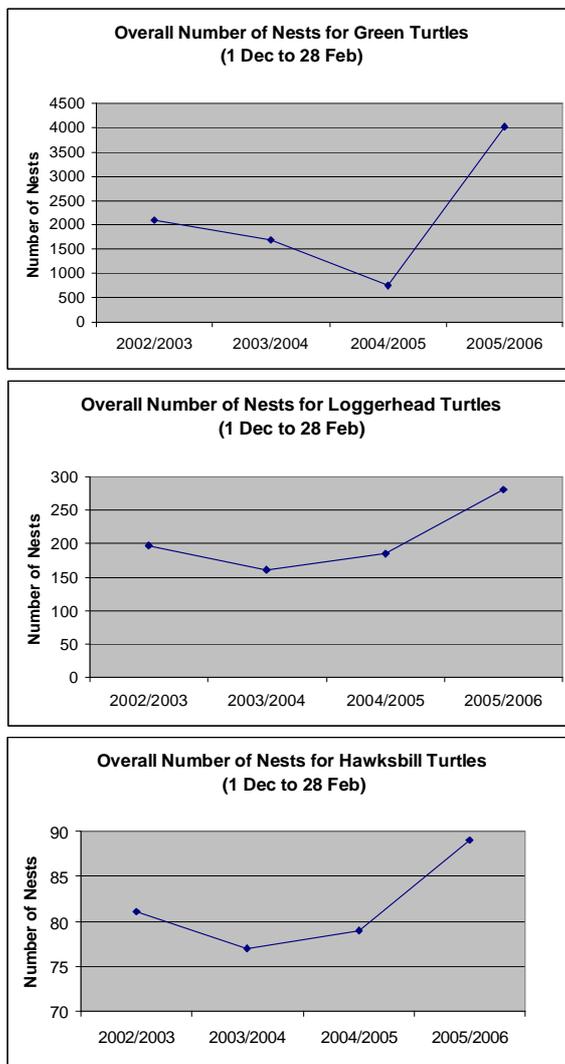


Figure 1: Numbers of Nests for Green, Loggerhead and Hawksbill Turtles in the North West Cape Division for four consecutive turtle nesting seasons.

- 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 and monitored.
- The abundance of turtle nesting activities over specified time intervals has been determined and monitored.
- A significant loggerhead turtle rookery on the mainland of the Ningaloo coast has been identified at Bungelup in the Cape Range National Park and monitored for trends involving loggerhead turtles.
- 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 108 mature female turtles from stranding in the sand dunes over the four seasons has provided an added benefit to populations of recovering marine turtles.

The Jurabi Turtle Centre commenced operations in 2004/2005 and continued development during the 2005/2006 nesting season. 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 that the impacts of commercial tour operators can influence operational objectives. Further development of the management of visitor-turtle interactions is an outcome from this season.

The capacity building and outreach component has resulted in monitoring of flatback rookeries at Port Hedland and flatback and hawksbill rookeries at Wickham. 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 four years of monitoring and data analysis and two seasons of operations at the JTC, the following recommendations can be made:

Recommendations

1. Monitoring

- a. Monitor the Graveyards-Hunters-Lighthouse sections to obtain long-term trends related to turtle populations.
- b. Monitor the Jurabi Point sub-section in all future monitoring programs at the North-West Cape Division.
- c. Monitor nesting activity in Bungelup section to indicate loggerhead nesting and population trends.
- d. Monitor nesting activity for a 13 week period in the 2006/2007 season to further verify weeks 4-11 as being the period where 53% of the total nests are laid.
- e. Define a cost effective and statistically rigorous monitoring program based on spatial and temporal nesting data obtained to date.
- f. Consider Hunters and Graveyards sections as high risk beaches for Turtle strandings and rescues during the turtle nesting season.

2. Fox Control

- 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. Maintain a 1080 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 1080 fox baiting program and monitor for fox presence and predation in 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. Impacts of windsurfing, kite surfing and visitor disturbance at the key green turtle mating location on North-West Cape in September to November each season.
- c. Migration and foraging habits of turtles nesting on the North West Cape by facilitating a satellite tagging program in conjunction with the NTP.
- d. Accuracy of Loggerhead/Hawksbill species identification through track observation.
- e. Continue to provide tag information to the West Australian Marine Turtle Tagging Program.
- f. Effectiveness of education programs in reducing visitor disturbances.

- g. The impacts of vehicle lights on turtle nesting success at Jacobsz, Jansz and Wobiri access carparks.
- h. The influence of El Nino on seasonal nesting activities at Ningaloo.
- i. Investigation of nesting beach dynamics such as beach sand temperatures and hatchling sex ratios.
- j. Modelling climate change impacts on turtle populations.

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. 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.

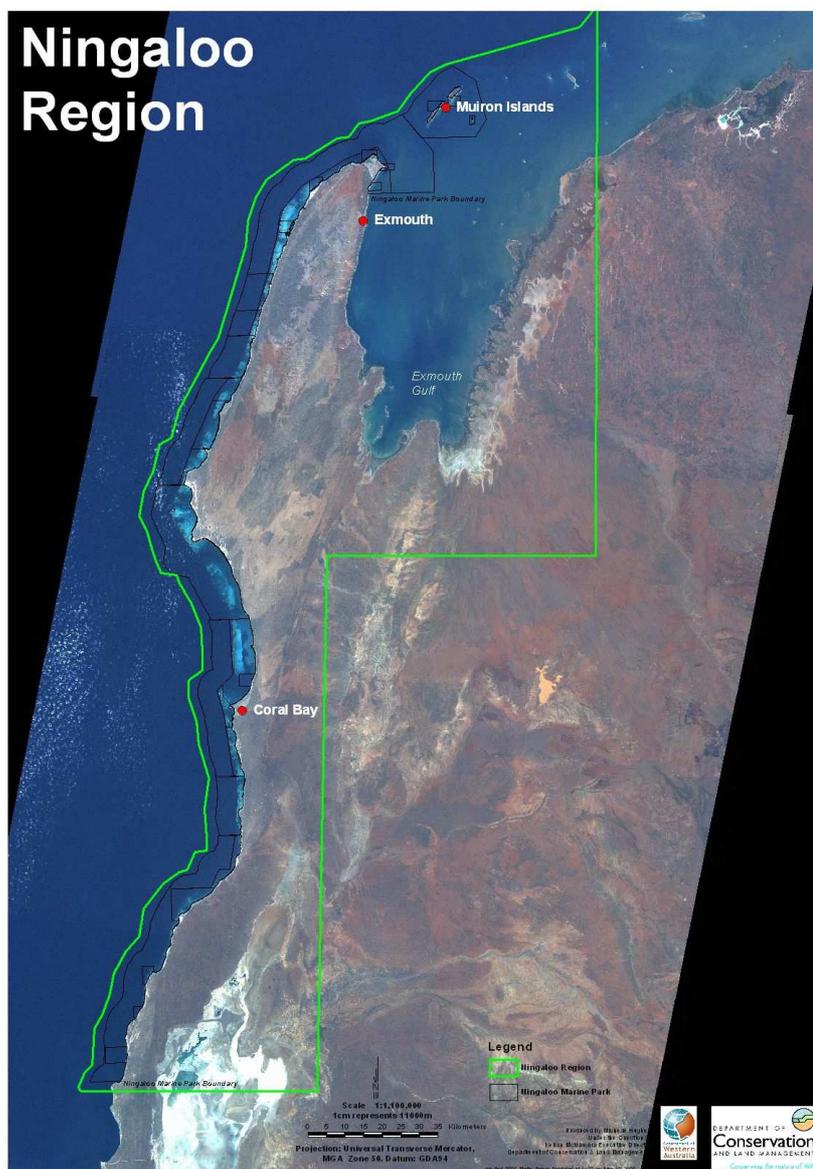


Figure 2: Map of the Ningaloo Region

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 travel 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 indo-pacific 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 or degradation of habitat of 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) 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:

- 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.

1.4 Ningaloo Community Turtle Monitoring Program

Background

The Cape Conservation Group (CCG), Department of Conservation and Land Management (CALM) Exmouth District and Murdoch University (MU) formally established the Ningaloo Community Turtle Monitoring Program in 2002, with the assistance of a Threatened Species Network¹ 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 corresponding high visitation specifically during the low season from November to March (see Figure 3), which relates 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.

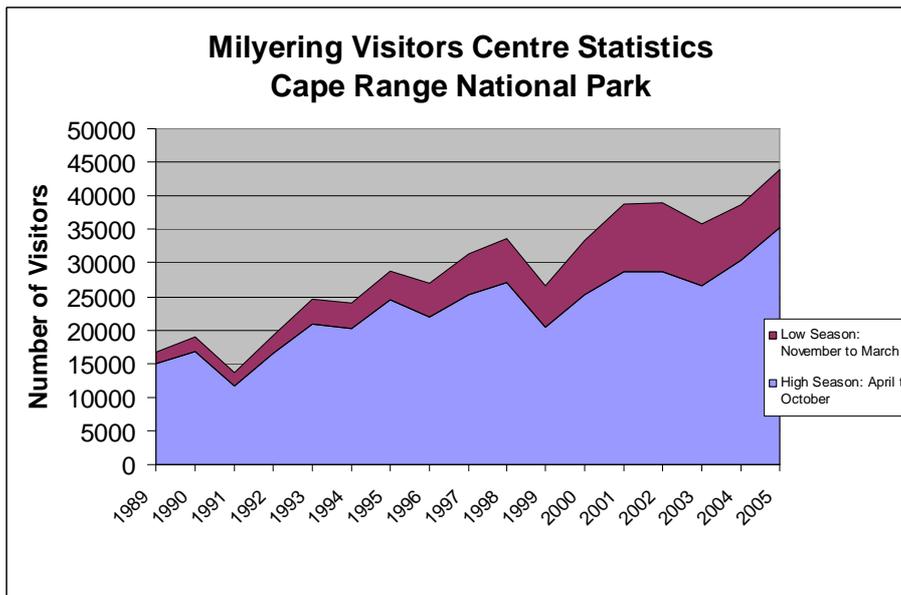


Figure 3: Milyering Visitor Centre visitor numbers for sixteen years including high and low seasons.

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.

The Ningaloo Turtle Program is the recipient of an NHT Regional Competitive Component grant to deliver “Community Turtle Conservation through Cross-Regional Collaboration”. The purpose of this project is to share knowledge across Australia on marine turtle monitoring, beach-based turtle tourism and the development of standardised education and interpretation materials for community awareness. The methodology will increase the capacity of groups to deliver standardised nesting-beach monitoring data that can contribute to national knowledge.

2.0 The Ningaloo Community Turtle Monitoring Program



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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 the NCTMP Field Guide at 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 presentations at universities in Perth and through, 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).

Aerial Survey methodology

Aerial survey techniques form the first stage in the process of identifying rookeries and providing an indication of relative significance. However, the technique is limited in its accuracy and should therefore be applied as an indicative measure and used in conjunction with ground-truthing methods to confirm species identity through track pattern.

It is recommended to use digital imagery as a technique of counting and identifying turtle tracks from the air. This method only requires a pilot and one observer in the aircraft. Furthermore, a permanent record of turtle activity on nesting beaches can be obtained.

The duration of each flight should not exceed four hours and commence at approximately 0530 hours to take advantage of the angle of the sun, which throws long shadows on the tracks just after rising. The aircraft is positioned at about 45° off the beach at an altitude between 250 and 400 feet and a speed of 50-90 knots (depending on the density of turtle

tracks). In this way, turtle tracks originating from the previous night can be recorded using a digital video camera. The actual position of the tracks was recorded digitally on the videotape using a GPS and Sea Trak™ GPS Video overlay.

The video images were analysed using digital editing software that is capable of converting the digital images in to still-frame (using jpeg files) for further analysis. However, due to environmental conditions and movement of the plane, not all tracks were successfully identified.

Aerial surveys should be conducted in the morning after the optimal tide, which is usually a high tide that peaks around midnight (dawn low tide), to maximize track visibility in the early morning flight. This allows new tracks to be distinguished from older tracks.

The aerial survey method is limited in accurately differentiating between alternate and paired track patterns, and the other subtle track differences that differentiate greens, loggerheads, flat backs and hawksbills. However, once beaches with high numbers of track counts have been identified from aerial surveys, beach surveys can then be conducted to identify the nesting species, quantify the nesting effort and success, and to verify whether the area under investigation is a significant turtle rookery. The standard operating procedure for the Ningaloo Community Turtle Monitoring Project (NCTMP 2005) method is recommended for this purpose.

The results of the 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.

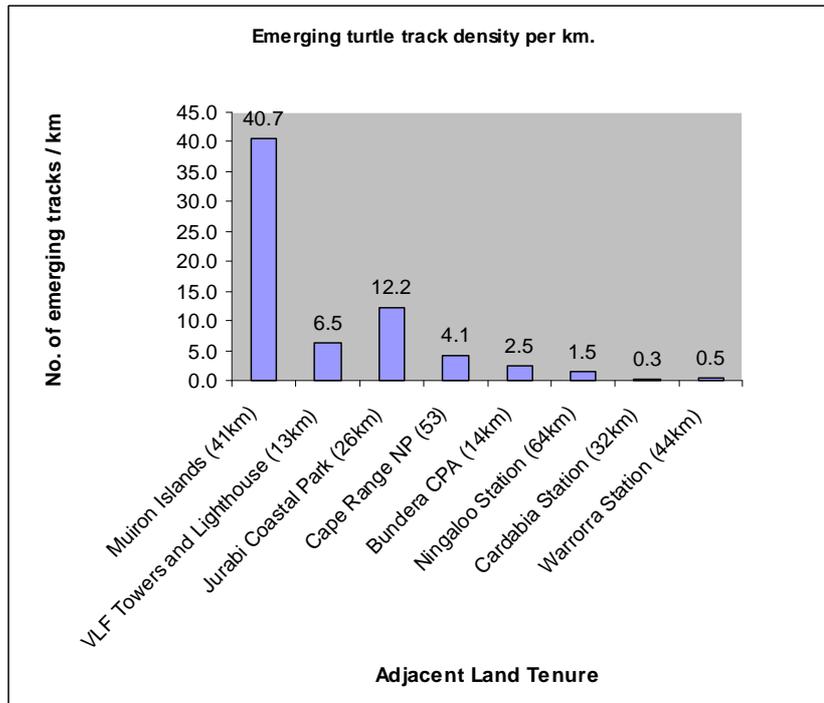


Figure 5: Density of total number of emerging tracks per kilometre of beach, recorded over 6 flying days sorted geographically according to adjacent land tenure. (Note: This does not account for the actual areas of suitable nesting beach within the land tenure)

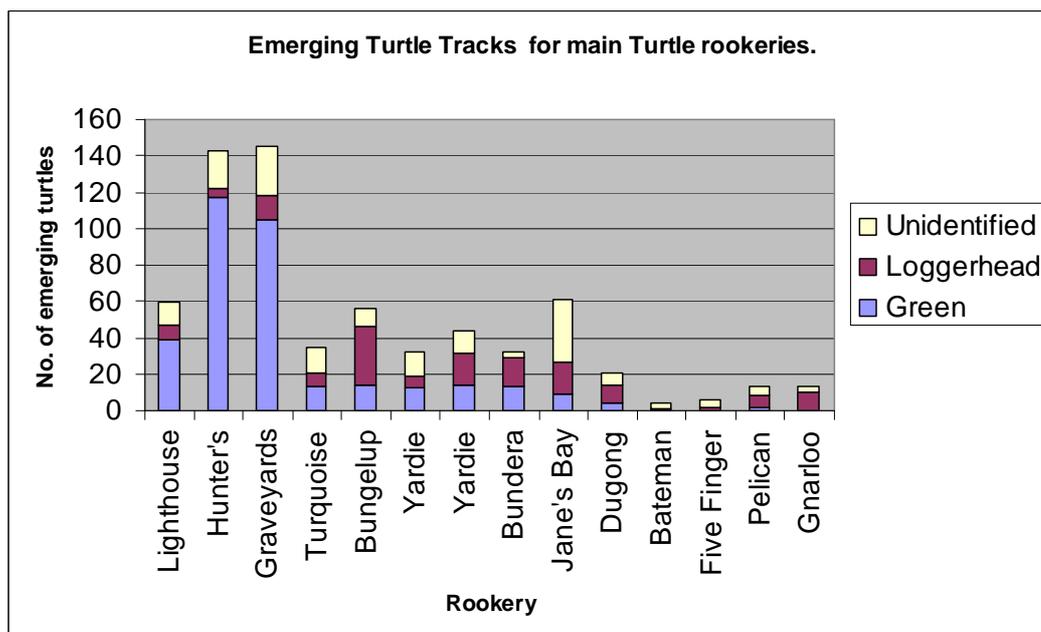


Figure 6: Total Number of emerging tracks recorded over 6 flying days sorted geographically according significant mainland aggregations.

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).

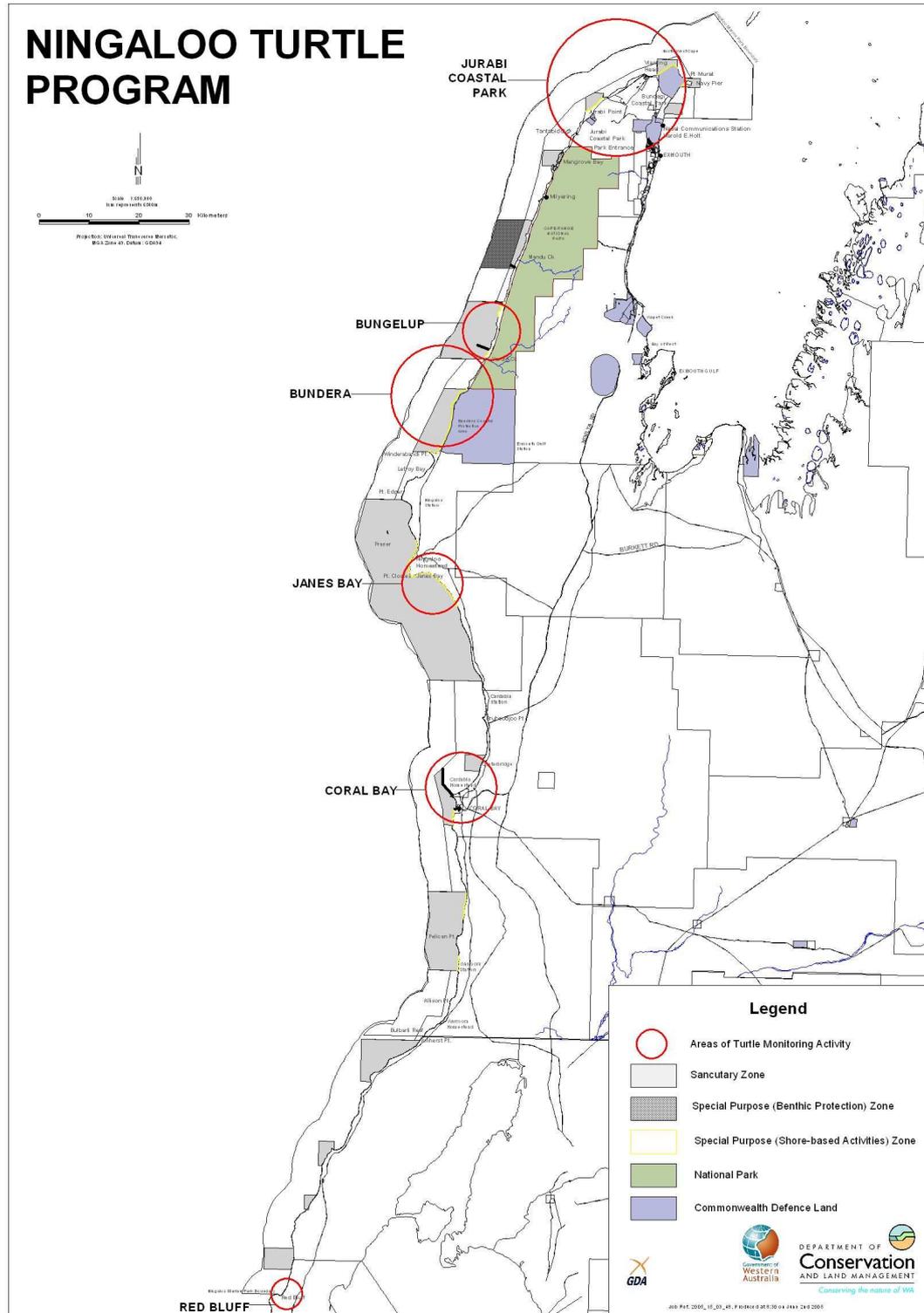


Figure 7: Area of monitoring activities in the Ningaloo region.

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.

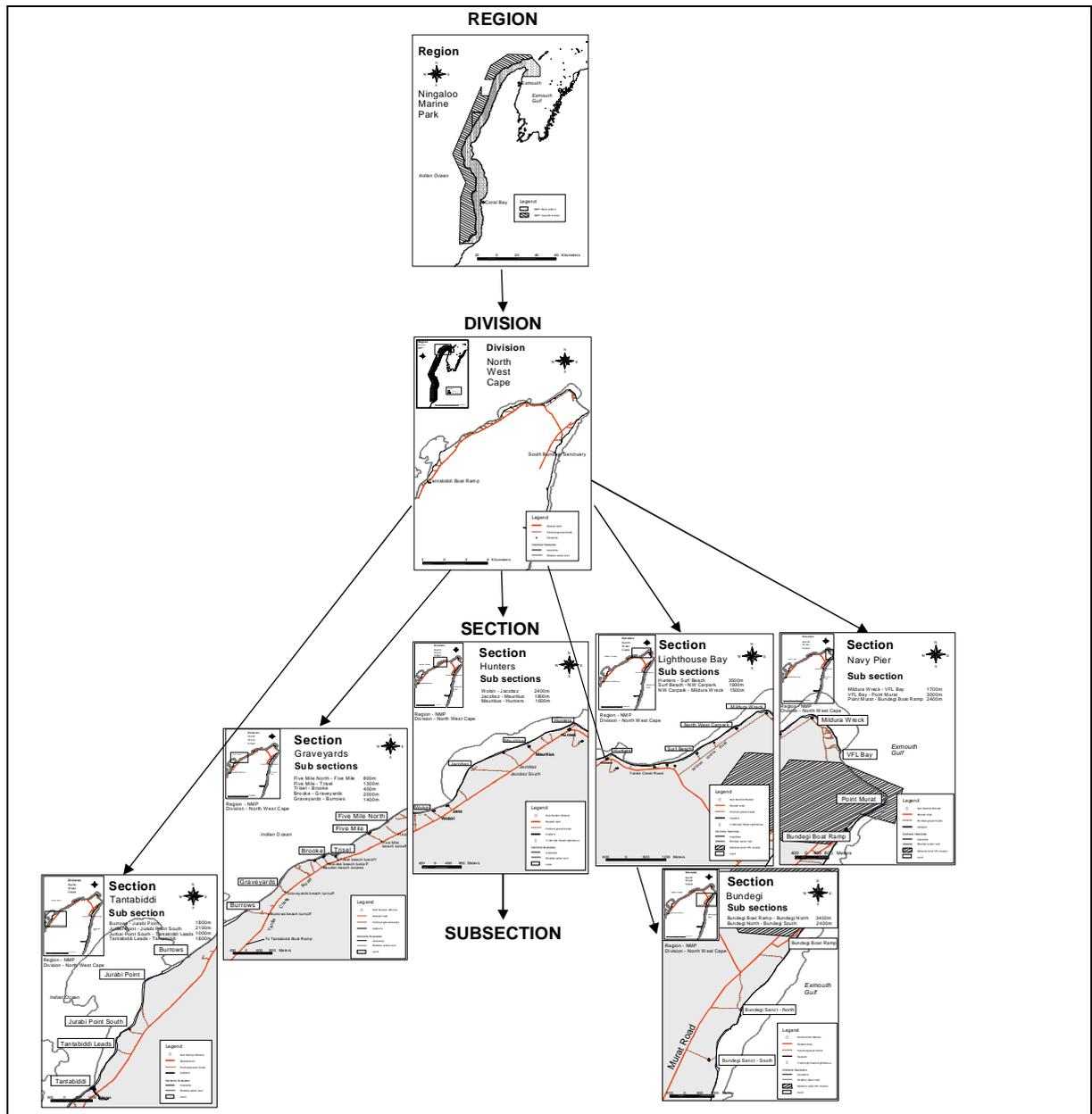


Figure 8: Sections and Subsections of the North West Cape Division

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 and Coral Bay 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.

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 and 2005/2006

| 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 | 9/12/02 | 16/12/02 | 23/12/02 | 30/12/02 | 6/1/03 | 13/1/03 | 20/1/03 | 27/1/03 | 3/2/03 | 10/2/03 | 17/2/03 | 24/2/03 |
| 8/12/02 | 15/12/02 | 22/12/02 | 29/12/02 | 5/1/03 | 12/1/03 | 19/1/03 | 26/1/03 | 2/2/03 | 9/2/03 | 16/2/03 | 23/2/03 | 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 | Week 10 | Week 11 | Week 12 | Week 13 |
| 1/12/03 | 8/12/03 | 15/12/03 | 22/12/03 | 29/12/03 | 5/1/04 | 12/1/04 | 19/1/04 | 26/1/04 | 2/2/04 | 9/2/04 | 17/2/04 | 24/2/04 |
| 7/12/03 | 14/12/03 | 21/12/03 | 28/12/03 | 4/1/04 | 11/1/04 | 18/1/04 | 25/1/04 | 1/2/04 | 8/2/04 | 16/2/04 | 23/2/04 | 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 | 6/12/04 | 13/12/04 | 20/12/04 | 27/12/04 | 3/1/05 | 10/1/05 | 17/1/05 | 24/1/05 | 31/1/05 | 7/2/05 | 14/2/05 | 21/2/05 |
| 5/12/04 | 12/12/04 | 19/12/04 | 26/12/04 | 2/1/05 | 9/1/05 | 16/1/05 | 23/1/05 | 30/1/05 | 6/2/05 | 13/2/05 | 20/2/05 | 28/2/05 |
| 2005/2006 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 |
| 28/11/05 | 5/12/05 | 12/12/05 | 19/12/05 | 26/12/05 | 2/1/06 | 9/1/06 | 16/1/06 | 23/1/06 | 30/1/06 | 6/2/06 | 13/2/06 | 20/2/06 |
| 4/12/05 | 11/12/05 | 18/12/05 | 25/12/05 | 1/1/06 | 8/1/06 | 15/1/06 | 22/1/06 | 29/1/06 | 5/2/06 | 12/2/06 | 19/2/06 | 28/2/06 |

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.

North West Cape Division

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

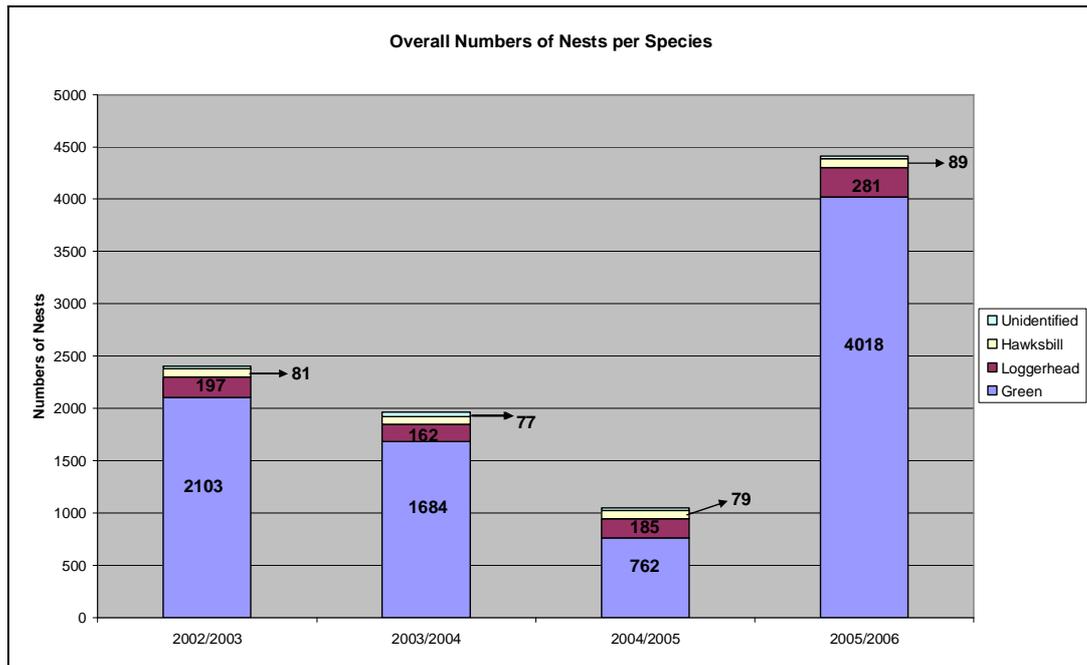


Figure 9: Overall Number of Nests per Species for the North West Cape Division

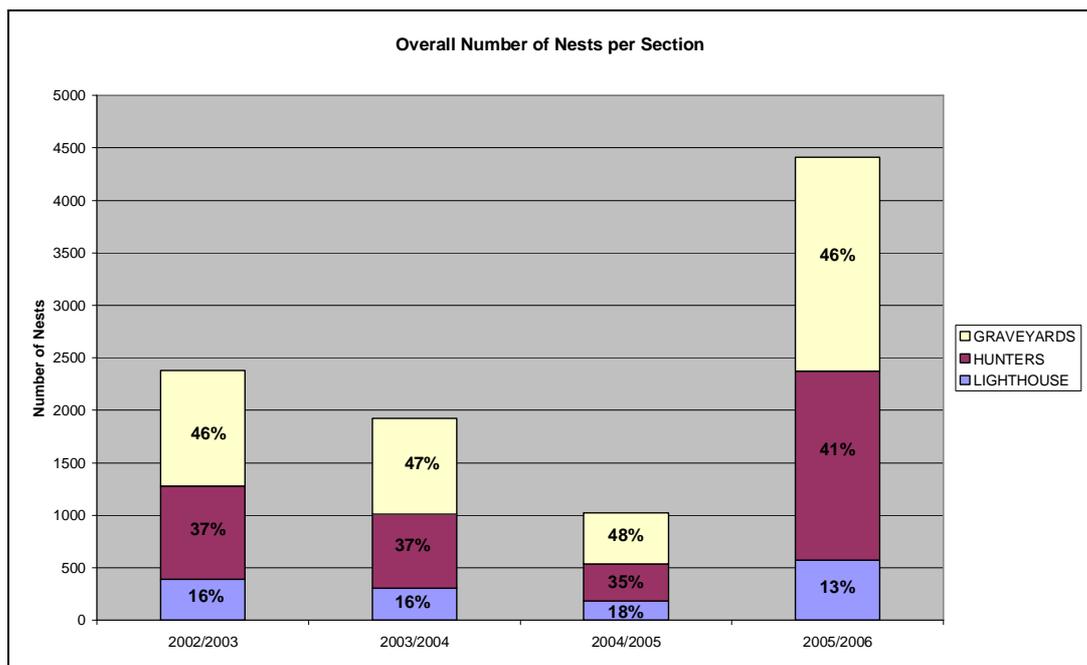


Figure 10: Overall Numbers of Nests per Section for the North West Cape Division

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 four monitoring seasons. The ratio of abundance in each section remains relatively consistent over four years irrespective of the fluctuating abundance of successful nests.

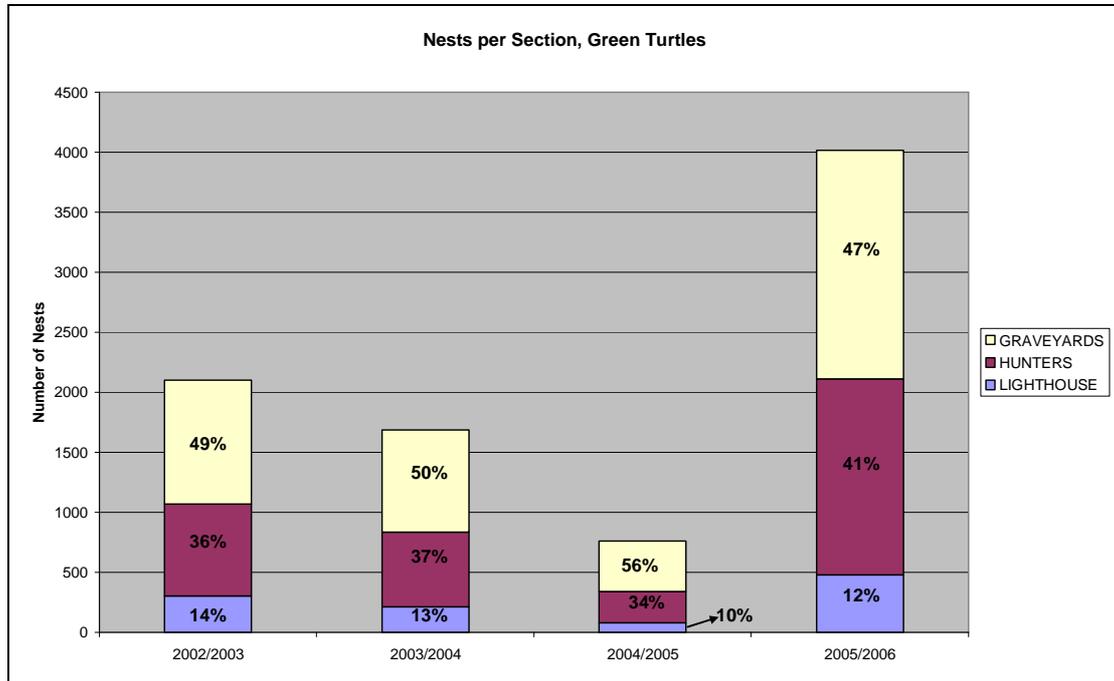


Figure 11: Nest Numbers per section for Green Turtles

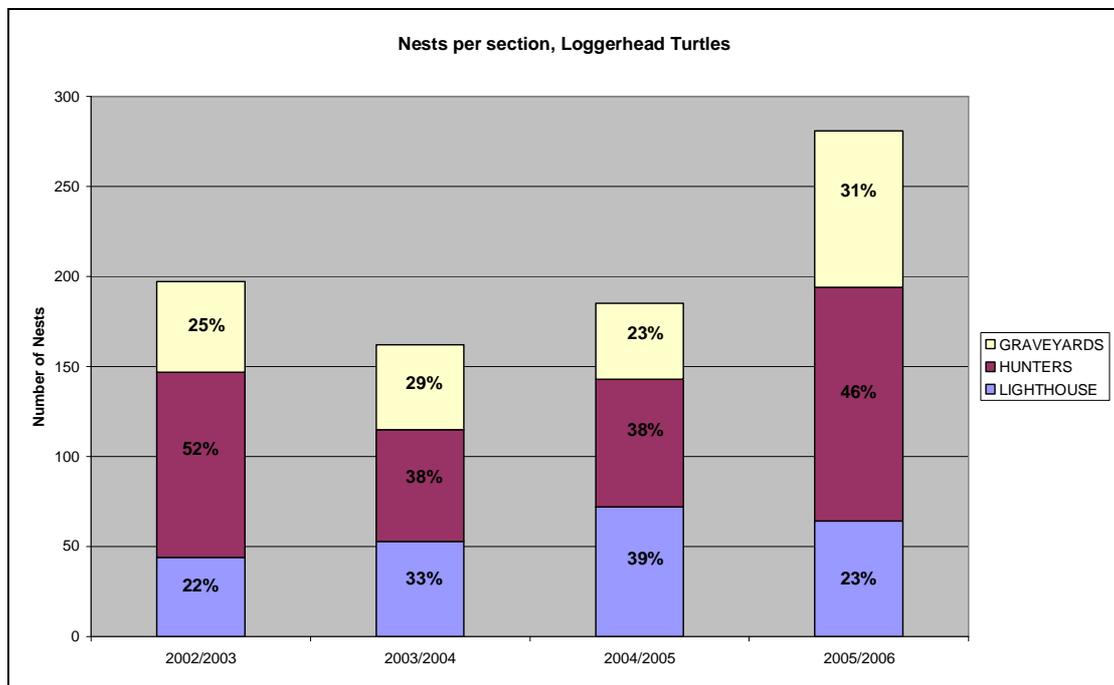


Figure 12: Nest Numbers per section for Loggerhead Turtles

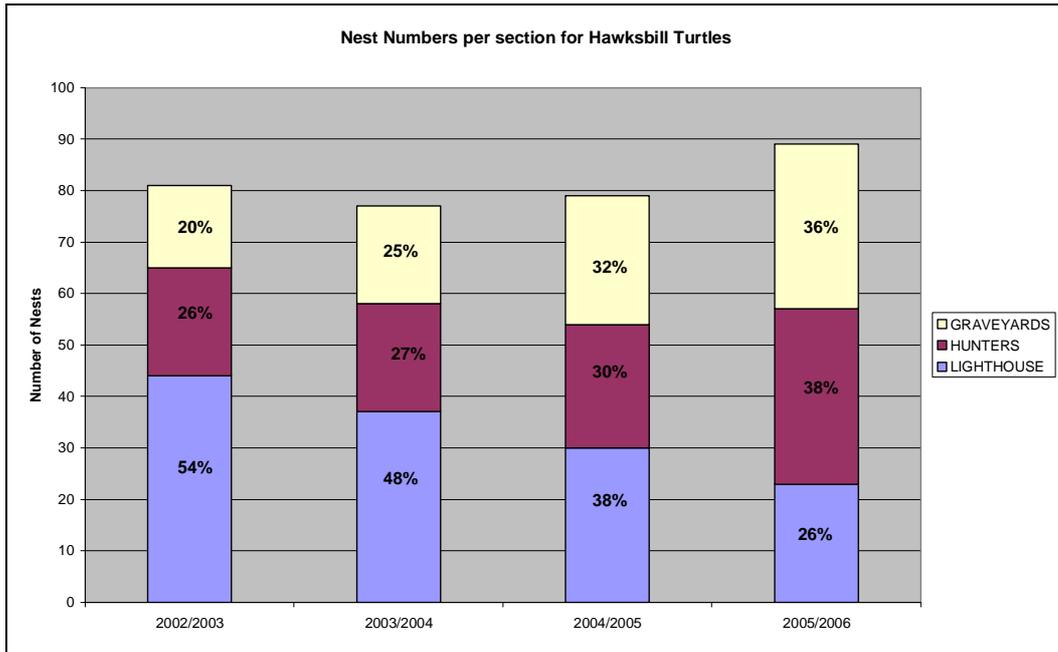


Figure 13: Nest Numbers per section for Hawksbill Turtles

Figure 11 through 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 being laid in this section. 40 -50 % of Loggerhead nests were located in Hunters section while there are insufficient Hawksbill turtle nests to indicate any specific site preference. 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.

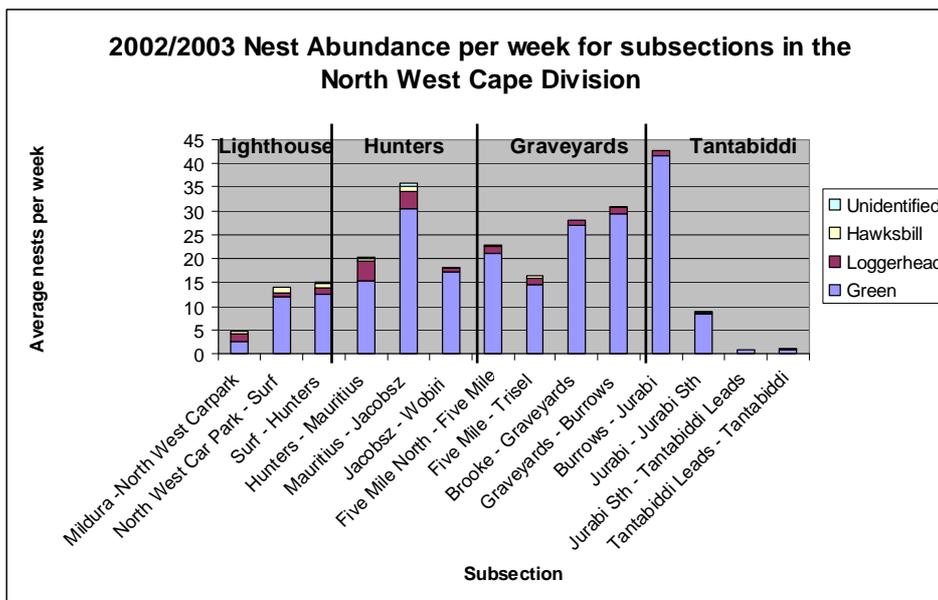


Figure 14: 2002/2003 Nest Abundance per week for subsections in the North West Cape Division.

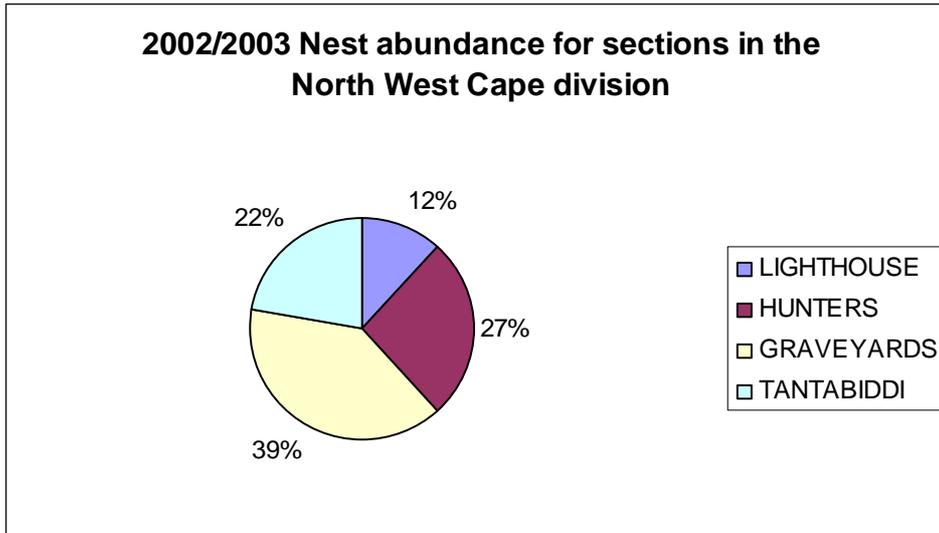


Figure 15: 2002/2003 Nest Abundance for sections in the North West Cape

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. Overall, Tandabiddi accounted for 22% of successful nests in 2002/2003 (Figure 15).

The Lighthouse to Tantabiddi sections were monitored in 2005/2006 to confirm the significance of the Burrows to Jurabi Point subsection. Figure 16 demonstrates the number of nests per week based on collected data from the subsections.

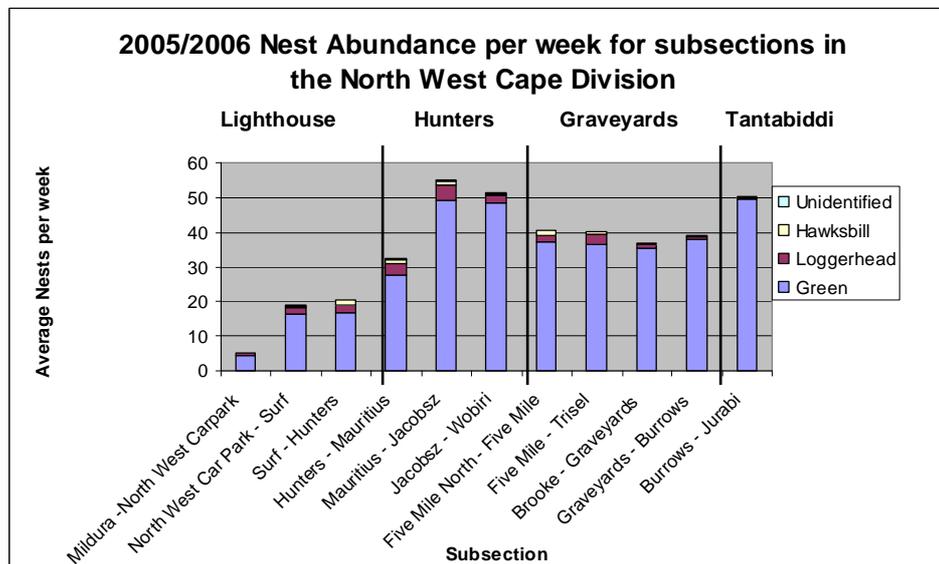


Figure 16: 2005/2006 Nest Abundance for sections in the North West Cape

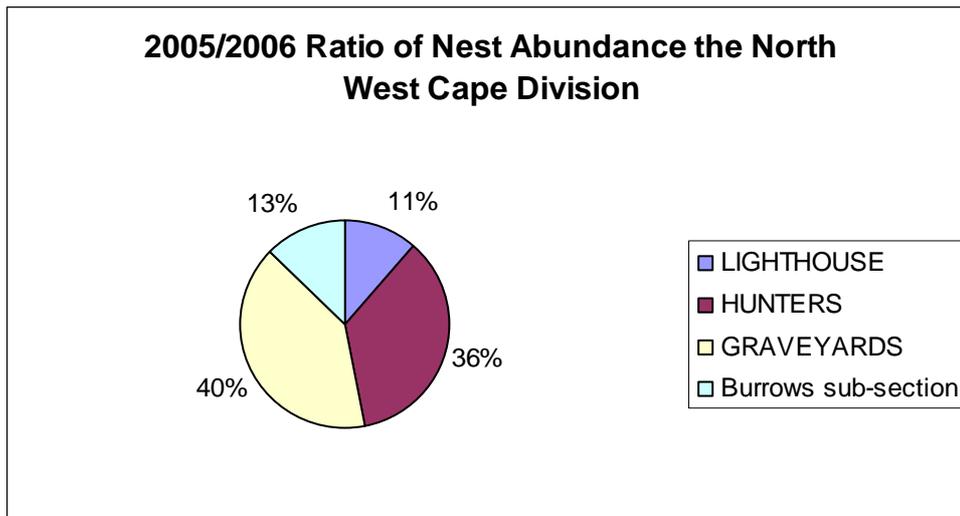


Figure 17: 2005/2006 Nest abundance for sections in the North West Cape

These results confirm a relatively significant abundance of nests in the Burrows to Jurabi Point sub-section. Figure 17 demonstrates that 14% of nests in 2005/2006 were located in the Burrows sub-section (Tantabiddi section) in comparison to 10% in Lighthouse, 35% in Hunters and 41% in Graveyards sections. The Burrows to Jurabi Point subsection within the Tantabiddi section was significant compared to other subsections monitored in the North West Cape Division considering that the entire 14 % represented a 1.8km stretch of beach.

Relative abundance and significance of each section in the North-West Cape Division

Beach nest monitoring over the last four years has revealed the relative importance of the various sections for turtle nesting. At this time, only three sections have been monitored consistently over the last four seasons from 2002 to 2006. When comparing the Graveyards-Hunters-Lighthouse sections (Figure 18) it becomes apparent that relative to another, the ratio between the sections changes little with Graveyards accounting for about 47%, Hunters for about 37% and Lighthouse for about 16% of the total number of nests counted in these sections.

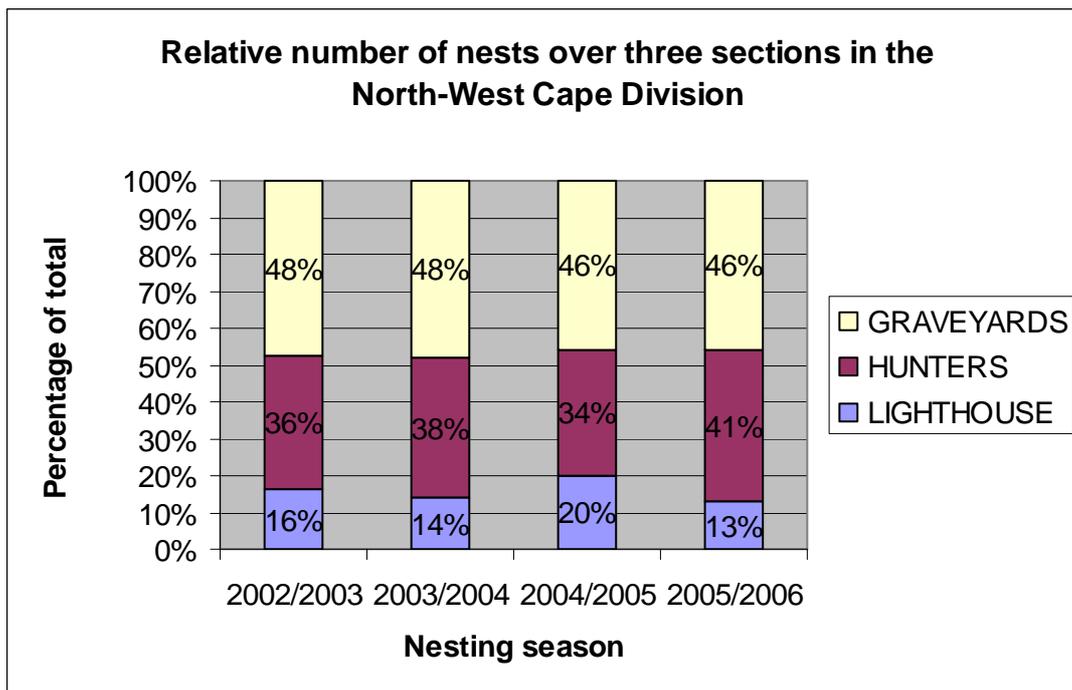


Figure 18: Comparison of the relative abundance of nests at three main sections of the North-West Cape Division

Due to logistical considerations, the Tandabiddi section was not included in surveys from 2003/2004 onwards. In 2005/2006, the Burrows to Point Jurabi sub-section was monitored following anecdotal observations of high numbers of nests there in the previous season. A review of this data (see Figure 14 and Figure 16) suggested that the Point Jurabi sub-section should be included in future monitoring programs.

Recommendation:

That the Point Jurabi sub-section be monitored annually as part of the Ningaloo Turtle Program.

Based on limited continuous data across seasons, it can be estimated that Graveyards section accounts for about 40%, Hunters section 34%, Tandabiddi section 14%, Lighthouse section 10% and the Navy Pier section 2% of the total number of nests each season.

Bundera Division

The Bungelup section of the Ningaloo coast (see Figure 7) has been identified as an indicative turtle nesting rookery for loggerhead turtles on the mainland coast of North Western Australia. This is based on monitoring conducted during the 2004/2005 turtle nesting season. The three subsections making up Bungelup were marked and monitored as the Bundera Division (see Appendix 11.3) in season 2005/2006 to establish a trend for nesting loggerhead turtles over time.

Figure 19 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 20 indicates an increase in the average number of nests per week in the Bungelup section from the 2004/2005 to the 2005/2006 turtle nesting season.

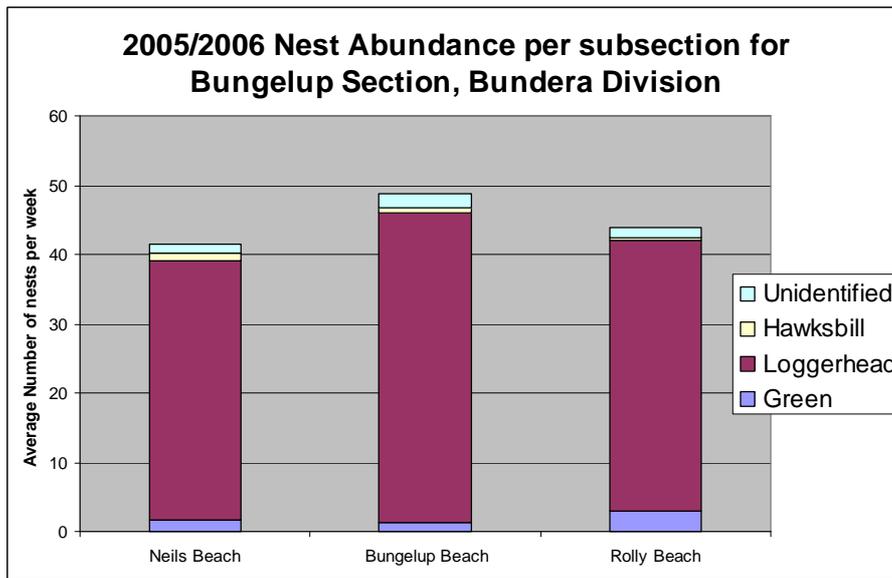


Figure 19: 2005/2006 Nest abundance per subsection for Bungelup Section, Bundera Division

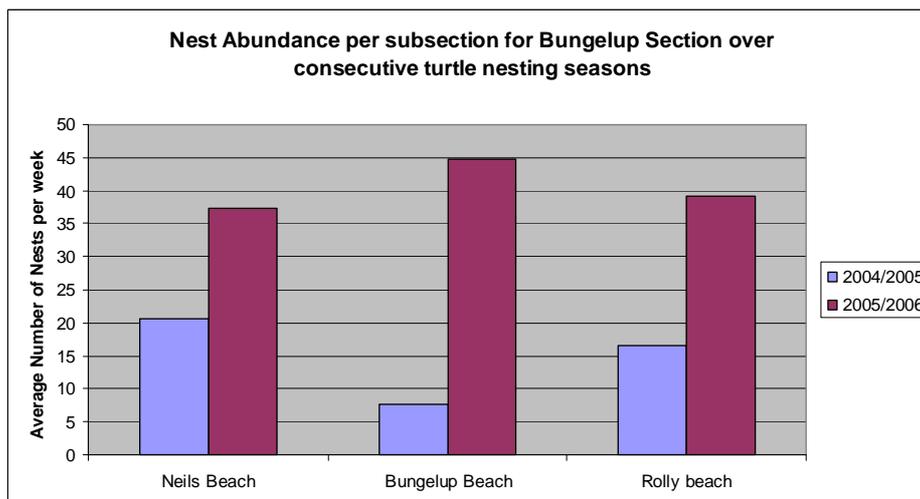


Figure 20: Nest abundance per subsection for Bungelup Section, Bundera Division over two consecutive turtle nesting seasons.

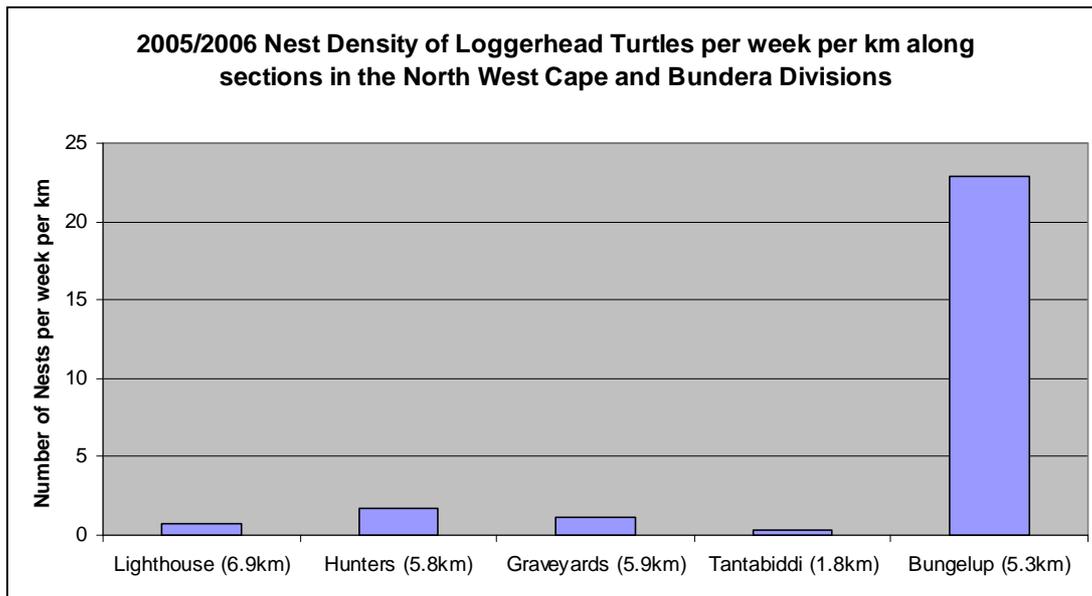


Figure 21: 2005/2006 Nest Density of Loggerhead Turtles in the North West Cape Division compared to Bungelup Section.

Figure 21 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 four consecutive turtle seasons prompted by historical evidence of turtle nesting activity in the area (Mack 2003). Figure 22 demonstrates the number of nests from the data collected over four turtle nesting seasons.

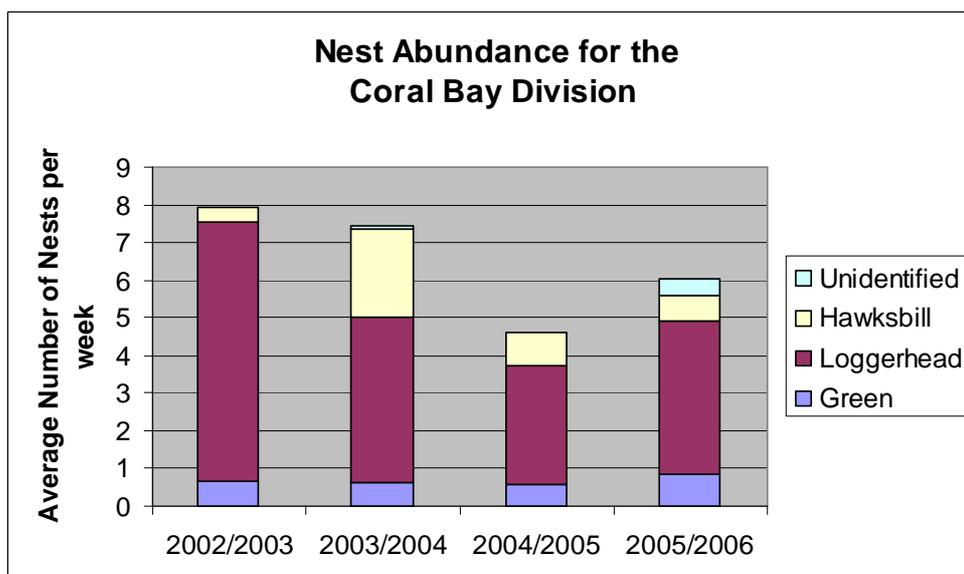


Figure 22: Number of Nests per week over four years in the Coral Bay Division (Batemans Bay)

During the 2005/2006 turtle nesting season the subsections and smaller beaches previously included in the nest numbers for Batemans Bay were investigated to determine their relative significance in relation to the Batemans Bay subsection. Figure 23 demonstrates the percentage of nests observed within each subsection in the Coral Bay Division.

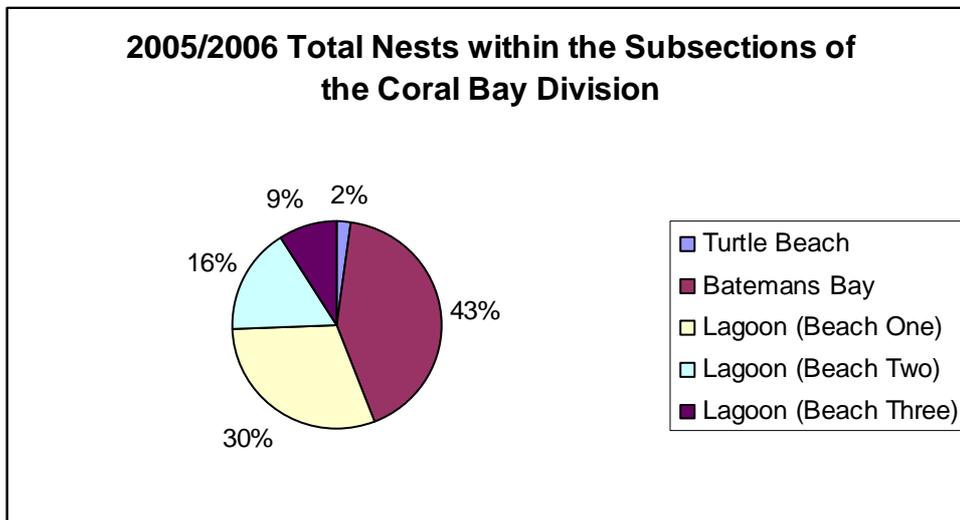


Figure 23: 2005/2006 Total Nests within subsections of the Coral Bay Division

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 four turtle seasons due to limited resources along this isolated section of the coast. During the 2005/2006 season Janes Bay was monitored consistently for a 28 day period to obtain a better indication of the significance of this rookery. The average number of nests per week is displayed in Figure 24 and compared with previous seasons.

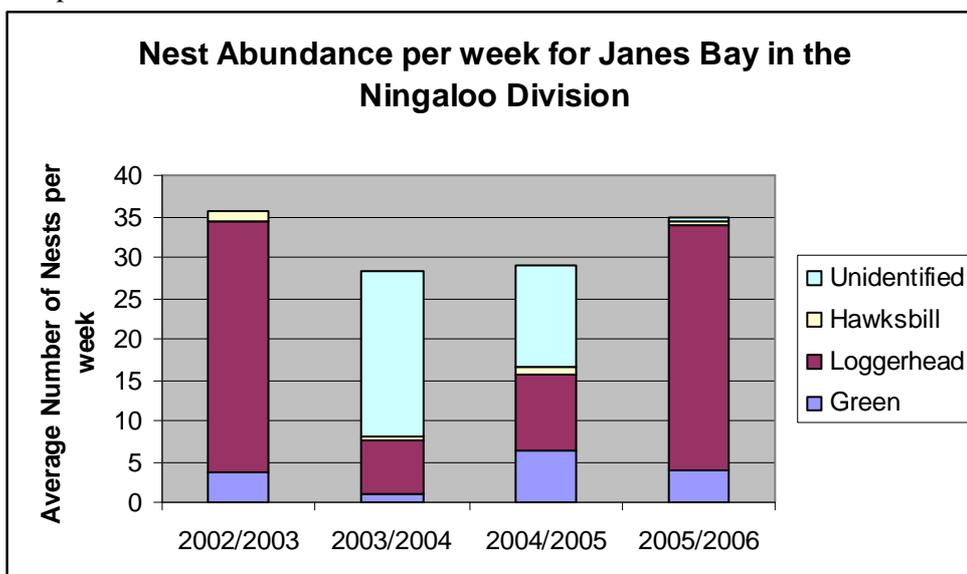


Figure 24: Nest Abundance per week for Janes Bay in the Ningaloo Division

The results of these surveys can be used as an indication of the relative significance of the Janes Bay turtle rookery for turtles compared to other sections along this coast (Figure 25).

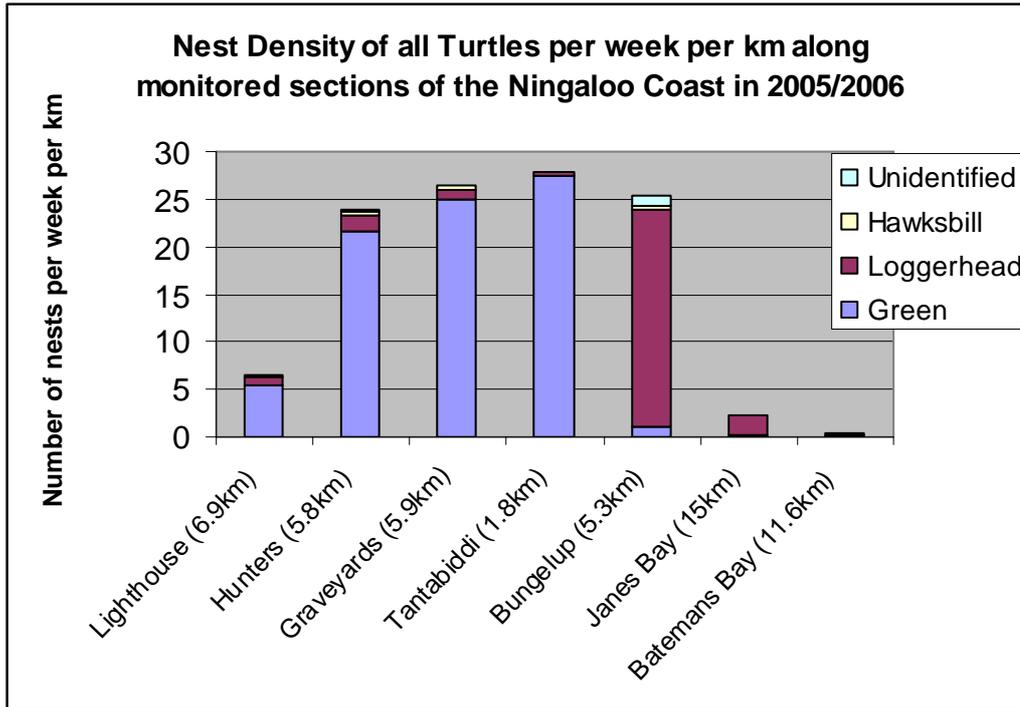


Figure 25: Nest Density of all turtles per week per km along the monitored sections of the Ningaloo Coast in 2005/2006

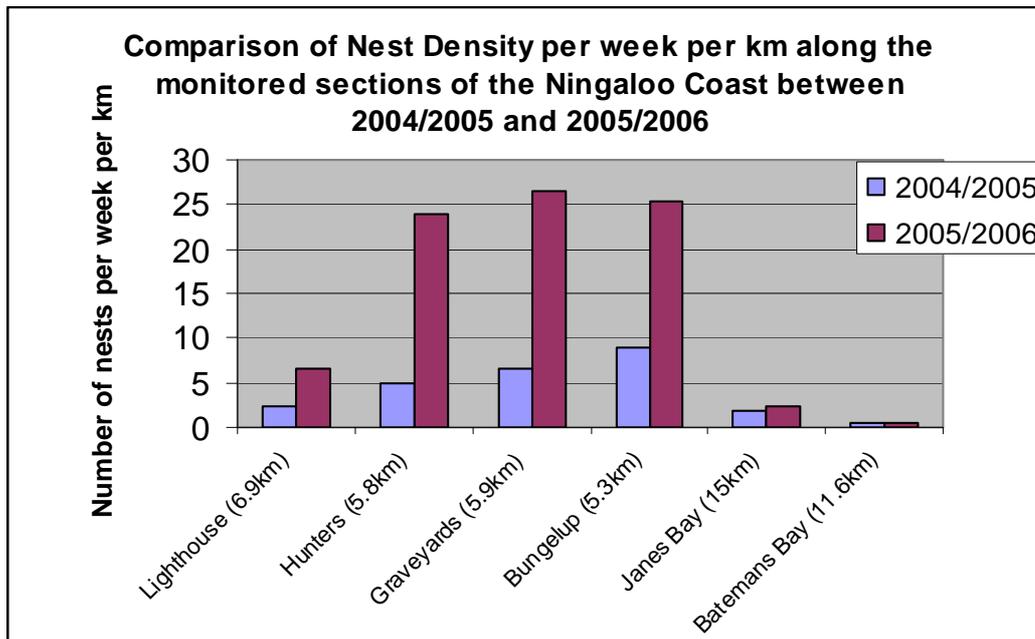


Figure 26: Comparison of Nest Density per week per km along monitored sections of the Ningaloo Coast between 2004/2005 and 2005/2006.

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 four successive turtle nesting seasons from 2002/2003 to the 2005/2006 season. 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.

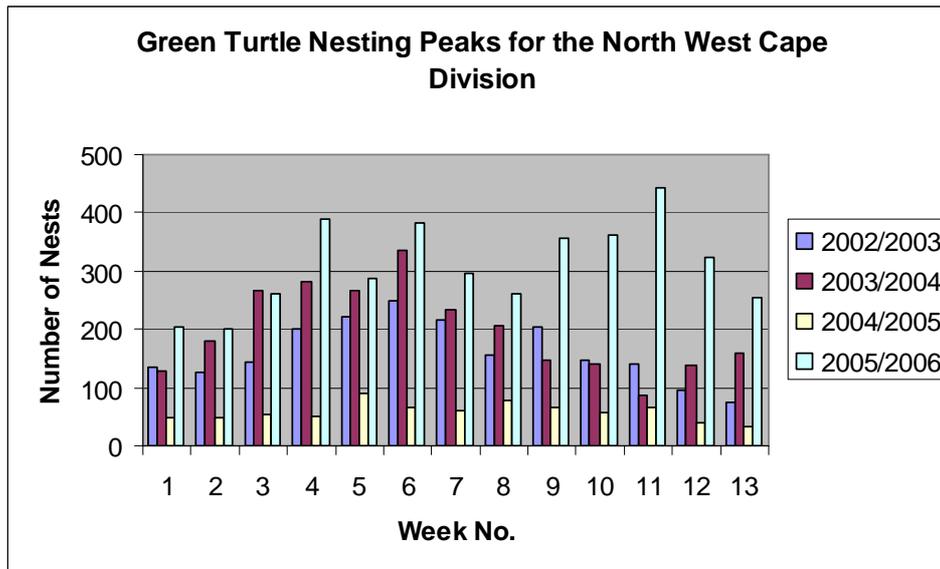


Figure 27: Green turtle nesting peaks for the North West Cape Division

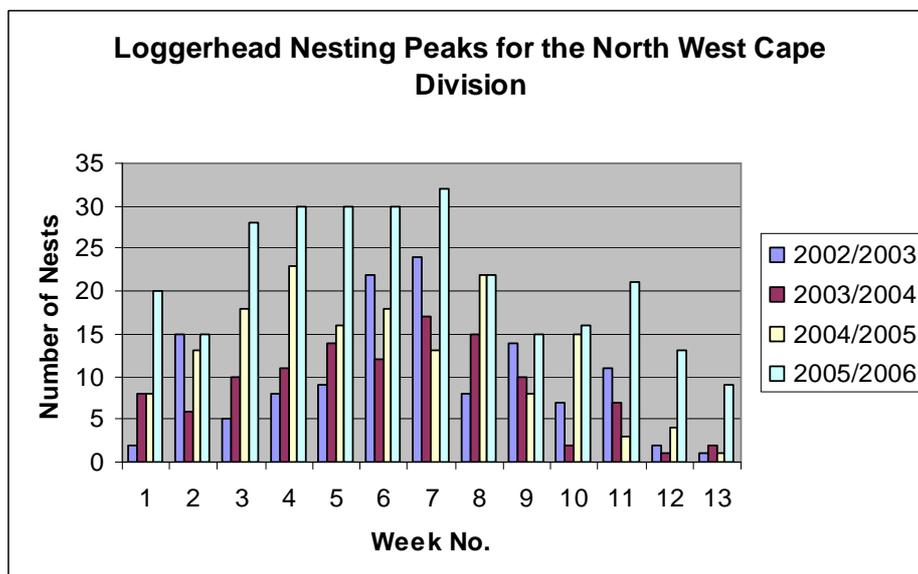


Figure 28: Loggerhead turtle nesting peaks for the North West Cape Division

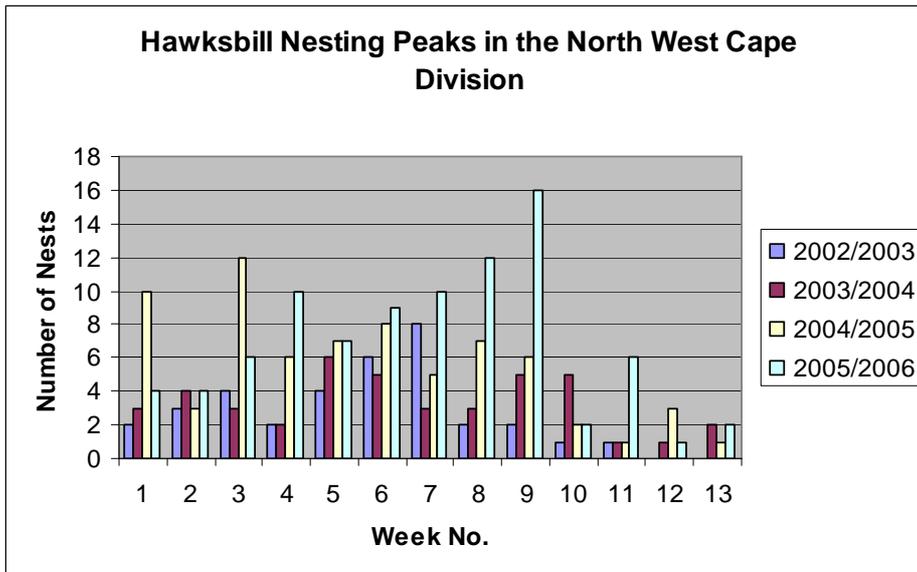


Figure 29: Hawksbill turtle nesting peaks for the North West Cape Division

Figure 27 to Figure 29 indicate the nesting peaks for each species over four 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 first three year period (See Figure 30), however the peak nesting period shifts slightly later in season 2005/2006.

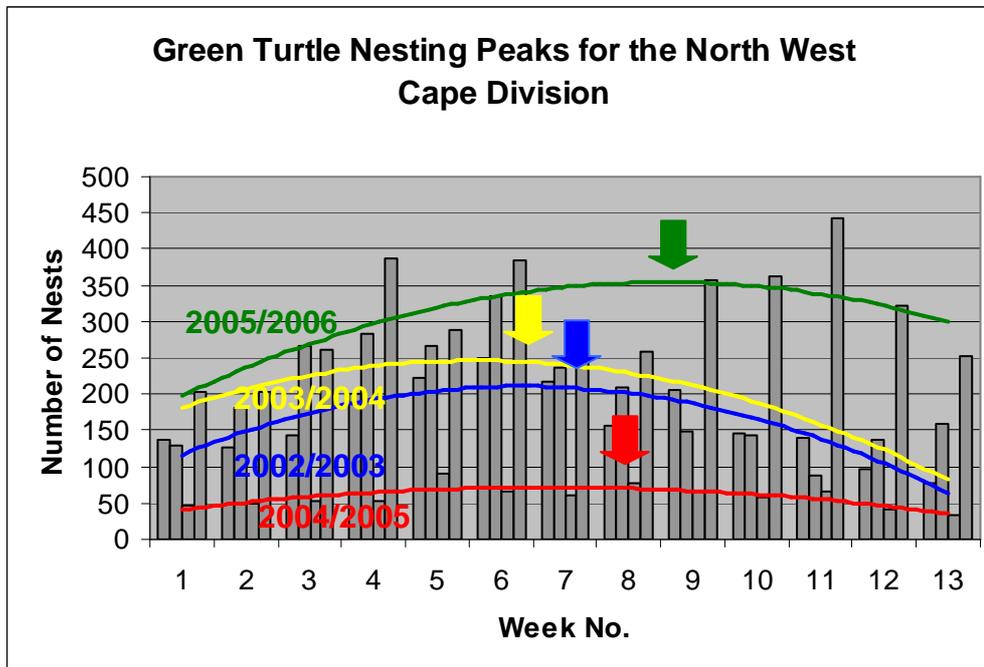


Figure 30: Green Turtle Nesting Peaks for the North West Cape Division

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.

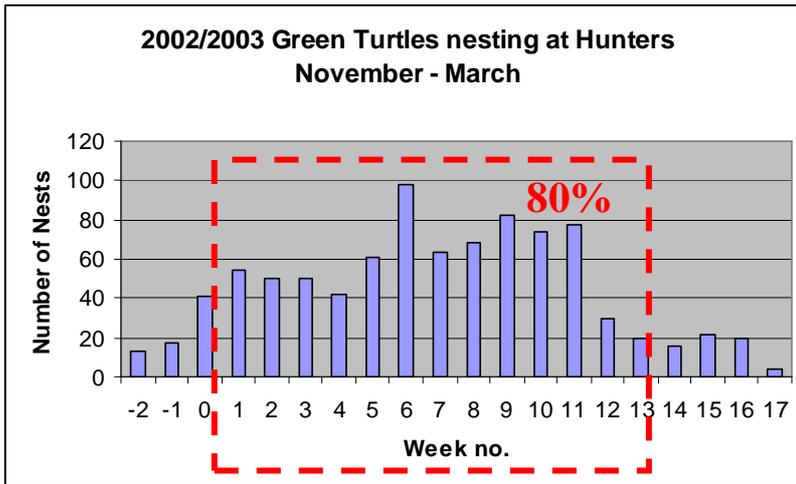


Figure 31: 2002/2003 Green Turtles nesting at Hunters. November-March

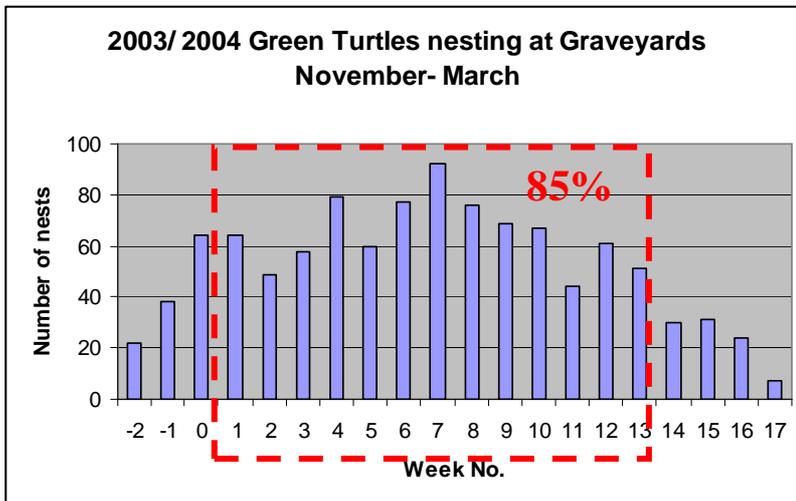


Figure 32: 2003/2004 Green Turtles nesting at Graveyards. November –March

Figure 31 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 32 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.

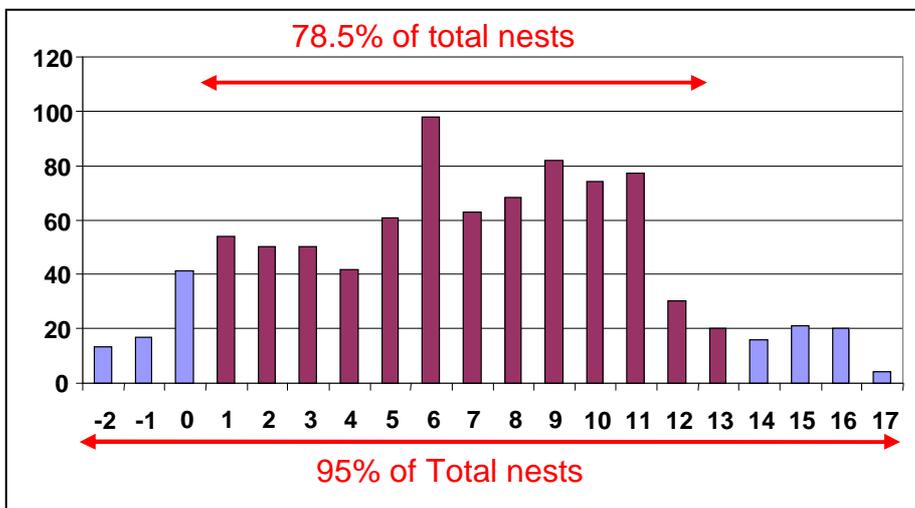


Figure 33: Percentage of Nests in 13 week period

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 (See Table 2).

Table 2: Estimate of the total numbers of green turtle nests for the four years of monitoring.

| | 78.5% of green turtle nests (1 Dec to 28 Feb) | 100% of green turtle nests |
|------------------|--|-----------------------------------|
| 2002/2003 | 2103 | 2679 |
| 2003/2004 | 1684 | 2145 |
| 2004/2005 | 762 | 971 |
| 2005/2006 | 4018 | 5118 |

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 33) 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 34, to Figure 37)

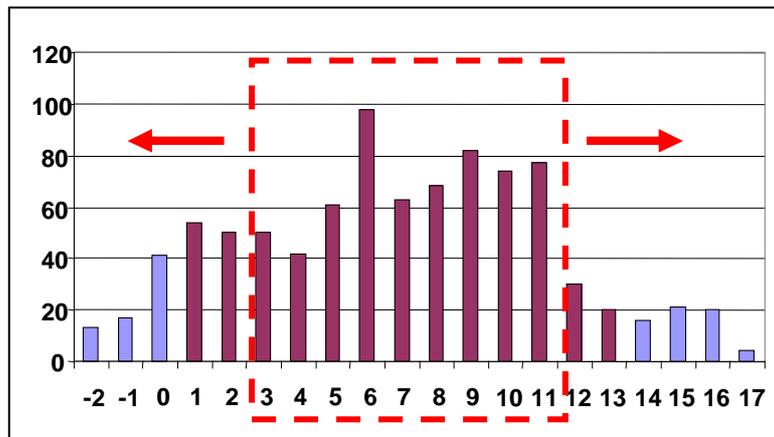


Figure 34: Trial and Error with different lengths and starting dates

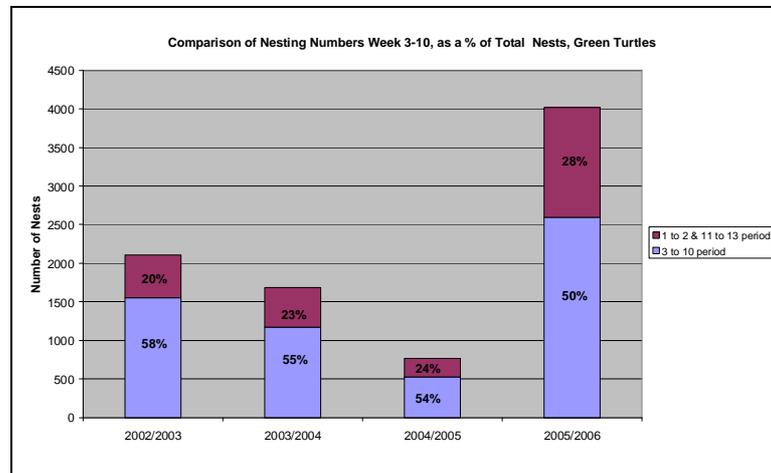


Figure 35: Weeks 3-10

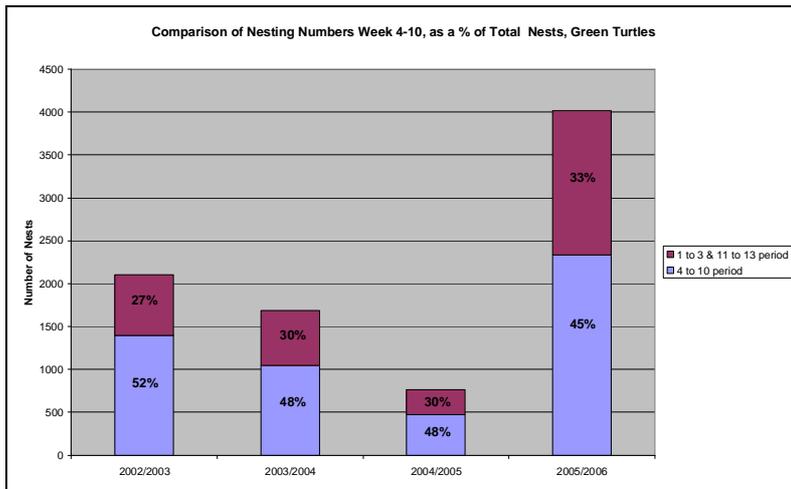


Figure 36: Week 4-10

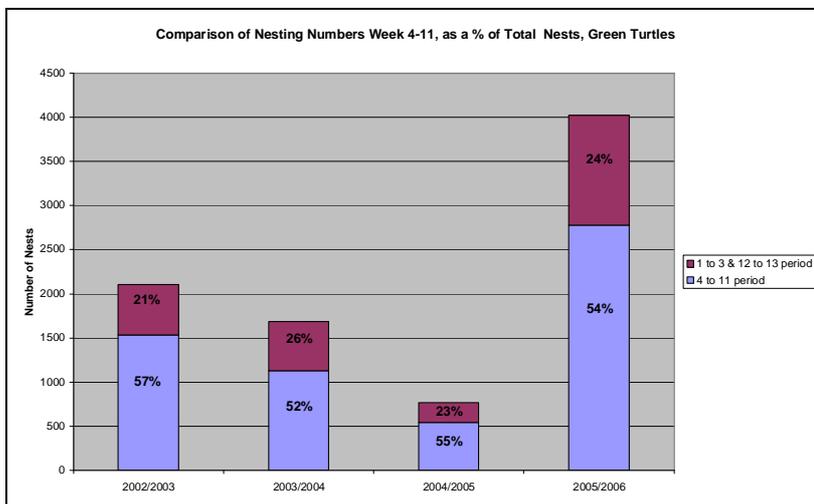


Figure 37: Week 4-11

From

Figure 35, to Figure 37 it can be seen that:

- Weeks 3 to 10 covers $54.4 \pm 3\%$ of total nests
- Weeks 4 to 11 covers $54.9 \pm 2\%$ of total nests
- Weeks 4 to 10 covers $48.8 \pm 2.5\%$ of total nests

Thus an 8 week index time period in the window from week 3 to 11 will generally provide averages with a standard deviation of $\pm 3\%$.

Bundera Division

Data from the Bungelup Section, Bundera Division in season 2005/2006 was analysed to follow the trend of the peak nesting period for nesting turtles in the division over the last two seasons. Due to logistical and training constraints monitoring was conducted over a 7 week period from the 20th of December to the 3rd of February.

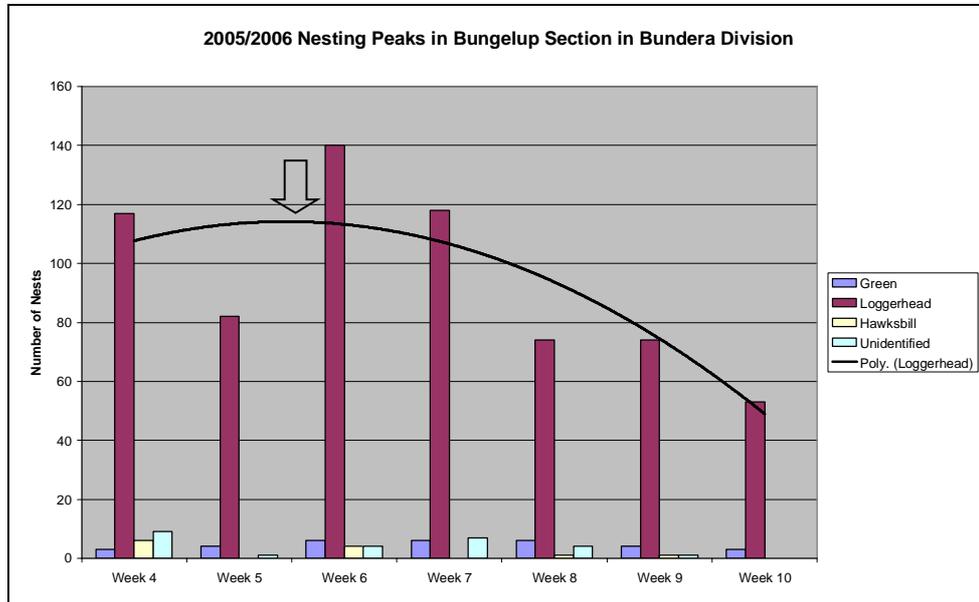


Figure 38: 2005/2006 Nesting Peaks in Bungelup Section, Bundera Division

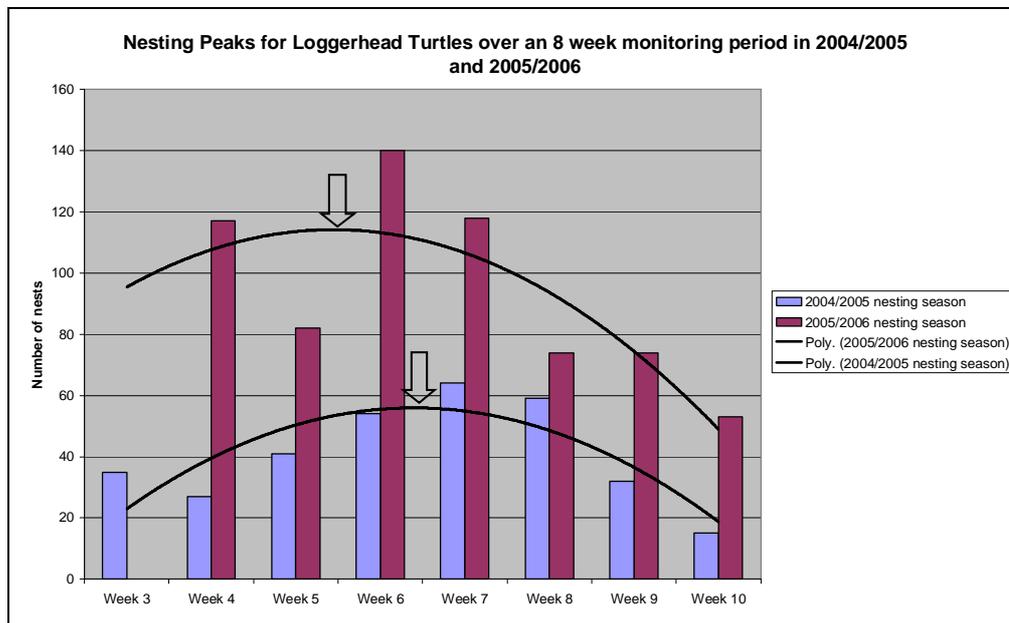


Figure 39: 2004/2005 Vs 2005/2006 Nesting Peaks in Bungelup Section, Bundera Division

The nesting trendline in 2004/2005 appears to indicate that the peak occurs in Week 6-7 in the Bundera Division (See Figure 38) while the nesting peak appears earlier in Week 5-6 in the 2005/2006 nesting season. (See Figure 39)

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 22). Figure 40 indicates low weekly nesting numbers providing insufficient information to indicate overall peak nesting times.

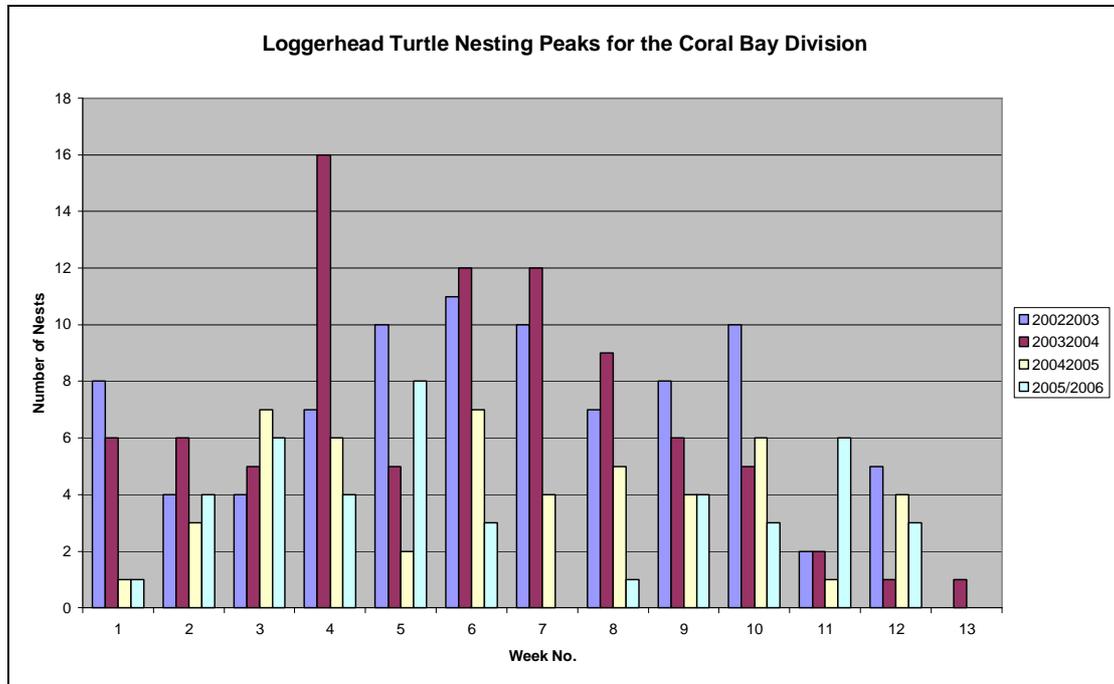


Figure 40: Loggerhead Turtle nesting peaks for the Coral Bay Division.

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 four years of data (see Figure 41, to Figure 44).

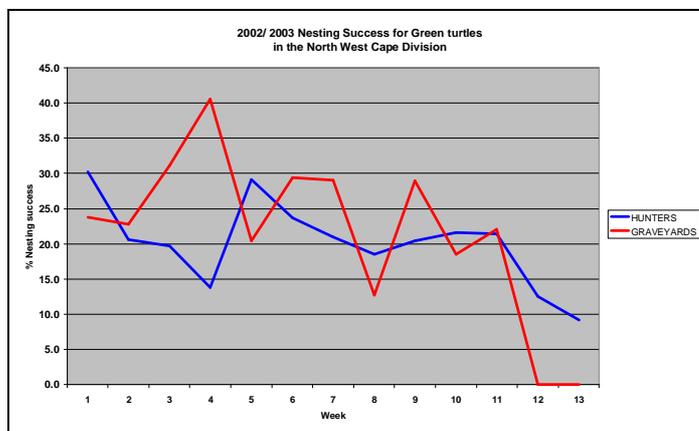


Figure 41: 2002/2003 Nesting success for Green turtles

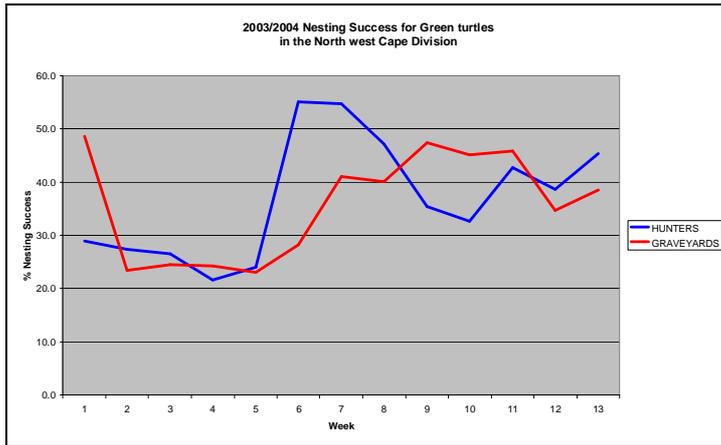


Figure 42: 2003/2004 Nesting success for Green turtles

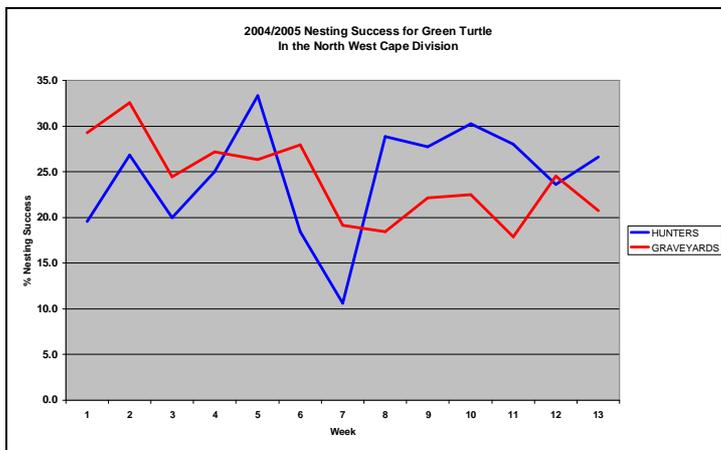


Figure 43: 2004/2005 Nesting success for Green turtles

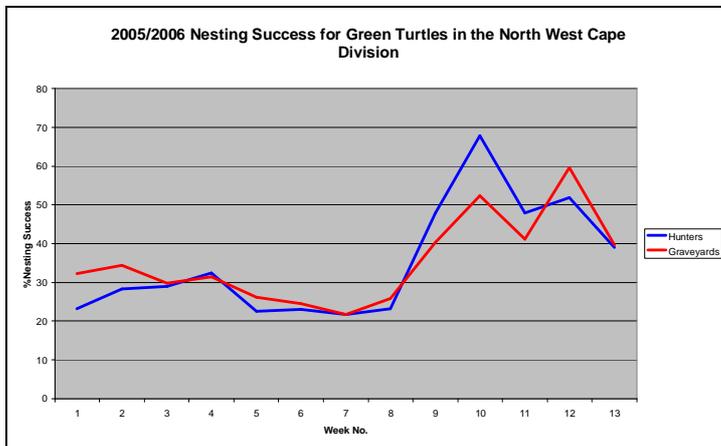


Figure 44: 2005/2006 Nesting success for Green turtles

Bundera Division

Bungelup section was monitored in the Bundera Division in season 2004/2005 and 2005/2006 to establish the trends in this area for nesting turtles. The high density of loggerhead turtles nesting in this division (see Figure 21) allowed an analysis of nesting success over the two consecutive monitored seasons.

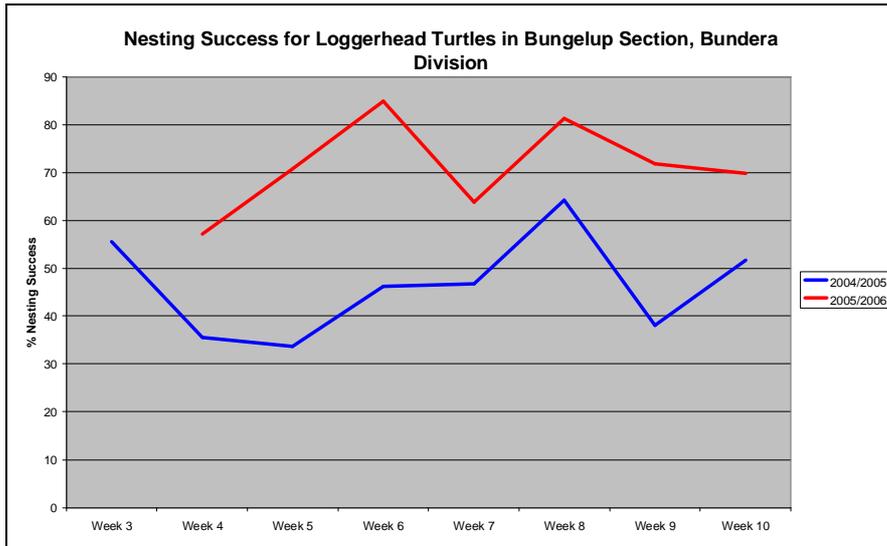


Figure 45: Nesting Success for Loggerhead Turtles in Bungelup section, Bundera Division during two consecutive nesting seasons.

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 four turtle nesting seasons (Figure 46). Actual fox predation rates are demonstrated in Figure 47.

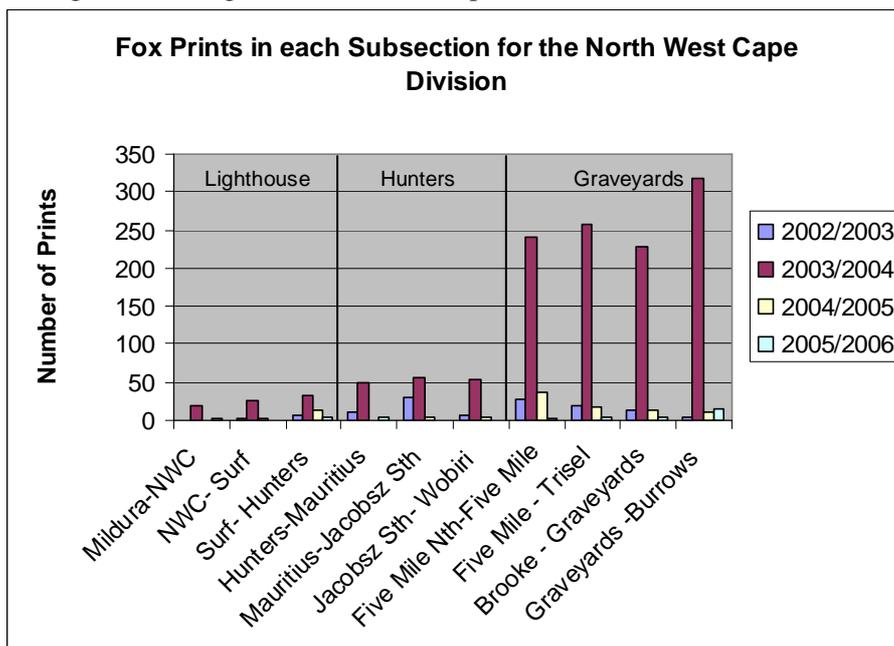


Figure 46: Fox Prints in each subsection for the North West Cape over four turtle nesting seasons

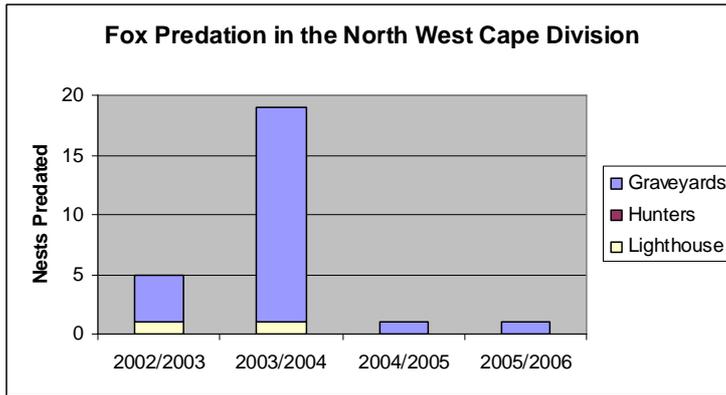


Figure 47: The total number of nests disturbed by fox predation in the North West Cape Division

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 48 demonstrates the fox presence on this beach for the four years of monitoring.

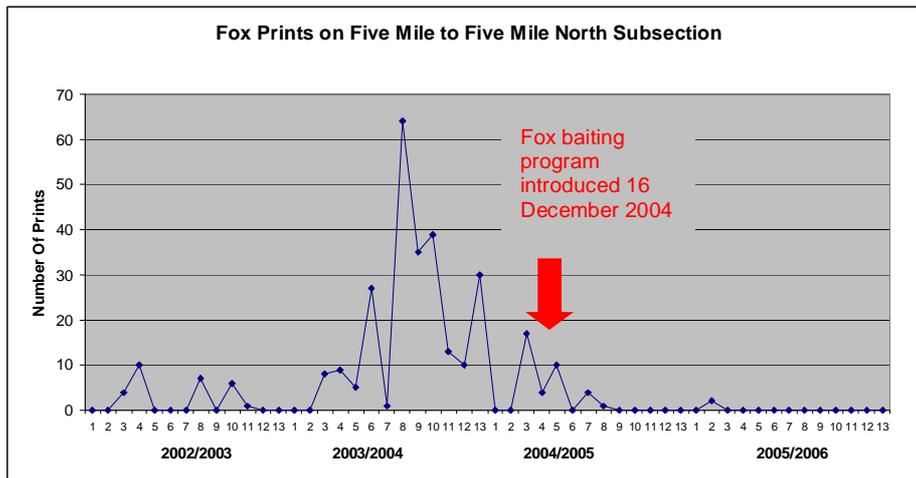


Figure 48: Fox Prints on Five Mile Beach

Bundera Division

Sections were monitored in the Bungelup Section in season 2004/2005 to establish the presence of foxes along this stretch of coastline and in 2005/2006 to establish the effectiveness of the baiting program begun in early November 2005. The number of tracks in individual subsections is recorded in Figure 49.

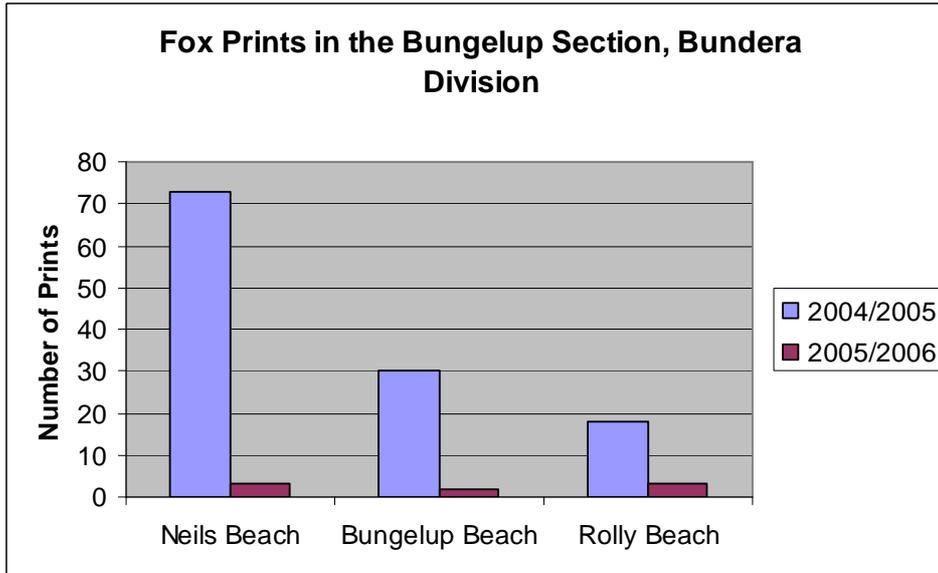


Figure 49: Fox Prints in Bundera Division for the 2004/2005 and 2005/2006 monitoring period.

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 four years is recorded in Figure 50. The predation rates of observed nests are displayed in Figure 51. Fox baiting was introduced in Batemans Bay on the 16th of October 2003.

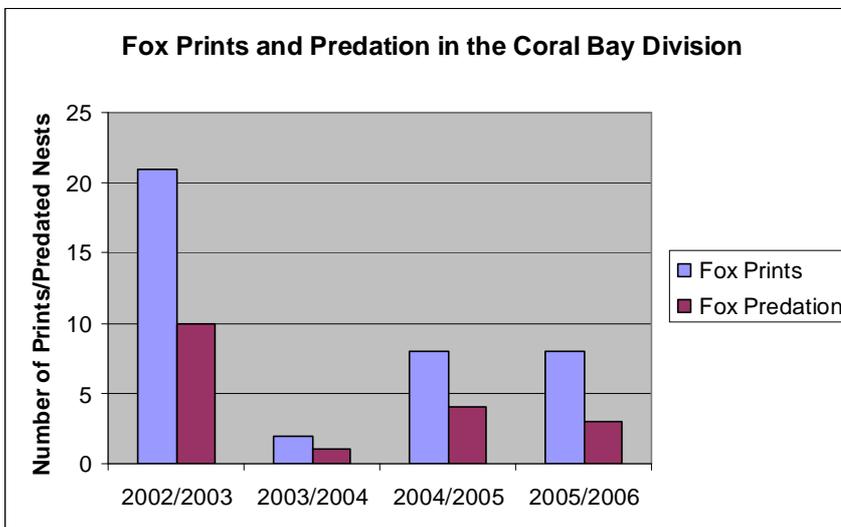


Figure 50: Fox prints and predation in the Coral Bay Division for the 2004/2005 and 2005/2006 monitoring period.

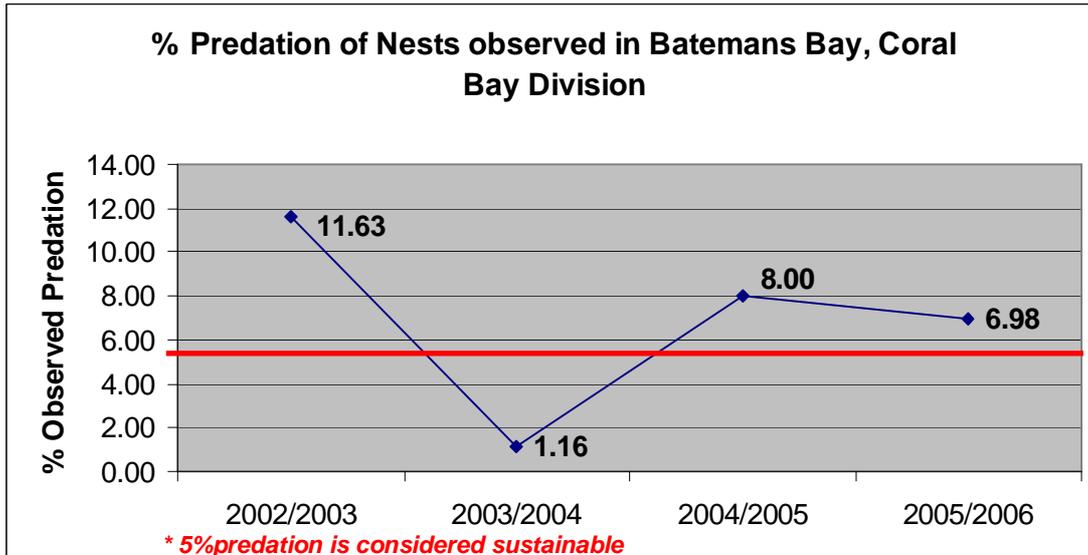


Figure 51: % Predation of the total number of nests observed in Batemans Bay over three Turtle nesting seasons

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 four years is recorded in Figure 52. Predation rates can also be expressed as a percentage of observed nests predated per overall nests observed during surveys during each year (See Figure 53). A restricted baiting program was introduced in Janes Bay on the 16th of January 2004.

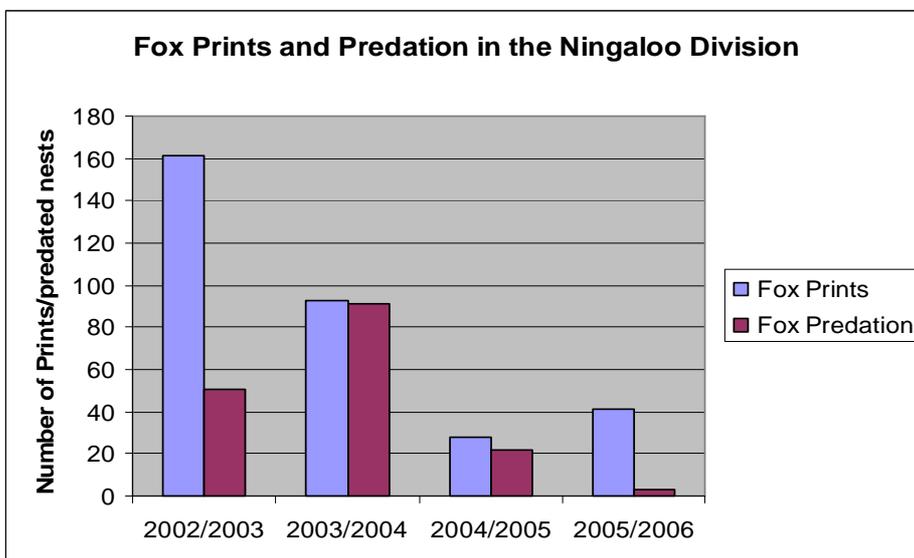


Figure 52: Fox Prints and Predation in the Ningaloo Division

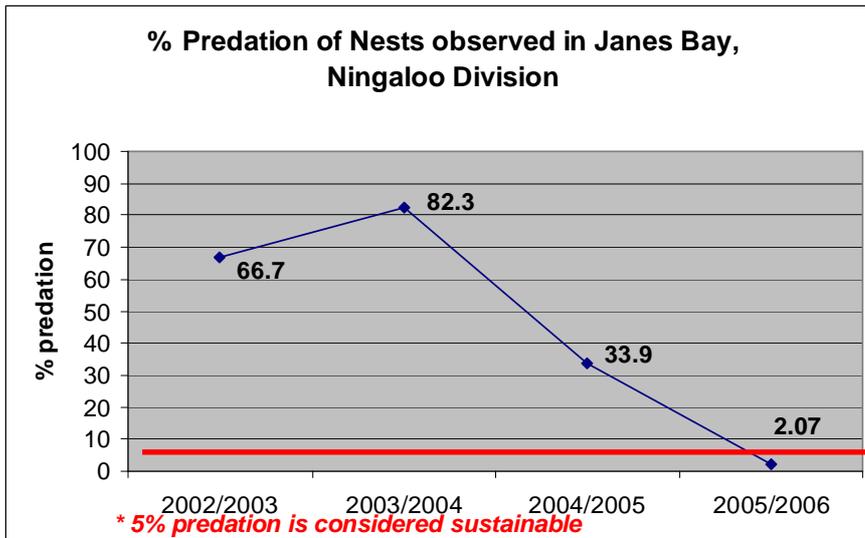


Figure 53: %Predation of nests observed in Janes Bay.

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 54).

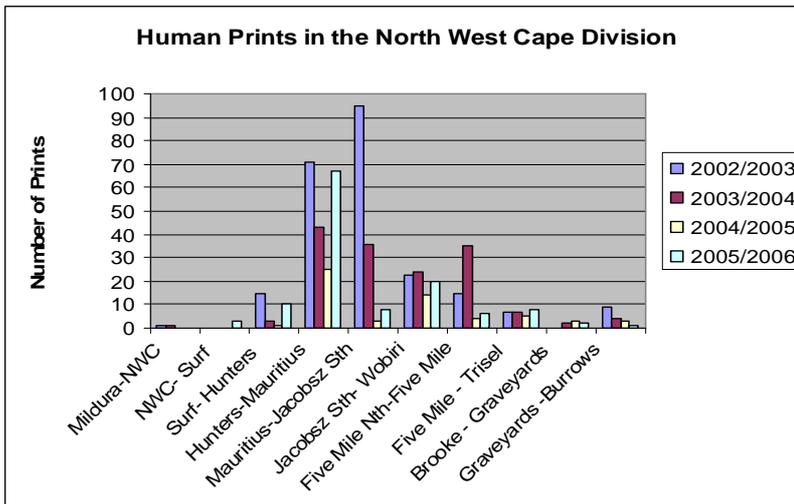


Figure 54: Human Presence on the subsections of the North West Cape Division

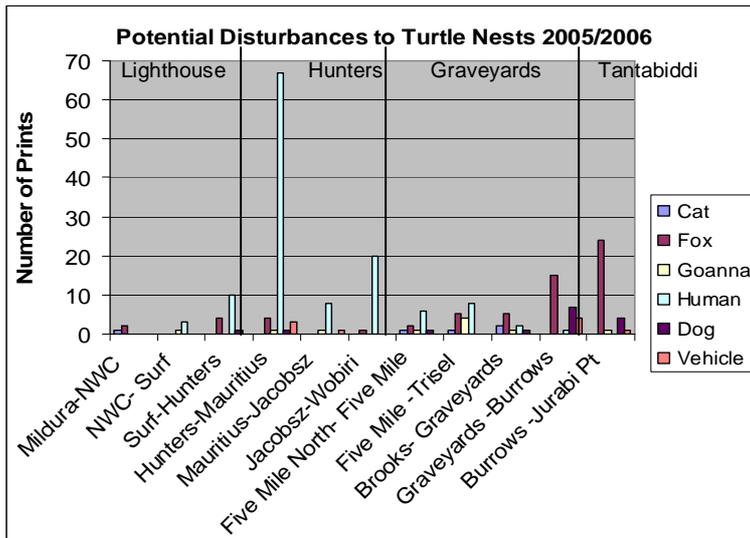


Figure 55: Other Potential Disturbances to Turtle Nests 2005/2006 for the North West Cape Division

6. Turtle Rescues

There were 40 successful turtle rescues from stranding in the dunes in the various subsections monitored during the 2005/2006 season, The locations of these rescues was recorded by a new data sheet and are demonstrated in Figure 56.

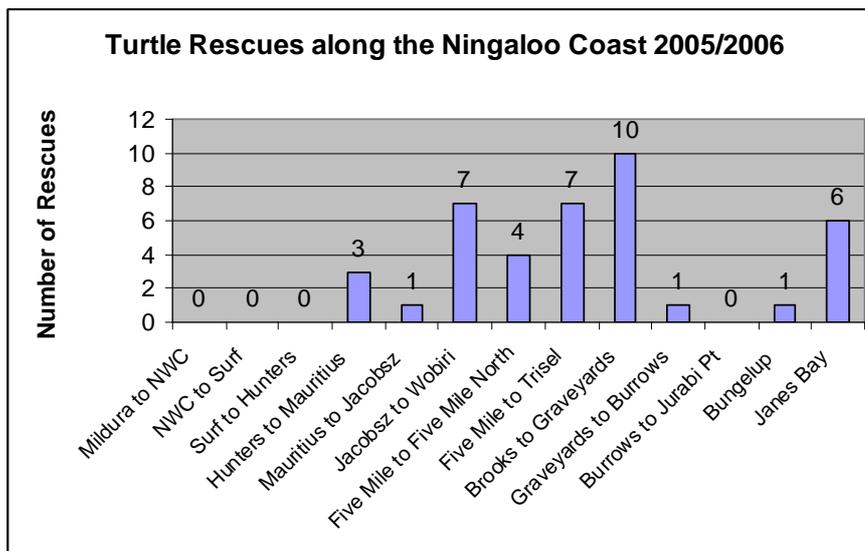


Figure 56: Turtle Rescues along the Ningaloo Coast 2005/2006

7. Stochastic Events

Six tropical cyclone events were recorded along the North West Coastal region during the turtle nesting and hatching season 2005/2006. Five of the six events impacted the coast to the east of the North West Cape minimising the damage to the turtle nesting beaches. Cyclone Daryl, a “Category 2” cyclone passed within 450km of the North West Cape on the 23rd of January 2006. The swell and weather conditions associated with this cyclone resulted in a significant storm surge that inundated the turtle nesting beach areas well above the usual 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 in the Intertidal zone and High tide to edge of vegetation zone were lost to storm surge. There were 1443 nests laid in all divisions in the Intertidal zone and High tide to edge of vegetation zone, 60 days prior to the 23rd of January. It can be estimated that between approximately 722 and 1155 nests were lost to inundation from storm surge associated with Cyclone Daryl.

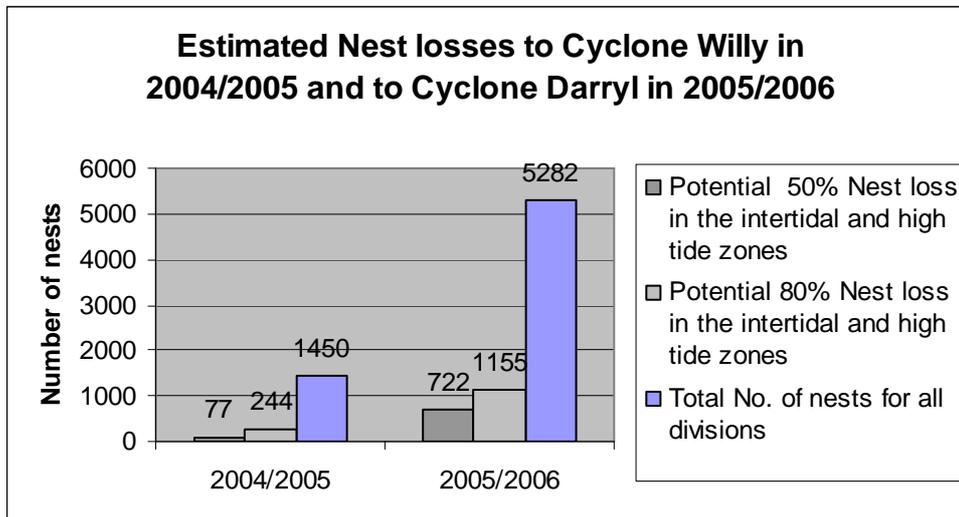


Figure 57: Estimated potential Nest losses due to Cyclone damage in turtle nesting seasons 2004/2005 and 2005/2006

8. West Australian Marine Turtle Tagging Program

The Western Australian Marine Turtle Project is a CALM initiative aimed at understanding the distribution and abundance of various marine turtle populations utilizing Western Australian breeding sites. The project began in the 1986/87 turtle nesting season and uses marker tags to monitor turtle movements. The sites where tagging has occurred include the Lacepede, Muiron, Barrow, Varanus, and Rosemary Islands, North West Cape, Exmouth Gulf, Cape Thoun and other locations in WA. Tagging has occurred with varying intensity in some of these areas over several intermittent turtle nesting seasons.

The Ningaloo Turtle Program has contributed to this long term tagging project by providing feedback on resighting of tagged turtles during the course of track monitoring in the mornings and evening turtle visitor interactions. This season 12 tagged turtles were resighted visiting the Jurabi Coastal Park (See Table 3) and two turtles originally tagged on the North West Cape were sighted on Barrow Island.

Table 3: Western Australian Marine Turtle Project - Tag resightings related to the North West Cape in 2005/2006, (source Dr. Bob Prince)

| Turtle ID | Species | Tag Ref | Sex | Group | Date | Time | Place | Locations Tagged | Resighted | Resighted | Resighted | Sighted 05/06 | Comments |
|-----------|---------|------------|-----|-------|------------|-------|-------|----------------------------|--------------------------------------|------------------------------|----------------------------|-------------------------------|----------------------------|
| 6155 | GN | WA 7454 Lt | F | NW | 7/12/2005 | 6:32 | NWTR | <i>Trisel 1988</i> | | | | <i>Five Mile - Trisel 05</i> | ISR 1: 17 YEARS |
| 6950 | GN | WA 9925 Rt | F | NW | 20/12/2005 | 6:15 | NWJC | <i>Jurabi Coast 1988</i> | | | | <i>Jacobsz - Wobiri 06</i> | ISR 1: 17 YEARS |
| 7670 | GN | WA10904 Rt | F | NW | 14/01/2006 | 6:15 | NWBR | <i>Wobiri 1989</i> | <i>Brookes Access 1989 (4 times)</i> | <i>Trisel 95</i> | <i>Brookes Access 1996</i> | <i>Brookes Access 06</i> | ISR 2: 6 + 10 YEARS |
| 8013 | GN | WA11380 Rt | F | NW | 13/12/2005 | 7:30 | NWGY | <i>Jurabi Coast 1990</i> | | | | <i>Graveyards 05</i> | ISR 1: 16 YEARS |
| 8534 | GN | WA13746 Rt | F | NW | 18/12/2005 | 6:45 | NWJC | <i>Jurabi Coast 1991</i> | <i>Jurabi Coast 92</i> | | | <i>Jacobsz-Wobiri 06</i> | ISR 2: 8 + 6 YEARS |
| 9419 | GN | WA15815 Rt | F | NW | 20/12/2005 | 6:40 | NWTR | | | | | <i>Five mile- Trisel 05</i> | ISR 1: 14 YEARS |
| 9503 | GN | WA15938 Rt | F | NW | 5/12/2005 | 7:20 | NWFM | <i>Trisel 1991</i> | <i>FI 1991 (2 times)</i> | | | <i>Five Mile North 05</i> | ISR 2: 6 + 8 YEARS |
| 9568 | GN | WA16036 Rt | F | NW | 17/01/2006 | 9:00 | NWBS | <i>Trisel 1991</i> | <i>FI 1991 (2 times)</i> | <i>Trisel 1991 (4 times)</i> | | <i>Brooks – Graveyards 06</i> | ISR 2: 6 + 8 YEARS |
| 13939 | GN | WA21797 Rt | F | NW | 31/12/2005 | 6:09 | NWFM | | | | | <i>Five Mile Car park 05</i> | ISR 1: 12 YEARS |
| 15402 | GN | WA28106 Rt | F | NW | 5/02/2006 | 7:25 | NWFM | <i>FM 1995</i> | | | | <i>Five Mile North 06</i> | ISR 1: 10 YEARS |
| 18749 | GN | WA34666 Rt | F | NW | 30/01/2006 | 6:30 | NWFM | | | | | <i>Five Mile North 06</i> | ISR 1: 8 YEARS |
| 18766 | GN | WA34718 Rt | F | NW | 28/01/2006 | 6:50 | NWJC | | | | | <i>Jacobsz South 06</i> | ISR 1: 8 YEARS |
| 6206 | GN | WA 7555 Rt | F | NW | 5/12/2005 | 1:24 | BWJW | <i>Trisel 1988</i> | <i>Trisel1995</i> | | | <i>Barrow Island 05</i> | ISR 2: 6 + 11 YEARS |
| 15592 | GN | WA28374 Rt | F | NW | 13/12/2005 | 20:31 | BWJW | <i>Brookes Access 1996</i> | | | | <i>Barrow Island 06</i> | ISR 1: 10 YEARS |

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. Aerial surveys indicate a general trend of diminishing significance of nesting rookeries from North to South which has been ground-truthed by continuing monitoring surveys.

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 and sporadically from 1990 to 2000. 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 four turtle nesting seasons from 2002 to 2006 in the North West Cape Division have fluctuated in the overall numbers of turtle nests observed (Figure 1). Loggerhead turtle and hawksbill turtle nest numbers have remained relatively consistent over the three years. The fluctuation in overall nests can be attributed to changes in the number of 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.

Turtle nesting populations can be approximately estimated from the number of nests observed each season. Assuming a normal distribution over the whole year, 95% of all successful nests occur in the 20 week period between the months of November to March and 85% of monitored nests occur in a 13 week period thus 78.5% of total nests are observed from December to February (see Table 2). Turtles will lay anywhere from 1 to 12 clutches of eggs per season, with an average of 3 to 6 clutches (Gulko and Eckert, 2003). This means that approximately 446-893 turtles nested in the 2002/2003 season, 358-715 turtles nested in the 2003/2004 season, 162 -324 turtles nested in the 2004/2005 season and over 853-1706 turtles nested in 2005/2006 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 fluctuating 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 four years of monitoring Lighthouse, Hunters and Graveyards sections and expanding monitoring in specific seasons to establish the significance of adjacent sections. Over four 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. Based on limited continuous data across seasons, it has been estimated that Graveyards section accounts for about 40%, Hunters section 34%, Tandabiddi section 14%, Lighthouse section 10% and the Navy Pier section 2% of the total number of nests each season.

The spatial distribution of the three species of turtles over four years indicate that Graveyards section is significant to Green turtles (Figure 11) with 47-56% of green turtle nests laid in this section. 38-52% of Loggerhead nests were located in Hunters section (Figure 12), while Hawksbill nests are inconsistently located in all the sections of the North West Cape (Figure 13). 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 were identified during the 2004/2005 nesting season to be concentrated in the Bungelup section which is located in the southern Cape Range National Park. The increase in loggerhead turtle nest numbers from the previous season (Figure 20) and the comparative high density of loggerhead turtle nests (Figure 21) in the Bungelup section in 2005/2006 reinforces that Bungelup 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 trends.

The nest distribution in the southern divisions of Ningaloo and Coral Bay were monitored with varying degrees of consistency over four 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 26 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 between 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 relatively normal distribution from year to year and nesting peaks can be recognised to be consistently within a specific eight week period irrespective of changes in overall numbers of nests (Figure 27).

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 37).

Recommendation: Continue to monitor nesting activity for a further 13 week period in the 2006/2007 season to further verify weeks 4-11 as being the period where an average of 53% 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 in future seasons.

The temporal trends of the loggerhead turtle nesting activities in the Bungelup section over an eight week period showed a peak occurring in between week five and week six for both the 2004/2005 and 2005/2006 turtle nesting season (Figure 39). 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 41 to Figure 45) do not display any significant trends over the four years of data. Nesting success can possibly be related to environmental factors such as tide, moon phase, wind, ocean currents and other environmental conditions. Research into environmental factors influencing nesting success in the Ningaloo Region did not show any significant indicators for successful emergences (Carter 2005) however successful nesting emergences and false crawls should continue to be collected to monitor long term trends. 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.

Recommendation: Continue to monitor successful emergences and false crawls for any long term trends.

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 on hatchlings 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 and a very low number of fox prints in 2005/2006 demonstrates that the baiting program produced an overall reduction. The decrease in fox presence on the beaches (Figure 48) appears to have dramatically decreased predation rates and only one predation event was actually recorded up to February in the 2005/2006 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 significant reduction in the number of fox prints was recorded in the Bungelup section between the 2004/2005 and 2005/2006 turtle nesting season. No nests were recorded as dug up by foxes during the 2005/2006 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 higher than reported.

The reduction in fox presence in the Bungelup section can be directly attributed to the implementation of a targeted baiting program in the area. The decrease in fox prints and predation levels indicate the success of the baiting measures for marine turtles.

Recommendation: Continue with the 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 four 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 appears to have reduced the number of predations during the 2003/2004 nesting season (Figure 51) with a rise in predation levels during the 2004/2005 which can be attributed to the method of distributing and tethering the baits. There was a decrease in % observed predation during the 2005/2006 nesting season.

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 were recorded as very high in previous seasons (Figure 53). 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 53). A limited 1080 fox baiting program began on the 16th of January 2004 and has continued until the end of the 2005/2006 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 dramatically reduced fox predation events. Loggerhead turtles are endangered under the *EPBC Act 1999* and considered "in need of special protection" under the *Western Australian Wildlife Conservation Act 1950 (Wildlife Conservation Notice 2003)*. Continued action to reduce the fox predation threat is required.

Recommendation: Continue with the current 1080 fox baiting program 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. The collection of human impact data should be reviewed and conducted through the JTC in future seasons.

The Jurabi Turtle Centre began operations in 2004/2005 and continued during the 2005/2006 nesting season with the purpose of managing visitor–turtle interactions and minimising the disturbance to turtles during the nesting process. The 2005/2006 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 2005/2006 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: Assess 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

Forty turtles stranded behind sand dunes and wedged in on the rocky shoreline were rescued in the 2005/2006 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 or are physically constrained by surrounding rock before suffering fatal exhaustion and dehydration in the summer heat. Turtle skeletons and carcasses are frequently observed in high risk dunes and rocky areas adjacent to the nesting beaches indicating that outside of the monitoring period, when volunteers are not present to assist, females have stranded, and succumbed to the heat and physical exhaustion. Although this is a natural event, all intervention on behalf of breeding females of 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. Information regarding the high risk beaches was collected in the 2005/2006 season (Figure 56). The beaches of the Hunters and Graveyards sections were common areas for strandings and these beaches should be considered and included in any reviews of survey of index beaches and index time periods.

Recommendation: Consider Hunters and Graveyards sections as high risk beaches for Turtle strandings during the nesting season and include these sections in any review of survey index beaches and index time periods.

7. Stochastic Events

The loss of an estimated 50-80% (722 to 1155) of turtle nests laid 60 days prior to Cyclone Daryl in January 2006 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.

8. West Australian Marine Turtle Tagging Program

The 12 resightings of tagged marine turtles this season contributed by the Ningaloo Community Turtle Monitoring Program to this tagging initiative has helped to expand the knowledge of the geographical range and remigration intervals of these tagged turtles. A more

comprehensive contribution could be achieved by surveying the 26km of beaches at night to record emerging turtles and tag unmarked turtles as appropriate. The resources required to complete this are beyond the scope of this community based program and should only be considered once a defined methodology and appropriate resources are available.

Recommendation: Continue to provide tag information to the West Australian Marine Turtle Tagging Program.

2.4 Conclusions

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

The abundance of nests on specific sections of beach over specified time intervals for four seasons for each of the three species has been determined. 4018 green turtle nests, 281 loggerhead nests and 89 hawksbill turtle nests were observed in the North West Cape Division for the 13 weeks of the 2005/2006 turtle nesting season. The identification of the key nesting beaches located in Bungelup, Tantabiddi, Graveyards, Hunters and Lighthouse sections and 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 with 728 nests observed during six weeks of the 2005/2006 nesting season.

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 four and week eleven of the 13 week period from December to February.

The levels of potential and physical predation of the European fox (*Vulpes vulpes*) in the North West Cape Division 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 and 2005/2006 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 southern Cape Range National Park in 2004/2005 has been addressed by a targeted fox baiting program in 2005/2006. A significant decrease in fox presence at Bungelup monitored this season has indicated a reduced threat to the threatened loggerhead turtles nesting in this area. 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 above the 5% rate for unnatural causes in some areas. To ensure this level of protection continues and to reduce the predation rate further to sustainable levels in all areas, a continued baiting program is 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.

Forty turtle rescues were recorded in the 2005/2006 nesting season. 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 fluctuated 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, Graveyards and the Jurabi Point sub-section.
- 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 2006/2007 season to further verify weeks 4-11 as being the period where 48-55% 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. Consider Hunters and Graveyards sections as high risk beaches for Turtle strandings and rescues during the turtle nesting season.

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. Maintain a 1080 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 1080 fox baiting program and monitor for fox presence and predation in 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

5. Research

Encourage further research projects into:

- a. Impacts and compliance of human activities on turtle nesting beaches of the North West Cape
- b. Impacts of windsurfing, kite surfing and visitor disturbance at the key green turtle mating location on North-West Cape in September to November each season.
- 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.
- e. Continue to provide tag information to the West Australian Marine Turtle Tagging Program.
- f. Effectiveness of education programs in reducing visitor disturbances.
- g. The impacts of vehicle lights on turtle nesting success at Jacobsz, Jansz and Wobiri access carparks.
- h. The influence of El Nino on seasonal nesting activities at Ningaloo.
- i. Investigation of Nesting beach dynamics such as beach sand temperatures and hatchling sex ratios.
- j. Modelling climate change impacts on turtle populations.

3.0 Jurabi Turtle Centre

Season Report

2005 – 2006



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1. Introduction

The Jurabi Turtle Centre (JTC) is an interpretative 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- the Green (*Chelonian mydas*), Loggerhead (*Caretta caretta*) and Hawksbill (*Eretmochelys imbricata*).

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. In recognition of this problem the JTC was constructed as 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, Ningaloo Draft Business and Operational Plan (Macgregor and Hogstram, 2003):

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 2005-2006 turtle breeding season was the second year that JTC operated. On recommendations from the previous season, changes were made to JTC operations in regards to self guided visitors.

Visitor attendance at JTC in the previous year did increase compliance with the Turtle Watcher's Code of Conduct (CoC), however 55% of visitors to JTC still did not comply with the CoC during self guided interactions. It was observed that the most effective means to ensure compliance with the CoC was to supervise interactions on the beach. Therefore during the 2005/6 season the JTC experience was promoted as a talk and a tour which visitors could book through the Exmouth Visitors Centre or the licensed operator. Self driven visitors to the centre were encouraged to participate in a commercial guided tour with the licensed operator. Tours entailed a visit to the JTC, a presentation given by a CALM volunteer and a guided tour viewing nesting turtles with accredited guides.

The goals of JTC are:

- to protect threatened species and conserving biodiversity;
- to advocate and facilitate sustainable tourism;
- to promote and maintain community participation and stewardship for coastal management; and
- to integrate the interests of conservation and recreation.

2. Operations

The centre was run by volunteers from the Ningaloo Turtle Program (NTP) from the 10th December 2005 to the 28th of January 2006. A presentation was delivered at 8pm from Monday to Saturday, with the exception of Christmas Eve, New Years Eve and Australia Day. Tours ran for 38 nights in total, with a few nights cancelled due to poor weather conditions.

Prior to the 2005/6 season solar lighting was installed at the JTC which addressed a visitor risk management issue of inadequate lighting. This installation provided low level lighting which produced a welcoming ambiance to the JTC whilst not allowing light to reach the

adjacent beaches. Solar lighting was activated by the movement of vehicles or visitors arriving in the JTC car park. Lighting at the centre was programmed to stay on for 40 minutes before turning off or movement triggering the system to remain on. At 11pm the lighting turned off for the night. By having the lighting on a movement activated system means that lighting does not remain on unnecessarily.

The low level lighting allowed visitors to peruse the static interpretation material at the centre and also provided a source of renewable electricity which allowed volunteers to deliver a PowerPoint presentation using a projector and screen. The presentation was approximately 20 minutes in length, delivered by one of the three NTP team leaders. The presentation entailed a brief description of the Ningaloo Turtle Project, the JTC aims, turtle biology, ecology and the threats faced by turtles in the Ningaloo region. The team leader then handed over to the licensed operator's tour guide who briefed the participants on the code of conduct. Before presentations, volunteers welcomed visitors to the centre and interacted with them by answering questions and providing information as required.

2.1 Volunteer Roles

The roles that were undertaken by volunteers and the related training is summarised in Table 4.

Table 4 Volunteer roles at JTC

| Role Title | Tasks | Training |
|--------------------------------|--|--|
| Team Leader | Centre co-ordination, deliver talks, and liaise with Commercial operators and turtle scouts. | Completion of Tafe Turtle Tour Guide Training Course, on-the-job training at JTC. |
| Information Officers | Delivering talks, liaising with Commercial operators and Turtle Scouts, interacting with visitors and self guided tourists. | Completion of Tafe Turtle Tour Guide Training Course, on-the-job training at JTC. |
| Assistant Information Officers | Greeting visitors, interacting with self guided tourists. | Competent NTP volunteer, on-the-job training. |
| Turtle Scouts | Scouted beaches for turtle activity, monitored self guided turtle interactions, liaised via radios with team leaders, liaised with Commercial tour guides, data collection | Completion of Tafe Turtle Tour Guide Training Course and on-the-job training at JTC OR Competent NTP volunteer, completion of Turtle Scout training workshop and on- the-job training. |
| Assistant Turtle Scouts | Assisting turtle scouts on the beach. | NTP volunteer, community member. |

The JTC operation was supervised by an officer from the Department of Conservation and Land Management.

The centre was able to operate with a minimum of two volunteers per night at the centre itself. Depending on available trained scouts there were between 1- 4 scout groups on the adjacent beaches at any given time. Operations on a whole were successful and fulfilled the JTC goals.

2.2 Volunteer Effort

Fifty six volunteers contributed 1227 hours at JTC during this season, 3.4 times the 2004/2005 season. This represents 69% of the total volunteers involved in the NTP, compared to 50% for the previous season. This increase in volunteer effort can be contributed to the

change in the rostering system and the fact that participating in JTC was part of the volunteer commitment this season compared to last season when it was optional.

2.3 Volunteer Training

The role of the JTC volunteer was to educate the public outlining the Turtle Watchers Code of Conduct (CoC), monitoring turtle-visitor interactions on the adjacent beaches and assist visitors to follow the interaction guidelines. To be able to do this, volunteers require a high level of competency in turtle interaction. During the 2005/2006 season, four 8 hour Turtle Scout Workshops were conducted.

At all times throughout the season there was a minimum of two volunteers per night. However, there were periods when JTC lacked competent scouts due to the roster-training schedule and limited resources. Fortnightly scout workshops were aimed to target the large influx of volunteers. On their four week placement volunteers began their JTC training in week two. In addition to attending the scout workshop volunteer's required three night's experience, volunteers were not gaining competency until the end of the 3rd week. This resulted in each volunteer investing two weeks of training for one week actively scouting. The Christmas to New Year period left the project with fewer volunteers and no staff to train. The problem was addressed midseason and the training schedule was altered to be more intensive in the first week of arrival for the volunteers. Clearly the needs of the two branches of the NTP are different and need to be considered, keeping in mind providing benefits/rewards for the volunteers as well as the project as a whole.

Recommendations:

- ***Changes to roster-training for next year; volunteers can take one of three paths:***
 - ***combined stream – as is, both JTC and monitoring on a day on/day off basis;***
 - ***JTC stream – JTC only at least 5 nights a week;***
 - ***Monitoring stream – monitoring only at least 5 nights a week.***
- ***Team leaders to be trained as trainers.***
- ***JTC internships lasting the entire season.***
- ***Additional resources for an employed position over the Christmas/New Year period.***
- ***Increase community involvement.***

An important issue raised at the beginning of the season was the volunteers' lack of awareness of the JTC product. Volunteers became disgruntled when learning of the strong link with the tour operators, the talk and scouting being part of a paid tour, the belief being that the public, who didn't want to pay to go on a guided tour, were excluded from education regarding turtle conservation. Volunteers felt that the commercial operator was making undue profits from volunteer efforts.

Recommendations:

- ***target tourism students for JTC in addition to environmental students, this would hopefully balance the number of volunteers wanting to participate in morning monitoring and evening education;***
- ***in the literature sent to volunteers emphasise the tour as community collaboration, focusing on the history of the project and why such measures are necessary;***
- ***specify the role of the JTC volunteer in literature;***
- ***reiterate in the induction the goals of JTC;***
- ***tour operators to acknowledge CALM volunteers as an integral part of the experience.***

2.4 Visitor-turtle interaction

A duty of Turtle Scouts was to monitor visitor-turtle interactions on the adjacent beaches to JTC and to assist self guided tourists to follow the interaction guidelines. Visitors participating in a guided tour had negligible non-compliance with the CoC.

Data collected by scouts over the JTC season showed that 97 self guided groups were encountered or observed on three beaches, namely Hunters, Mauritius and Wobiri. Of these, 285 adults and 49 children were observed.

The main breach (27%) of the CoC observed was failing to walk along the high tide line (Figure 58). The high frequency of this behaviour is probably due to both the lack of emphasis in the varying CoC information and the difficulty of both the scouts and JTC staff to explain such a requirement, particularly to international visitors. Shining a torch to search and sudden movements were equal (20%) in the next main breach of conduct observed (Figure 58).

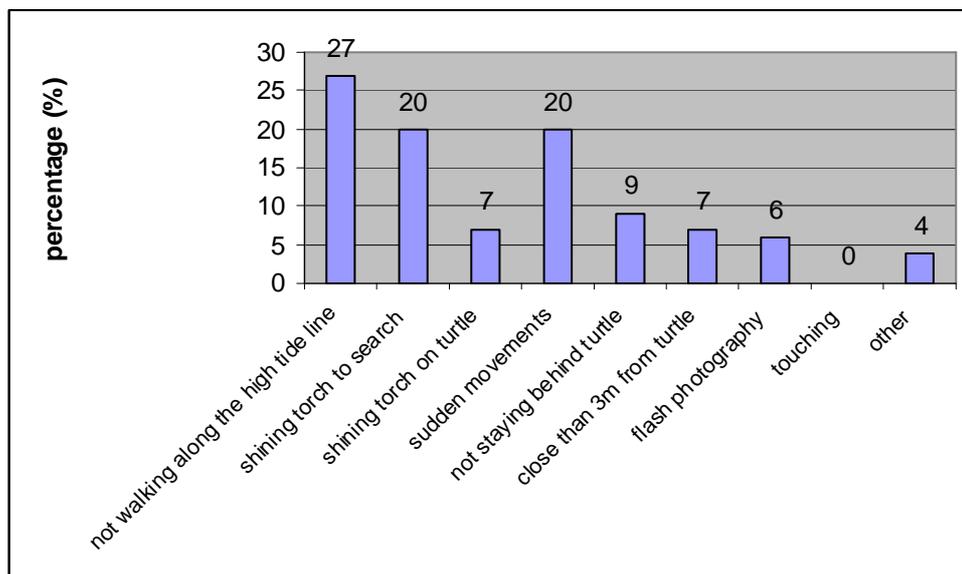


Figure 58: Breaches of CoC from visitor behaviour observed by NTP scouts.

Of the self guided tourists encountered on the beach, 62% were aware of the CoC. Of these 40% were observed breaching the CoC. Again the main breach was failing to walk along the high tide line, followed by sudden movements and shining a torch to search (Figure 59).

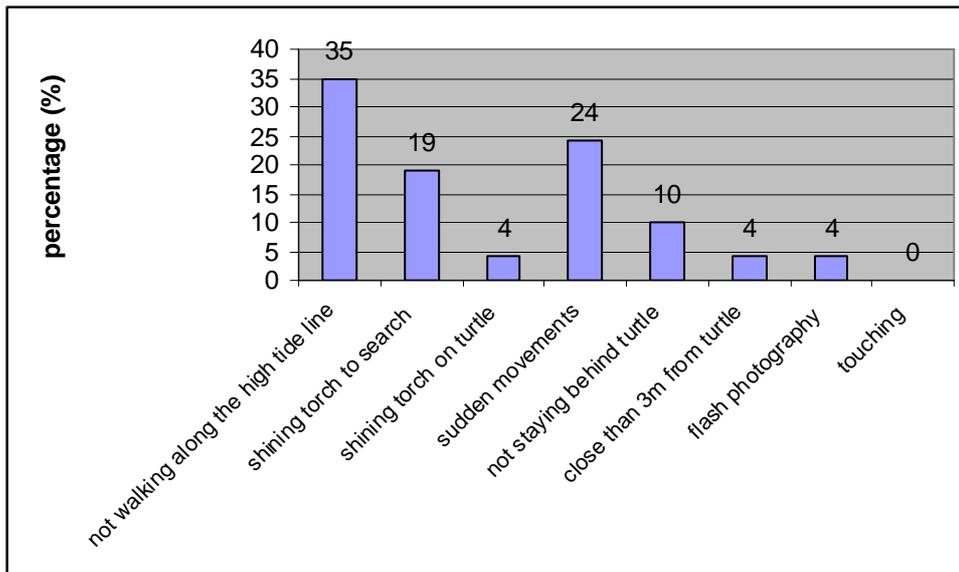


Figure 59: Breaches of conduct observed for visitors aware of the Turtle Watchers Code of Conduct (CoC). (n=84)

Over the Christmas - New Year period NTP scouts encountered high numbers of self guided tourists which occasionally led to confrontational situations. All self guided observations were recorded between the hours of 19:30 and 22:00. Scouts generally vacated the beach by 21:30, leaving the beaches unsupervised after this time.

Situations reported as difficult by volunteers included:

- Scouts having reported a turtle to JTC and waiting for the tour group to arrive when self guided visitors approach causing two possible scenarios: (i) the number of visitors (tour group and self guided) exceeding the limit of 15:1 so guides have to ask self guided visitors to keep looking further along the beach; and (ii) scouts asking the self guided visitors to join the tour group, in order to ensure they are complying with the CoC, causing paying tour participants to feel disgruntled.
- At times, self guided visitors interacted with the only nesting turtle and the scouts could not locate another turtle; subsequently scouts felt under pressure to invite the tour group down to the turtle potentially upsetting the self-guided visitors who were already with that turtle.
- Scouts still providing a tour for self guided visitors leading to the belief that if you turn up at the beach you can get a free tour.

This put a large responsibility on the volunteers to deal with potential confrontational situations so a response sheet to deal with potential situations was drawn up to assist volunteers with how to approach any such situations. It was also recommended that if a group of self-guided visitors were interacting responsibly with a turtle before the scouts arrived then that turtle should not be reported to JTC so as not to disgruntle responsible turtle watchers.

Recommendations:

- ***Provide public education for those not participating on the tour.***
- ***Manage influx of people onto the beaches at night.***
- ***Monitor beaches later than 9:30 or restrict public access.***

3. Effectiveness of Education at JTC

One of the key roles of the JTC is to reduce disturbance to nesting marine turtles by providing education about turtle behaviour and the Turtle Watchers Code of Conduct.

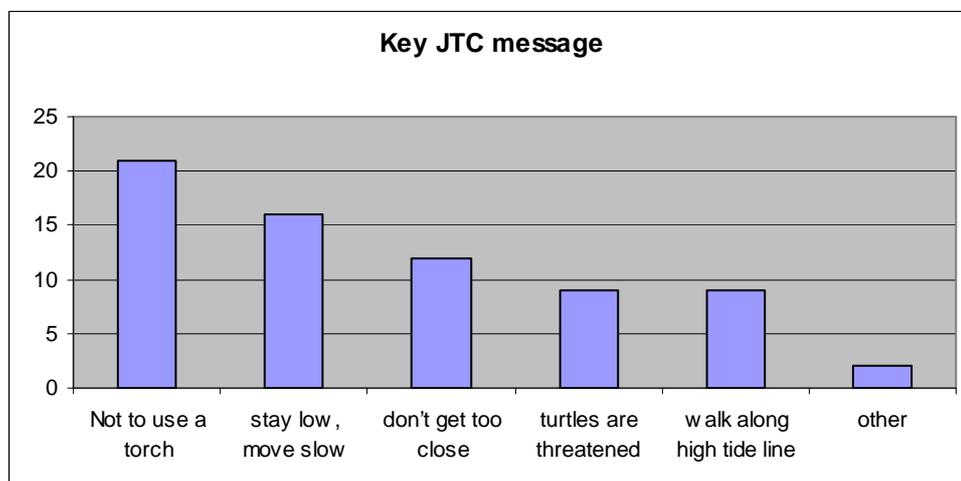


Figure 60: Key message obtained by self guided tourists encountered on the beach (n=334)

Of those self guided tourists encountered on the beach that visited JTC, the main message taken was not to use a torch (Figure 60). However torch use is still a common breach observed (Figure 59). As identified in the 2004/2005 season report (Macgregor and Silva, 2005) this can be accounted for partly due to conflicting information provided in JTC signage and at the beach accesses to turtle rookeries. Both forms of interpretation recommend that turtle watchers reduce (not eliminate) the use of light.

As demonstrated in Figure 59 the most frequent behaviour breach of the CoC was visitors walking along the beach rather than the high tide line, however it was the least of the key messages obtained at the JTC (Figure 60). This outcome is consistent with the 2004/2005 season also, and emphasised in the 2004/2005 season report report (Macgregor and Silva, 2005), demonstrating the need to focus on this in the static material, promotional material and the presentation (given by the tour operators). Disturbing a turtle once on the beach is an established threat to nesting turtles, with the potential of significantly impacting their energetic expenditure.

Recommendations:

- ***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.***

Another issue faced at the JTC was visitors that did not wish to participate on a tour for whatever reason believed to be alienated from turtle viewing and education. Unfortunately due to lack of data the main reason people did not want to participate could not be identified. Some families commented on the cost being too much at \$60 for 2 adults and 3 children. Locals felt they should not have to pay.

4. Commercial Tour Operators

The only licensed commercial turtle tour operator for the 2005/2006 season was Ningaloo Reef Retreat. Visitors were encouraged to participate in a guided tour to try and manage compliance with the CoC. By working in conjunction with tour operators it was hoped that they would assist CALM with the management of visitor numbers on turtle nesting beaches. Guide qualifications involved attending the TAFE Turtle Tour Guide training course or the CALM Scout Workshop, plus on-the-job training.

The tour comprised a visit to the JTC, the presentation and a guided tour viewing nesting turtles. Booking was advertised as essential so that the tour operator knew how many guides to provide (one tour guide per 15 tour participants). Scouts had the opportunity of working as a guide should the number of self driven visitors exceed that manageable by the operator. Tour costs were; adults \$25, children \$15, families \$60. Feedback suggests that prices were viewed as reasonable.

Over the season 38 tours ran, with a total of 742 participants of which 626 were adults. Of those on the tour 617 pre-booked with the Ningaloo Reef Retreat, thus 125 tour participants were collected at JTC without a booking (20%).

The Peak season was between Christmas and New Year (Figure 61).

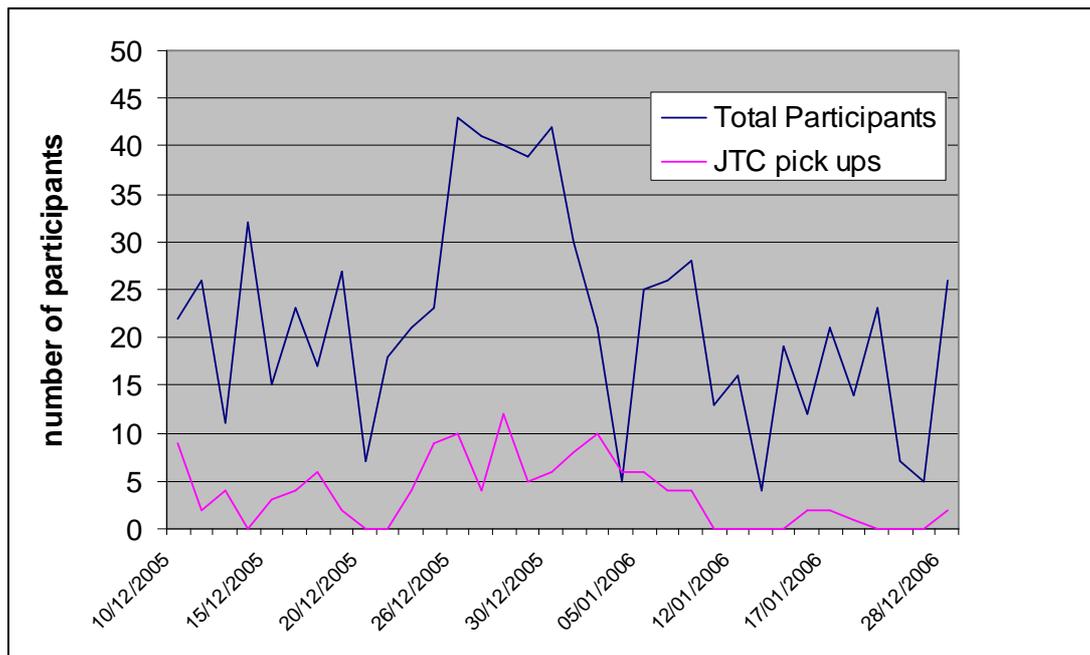


Figure 61: Total number of tour participants and total number of participants picked up at the JTC over the 2005/06 operating season.

From data collected by the scouts it was determined that 70% of self guided tourists encountered on the beach were aware of the tours, however not enough data was collected to determine why they chose not to participate.

The Ningaloo Reef Retreat provided a bus service from town, 89% of those that participated on the tour utilised this service, minimising the number of vehicles travelling to the Jurabi Coast, reducing threats to wildlife and reduction of light emittance on beach-front carparks.

Feedback from the tour participants was clearly positive across the board with respect to tour satisfaction. Feedback forms were divided into two sections, JTC and interaction component in order to provide feedback to both parties involved (CALM and Tour operator) for future improvements.

5. Tour Participant Feedback

5.1 Jurabi Turtle Centre Feedback

Feedback received for the JTC and the presentation delivered by the Team Leaders was very positive and indicated a very high level of visitor satisfaction (Table 5).

Table 5 JTC feedback

| Jurabi Turtle Centre | Yes | Partly | No |
|---|--------------|---------------|-------------|
| Staff at facility were welcoming and friendly | 100% | | |
| Lighting at the carpark, walkway and centre are adequate | 85% | 13% | 2% |
| The information panels and displays are interesting | 84% | 13% | 3% |
| The facilities at Jurabi Turtle Centre are satisfactory | 90% | 9.9% | 0.1% |
| The Presentation | | | |
| The presentation was enjoyable and informative | 99.9% | 0.1% | |
| The presentation was clear and easy to follow | 99.9% | 0.1% | |
| The presentation was too long | 11% | 12% | 77% |
| Safety messages were adequately covered | 93% | 6.8% | 0.2% |
| The presentation made me more aware of the threats sea turtles face | 91% | 8.8% | 0.2% |

The main messages that tour participants took from the JTC presentation were:

- turtles are threatened,
- save the turtles,
- no go, go slow, stay low.

5.2 Tour Interaction Feedback

Feedback received for the interaction component of the tour was also positive and indicated a high level of visitor satisfaction (Table 6). 89% of tour participants saw a turtle during their turtle tour.

Table 6 Interaction component feedback (%)

| | | | | | | |
|---|----|----|----|---|---|--|
| Enjoyed experience | 64 | 24 | 8 | 3 | 1 | did not enjoy the experience |
| Too long | 12 | 13 | 60 | 7 | 8 | too short |
| Made conservation seem more important | 55 | 24 | 17 | 3 | 1 | Made conservation seem less important |
| Tour was exciting | 45 | 33 | 14 | 6 | 2 | tour was boring |
| I would recommend to others | 74 | 16 | 5 | 4 | 1 | I would not recommend to others |
| Tour was worth money | 57 | 15 | 16 | 5 | 7 | tour was not worth money |
| Saw a turtle | 89 | 5 | 4 | 1 | 1 | Did not see a turtle |
| More should be done to conserve turtles | 55 | 21 | 21 | 3 | 0 | less should be done to conserve turtles |
| Info at centre complemented the tour | 72 | 18 | 8 | 1 | 1 | info at presentation was not complementary |
| Code of Conduct is reasonable | 83 | 12 | 3 | 1 | 1 | Code Of Conduct is not reasonable |

Shortage of qualified guides at the beginning of the season and over the Christmas period did prove a problem because:

- a) of the unexpected number of willing tour participants at JTC itself, attracted by the sign on the road;
- b) the Turtle Tour Guiding Course as a pre-requisite for Guides ran only at the end of November, resulting in a small pool of qualified candidates;
- c) of the 26 students enrolled in the course, few demonstrated interest in working as a guide, despite being aware of opportunities available with Ningaloo Reef Retreat;
- d) of the lack of interest generated amongst NTP volunteers to engage in paid employment.

The Reef Retreat did however by midseason have core staff, including Exmouth locals that were adequate to cover tour numbers.

Recommendations;

- ***Expand information in regards to bookings on roadside sign.***
- ***Focus on training and qualification for guides prior to the beginning of the season.***
- ***encourage local community participation to increase the number of willing guides.***

On a few occasions, incidents arose due to operational procedures that could result in tour guides failing to comply with license conditions such as limited numbers of participants per tour and distances which could easily lead to disturbances of emerging and nesting turtles.

Recommendations:

- ***That tour operators use radios to ensure that each tour group of 15 is independent of the other.***
- ***That compliance auditing of operations be conducted throughout the season***

On several occasions tour participants were observed to have incorrect clothing and footwear for the nature of the tour (commando crawling, dark cold conditions) increasing the risk of injury or incidents. Either tour participants chose to ignore information given to them on the occupational health and safety issues when booking or tour participants were not informed regarding appropriate clothing, footwear and risks.

Recommendations:

- ***That information given by tour operators and the various tourist outlets must specify requirements and conditions***
- ***That tour operator posters should depict the nature of the tour-nighttime.***

6. Visitor data and analysis

Visitors completed 255 feedback forms; all visitor data analysis was taken from feedback forms of tour participants only.

Visitors demonstrated a very high level of satisfaction with regards to the interpretation material at JTC, the facilities provided and the presentation and service provided by the NTP volunteers. The main message obtained by those attending the talk were ‘turtles are threatened’, ‘save the turtles’ and ‘no glow, go slow and stay low’.

In terms of demographics, international visitors comprised 48 % of tour participants (Figure 62). The second highest group of participants were visitors from the Perth metropolitan area (28%).

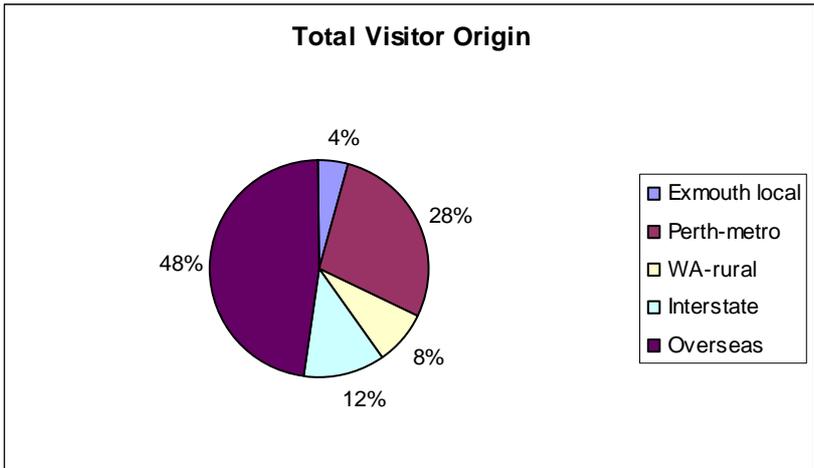


Figure 62: Origin of total tour participants (n=255).

Of the international visitors 29% percent were of UK origin, followed by 20% from Germany (Figure 63). Figure 63 demonstrates that a high proportion of international visitors to the JTC did not use English as a first language.

Recommendation:

- *That CoC and interpretive material should be available in languages of high use such as German, Swiss and Italian*

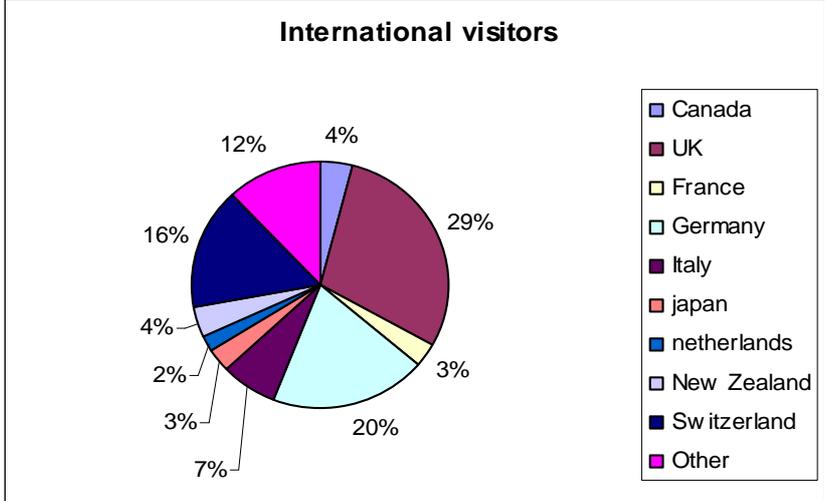


Figure 63: Origin of international visitors.

Of the Australian visitors, 54% percent were from the Perth metropolitan area, 8% from local Exmouth, a 3 % increase on the 2004/2005 season (Figure 64) and 23% of visitor originated from interstate.

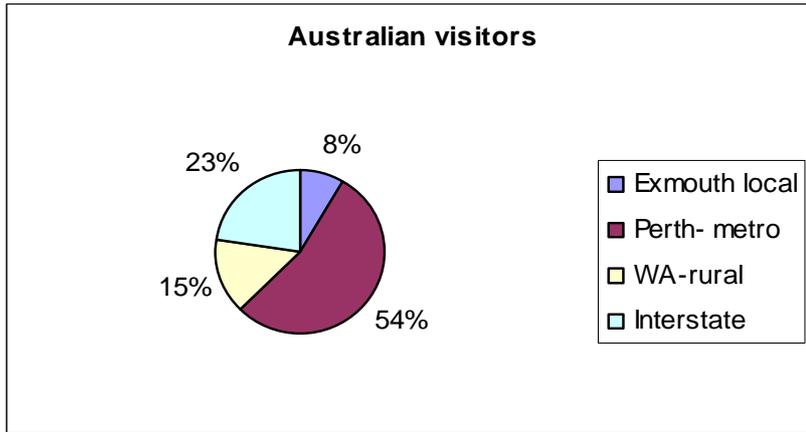


Figure 64: Origin of Australian visitors.

The majority of tour participants stayed at caravan parks (Figure 65). If consistent with last years results one can assume the majority of visitors were staying at the Lighthouse Caravan Park. As the accommodation options on the feedback form were broad it is hard to draw conclusions, however a high proportion of tour participants stayed at the backpackers/hotel (Figure 65) compared with last season. This maybe explained by the availability of the tour pickup this year as many backpackers do not have a vehicle and the relatively low cost of the tour making it more accessible to a wider audience. Also it highlighted the majority of tour participants being visitors to the area.

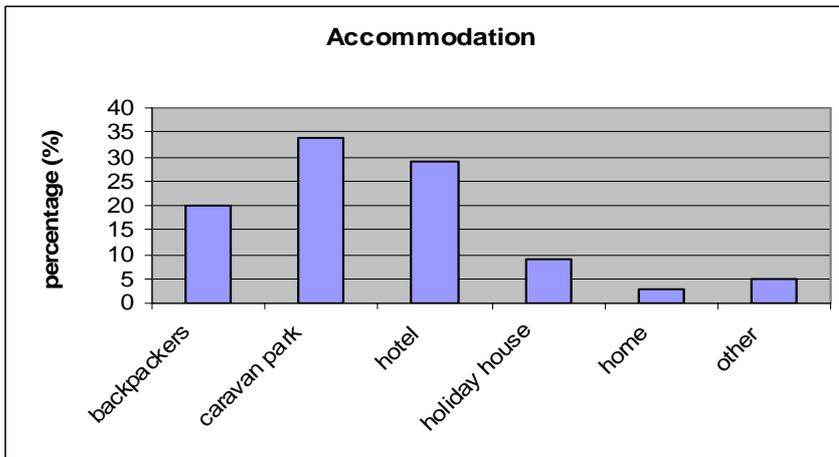


Figure 65: Tour participant accommodation in Exmouth.

48% of visitors were between the ages of 25-39, 25% above the age of 40 and 27% below the age of 24 (Figure 66).

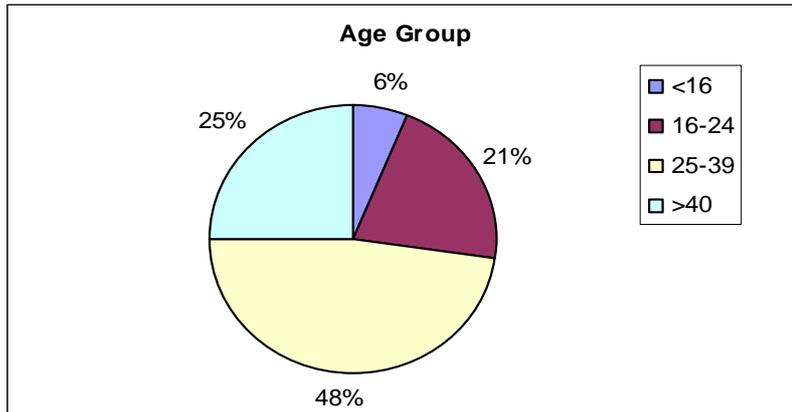


Figure 66: Age groups of tour participants.

The Visitors Centre was the main source of information regarding the Turtle Tours (Figure 67); this may be either the Exmouth Visitors Centre or the Milyering Visitors Centre, as the feedback forms did not distinguish between the two.

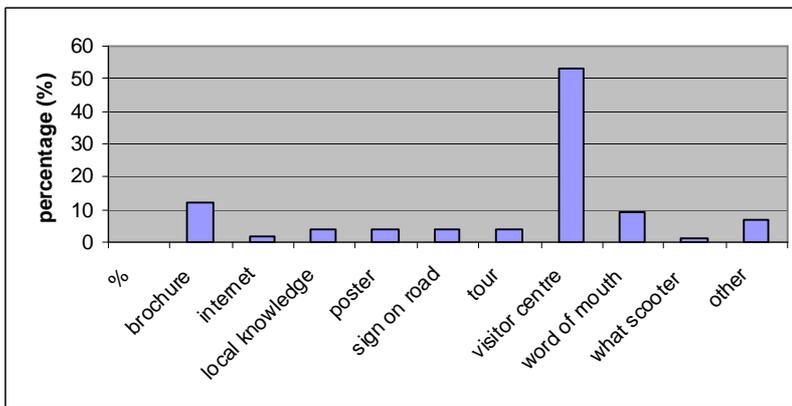


Figure 67: Location where tour participants learnt of turtle tour.

7. Mall Stall - Community education and involvement

In response to concerns regarding the lack of public turtle interaction education the Mall Stall was set up in the main square of Exmouth Shopping Centre. The aim was to provide education for Exmouth locals and tourists regarding the Turtle Watchers Code of Conduct, with the intention of educating those not interested in a turtle tour.

The Mall Stall began in the first week of January, running from 10am-12noon Tuesday, Thursday and Saturday. 50 people approached the mall stall, over the three week period of which it was running.

Feedback suggests that the Mall stall did not fulfil its goals due to:

- the Mall stall was set up post-peak season, missing the target tourists and locals;
- the location did not catch the wider, target audience; and
- the locals showed little interest in the stall.

Recommendations:

- ***That an information stall be set-up in the Exmouth Visitors Centre to target tourists.***

- *That the mall stall be improved and continued in order to attract the locals, maintain a presence and improve local perceptions of the NTP.*

What the 2005/2006 season did demonstrate is the need for community involvement and support with the aim of improving the view of the NTP. In a post-season meeting the following suggestions were proposed:

- Recruit volunteers locally through newspaper, letter drop and personal contact.
- A Local Liaison Person to improve the local perception of the project. The person would give talks to local groups representative of the community, organise social events thus making the project more accessible to the community.
- Improve signage detailing the CoC at beach accesses and put a positive spin on it.
- 2006 is the Year of the Turtle - perfect emphasis for ongoing community events throughout the year such as the Whale shark festival, quiz night, school poster competitions, - a 'Turtle Festival' before the 2006/7 season, a stall at the Exmouth Christmas street party, etc.

8. Occupational Health and Safety

Occupational Health and Safety guidelines for JTC are detailed in the Operational Procedures for Interpretation Volunteers and Turtle Scouts. All volunteers are formally briefed about OH & S and are required to complete a CALM Volunteer Registration form prior to attending the centre in a volunteer capacity. There were no OH & S incidents or issues recorded this year.

9. Visitor Risk Management

Inadequate lighting was addressed this season with the installation of solar lighting at the centre, along the pathways and at entrance bollards. The toilet also had a solar light installed during the season allowing for safe use by visitors.

10. Marketing

The following marketing was undertaken for the 2005/2006 season;

- a) A letter detailing operational information sent to all tourism related businesses in and around Exmouth.
- b) NTP season launch 26th November at JTC. Targeting local stakeholders, businesses, sponsors, volunteers
- c) Article published in the local paper, the Northern Guardian announcing official opening to the turtle nesting season and upcoming tours available.
- d) Friday 9th, free tour for locals and tourism representatives
- e) Ningaloo Reef Retreat Turtle Tour Posters distributed to all local accommodation suppliers, Exmouth Visitors Centre, Milyering Visitors Centre, Coral Bay and Exmouth Community and CALM notice boards.
- f) Visitors Centres - provide tour participants with more information about clothing and nature of the tour
- g) Sign on the road "Turtle Tours Tonight"

In general the marketing provided to the tourists visiting the region appeared adequate. The suggested recommendations below targeting the local involvement, if fulfilled, would clearly spill over to the visiting tourists.

Recommendations:

- *That free tours targeting locals should not be during peak Christmas party season*

- *That commercial operators should better represent the tour conditions for instance depicting night beach setting. In addition, the NTP volunteers should be recognised and the community collaboration should be emphasised to portray a better image within the community.*
- *That visitor centres need to provide people with more accurate information regarding tour conditions and requirements.*
- *That the sign on the road requires more specific information regarding bookings.*
- *That the 2006 Year of the Turtle be utilised as a, launch pad for marketing events.*

11. Research

11.1 “Evaluating the Effectiveness of the Jurabi Turtle Experience in managing turtle-tourist interactions” by Leanne Smith

Murdoch University Honours student Leanne Smith has been working closely with CALM in Exmouth to evaluate the effectiveness of the Jurabi Turtle Experience in managing turtle-tourist interactions. Leanne aims to determine the influence of the Jurabi Turtle Experience on tourist behaviour and satisfaction and, specifically, to answer the questions:

1. Does the Jurabi Turtle Experience reduce tourist non-compliance with the CALM code of conduct (CoC) for viewing nesting turtles?
2. Does the Jurabi Turtle Experience increase tourist satisfaction with the turtle nesting experience?

Leanne carried out her fieldwork during the 2005/06 season where she used participant observation and a questionnaire to gather data on tourist levels of:

1. Non-compliance with the code of conduct for viewing nesting turtles
2. Awareness of the code of conduct
3. Satisfaction with the turtle nesting experience

Leanne will be comparing data for Jurabi Turtle Experience participants (tour participants) with self guided independent travellers to determine the effectiveness of the Jurabi Turtle Experience in managing tourist interactions with the nesting turtles. The results of Leanne’s work will assist CALM in future management of turtle-tourist interactions in Ningaloo Marine Park.

11.2 Community Turtle Conservation Through Cross-Regional Collaboration

This project is designed to support and standardise the existing sea turtle monitoring initiatives throughout Australia based on the success and practices of the Ningaloo Turtle Program.

The purpose of this project is to share knowledge across Australia on marine turtle monitoring, beach-based turtle tourism and the development of education and interpretation material and the standards for monitoring and the development of educational materials can be quality enhanced and standardised where appropriate.

The methodology will increase the capacity of groups to deliver standardised nesting-beach monitoring data that can contribute to national knowledge. To support sustainable turtle ecotourism practices, a national Code of Conduct and uniform interpretive materials will be trialled on the Ningaloo Coast using the expertise from James Cook University. This project aims to build enhanced communication, increase capacity and improve coordination over

community driven marine turtle programs to assist in the implementation of the National Recovery Plan for Marine Turtles in Australia.

12. Finance

The revenue produced through donations by Ningaloo Reef Retreat for every adult tour participant totalled \$1252.00 (\$2 per adult; 626 adults participated in tours during 2005/06 season). There was also discussion regarding a recommendation from the draft business plan that the commercial operator would pay back to the program the going rate (\$15/hr) for every turtle interaction facilitated by turtle scouts.

The revenue produced through gold coin donations at the centre itself totalled \$437.35 despite not highlighting 'gold coin donations' on advertising and marketing material this season, due to donations coming from commercial operators for every adult participating on a guided tour. This overcame the issue of visitors to the centre not paying a gold coin donation and highlighted that tour participants were even willing to donate money despite having paid to participate on a tour and \$2 per adult already being donated on their behalf by the commercial operator. NTP volunteers felt that \$2 donation was insufficient and it is recommended that next year:

- That \$5 per adult is donated by commercial operators for use of the JTC NTP services.

Any revenue raised by the centre will assist covering operational costs, which are presently absorbed by CALM and the Shire of Exmouth. The JTC Draft Business and Operational Plan identified a revenue objective of cost recovery for CALM's vehicle running expenses associated with the centre. The total revenue raised, once collected, exceeds vehicle running costs of \$1064 (38 nights @ 40kms x \$0.70) however a second vehicle was used on several nights for training purposes so the extra money collected would cover these additional costs.

13. Conclusion

The goals projected for JTC in its second year were partly achieved.

As recognised from the 2004/2005 report it was determined that the best way to avoid turtle disturbance during nesting is by supervised interactions, encouraging all tourists to participate on a tour was how this was achieved. When considering 742 people participated on a tour, assuming that they did not disturb a turtle, the goal of facilitating sustainable tourism has been met. However 334 self guided tourists observed on the beach is an extremely high figure, an issue facing the turtles that is not being sufficiently managed. Clearly with figures this high, if turtle tourism is to continue the goal must be to continually encourage people to participate on a guided tour. For those not willing to participate, channelling people through the JTC and an increase in public education is essential. Clearly a need to streamline information provided to the public, making it both concise and consistent is necessary.

If the numbers of visitors impacting on the nesting turtles significantly increases over time alternative management strategies may need to be considered. Channelling visitors to JTC and adjacent beaches should continue in order to assist visitor management.

The goal of promoting and maintaining community participation and stewardship for coastal management clearly still needs to be pursued. The 2005/2006 season emphasised the need to rally local support not only to improve the perception of the project amongst the community but to give them ownership. Valid suggestions have been made for consideration with the attempt to generate pride in 'Exmouth's turtles' and encouraging locals to become involved in both the protection of turtles and education of the public.

Tour operators, despite occasionally lacking in competent guides, did a great job. In future years more tour operators participating is essential, focusing on community collaboration.

The number of volunteers as a whole was adequate; however the number of available trained volunteers was not always enough throughout the season. Changes to the rostering system will clearly rectify this problem. Additional resources are required to meet training requirements for JTC. Although the NTP is one entity the two branches do need to be considered independently as the volunteer requirements are different.

The activities at JTC, visitor feedback and surveys conducted by volunteers on the beach during the 2005/06 breeding season have all provided valuable information that will direct and assist the Turtle Interpretive Facility Advisory Committee to develop the centre still further. The successes of the centre during the 2005/06 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, Ningaloo Reef Retreat and the Shire of Exmouth. Collaboration among stakeholders continues to contribute to the spirit of this project and assist in achieving the successes of JTC to date.

The following table summarises issues and recommendations based on the 2005/06 turtle breeding season.

Table 7 Summary of issues and recommendations

| Issue | Recommendation |
|--|---|
| Lack of adequate numbers of trained volunteers | <ul style="list-style-type: none"><li data-bbox="858 1890 1465 1984">➤ Changes to roster-training for next year, needs of both branches of the NTP to be factored in when recruiting volunteers<li data-bbox="858 1991 1465 2018">➤ Team leaders to be trained as trainers |

| | |
|--|---|
| | <ul style="list-style-type: none"> ➤ JTC specific volunteers ➤ JTC internships |
| Some volunteers lacking interest in JTC involvement | <ul style="list-style-type: none"> ➤ Target tourism students |
| Lack of resources to train volunteers | <ul style="list-style-type: none"> ➤ Train team leaders as trainers ➤ Seek additional budgetary and/or external funding to train volunteers |
| Confusion amongst volunteers regarding their role as a JTC volunteer | <ul style="list-style-type: none"> ➤ Initial information provided to the volunteer to outline specifically the JTC history, the aims and the specific requirements for a JTC volunteer |
| Large, uncontrolled influx of self guided tourists over the Christmas- New Year holiday | <ul style="list-style-type: none"> ➤ Additional resources for an employed position over the Christmas/New Year period. ➤ Public education pre-season ➤ Target all accommodation outlets regarding both tours and CoC ➤ Community involvement and education ➤ Target the Visitors Centre |
| Main breach of the CoC was failing to walk along the high tide line, thus disturbing emerging turtles. | <ul style="list-style-type: none"> ➤ Changes need to be made to static material at JTC, printed material and the signage at beach accesses putting greater emphasis on this element. ➤ Visitors to be encouraged to participate on a tour |
| People aware of the CoC are still doing the wrong thing | <ul style="list-style-type: none"> ➤ Volunteers stationed at beach accesses explaining CoC ➤ Scouts patrolling beaches past the current 21:30 departure ➤ Limit beach access to significant turtle rookeries |
| Disgruntled people who did not want to participate on the tour believed to be excluded from turtle watching experience | <ul style="list-style-type: none"> ➤ Encourage all visitors to participate on a tour ➤ Greater focus on providing information to those people unwilling to participate on the spot- brief CoC notes. |
| Tour Operators lacking competent Guides | <ul style="list-style-type: none"> ➤ Target locals as they can be trained prior to the season ➤ Tour operators to improve publicity signage, encouraging bookings to therefore have better estimates on tour numbers |
| Tour Operators occasionally not complying with turtle interaction licensing conditions | <ul style="list-style-type: none"> ➤ Tour operators to use radios, each group of 15 is completely independent of the other. ➤ Strict guidelines to be followed, 15 people per one turtle only. ➤ Auditing of tour operators to ensure complying, otherwise licence removal. ➤ additional training for guides by operators ➤ guides sign to say they have read license conditions |
| Tour participants not adequately informed of necessary physical and clothing requirements | <ul style="list-style-type: none"> ➤ All information outlets to be briefed and must inform people of conditions ➤ Promotional posters must better depict the nature of the tour |
| A high proportion of international visitors do not use | <ul style="list-style-type: none"> ➤ Have CoC translated into select languages |

| | |
|---|--|
| English as a first language | |
| Mall Stall did not fulfil its aim to educate and inform the local community. Lack of emphasis on the community collaboration that is the NTP. | <ul style="list-style-type: none"> ➤ Local Recruitment ➤ Information sessions, outlining the community structure of the NTP. ➤ A Local Liaison Role to improving the local perception of the project. ➤ Improve signage detailing the CoC at beach accesses. ➤ 2006 is the Year of the Turtle- perfect emphasis for ongoing Community events throughout the year. |

4.0 Community Monitoring Expansion and Outreach

Community monitoring of turtle nesting activities were continued in 2005/2006 in the communities of Port Hedland and Cape Lambert, near Wickham. The participation of the Care for Hedland Group in Port Hedland and the West Pilbara Community Turtle Monitoring Group, in turtle monitoring activities in early 2004/2005 has demonstrated their interest and commitment to 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 2005 to introduce and train volunteers in the turtle monitoring methodologies used and provide educational and interpretive information for the local community. There were 40-50 participants during the day session and a large group to view turtles that evening and the following morning.

The first training and education workshop in turtle monitoring methodologies in Wickham was held during the weekend of the 12th-13th of November 2005 to introduce and train volunteers and provide educational and interpretive information for the local community. The workshop attracted 12 participants and further training during the ensured that 10 local volunteers received their competency from a certified trainer.

A Train the Trainer workshop was held for coordinators and committed volunteers on the weekend of the 4th and 5th of Wednesday. Four participants attended from Port Hedland, Wickham and Christmas Island and achieved their Trainer's competency in the NCTMP turtle monitoring methodology. These Trainers are now able to work with and certify volunteers within their individual community groups.

Recommendation: Continue to conduct education and training for regional community groups to build capacity and raise awareness of turtle monitoring and conservation efforts on a regional scale.

5.0 Ningaloo Turtle Program - Volunteers and Coordination 2005/2006

The 2005/2006 turtle program was a great success for volunteers, coordinator and trainers who were facilitating, recruiting and training volunteers. The continued services of three volunteer team leaders responsible for the monitoring program, Jurabi Turtle Centre and social events continued to assist in the organisation of the overall program and created new opportunities for volunteers to engage in a wider range of activities.

During the 2005/ 2006 volunteers engaged in the following activities:

- “Turtle tracking” – ie beach monitoring;
- “Turtle scouting”-ie identifying emerging turtles at night time.
- data entry;
- remote camping on the Ningaloo Reef monitoring beaches;
- educational activities and interpretive talks at the Jurabi Turtle Centre;
- assisting with Turtle Rescues;
- completing a TAFE certified Turtle Tour Guiding Course;
- assistance with 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

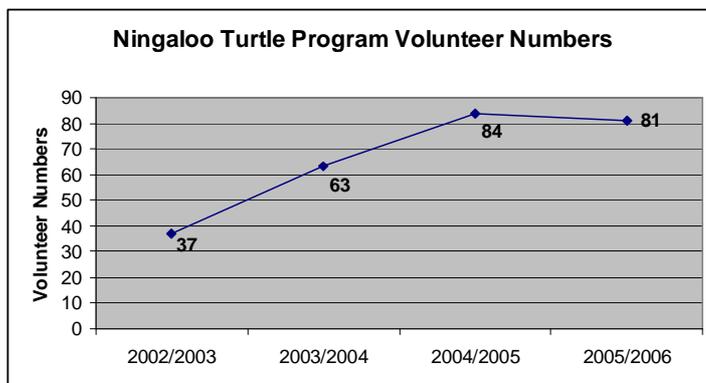


Figure 68: Participant numbers over three years of the Ningaloo Turtle Program.

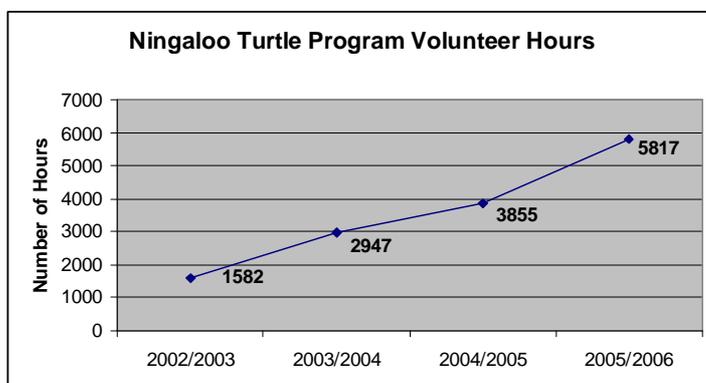


Figure 69: Volunteer hours over three years of the Ningaloo Turtle Program.

A total of 81 registered volunteers participated in the Ningaloo Turtle Program in 2004/2005. These volunteers contributed 5817 total volunteer hours to the program. 4464 hours were spent walking 2386 kilometres of beach along the Ningaloo coast. Volunteers covered contributed 127 hours to data entry. Volunteers donated 1227 hours towards educational and interpretive talks at the JTC and also assisted with scouting the beaches for nesting turtles.

5.2 Monitoring Effort Statistics

A consistently high number of participants involved in the programme throughout the 2005/2006 turtle nesting season ensured that an elevated monitoring effort was maintained throughout the season. The Ningaloo Region experienced the effects of two tropical cyclones (Cyclone Claire and Cyclone Daryl), which suspended monitoring for two days during the 2005/2006 season. As a consequence, 97.1% effort was achieved in the Lighthouse section, 98.9% in the Hunters and Graveyards sections, and 97.8% in the Tantabiddi section. 98% effort was achieved in the Bungelup section in the southern Cape Range National Park. And also 98% in Janes bay in the Ningaloo Division. The consistently high monitoring effort achieved could not have been possible without the enthusiastic efforts of dedicated Ningaloo Turtle Program volunteers.

5.3 Data Entry Effort Statistics

Ningaloo turtle programme volunteers successfully entered all monitoring data for the Jurabi Coastal Park ,Bungelup and Janes Bay sections. Of the 81 volunteers registered in the programme, 74% participated in the entry of data, and donated an average 2.4 hrs each. Local community volunteers were not required to participate in data entry.

5.4 Volunteer Demographics

Ningaloo Turtle Programme volunteers were received from various locations within rural and metropolitan Western Australia, Eastern Australia, New Zealand, the UK, USA, Canada, Germany, France and Norway. Of the 81 registered volunteers received, 28 were local residents of Exmouth, while 31 participants where from the Perth metropolitan area. A total of 23 volunteers were enrolled students from Perth universities, with an additional five students from eastern states universities. The age of volunteers ranged from 19- 70 years, with the majority of participants aged between 21-30 years.

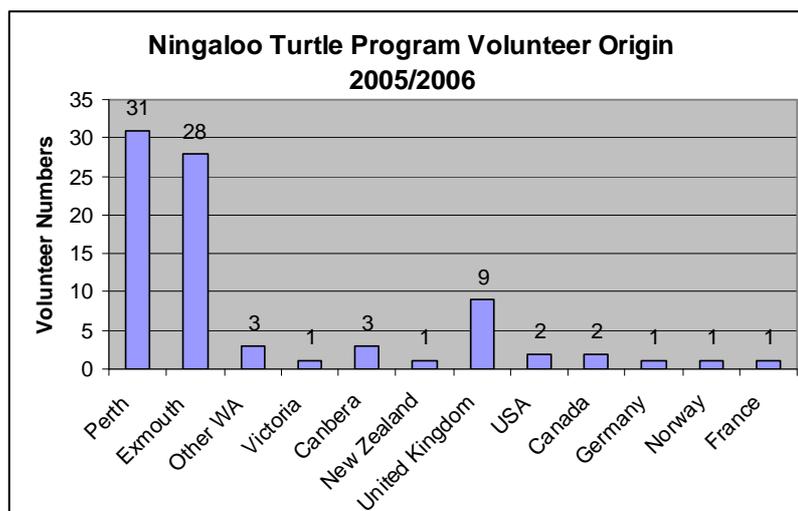


Figure 70: Ningaloo Turtle Program Volunteer Origin

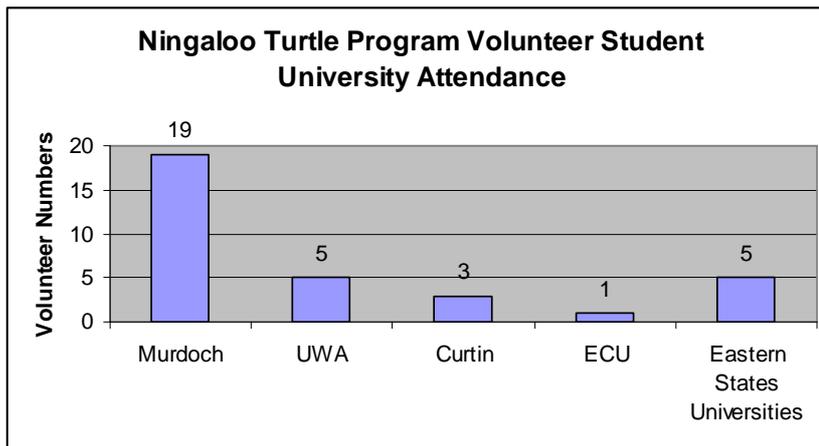


Figure 71: Ningaloo Turtle Program Volunteer Student University Attendance

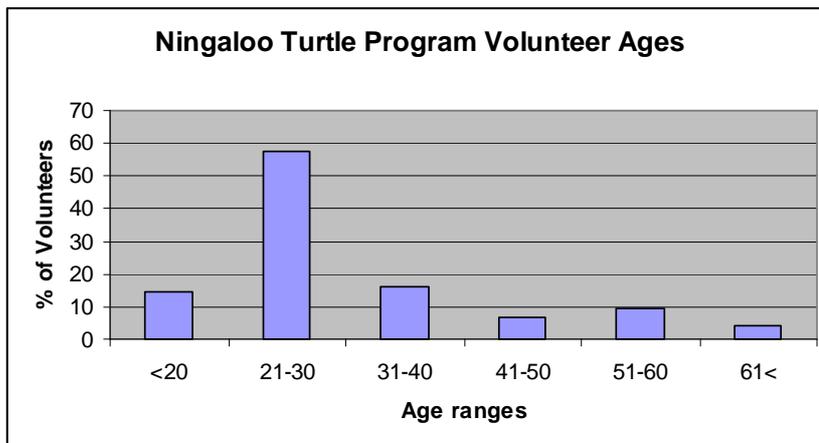


Figure 72: Ningaloo Turtle Program Volunteer Age

Recommendation: Continue to recruit international volunteers through websites and advertisements. Enhance focus on increasing local community participation in the programme, and continue to conduct targeted recruitment at Perth universities and conservation groups.

5.5 Ningaloo Turtle Program Launch

The seasonal launch of the Ningaloo Turtle Programme was celebrated on the 26th of November 2005. The event comprised a wine and cheese evening held at the Jurabi Turtle Centre from 6-8pm to allow viewing of the Ningaloo sunset. Roland Mau and Susie Bedford provided a summary of the success of the Ningaloo turtle Programme to date, and acknowledged the active involvement of various stakeholders and volunteers. Feedback from all 30-35 attendees was extremely positive.

5.6 Community Workshop

A community workshop was held on the 5th of November 2005, prior to the commencement of the 2005/2006 season to provide information about the program and community education. Allison Richards and Susie Bedford presented at the workshop in order to increase community knowledge and participation in the programme, and to encourage advocates for marine turtle conservation. Positive feedback was obtained in response to the professional and informative presentations conducted at the workshop. Of the 33 participants, 20 were successfully recruited as Ningaloo Turtle Program volunteers.

Recommendation: continue to provide community information workshops prior to the commencement of the turtle nesting season in order to maximise local community involvement in the Ningaloo Turtle Program.

5.7 Season Training

In order to provide accurate and reliable data, volunteers are required to have a thorough understanding of the turtle nesting process, be able to distinguish completed nests and species dependent tracks, and competently adhere to standardised monitoring procedures. As a consequence, all volunteers are engaged in a comprehensive four-day training schedule. Training commences with a theory based training session, followed by a minimum of three days field experience. Training is based on the methodology outlined in the NCTMP field guide, and is complimented by an informative training DVD. On completion of training, participants are required to pass a competency-based field assessment before being permitted to monitor turtle rookeries unaccompanied.

Turtle monitoring training was conducted throughout the nesting season, and was generously provided by the expertise of Susie Bedford (Cape Conservation Group), Allison Richards (CALM), Roland Mau (CALM) and Mistral Dodson. All 81 volunteers gained competency and subsequently received certificates and official monitoring T-shirts.

Volunteer arrivals were scheduled to coincide with the commencement of training on Monday mornings, with competency assessments conducted every weekend. This training system proved very successful. However, the occasional large influx of volunteers required two experienced trainers to be present each morning for training purposes, placing added strain on those providing training and conducting competency assessments.

Recommendation: Train and assess the volunteer Team Leaders as a Trainers earlier in the nesting season to minimise 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 2005/06 season, four 8 hour Turtle Scout Training Workshops were conducted.

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: Review the operational needs and training process required for the JTC.

5.8 Volunteer accommodation

Throughout the duration of the 2005/2006 turtle nesting season, Ningaloo Turtle Programme volunteers were required to participate in the program for a minimum of four weeks. Participants were subsequently offered subsidised accommodation (\$70/week) in one of two dorm rooms at the Potshot hotel for the duration of their stay. Feedback indicated that although weekly accommodation expenditure was satisfactory, living conditions and hygiene were not. Concentrating volunteers at one location benefited intra-participant relations and increased social activity.

Recommendation: Continue to subsidise accommodation through a local provider, concentrating volunteers in one location. Approach all local accommodation businesses in order to provide the best possible conditions for Ningaloo Turtle Program participants.

5.9 Volunteer transport

A 14-seater mini bus was employed as the principal means of transporting volunteers to monitoring beaches on a daily basis. Additional vehicles were utilized for training purposes. A CALM vehicle was employed on 27 occasions to assist training, and Susie Bedford's private vehicle on 19 occasions. Local community volunteers occasionally used private vehicles to commute to monitoring beaches in order to ensure they returned to town swiftly in order to meet daily commitments. Private vehicles were employed on 30 occasions. Reimbursement for vehicle used was calculated as 30 cents/km for an average of 60 km per morning.

For evening activities at the Jurabi Turtle centre, a CALM vehicle was employed to transport volunteers. The turtle bus was additionally utilized for training purposes. This arrangement was satisfactory, though it relied heavily on the cooperation and support of CALM Exmouth.

Recommendation: Continue use of a dedicated mini bus to transport volunteers for morning monitoring and evening JTC activities for the duration of the turtle nesting season.

5.10 Volunteer Social Events

Social activities were organised for volunteers every Sunday for the duration of the 2005/2006 season. Social events ranged from fancy dress barbeques, pool competitions, hiring of the local swimming pool and volleyball court, reef retreat days, attendance at the Australia Day concert, drinks at the local pub, to a champagne breakfast and Christmas lunch. Christmas day also involved a Secret Santa between volunteers, as many were spending their first Christmas away from family. Volunteers participated in this activity enthusiastically. Educational sessions were also held in order to increase knowledge of sanctuary zones, whale sharks, loggerhead turtles and international turtle programmes in a relaxed and friendly environment. Social interaction between volunteers was imperative in establishing and maintaining rapport between and among volunteers, team leaders and trainers.

Recommendation: Continue organization of weekly social events and educational sessions throughout the turtle nesting season. Continue to support local events.

5.11 Bungelup Remote Camp

The Bungelup Remote Camp was run from the 20th of December 2005 to the 3rd of February 2006 as part of the Ningaloo Community Turtle Monitoring Program for the 2005 – 2006 turtle season. The camp was situated at the Bungelup Rangers Camp, 6km north of Yardie Creek. The area monitored covered approximately 5km of the Cape Range National Park adjacent to the camp. 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 volunteers attended each camp, one volunteer qualified as a Camp Leader and proficient in quad bike use. Monitoring was carried out each morning from a quad bike and some sections were walked. The aims of the camp included monitoring turtle activity in this section of the Cape Range National Park particularly the loggerhead turtle rookery in this area, monitoring the levels of predation and prints present during this time period and the impacts of the targeted baiting program.

Table 8 : Summary of Bungelup Turtle Monitoring Data 2005/ 2006

| Turtle Species | False Crawls | Nests | Fox Prints | Predation |
|-----------------------|---------------------|--------------|-------------------|------------------|
| Loggerhead | 415 | 630 | | |
| Green | 25 | 31 | | |
| Hawksbill | 4 | 11 | | |
| Unknown | 18 | 22 | | |
| Totals | 462 | 694 | 3 | 0 |

5.12 Janes Bay Remote Camp

The Janes Bay Remote Camp was run from the 4th of January 2006 to the 3rd of February 2006 as part of the Ningaloo Community Turtle Monitoring Program. The camp was located at the Janes Bay Camp, south of Ningaloo Station Homestead. The area monitored covered approximately 15km of the Ningaloo Marine Park adjacent to Ningaloo Station. The camps were mostly run over a period of 4 -5 days, the last day being a changeover of volunteers and supplies for the next camp. Two volunteers attended each camp, one volunteer qualified in quad bike use and designated as a Camp Leader. Monitoring was carried out each morning from a double quad bike. The aim of the camp was to establish the level of turtle activity in the Ningaloo Marine Park adjacent to Ningaloo Station and to monitor predation levels and fox presence along this turtle rookery. In addition to turtle monitoring activities a beach clean up was incorporated into beach patrols and proved to have a drastic impact on the beach environment, however many months would be required to remove the majority of litter. Data collected on rubbish types, volumes and codes were recorded and details sent to the WWF marine debris study (WWF Australia, Arafura Eco-region Program, GPO Box 1268, Darwin NT 0801).

Table 9: Summary of Jane's Bay turtle monitoring data 2005/2006

| Turtle Species | False Crawls | Nests | Fox Prints | Predation |
|-----------------------|---------------------|--------------|-------------------|------------------|
| Loggerhead | 117 | 124 | | |
| Green | 34 | 16 | | |
| Hawksbill | 0 | 2 | | |
| Unknown | 2 | 1 | | |
| Totals | 153 | 143 | 68 | 3 |

5.13 Coordination of the Ningaloo Turtle Program

A full time coordinator of the NTP was employed by Dept. Of CALM (with support from CCG) in season 2005/2006. 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 continuation of full time position has proven successful.

An education officer was employed by CALM to oversee operations at the Jurabi Turtle Centre during season 2005/2006. This part time position facilitated the running of the centre and assisted with training requirements.

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 different aspects of the program; the morning community monitoring, JTC operations and social activities. The provision of team leaders to help the coordinator has enabled a sustained monitoring effort with positive feedback being received. 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: Continue to recruit for an indigenous internship for 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, Waves newsletter and several online newsletters. A total of two radio interviews were conducted during the turtle nesting season with local and state radio programs. A feature article was placed in the Threatened Species booklet "Inspiring Community Conservation: Lessons from

Seven Case Studies.” The Ningaloo Turtle Program was also featured on the IOSEA website as the Profile of the Month for February 2006.

The Ningaloo Community Turtle Monitoring Program was the winner of the State Landcare award in the category of Coastcare Community Award in 2005. The award was presented in Denmark in November 2005 and recognises community groups who invest time and energy into looking after WA’s environment for future generations. The Ningaloo Community Turtle Monitoring Program was also the recipient of a Western Australian Coastal Award in the category of Outstanding Monitoring and Identification Coastal Project presented by the Dept. of Planning and Infrastructure. Representatives of the program attended the awards dinners raising awareness about the program.

The Ningaloo Turtle Program website was completed in late 2005 with comprehensive information for volunteers and all publications produced by the program available for downloading. The Ningaloo Turtle Program and North West Turtle Conservation project briefs were also updated on the IOSEA website during 2005 with more information available on project aims and partners.

A new brochure “Sea Turtles in Ningaloo Marine Park” was compiled and produced this year providing educational information on turtles as well as highlighting the Turtle Watchers Code of Conduct. 5000 of the brochure were distributed during the 2005/2006 season through various local tourist outlets and visitor centres. A new series of poster displays based on this brochure were set up in strategic locations to educate and inform local residents and visitors about turtle conservation and the efforts of the program.

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.

Recruitment seminars were conducted at WA universities in September 2005. 8 presentations were given to different groups and specific information was provided to potential volunteers. Good contacts were made at the relevant universities and over 40-50 enquiries were recorded, resulting in several students booking on with the program.

Recommendation: Continue to conduct targeted recruitment seminars to encourage participation from relevant groups and focus on eco tourism students for JTC volunteer requirements.

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 and Wickham.

The Ningaloo Community Turtle Monitoring Program has collected data over four 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 and monitored 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 targeted baiting program has had an effect. 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 and continued through the 2005/2006 nesting season. 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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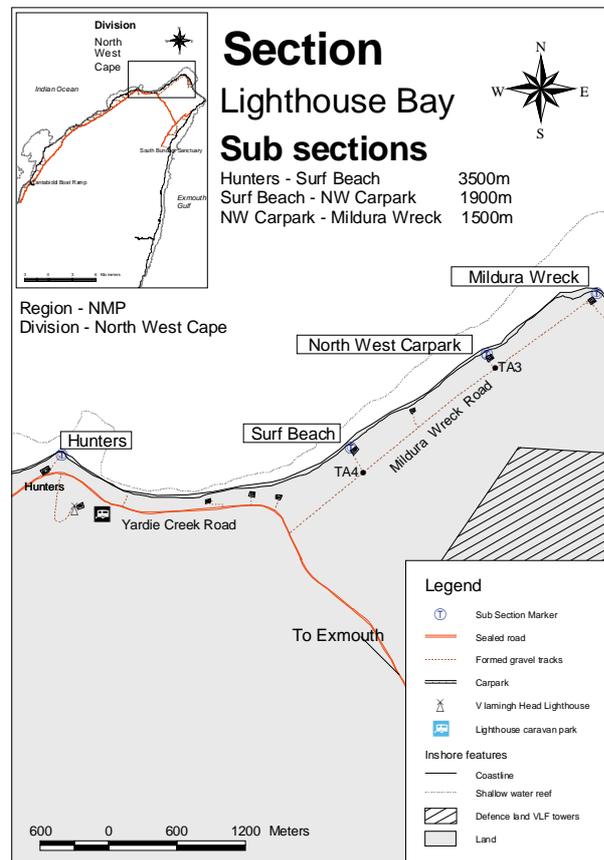
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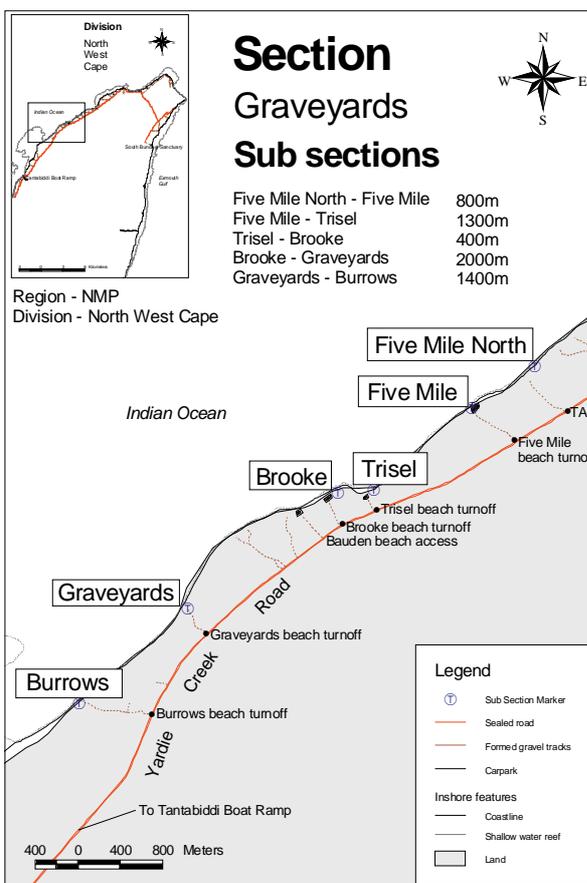
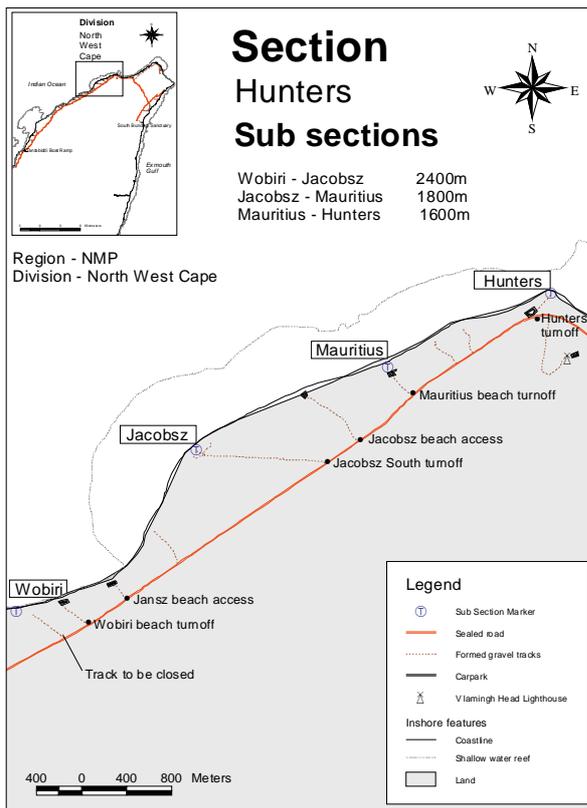
10.0 Glossary

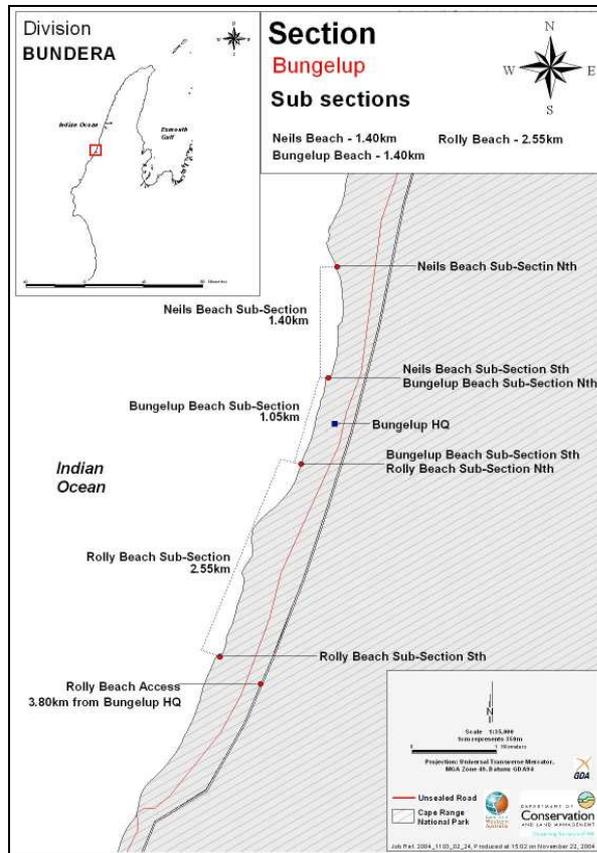
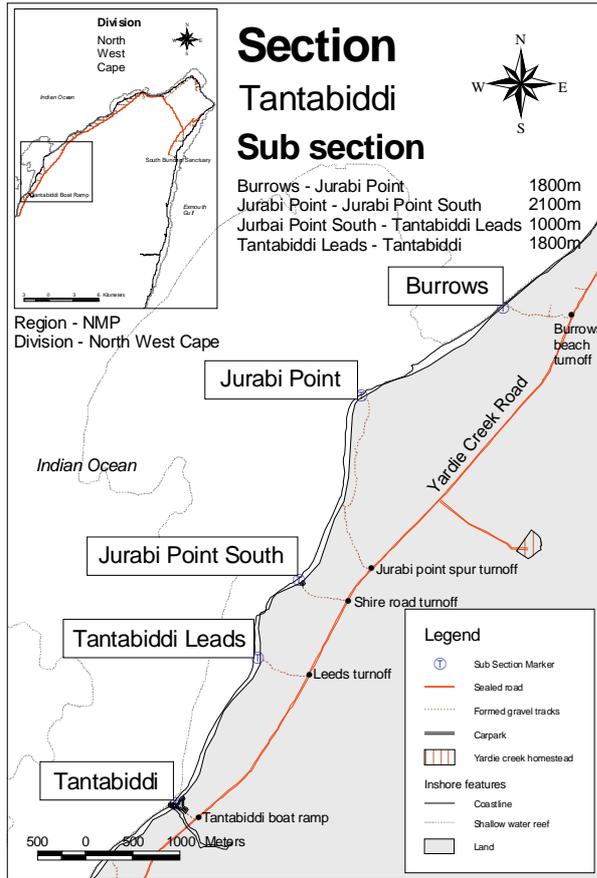
| | |
|----------------------|---|
| Anecdotal | Consisting of or based on second hand accounts rather than scientific investigation. |
| CALM | Department of Conservation and Land Management, Western Australia |
| CCG | Cape Conservation Group, Exmouth Western Australia |
| Effort | The number of days 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

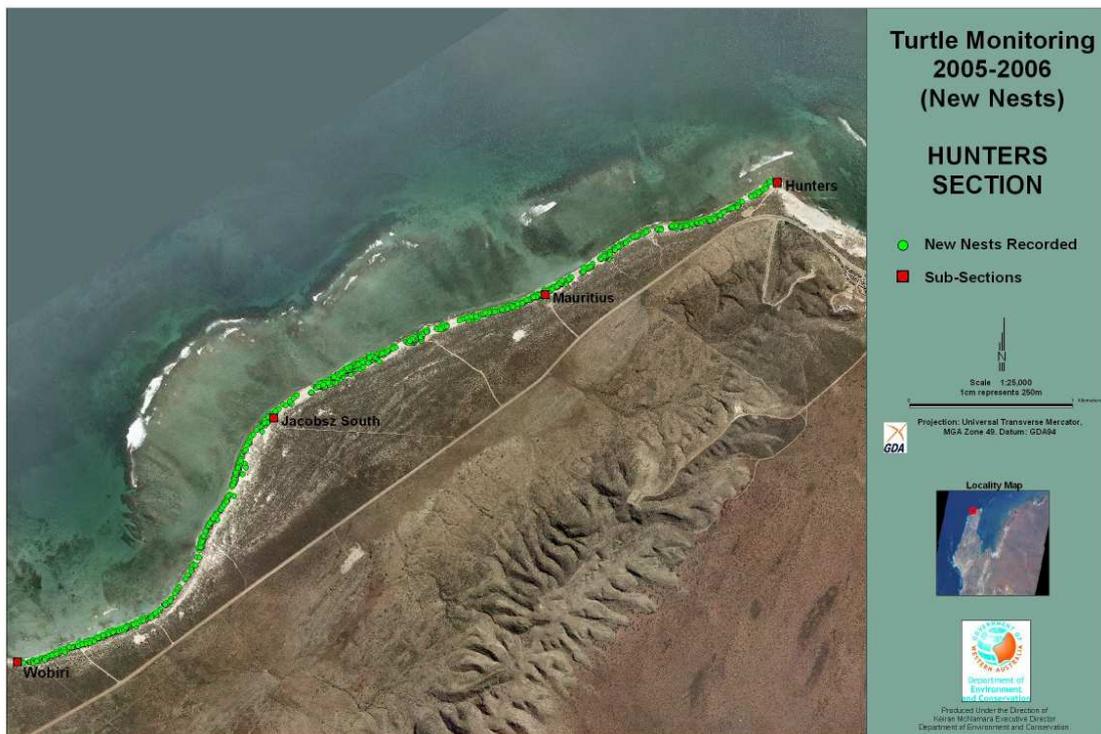
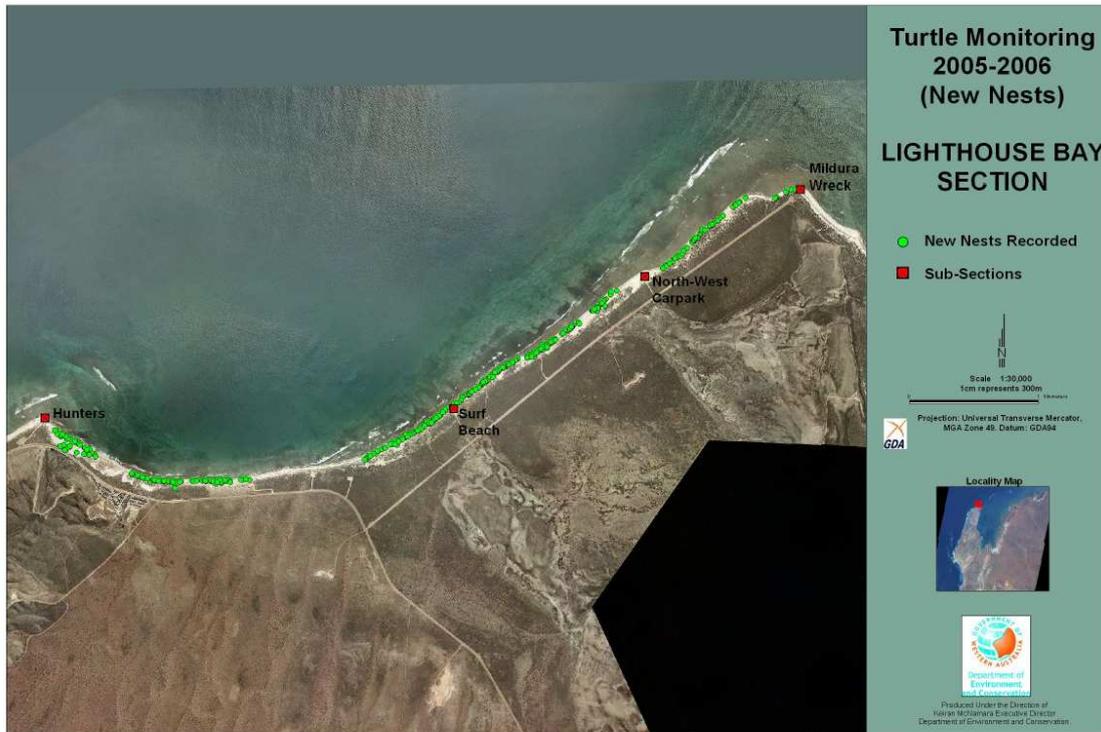
11.1 Maps of Sections and Subsections monitored in the North West Cape and Bundera Divisions in 2005/2006.







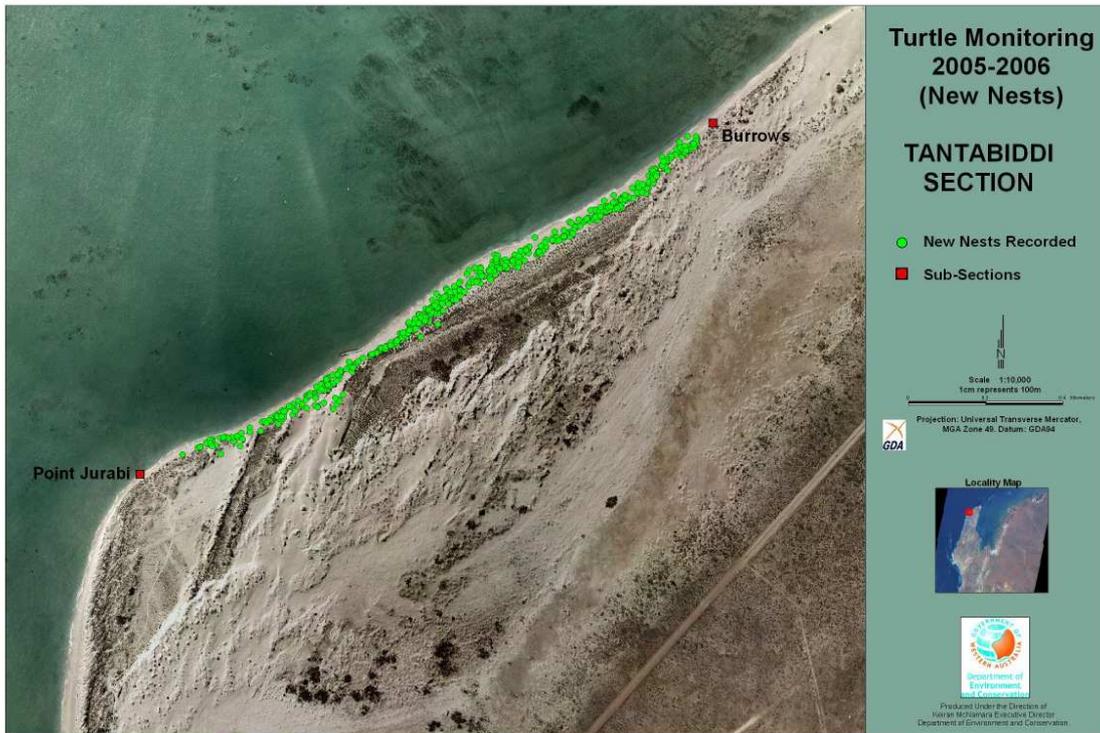
11.3 GIS maps of New Nests in the sections of the North West Cape Division in 2005/2006





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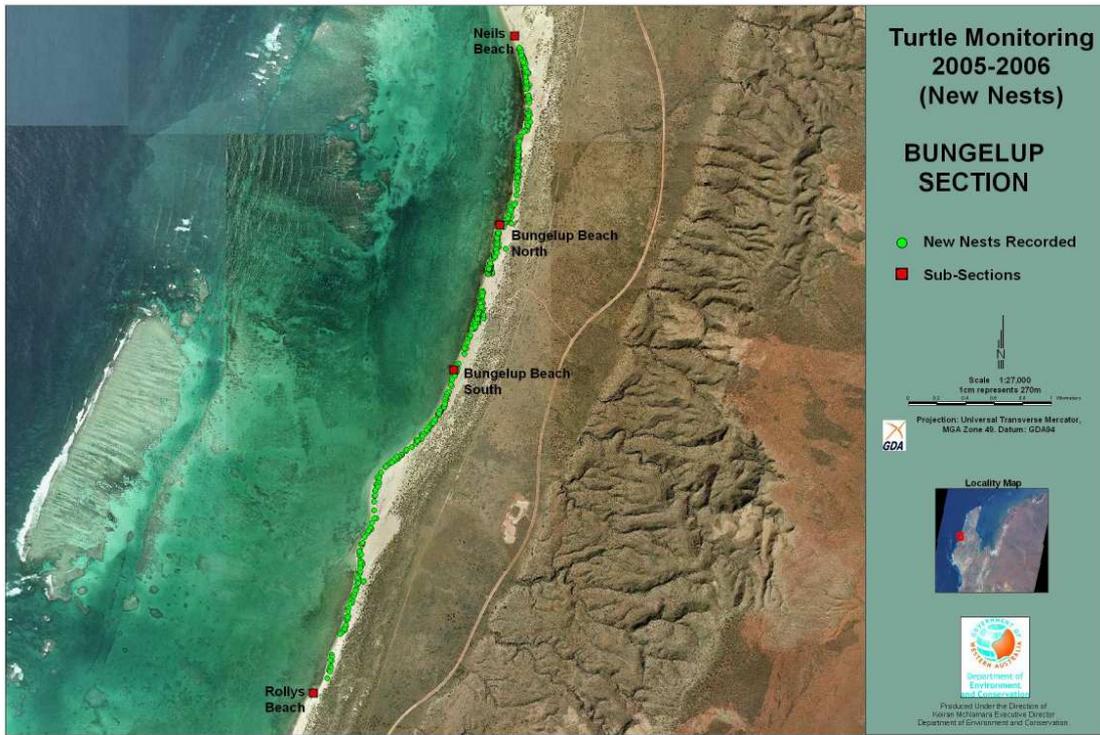
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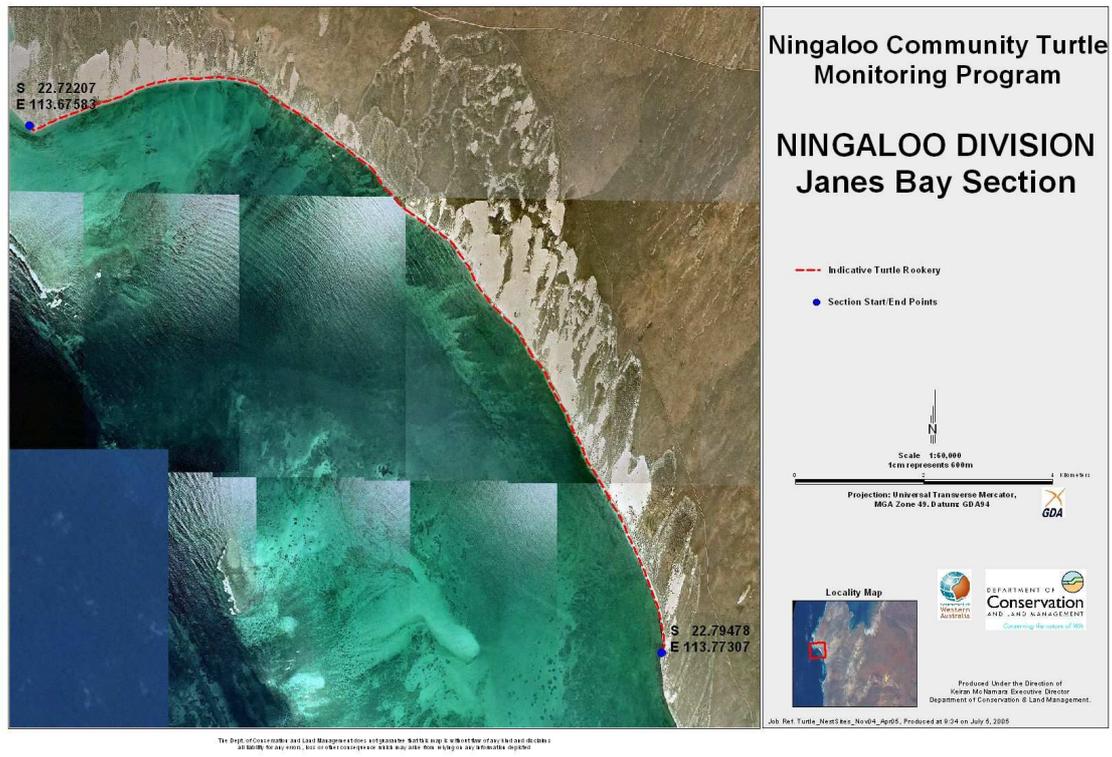
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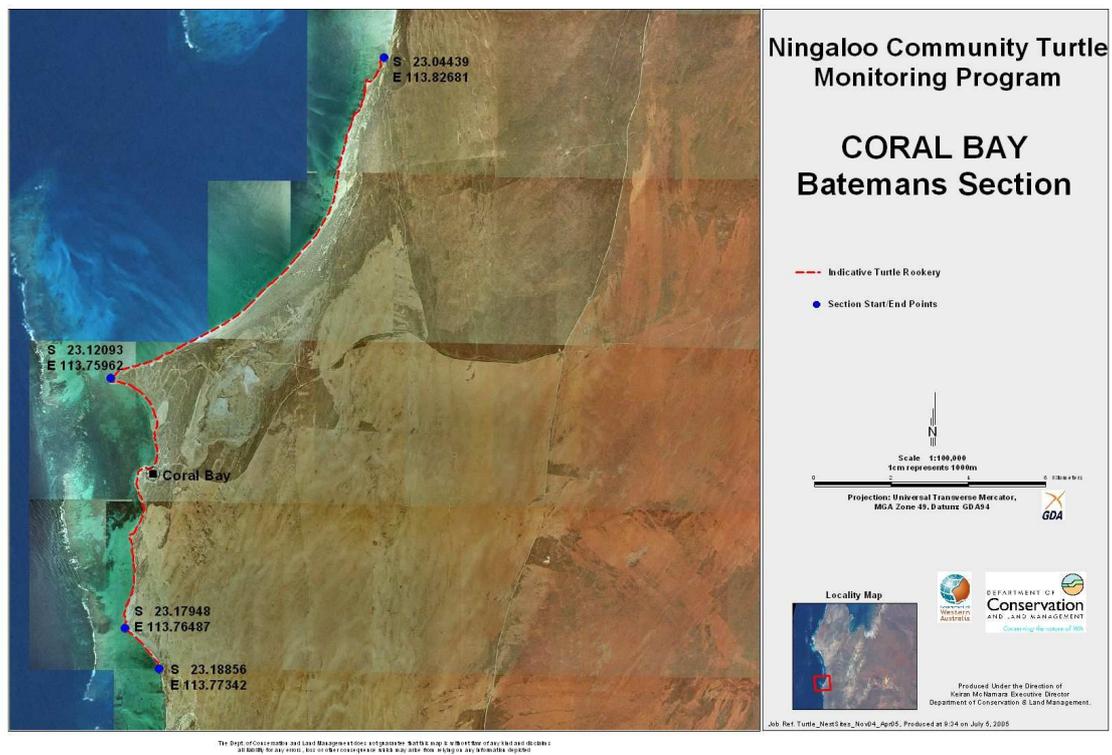
11.4 GIS maps of New Nests in the sections of the Bundera Division in 2005/2006



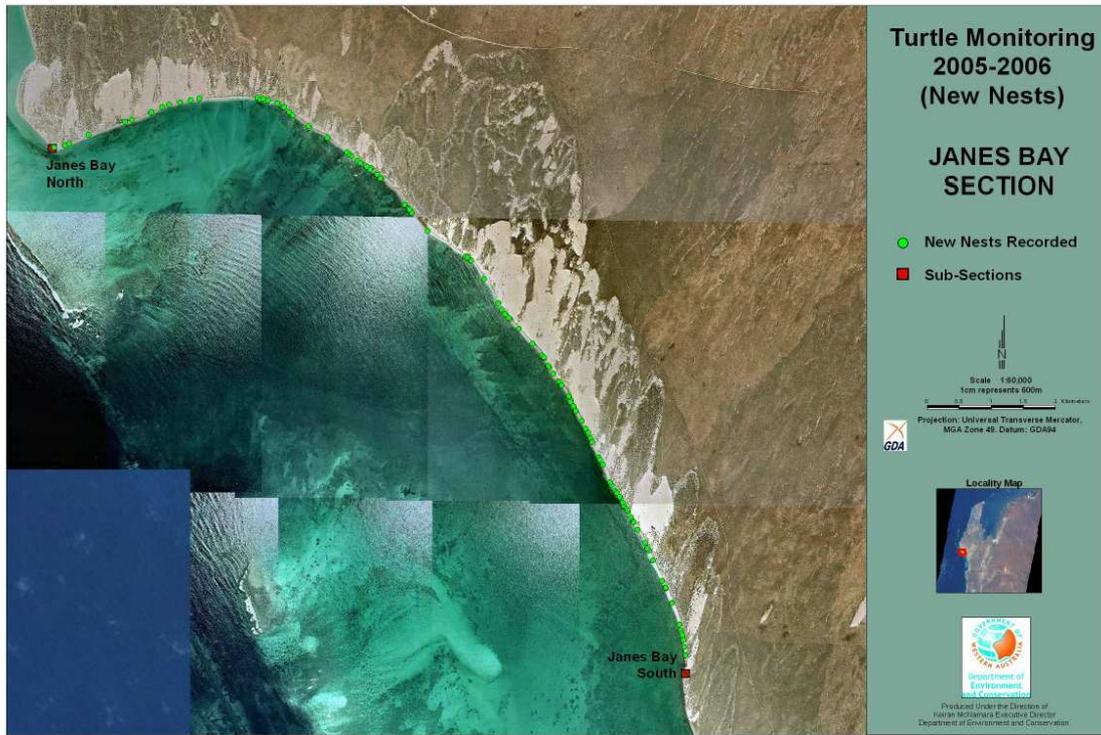
11.5 GIS map of the boundaries of the Janes Bay Section



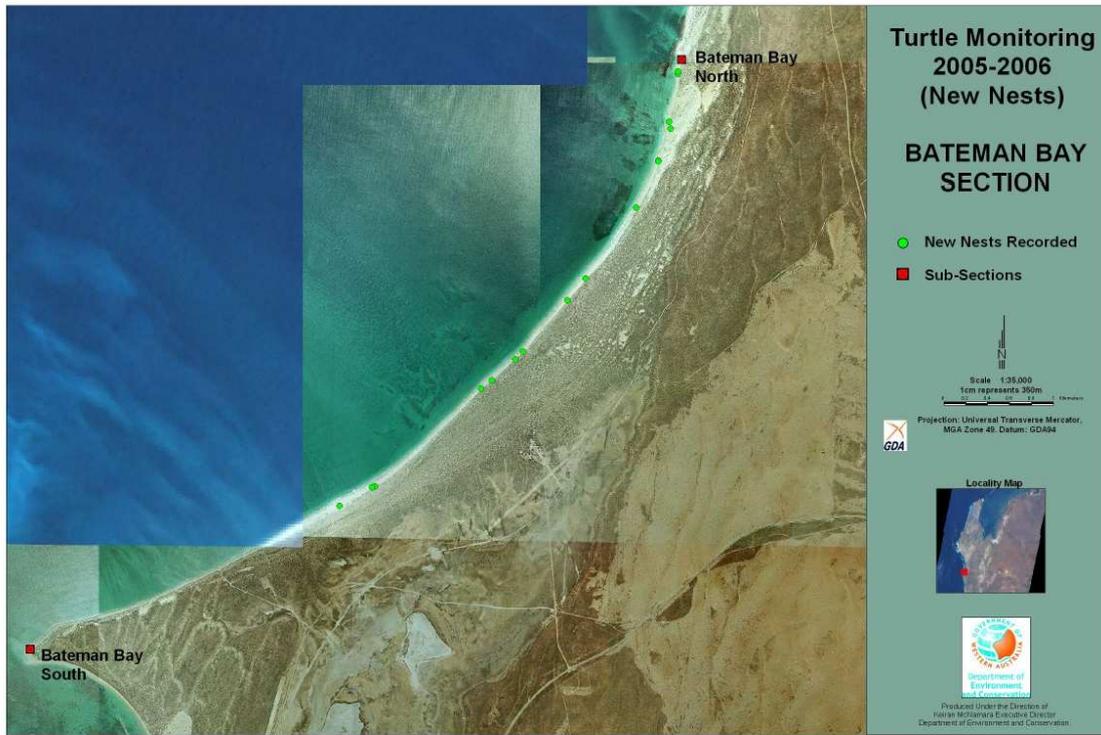
11.6 GIS map of sections of the Coral Bay Division



11.7 GIS map of New Nests in the Janes Bay Division in 2005/2006

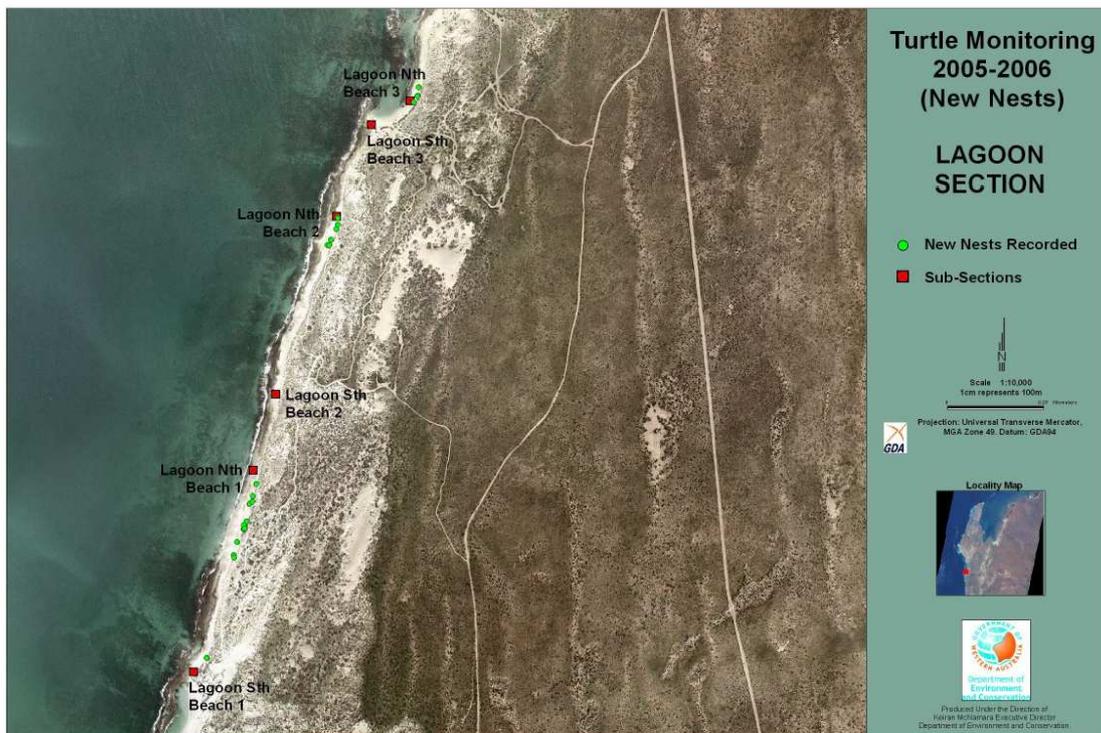


11.8 GIS maps of New Nests in the Coral Bay Division in 2005/2006



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