Ningaloo TURTLE PROGRAM

# ANNUAL REPORT 2009-2010



Department of Environment and Conservation
Our environment, our future

CAPE CONSERVATION GROUP

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Australian Government
Department of the Environment, Water, Heritage and the Arts

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# GLOSSARY

| | |
|---|---|
| **Body pit** | A depression dug in the sand by a turtle during a nesting attempt. |
| **Carapace** | The shell covering the dorsal surface of the turtle. |
| **Costal scales** | Large scales lining both sides of the carapace, below the centre row of scales. |
| **Egg chamber** | A deep cylindrical hole which a turtle digs into a primary body pit with her back flippers only. The eggs are deposited here. |
| **Emerging track** | Track of a turtle emerging from the ocean onto land. |
| **Escarpment** | The edge of a ridge which indicates a filled in primary body pit. |
| **False crawl** | An abandoned nesting attempt. |
| **GPS unit** | Global Positioning System unit: an electronic navigational device which obtains a position on the earth using satellite signals. |
| **Hatchling** | A newly hatched turtle. |
| **Nesting success** | The number of successful nests as a percentage of total turtle activities. |
| **Plastron** | The underside of a turtle. |
| **Prefrontal scales** | Situated on the head of a turtle, anterior to the frontal bone. |
| **Preoccular scales** | Situated on the head of a turtle, anterior from the eyes. |
| **Primary body pit** | A depression dug in the sand by a turtle during a nesting attempt. The egg chamber is located here. |
| **Returning track** | Track of a turtle returning from the land to the ocean. |
| **Rookery** | A significant breeding area for a large number of animals. |
| **Secondary body pit** | Dug during a successful nesting attempt to cover the primary body pit and egg chamber with sand. |
| **Successful nest** | A nesting attempt which has resulted in eggs being deposited and the nest completely covered. |
| **Survey Effort** | The number of days and subsections monitored throughout the duration of the program. |

| | |
|---|---|
| **Turtle activity** | Includes both successful nests and false crawls. |
| **Turtle tracker** | A competent volunteer in identifying turtle species and observing activity during monitoring. |

# LIST OF ABBREVIATIONS

| | |
|---|---|
| **CCG** | Cape Conservation Group Inc. |
| **DEC** | The Department of Environment and Conservation (formally the Department of Conservation and Land Management (CALM)) |
| **EPBC Act** | Environmental Protection and Biodiversity Conservation Act 1999 |
| **JTC** | Jurabi Turtle Centre |
| **NTP** | Ningaloo Turtle Program |
| **NW Cape** | North West Cape |
| **NMP** | Ningaloo Marine Park |
| **WWF** | World Wildlife Foundation |

# 1.0 EXECUTIVE SUMMARY

The Ningaloo Turtle Program (NTP) was established in 2002 as a collaborative project between Cape Conservation Group Inc (CCG), World Wildlife Fund (WWF)-Australia and the Department of Environment and Conservation (DEC)-Exmouth District. The primary aim of the program is to promote the long-term survival of turtle populations within the Ningaloo region by collecting long-term trend data on marine turtle population size.

For the purpose of the program, the Ningaloo region is divided spatially into a hierarchical classification. There are four divisions within Ningaloo: North West (NW) Cape division, Cape Range division, Bundera/Ningaloo division, and Coral Bay division. Each division is then further divided into sections and sub-sections.

## 1.1 NTP Summary 2009-2010

### Volunteer Participation

Since commencement of the program in 2002, volunteers have contributed 40563 hours to the NTP. This figure alone demonstrates the importance of volunteers for the continuation and sustainability of the community program.

The 2009-2010 NTP introduced a financial cost recovery for program participation, where volunteers were required to pay a reasonable fee relating to NTP operational costs. In return volunteers where provided with accommodation, food, transport to and from monitoring and NTP social activities for the full four week period. The aim of the cost recovery is to increase the cost effectiveness of the program subsequently supporting the longevity of the NTP. This was achieved in 2009-2010.

### Survey Effort

Since the commencement of the NTP in 2002, there has been a steady reduction in the program survey area. This can be attributed to changes in stakeholder support and funding availability. In 2008, research was also undertaken to determine the amount of survey effort required to adequately predict long term trends in the marine turtle population within the Ningaloo region. Results have indicated that survey effort can be drastically reduced compared to that of previous seasons. Based on the findings the 2009-2010 NTP the survey period was reduced to a period of intensive block monitoring and intermittent monitoring outside of the period.

The 2009-2010 NTP included both the NW Cape and Cape Range divisions only. Monitoring within the NW Cape occurred between 7 November 2009 and 27 March 2010 and included an intensive block period of monitoring between 28 December 2009 and 24 January 2010 and intermittent monitoring Outside of this period. Monitoring for Cape Range occurred between 1 January 2010 and the 24 January 2010 as an intensive block period. The 2009-2010 NTP operations did not include monitoring within both the Bundera/Ningaloo and Coral Bay divisions due to the considerable reduction the NTP survey area.

### Nesting Abundance 2002-2010

A total of 1069 successful turtle nests and 2134 false crawls were recorded for the Ningaloo region during the 2009-2010 season. 785 nests and 1671 false crawls were recorded within the NW Cape division. The greatest nesting activity (both new nests and false crawls) recorded was the green turtle (71.8%), followed by the hawksbill (14.8%), and loggerhead turtle (13.0%). 284 nests and 463 false crawls were recorded within the Bungelup section (Cape Range division). The loggerhead turtle had the greatest number of successful nests recorded (65.5%), followed by hawksbill (30.6%), and green (2.5%). 1.4% of new nests was identified as unknown (Table 3 andTable 4).

Since commencement of the program (2002) the NTP has recorded 31787 new nests and 69746 false crawls within the Ningaloo Region (including all divisions). For a detailed summary of season survey effort and turtle activity see Appendix 11.11

### *Objective 1: Determine the abundance of nests on specific sections of beach over specified time intervals for each species*

### Nesting Abundance

Nesting abundance for the 2009-2010 season was the lowest for green and loggerhead turtles since monitoring began in 2002-2003 (Figure 17, Figure 18,Figure 19,Figure 20). Nesting abundance for hawksbill turtles was recorded at a similar level to nesting during the 2003-2004 and 2007-2008 seasons (Figure 17, Figure 18, Figure 19, Figure 20). This is not however indicative of a decline in population, as marine turtle populations fluctuate considerably between years (see Broderick et al. 2001) due to the non-annual breeding behaviour of marine turtles (Miller 1997; Plotkin 2003).

### Nesting Success

Nesting success was similar during the 2009-2010 season to the mean values from 2002-2009 (Figure 23; Table 11). Nesting success for loggerhead and unidentified turtles was lower than mean values, whereas nesting success for hawksbill and green turtles were equal to mean values from 2002-2009 seasons (Figure 23). Nesting success was lowest for green turtles, with similar nesting success occurring for hawksbill, loggerhead and unidentified turtles (Figure 24).Nesting success fluctuated within the season, but there was no apparent overall seasonal trend across the divisions for each species (Figure 25).

### Nesting Trends

The apparent upward trend in nesting abundance for green turtles shown for the 2003-2008 data (Bool *et al.* 2009) did not continue during the 2009-10 season, indicating that this upward trend may have been due to the relatively short-term monitoring of the population. The upward trend in hawksbill turtle nesting is still apparent for the NW Cape division (Figure 20), although the confidence limits in predicting this trend are much broader and the scale of the trend is lower. Hawksbill turtle nesting within the Cape Range division still appears to show an upward trend (Figure 18), although this could as a result of either survey error or short term monitoring.

NTP (2008/09-2009/10) data has been modelled to estimate full season data so that it can be compared with previous years and sites. Modelling reports have indicated there is an amount of error associated with surveys spanning a shorter time frame. For the 2009-2010 NTP, monitoring was shortened to 3½ weeks of intensive monitoring during January, lower than what is considered adequate to provide results with a reasonable level of error (Whiting, 2010 (see Section 7.0)).

### *Objective 2: Identify the relative significance of specific nesting beaches to each species*

**Nesting Locations**

At the commencement of the program significant turtle nesting locations found along the Ningaloo coastline were identified. NTP data (2002-2010) indicates that the turtle nesting locations originally identified remain important within the region:

- The NW Cape division is an important rookery for the Green and Hawksbill turtles.
- The Cape Range division is the most significant mainland rookery for the Loggerhead turtle followed by Jane's Bay (Bundera/Ningaloo division) and the Coral Bay division.
- Gnaraloo Bay is also considered a significant loggerhead rookery. The Gnaraloo Bay Marine Turtle Survivorship Project has adapted the NTP monitoring procedures to collect nesting abundance and nest disturbance data. 2009-2010 data is to be provided to the NTP for comparison.
- No research was carried out during 2009-2010 NTP to identify additional significant turtle nesting locations within the Ningaloo region.

### *Objective 3: Establish the level of disturbance on nests*

**Nest Disturbance**

Since NTP monitoring began in 2002, 2.3 percent of the total nests recorded have been recorded as disturbed within the Ningaloo region (2002-2010) (Table 15). However with the considerable reduction in survey effort over the years this figure could potentially be much higher (see Appendix 11.11).

***The level of predation on turtle nests by the European red fox***

Foxes have been present along the beaches of the Ningaloo coastline since the 1960s and have the potential to destroy a large percentage of turtle nests each nesting season (Limpus 2002; Dean 2003; Mckinna Jones 2005). Consequently, the implementation of fox control programs has been flagged as a key management strategy under the Ningaloo Marine Park Management Plan 2005-2015. This includes the controlled distribution of 1080 poison (sodium fluoroacetate) in the form of dried meat baits. The aim is to reduce the number of foxes within the area subsequently reducing the number of nests predated by foxes, and therefore increasing nest success within the area. Nest disturbance data collected by the NTP assists DEC to target fox control in areas of high nest predation.

Loss of up to 5 percent of nests to foxes and dogs/dingoes is considered sustainable to the overall production of nests (Flakus 2002). Based on such research findings and agreement between departmental management, at the commencement of the program the Exmouth district established a threshold of 5 percent for nest predation within the Ningaloo region.

During the 2009-2010 NTP foxes/dogs were recorded as accounting for 43.5 percent of all damaged nests within NW Cape and Cape Range divisions (38.5 percent and 5.1 percent respectively). An additional 38.5 percent of damaged nests were recorded where the actual cause of predation could not be identified (predator print unknown). (Table 5: The total number of disturbed nests and cause, NTP 2009-2010. This indicates that fox predation percentage could potentially be much higher for this season.

Since monitoring began in 2002, foxes and dogs have damaged 39.9 percent of the total disturbed nests recorded within the Ningaloo region. However, fox/dog predation as a percentage of the total

nests recorded (2002-2010) has remained below the 5 percent threshold (Table 6). Results also show that 1.0 percent of the total number of nests recorded within the region has been predated by foxes/dogs since monitoring began in 2002.

It is important to note however that during the 2003-2004 season fox predation along the 5 Mile Beach sub-section (NW Cape division) was at its highest during March (McKinna Jones 2005). Over the past six seasons (2004/05-2009/10) monitoring has not been carried out during March (with the exception of 2004-2005 which finished mid March and 2009-2010 which had intermittent monitoring end of March) (Table 15). This indicates that the level of predation may in fact be higher than the 5 percent for some or all of the previous seasons.

***Ghost crabs: natural predators of marine turtle eggs***

The level of predation by ghost crabs and the impact on clutch success are not known within the Ningaloo region. Determining ghost crab predation by visual assessment of a nest alone is prone to uncertainty, as the presence of a ghost crab hole into the egg chamber does not necessarily indicate that ghost crabs depredated the nest, nor does it give an indication if predation has occurred how many eggs within a clutch were depredated. For this season crab damage to a nest was determined by: the evidence of several crab holes in the egg chamber and the presence of fresh shells and or eggs at the surface of the nest; and visually seeing a ghost crab carrying an egg to its burrow from the damaged nest. Ghost crabs are natural predators within the area and research is required to determine the dynamics of ghost crab predation and nesting turtle populations at Ningaloo over space and time.

### *Objective 4: Determine the impact of human interaction on nesting success of each species*

### Human Interaction with Nesting Turtles

Since the commencement of the NTP (2002-2003), human disturbance to nests has been recorded as minimal (Table 6). This is done through volunteers recording human prints within a 5 metre radius of the nest. The data however does not necessarily indicate the level of disturbance to nesting female turtles by human interactions, because it does not include visual observation of visitor interacting with nesting turtles. The presence of people on nesting beaches are likely to cause disturbance to nesting females and hatchlings if they do not follow appropriate interaction protocols (Waayers 2003; Johnson et al. 1996; Lorne & Salmon 2007). Disturbance by humans can lead to the female abandoning her nesting attempt (prior to the laying of eggs) and returning to the ocean, resulting in a failed nesting attempt. Further research into visual assessments of turtle-visitor interactions is required to determine the level of impact on successful nests within the Ningaloo region and subsequent impact on local turtle populations.

The development of the DEC Jurabi Turtle Centre program in 2008-2009 was supported by Woodside Energy Ltd and Mitsui Ltd (2009 to 2011) through the Community Partnerships Program. The program operates along the NW Cape and provides a supervised interaction experience with nesting female turtles using TAFE accredited turtle tour guides. Visitors have an opportunity to observe turtles nesting in their natural environment and contribute to turtle conservation within the region.

### Turtle Rescues and Mortalities

For the 2009-2010 NTP there was a significant decrease in the number of turtles stranded on land from 39 in 2008-2009 NTP to a total of 4 turtles this season. The can be attributed to the considerable reduction in survey effort and reduction in nesting abundance. The number of deceased turtles found

this season has also reduced (9 turtles) compared with 27 in the 2008-2009 NTP. Even though only a small number of turtle mortalities are recorded in the Ningaloo region each year, on-shore deaths are not representative of the total number of mortalities as turtles are aquatic animals.

### Additional Achievements NTP 2002-2010

- Ongoing distribution of the NTP monitoring field guide and monitoring training videos to community turtle projects worldwide.
- Continual support for marine turtle monitoring programs throughout Western Australia.
- Continual collection of nesting data to assist with the implementation of beach access and 4WD vehicle restrictions.
- Continual collection of nest distribution data to assist government agencies in future tourism development planning.
- Continual collection of nesting habitat locations to improve Oil Spill Contingency Atlas (OSRA) information and support potential oil spill response planning.
- Continual collection of nesting habitat encroachment data to assist in the removal of existing car parks within the Jurabi Coastal Park.
- The rescue of 179 stranded female turtles within the Ningaloo region (2002-2010).

In the coming years the program will continue to collect data on nesting female turtles within the Ningaloo region and continue to predict long term trends in turtle populations. This will assist management in identifying turtle population recovery targets within the region.

## 1.2 Key Program Recommendations

### Volunteer Coordination

***Volunteer Participation***

- Continue to build capacity among the local community and promote local program participation. Encourage greater local participation in the program prior to the commencement of the 2010-2011 NTP. Local volunteer involvement outside of the block monitoring period and with NTP social activities remains limited despite all efforts.
- Ensure external volunteers are provided with detailed accommodation information for the duration of the program prior to them accepting the positions. In particular, housing remoteness and distance from Exmouth Township and swimming beaches.
- Improve the level of interaction between external volunteers and local volunteers, the NTPSC and DEC staff throughout the program. Address issues associated with distances between volunteer accommodation and local community members, and location of NTP social activities.

***Occupational Health and Safety***

- Continue to improve occupational health and safety standards for volunteer accommodation.
- Continue to improve communication procedures between volunteer accommodation and NTP quarters (located in Exmouth Township).
- Consider a full manual license and senior first aid certificate as prerequisites for the external volunteer selection process. These qualifications are required for participation in Bungelup camp.

***Field Data Collection***

- Continue to ensure volunteer accuracy in track and nest identification by carrying out concurrent cross-checks of beach surveys and data collection comparison. Ensure volunteers fill in data sheets accurately, cross-check data sheets on a daily basis and maintain daily communication with volunteers regarding data recording issues. Continue to update the "Data Recording: common mistakes register" located on the DEC server.
- Improve monitoring techniques and data collection methods with all trainers and volunteers prior to the start of the monitoring. This will provide consistent methodology and accurate data collection.
- Provide additional volunteer training on species specific track identification - how to distinguish between loggerhead and hawksbill turtle tracks or green and flatback turtle tracks. To assist with this identification a "tracks tutorial" training session was held this season and was well received. Utilise Bungelup research station to expand knowledge base of loggerhead track identification.
- Encourage volunteers to use their own digital cameras to take photos of turtle tracks, deceased and stranded turtles.

***Organisation and Procedures***

- Continue to build and expand on the current email enquiry list for the NTP. It is recommended that in the years to come the professional relations between the universities and NTP staff are taken to a higher level to encourage student research projects.
- Consider past experience with the program a pre-requisite for both the Volunteer Coordinator and Team Leader positions, to assist in streamlining NTP procedures and maintaining consistency with NTP operations.
- Continue to rotate the Volunteer Coordinator and Team Leaders through both the Cape Range research camps.

***Data Management***

- Carry out intermittent checks of GPS waypoints during the season as they can be accidentally changed by volunteers.
- Reinforce the importance of accurate data entry to those entering the data: Consider a data entry roster to ensure data is entered daily, always check data accuracy and make clear, consistent instructions for data entry e.g. protocol for mistakes.
- Ensure weekly cross-checking of the data base by Volunteer Coordinator. Discontinue to cross-check data using additional Microsoft Excel spreadsheet to improve efficiency in time management for NTP staff.
- Ensure weekly cross-checking of the data base by Volunteer Coordinator.
- Discontinue to cross-check data entered in the database using a Microsoft Excel spreadsheet. This will improve efficiency in time management for the Volunteer Coordinator.

***Volunteer Education, Information and Communication***

- Encourage local participation in social activities prearranged for external volunteers.
- Continue with general turtle biology and conservation presentations to external and local volunteers.
- Organise for DEC staff to conduct a presentation on wildlife management within the area.
- Encourage local volunteers to give presentations relating to the Ningaloo region and their NTP experiences.
- Invite local Indigenous council members (Park Council) to provide information of Indigenous history in the area.
- Continue with program progress updates to all volunteers throughout the season.

- Continue with the seasonal photo competition for NTP volunteers.

## Field Monitoring

***Survey Effort and Nesting Abundance***

- Continue to monitor turtle activity along the NW Cape and Cape Range divisions. Opportunistic monitoring should continue within the Bundera/Ningaloo and Coral Bay divisions where possible to provide ongoing data collection.
- Continue with current reductions in the NTP survey period - an intense block period of monitoring with intermittent monitoring outside of this period.
- Increase the block period to a five week period to include one week of training and four weeks intensive monitoring. This will alleviate volunteer availability and logistical issues in covering all sub-sections, while also providing a full four week period of data collection for Bungelup (Cape Range division). Opportunistic monitoring can be incorporated into training sessions for the training week to provide additional data collection.
- Centre the block period of monitoring to cover mid December to capture the peak of nesting and alleviate trainer availability issues.
- Determine nesting success for a sample of turtles using night time surveys observing turtles. Nesting success has previously been calculated using visual assessment of the nest after the turtle left the beach, which is not a very accurate method of determining nesting success. Quantifying true nesting success will give an indication of the accuracy in assessing nesting success from morning track counts and will reduce error in converting between track counts and clutch counts.
- Ensure track counts outside of the intensive period are only counting the tracks from the previous night's nesting. I.e. turtle tracks are crossed off prior to the census day.

***Training***

- Continue to expand local trainer and assessor capacity prior to the arrival of the external volunteers. This will greatly reduce the work load of the coordinator and the other key trainers. Provide more encouragement to new local volunteers to work towards this.
- Ensure a "trainer calibration and refresher meeting" is held prior to commencement of monitoring. This will improve consistency in training information and techniques.
- Provide a glossary of training terms to volunteer induction pack. E.g. costal scales, prefrontal scales and false crawl definitions.
- Utilize training week to gain as much practical experience in track monitoring including identifying loggerhead and hawksbill tracks and night time beach-based nesting observations with qualified DEC staff.
- Ensure a minimum of two seasons experience as prerequisite to train volunteers in monitoring techniques to ensure accurate and consistent methods.
- Ensure smaller training and assessment groups where possible. Ideally, four volunteers per trainer/assessor.

## Predation Control

- Continue with the current DEC fox control program within the four divisions - NW Cape, Cape Range, Bundera/Ningaloo and Coral Bay. This will assist in maintaining the current level of fox predation on nests within the Ningaloo region.
- Ensure fox control within Cape Range division (Bungelup section) is adequate to reduce predation levels to less than 5 percent of recorded nests.
- Determine nest predation levels during the peak period: mid February to mid March. This will allow for comparison with previous seasons and will provide a more accurate result of nest predation within the Ningaloo region.
- Further investigate the impacts of ghost predation on nesting success within the Ningaloo region.

## Turtles Rescues

- Continue to conduct opportunistic turtle rescues when necessary.
- Prioritise areas with considerable numbers of turtle strandings and deaths recorded within previous seasons. These include “Brookes to Graveyards”, “Jacobs South to Wobiri, “5 Mile to Trisel” and “Burrows to Jurabi Point” sub-sections (NW Cape division).
- Consider listing turtle stranding rescues as a program objective.
- Incorporate ‘rescue’ observation points into the DEC operational staff works program. This will increase the likelihood of DEC staff finding stranded turtles and subsequently rescuing them outside of the block monitoring period.

## General Recommendations

- Continue to investigate funding opportunities for the program.
- Compile a report over outlining NTP achievements, monitoring amendments, and research conducted over the past eight years and future research goals.
- Review and update the NTP overarching goals and objectives to reflect the progression of the program and changes which have occurred since the commencement of the program in 2002.
- Continue to develop the NTP to match current environmental conditions and resource demands through the Ningaloo Turtle Program Steering Committee.

# 2.0 BACKGROUND

## 2.1 Ningaloo Marine Park

Ningaloo reef is Australia's largest fringing reef, extending 300 km from the North-West Cape to Red Bluff in Western Australia (Department of Conservation and Land Management (CALM) 2005). Over 500 species of finfish, 600 species of mollusc and 90 species of echinoderms inhabit Ningaloo reef, as well as many species of coral, crustacean and worms (CALM 2005). The area is also important habitat for charismatic mega-fauna such as whale sharks, turtles, dugongs, whales, dolphins, sharks and manta rays (CALM 2005). The diversity of marine life combined with the near-shore accessibility of the coral reef system promote Ningaloo reef as a prime tourism and conservation location.

In recognition of its uniqueness and cultural importance to West Australians, approximately 90 percent of Ningaloo reef was gazetted as a Marine Park in 1987 with the remaining area included within the Marine Park in 2004 (CALM 2005). Ningaloo Marine Park and its surrounding area is a popular holiday destination for Western Australians and increasingly to visitors from other areas of Australia and abroad (CALM 2005).

## 2.2 Marine Turtles of Ningaloo

Of the seven species of marine turtles recognised internationally, four of the species have breeding populations within Western Australia - the green turtle(*Chelonia mydas*), loggerhead turtle (*Caretta caretta*), hawksbill turtle (*Eretmochelys imbricata*) and flatback turtle (*Natator depressus*) (CALM 2005). Green, loggerhead and hawksbill turtles primarily nest along the coast of the Ningaloo Marine Park with the flatback turtle occasionally nesting within the area (Cape Conservation Group Inc (CCG) 2007).

Green turtles are the most abundant within the area while loggerhead and hawksbill turtles are found in much smaller populations. The Western Australian population of green turtles is thought to be the largest population in the Indian Ocean (Limpus 2007), which highlights the significance of nesting rookeries found within the Ningaloo region.

Currently all species of marine turtles within Australia are protected under the *Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act)*, the *Endangered Species Protection Act 1992* and the *Wildlife Conservation Act 1950*. The protection of marine turtles is vested with the Department of Environment and Conservation (DEC) (CALM 2005).

## 2.3 Marine Turtle Threats

Marine turtles face numerous anthropogenic threats around the world including over-harvesting for food; entanglement in marine debris and commercial fishing nets; nesting beach and foraging area alteration; disturbance to nesting turtles and to emerging hatchlings by humans, egg poaching by humans; and predation of eggs and hatchlings by feral predators (Lutcavage et al. 1997). Marine turtles undertake long migrations of up to 2500 km from their feeding grounds to their breeding and nesting areas, magnifying their vulnerability to human induced threats (Plotkin 2003; Spotilla 2004).

For example, tagged green and loggerhead turtles that nest in Western Australia have been resighted in Arnhem Land and as far north as the Java Sea near Indonesia (Baldwin et al. 2003; Limpus 2007).

The increased anthropogenic threats, coupled with natural threats and the low fecundity of marine turtles, has resulted in many turtle species being threatened with extinction throughout their distribution around the world (Gulko & Eckert 2003). The International Union for Conservation of Nature (IUCN) Red List classifies green and loggerhead turtles as endangered species whereas the hawksbill turtles are listed as critically endangered. The flatback turtle is not classified as there is insufficient data on their population size (IUCN 2007). Turtle populations in Australia are reported to have declined significantly (Environment Australia 2003).

1. Marine turtles and their eggs were commercially harvested in the Ningaloo region from the early 1950s until 1973, with historical reports suggesting that tens of thousands of turtles were harvested (Limpus 2002; Limpus 2007). The size of turtle populations prior to commercial harvesting is not quantified due to a lack of data (Dean 2003), in part because monitoring entire populations of turtles is complex given their migratory nature (Girondot et al. 2006). Consequently, whether turtle populations are recovering within the Ningaloo region following intensive harvesting is not known. This highlights the importance of collecting data on nesting abundance, to predict long term trends which will assist future conservation and management strategies for turtle populations within the region.

2. Post commercial harvesting, a key threat to turtle population recovery within the Ningaloo region is the predation of eggs and hatchlings by introduced species, in particular the European red fox (Vulpes vulpes) (Limpus 2002; Dean 2003; McKinna-Jones 2005). Foxes have been reported to have damaged between 40-70 % of nests on some beaches in the Ningaloo region (Dean 2003). Predation of turtle nests by foxes could severely reduce the chance of population recovery within the region.

3. Growing ecotourism within the region has led to an increase in people seeking to view nesting female turtles and hatchlings and an increase in turtle interactions. Marine turtles are extremely vulnerable to disturbance during the nesting period as adults aggregate in shallow waters and come ashore to nest (Collins 2000). The presence of people on a nesting beach at night coupled with the use of torch and car light can cause disturbance to nesting females and hatchlings (Waayers 2003; Johnson et al. 1996; Lorne & Salmon 2007). Female turtles are sensitive to any kind of disturbance and can abandon a nesting attempt at any given time and return to the ocean. By doing this they expend an enormous amount of wasted energy which can potentially reduce their nesting success rate. Hatchlings are also easily disturbed through sources such as artificial light, which causes disorientation from the water's edge. This can lead to dehydration and increase the risk of predation (Luctavage et al. 1997).

4. Other threats associated with human interaction with marine turtles include 4WD vehicles on the beach, resulting in sand compaction and the formation of wheel ruts in which hatchlings can become trapped (Limpus 2002).

# 3.0 INTRODUCTION

## 3.1 The Ningaloo Turtle Program

The Ningaloo Turtle Program (NTP) was established in 2002 as a collaborative project between Cape Conservation Group Inc. (CCG), World Wildlife Fund - Australia (WWF) and the Department of Environment and Conservation (DEC) - Exmouth District. The primary aim of the program is to predict long-term trends in marine turtle populations within the Ningaloo region. This is achieved through the collection of turtle nesting information including nesting abundance and nest disturbance data. The data collected assists DEC in reducing disturbance levels to nesting turtles across the Ningaloo region.

As a community-based volunteer program volunteers are central to its operations. Based in Exmouth, Western Australia the NTP provides an opportunity for local community members, as well as interstate and international volunteers to actively take part in turtle conservation within the Ningaloo Marine Park

Participating in the NTP provides volunteers with an opportunity to undertake practical field experience and acquire scientific monitoring techniques. Each volunteer is given the opportunity to further contribute to localised turtle conservation and further their understanding of fauna conservation management.

The programs overarching goals and objectives are listed below:

NTP Overarching Goals:

- Identify key nesting beaches;
- Monitor populations and assess trends at key index sites;
- Identify the level of threat of feral predators 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 (CCG 2007).

NTP Primary Objectives:

1. Determine the abundance of nests on specific sections of beach over specified time intervals for each species;
2. Identify the relative significance of specific nesting beaches to each species;
3. Establish the level of disturbance on nests; and
4. Determine the impact of human interaction on nesting success of each species (CCG 2007).

### *Consolidation of the Ningaloo Turtle Program*

The NTP has monitored marine turtle activity along the Ningaloo coast for the past eight nesting seasons, with the survey effort varying from season to season. In 2008 the program undertook research into consolidating the program. Modelling has shown that trends in marine turtle populations (Ningaloo region) can still be detected with a reasonable level of error when monitoring/survey effort is substantially reduced. Survey effort would include both intermittent monitoring throughout the turtle nesting season and intensive monitoring mid-season to increase the confidence in abundance estimates (Whiting, 2008).

Currently NTP survey effort is based on an intensive block monitoring period which is to take place within the peak of the turtle nesting season for a 28 day period. Intermittent monitoring will also be conducted outside of this period throughout the remainder of the turtle nesting season.

## 3.2 NTP Hierarchical Classification

For the past eight consecutive years, since establishment the NTP has recorded turtle nesting activity within Ningaloo Marine Park. Monitoring sites were established from past aerial and on-ground surveys, including:

- Identifying key nesting beaches and nesting turtle species;
- Quantifying the survey effort required by the program to detect trends in marine turtle abundance and;
- Determining the months that turtles nest within the region.

For the purpose of the program, the Ningaloo region is divided spatially into a hierarchical classification. There are four divisions within Ningaloo which are further divided into sections and sub-sections). Beaches were originally divided into these sub-sections based on factors such as geographical barriers that separate beaches, the locations of car parks and the distance and time required to monitor the sub-sections. Each subsection is defined by totem markers which mark the start and finish of each.

The Ningaloo coastline is surveyed according to the NTP hierarchical classification to record the turtle activity abundance and nest disturbance. Turtle mortality locations are also recorded and turtle rescues are conducted opportunistically. Monitoring techniques are carried out in conformity with the NTP Turtle Monitoring Field Guide Edition 6 (CCG 2007).

***North West Cape Division***

The NW Cape division encompasses the Lighthouse, Hunters, Graveyards and Tantabiddi sections, which are further divided into sub-sections (See Appendix 11.1 for division information).

***Cape Range Division***

The Cape Range Division encompasses the Bungelup section, which is divided into three separate sub-sections. (See Appendix 11.2 for division information).

***Bundera/Ningaloo Division***

The Bundera/Ningaloo division encompasses six separate sections. These sections are each classified into one or more subsections.

***Coral Bay Division***

The Coral Bay division is divided into two sections: Batemans Bay and Lagoon. These sections are each classified into one or more sub-sections (See Appendix 11.3 for division information).

# 4.0 VOLUNTEER COORDINATION

The 2009-2010 NTP introduced a financial cost recovery for program participation, where volunteers were required to pay a reasonable fee relating to NTP operational costs. In return volunteers where provided with accommodation, food, transport to and from monitoring and NTP social activities for the full four week period. The aim of the cost recovery is to increase the cost effectiveness of the program subsequently supporting the longevity of the NTP.

## 4.1 Participation, Recruitment and Accommodation

***NTP Volunteer Coordinator***

The NTP appoints a Volunteer Coordinator to manage the seasonal program. This position is employed through DEC-Exmouth District and is responsible to DEC management. Duties include volunteer recruitment, support and coordination, data management, field work coordination and general reporting.

***NTP Volunteer Team Leader Internship***

Volunteer Team Leaders are appointed in a supervisory role for the volunteer participants. Positions are advertised through universities state wide with successful applicants required to participate for a period of nine weeks as part of a volunteer internship placement. Team Leaders are provided a subsidy for accommodation, food and travel as part of the internship.

***NTP Indigenous Internship***

The NTP encourages the participation of local Indigenous people within the program in a supervisory capacity similar to that of the NTP Volunteer Team Leader role including the provision of a subsidy for accommodation, food and travel.

***NTP Local Volunteers***

The local community plays an integral role in the longevity of the NTP. Community volunteers participate in the program, through a flexible monitoring schedule.

***NTP External Volunteers***

External volunteers are also vital to the operation of the NTP and include both Australian and International participants. Volunteers are required to commit to the program for a period of block monitoring.

***Recruitment***

- The NTP Volunteer Coordinator and volunteer positions are advertised through the NTP website, NTP workshops and information days, the CCG Newsletter, Exmouth community notice boards and through local media.
- Western Australian universities advertise the Team Leader internship placements through their information channels.
- Previous local and external volunteers are invited to participate in this season's program. Volunteers are contacted via email prior to the commencement of the season.
- Individuals enquiring about the program through the year are also contacted by email.

***Accommodation***

- NTP external volunteers are provided accommodation for a four week block period at the DEC research stations in Cape Range National Park, Exmouth, Western Australia. All external volunteers are required to pay a fee of $990 which includes accommodation, food and transport costs and all official NTP activity costs.
- External volunteers also have an opportunity to participate in remote camping at the Bungelup Station Camp, located 6km north of Yardie Creek, Cape Range National Park. Volunteers will camp between the two camp stations on a three day rotational roster.
- Team Leaders are provided accommodation in Exmouth Township for dates outside of the block monitoring period. During the block monitoring period they are housed with the external volunteers within the national park.
- The Volunteer Coordinator is not provided with accommodation for their contract period.

## 4.2 Monitoring Operations

***North West Cape Division***

- A minimum of twelve volunteers is required to adequately survey each subsection within the NW Cape division and Cape Range Division (Bungelup).
- The block monitoring period is conducted mainly by the external volunteers on a rotational basis between NW Cape and Cape Range divisions. Local volunteers assist with the roster to allow for external volunteer rostered days off. Outside of the block period local volunteers undertake monitoring in NW Cape division only.
- A 12-seater minibus is required or the duration of the block monitoring period to transport external volunteers to and from monitoring.
- DEC vehicles are required to transport local volunteers to and from monitoring both during and outside of the block monitoring period, including the training week.
- Volunteers may chose to make use of their own vehicle without receiving any reimbursement for fuel costs or additional expenses relating to their vehicle.
- Monitoring hours are approximately between 5:30am - 9:00am depending on light availability.

***Cape Range Division***

- A one team leader accompanied by a maximum of two volunteers adequate for monitoring Bungelup section.
- A DEC vehicle is required for use at the Bungelup remote camp throughout the block monitoring period.

Due to significant reductions in survey effort monitoring, as part of NTP operations for 2009-2010, did not occur within the Bundera/Ningaloo division and the Coral Bay division.

## 4.3 Volunteer Training and Assessment

NTP participants are required to have a high level of knowledge of monitoring techniques and sound understanding of turtle nesting activity in order to adequately record findings. Volunteers undertake an induction which includes the following:

- A briefing on NTP and its operations, Exmouth Township and surrounding area including Ningaloo Marine Park and Cape Range National Park,
- Occupational health and safety procedures
- NTP monitoring procedures,
- A briefing on the Code of Conduct for beach based marine turtle observation interactions,
- A temporary copy of the NTP Turtle Monitoring Field Guide (CCG 2007),
- A practical training session in radio protocol and using a hand held Global Positioning System (GPS).

Each participant is required to undertake three practical training sessions followed by a practical competency-based assessment. Additional training sessions are available if required to ensure volunteers are confident to survey a subsection unaccompanied and competent in recording findings. Once qualified "turtle trackers" are provided with a competency certificate and NTP clothing.

## 4.4 NTP 2009-2010 Summary

### Recruitment and Participation

- A Volunteer Coordinator was appointed for a period of 4 months 16 November 2009 – 15 February 2010.
- The NTP did not receive any interest for an internship placement this season, therefore the team leader positions were advertised with the volunteer coordinator position. Two team leaders were appointed for the 2009-2010 season 7 December 2009 – 25 January 2010.
- No Indigenous Interns were recruited this season.

This season a total of 43 volunteers assisted with NTP operations - monitoring, training, data entry and administration, contributing 2370 hours equating to $47,400 (based on a pay rate of $20/hour) ( Table 1).

**Table 1: Summary of volunteer contribution and associated monetary value, NTP 2009-2010**

| Volunteer type | Number of Volunteers | Hours | Days | Volunteer Hours at $20 p/hr |
|---|---|---|---|---|
| Local | 29 | 495.5 | 143 | $9,910 |
| Internship | 2 | 669.75 | 110 | $13,395 |
| Externals | 12 | 1204.65 | 303 | $24,093 |
| **Total** | 43 | 2369.9 | 556 | **$47,398** |

### *Volunteer Origin and Demographics*

43 volunteers participated in 2009-10 season including both local and external volunteers. 67% were residents of Exmouth, 7% were external volunteers from other areas in Western Australia, 12% came from interstate, and the remaining volunteers (14%) were from abroad. The age of volunteers ranged from 19 to 69.

### *Volunteer Contribution 2002-2010*

From the commencement of the NTP (2002-2003) to date, volunteers have contributed at total of **40563** hours (Figure 1). Please note that in comparison to previous season's volunteer time

contributions has significantly reduced in the past three seasons. Please note that the 2009-2010 season included monitoring within NW Cape and Cape Range division only.

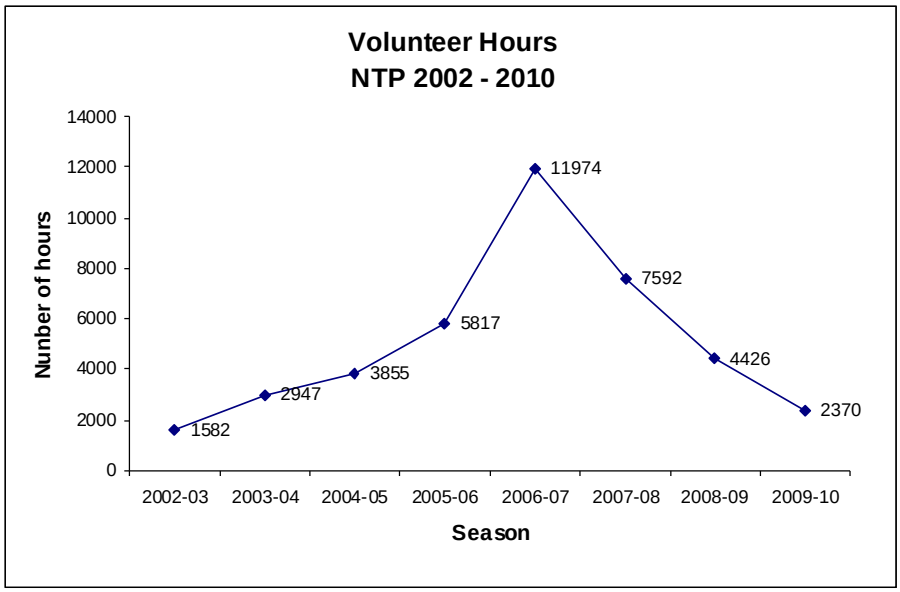



**Figure 1: NTP volunteer contribution per year 2002-2010.**

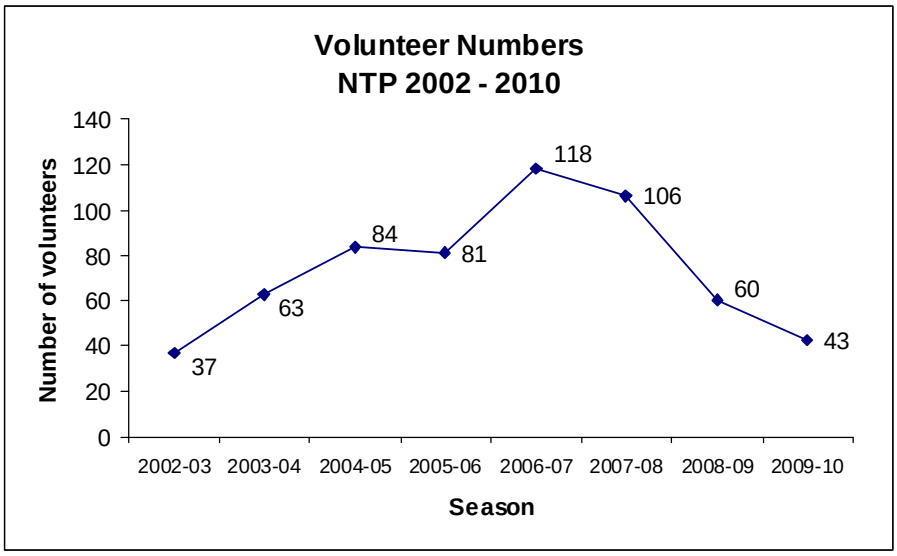



**Figure 2: The number of NTP volunteers per year 2002-2010.**

From the commencement of the NTP (2002-2003) to date, volunteers have participated in the NTP. Please note that in comparison to previous the number of volunteers that participated in 2009-2010 has also significantly decreased (Monitoring Operations). Please note that 2009-2010 season included NW Cape and Cape Range division monitoring only.

## Monitoring Operations

- From the 28 December 2009 - 24 January 2010 majority of monitoring was conducted by external volunteers.
- Outside of this period 7 November 2009 - 24 January 2010 monitoring was undertaken solely by local volunteers.

## Training and Assessment

- NTP volunteers were trained an assessed throughout the turtle nesting season, with majority taking place within the block monitoring period.
- Training and assessment for the program was covered by NTP staff and local volunteers (8 trainers and 6 assessors).
- 2009-2010 NTP Turtle Trackers: 6 new competent local volunteers and 14 new competent external volunteers.
- 2009-10 NTP Trainers and Assessors: 2 new volunteer trainers, 3 new trainer trainers and 2 new assessors.

# 5.0 MONITORING METHODS AND DATA COLLECTION

## 5.1 Identification of Successful Nests and False Crawls

- To determine turtle nesting activity, Volunteer's survey beaches along the Ningaloo coast at sunrise. Turtle tracks and nest markings in the sand from the previous evening are recorded. Species-specific track markings allow volunteers to identify the presence of green, loggerhead, hawksbill or flatback female turtles.
- Successful nesting is determined by the presence of a nest mound and additional key nest features (CCG 2007).
- The position of the nest is recorded using a GPS and its specific location on the beach is noted: (I) Inter-tidal; (H) High tide area, (E) edge of vegetation, or (D) dunes and beyond.
- If a nest is not located with the associated turtle track, and the turtle has abandoned any nesting attempt and returned to the water this activity is recorded as a false crawl.
- Once the turtle activity is identified and recorded as either a nest or a false crawl, volunteers mark the activity by drawing a line in the sand (across the neck of the nest away from the egg chamber, or through the track in the case of a false crawl) to avoid double counting of turtle activities on subsequent beach surveys.
- Turtle activity is recorded on the NTP monitoring data sheet, to be entered into the NTP database at a later stage (Appendix 11.4).
- Other observations and general comments such as: a turtle still nesting on the beach; comments relating to a photograph taken; illegal activities sighted on the beach are also recorded on the data sheet.

## 5.2 Identification of Predation and Predator Prints

- Evidence of damage to new and old nests and the potential cause of damage are recorded on the NTP monitoring data sheet. This includes the presence of eggshells, partially consumed eggs, and significant holes dug in the immediate locality of the egg chamber (CCG 2007).
- Any prints within a 5m radius of the nest, including dog (D), fox (F), goanna (G) or human (H) prints are recorded. Cats are generally not classified as predators of the nests because they are not known to dig up the eggs.
- Fox and/or dog presence in any sub-section are also recorded. Please note a single dog or fox could walk along a stretch of beach for many kilometres, subsequently leaving prints on a number of subsections within a single evening. Therefore, the presence or absence of fox and dog prints is recorded and does not indicate the number of individual animals present on a beach in one evening.

## 5.3 Data Entry

- All data recorded on NTP data sheets is entered into a Microsoft Access database managed by DEC - Exmouth District. The database allows for information to be retrieved via standard queries and through the output of summary reports.
- Data is entered according to the date, division, section and subsection on the data sheet.
- All activity details are entered including species type, nest location coordinates, details of predation, general comments and the confidence level associated with the accuracy of the GPS coordinates, the presence of fox and dog tracks and the number of false crawls (Appendix 11.4).

## 5.4 Rescues and Mortalities

- Volunteers will occasionally encounter stranded turtles, which they assist back to the ocean. Nesting turtles are likely to become stranded in either the rocky shoreline or behind the sand dunes. The NTP has a purpose-made turtle stretcher which is kept on the NTP bus throughout the season. Volunteers are required to fill in a DEC form "Marine Turtle Stranding or Mortality Datasheet" for every stranded turtle
- Volunteers are also required to fill in a "Marine Wildlife Stranding and Mortality Datasheet" for all deceased turtles and other deceased wildlife - dolphins, whales, dugongs, sea birds, sharks and sea snakes that may be encountered.

## 5.5 Tagged Turtles

- During the 1986/87 turtle nesting season the Western Australian Marine Turtle Project (WAMTP) was introduced by DEC (formally known as CALM) in order to gather information on the distribution and abundance of Western Australian marine turtle populations and the movements of individual turtles. Turtles were tagged at several locations in WA such as the Lacepede, Muiron, Barrow, Varanus, and Rosemary Islands, the North West Cape, Exmouth Gulf and Cape Thouin. Tagging was conducted over several intermittent turtle nesting seasons with varying intensity at the tagging locations.
- Turtles encountered on the beaches during NTP monitoring activities are checked for tags wherever possible, without disturbing the turtle (preferably when the turtle is returning to the waters edge). Tagged turtles are recorded on the Tagged Turtle Resighting datasheet for DEC's West Australian Turtle Research program. The locality, date and observer are recorded, along with the left and right tag numbers, turtle species, time of observation, turtle activity and nest location if relevant.

# 6.0 MONITORING RESULTS

## 6.1 Survey Effort 2009-2010

***North West Cape Division***

Within the NW Cape division monitoring occurred between the 7 November 2009 and the 27 March 2010. A block period of monitoring occurred between the 28 December 2009 and the 24 January 2010. Outside of this period sporadic monitoring was conducted in the NW Cape division on the following dates: 7/11/2009, 8/11/2009, 28/11/2009, 29/11/2009, 19/12/2009, 20/12/2009, 13/02/2010, 14/02/2010, 6/03/2010, 7/03/2010, and 27/03/2010. No monitoring was conducted on 1 January 2010; counts of tracks on 2 January 2010 included tracks from 1 January and 2 January so track counts were averaged over the two days.

All subsections were monitored between 26-41 days, depending on the availability of volunteers (Table 2). In the case of insufficient volunteers to cover all sections, the most northern subsections (between Mildura Wreck and Hunters) were omitted from monitoring, followed by the most southern subsection. This is due to the northern and southern sub-sections typically having lower turtle nesting density.

**Table 2: NTP survey effort, 2009-2010.**

| Division | Section | Sub-section | Number of Days Monitored | Total Days Monitored |
|---|---|---|---|---|
| North West Cape | Lighthouse | Mildura Wreck - NW Car park | 26 | **83** |
| | | NW Car park - Surf Beach | 26 | |
| | | Surf Beach - Hunters | 31 | |
| | Hunters | Hunters - Mauritius | 41 | **117** |
| | | Mauritius - Jacobsz Sth | 38 | |
| | | Jacobsz Sth - Wobiri | 38 | |
| | Graveyards | Five Mile - Five Mile nth | 41 | **160** |
| | | Five Mile - Trisel | 40 | |
| | | Brooke - Graveyards | 40 | |
| | | Graveyards - Burrows | 39 | |
| | Tantabiddi | Burrows - Jurabi Point | 38 | **38** |
| Cape Range | Bungelup | Bungelup Nth - Neils Nth | 24 | **72** |
| | | Bungelup Sth - Bungelup Nth | 24 | |
| | | Bungelup Sth - Rollys | 24 | |
| **TOTAL** | | | | **470** |

***Cape Range Division***

Within the Cape Range division, monitoring occurred between the 1 January 2010 and the 24 January 2010. All three Bungelup sub-sections were monitored daily for 24 days (Table 2). No monitoring was conducted on 1 January 2010; counts of tracks on 2 January 2010 included tracks from 1 January and 2 January so track counts were averaged over the two days.

***Bundera/Ningaloo Division***

Due to significant reductions in survey effort, monitoring as part of NTP operations for 2009-2010, did not occur within the Bundera/Ningaloo division. Opportunistic monitoring was carried out by DEC staff, however for the purpose of this report data collected has been omitted from the results.

***Coral Bay Division***

Due to significant reductions in survey effort, monitoring as part of NTP operations for 2009-2010, did not occur within the Coral Bay division. Opportunistic monitoring was carried out by DEC staff, however for the purpose of this report data collected has been omitted from the results.

## 6.2 Summary of Turtle Activity, Ningaloo Region 2009-2010

A total of 1069 successful turtle nests and 2134 false crawls were recorded for the Ningaloo region during the 2009-2010 season (Table 3 andTable 4).

**Table 3: The total number of nests recorded for each species within the Ningaloo Region (NW Cape and Cape Range divisions), NTP 2009-2010.**

| | Turtle Species | | | | | |
|---|---|---|---|---|---|---|
| **Division** | **Green** | **Loggerhead** | **Hawksbill** | **Flatback** | **Unknown** | **Total** |
| **North West Cape** | 564 | 102 | 115 | 0 | 4 | 785 |
| **Cape Range** | 7 | 186 | 87 | 0 | 4 | 284 |
| **Total** | 571 | 288 | 202 | 0 | 8 | **1069** |

**Table 4: The total number of false crawls recorded for each species within the Ningaloo Region (NW Cape and Cape Range divisions), NTP 2009-2010.**

| | Turtle Species | | | | | |
|---|---|---|---|---|---|---|
| **Division** | **Green** | **Loggerhead** | **Hawksbill** | **Flatback** | **Unknown** | **Total** |
| **North West Cape** | 1435 | 136 | 92 | 2 | 6 | 1671 |
| **Cape Range** | 16 | 335 | 110 | 0 | 2 | 463 |
| **Total** | 1451 | 471 | 202 | 0 | 8 | **2134** |

***Comparison of new nests by species***

Green turtles accounted for 53.4 % of recorded new nests in the Ningaloo region, followed by loggerhead (26.6 %) and hawksbill turtles (18.8 %). A small percentage of nesting activity was recorded as unknown (0.7%) and no new Flatback nests were identified during the 2009-2010 season (Figure 3).

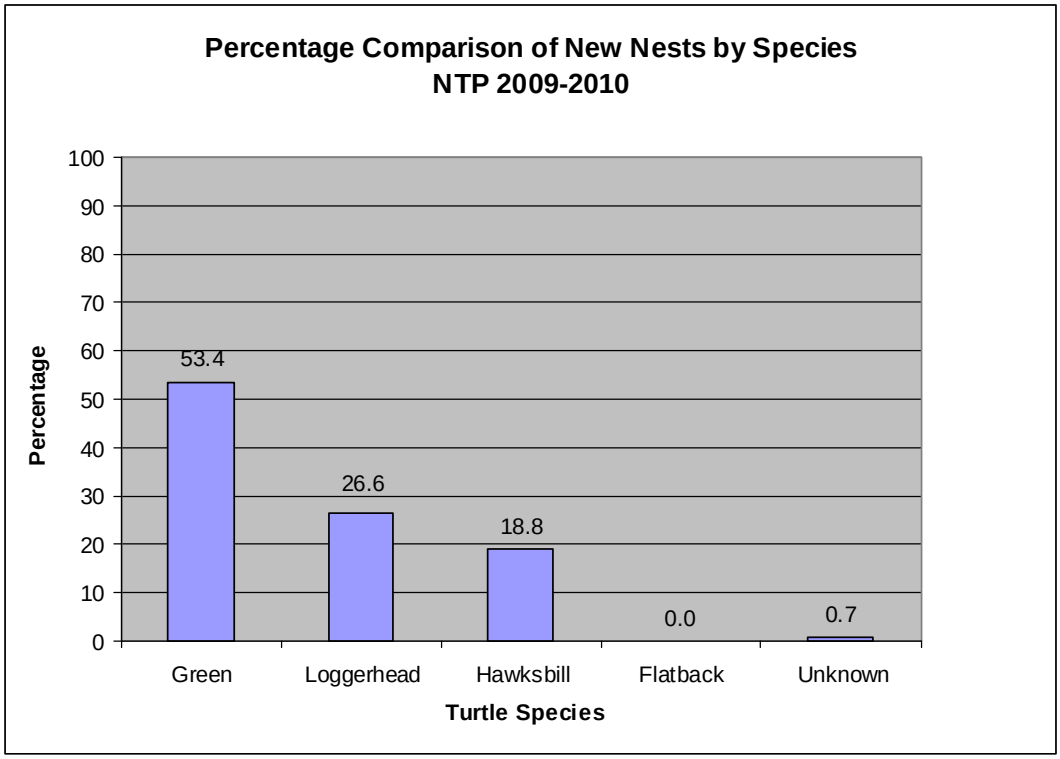



**Figure 3: Percentage comparison of new nests recorded for each species within the Ningaloo Region (NW Cape and Cape Range divisions), NTP 2009-2010.**

## NW Cape Division

A total of 785 nests and 1671 false crawls were recorded within the NW Cape division during the 2009-2010 NTP. The green turtle had the greatest number of nesting activity (both new nests and false crawls) recorded (71.8%), followed by the hawksbill (14.8%), and loggerhead turtle (13.0%) (Table 3 and Table 4).

***Turtle activities by section – NW Cape division***

Overall successful nesting activity (new nests) was greatest within the Graveyards section (340), followed by Hunters section (292), Lighthouse section (79) and Tantabiddi section (74). Unsuccessful nesting activity (false crawls) was greatest within the Hunters section (707) followed by Graveyards section (636), Lighthouse Bay section (195) and Tantabiddi section (133) (Figure 4). For individual nest locations see Appendix 11.7, 11.8 and 11.9.

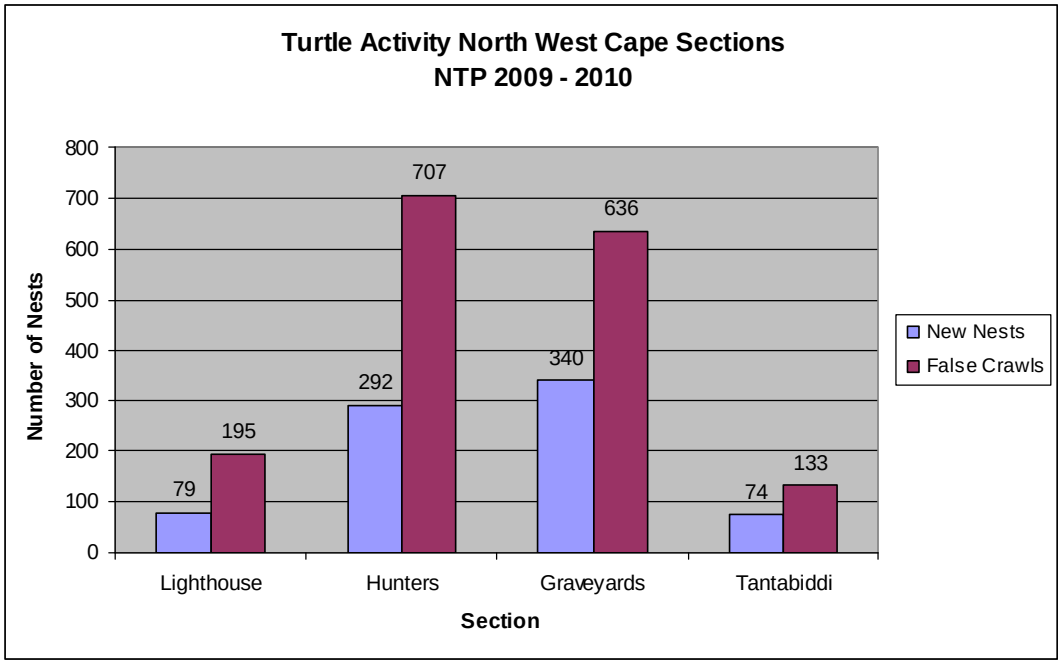



**Figure 4**: **Comparison of nesting activity (new nests and false crawls) recorded in each NW Cape section NTP 2009-10.**

***Percentage of nests laid for each species per section - NW Cape division***

The greatest percentage of green turtle nests were laid within the Tantabiddi section (93.2%), followed by Graveyards section (80.2%), Hunters section (62.0%), and Lighthouse Bay section (51.9%). Whereas the hawksbill turtle laid the greatest number of nests within the Lighthouse Bay section (27.9%), followed by Hunters section (19.5%), Graveyards section (10.3%) and Tantabiddi section (1.4%). Loggerhead nests were recorded as greatest within the Hunters section (18.1%), followed by Lighthouse Bay section (17.7%), Graveyards section (9.4%), and Tantabiddi section (4.1%). Lighthouse Bay section had 2.5% of new nests recorded as unknown, followed by the Tantabiddi section (1.4%) and Hunters section (0.3%) (Figure 5).

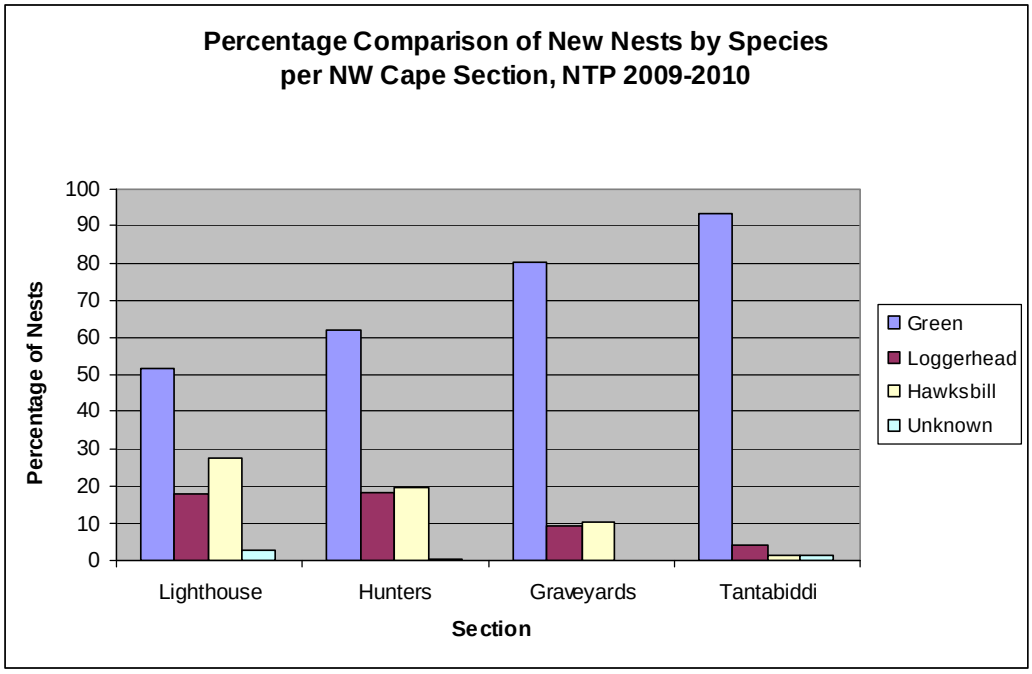



**Figure 5: Percentage comparison of new nests laid for each species per NW Cape section 2009-2010.**

## Cape Range Division

A total of 284 nests and 463 false crawls were recorded in the Bungelup section (Cape Range division) during the 2009-2010 NTP. The loggerhead turtle had the greatest number of successful nests recorded at Bungelup (65.5%), followed by hawksbill (30.6%), and green (2.5%). 1.4% of new nests was identified as unknown (Table 3 andTable 4).

***Turtle activities by section –Cape Range division***

Turtle activity (both new nests and false crawls) was the highest in the "Bungelup- Sth – Rolly Sth" section (112 and 219 respectively), followed by "Bungelup Nth- Bungelup Sth:" section (111 and 152 respectively) and "Neils Nth – Bungelup Nth" section (61 and 92 respectively) (Figure 6). For individual nests locations see to Appendix 11.10.

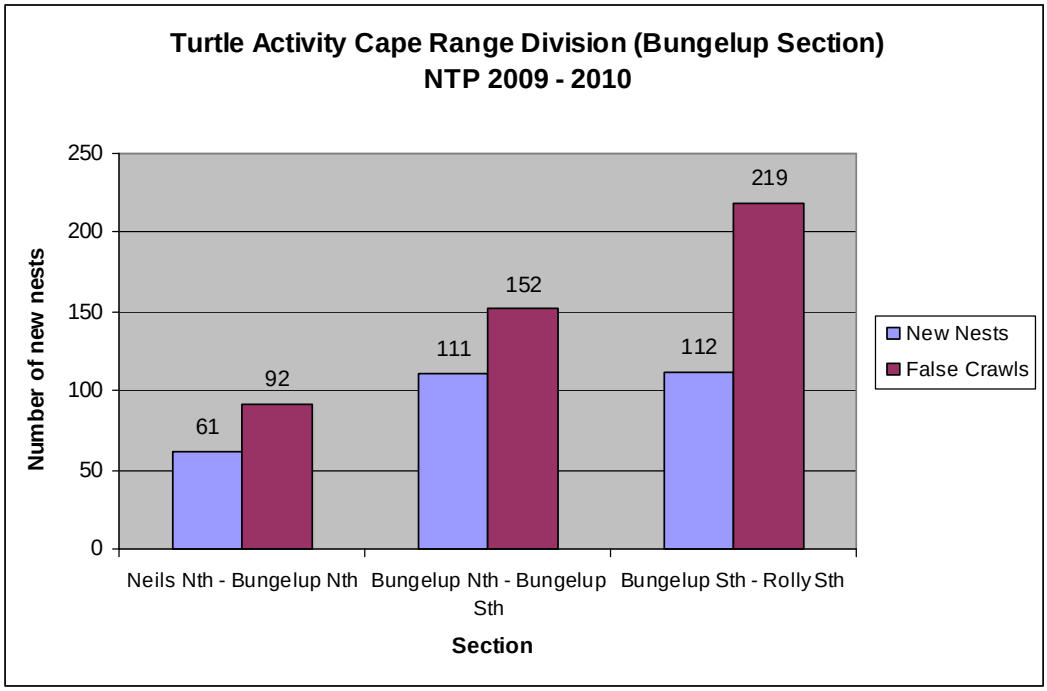



**Figure 6**: **The total number of nests and false crawls recorded within the Cape Range division (Bungelup section), NTP 2009-2010.**

***Percentage of nests laid for each species per section - Cape Range division***

The loggerhead turtle had the greatest percentage of new nests within the "Bungelup Nth- Bungelup Sth" section (68.5), followed by "Neils Nth – Bungelup Nth" section (63.9%) and "Bungelup- Sth – Rolly Sth" (63.4%). Whereas the hawksbill had the greatest number of new nests within the "Bungelup- Sth – Rolly Sth" section (33.0%), followed closely by the "Neils Nth – Bungelup Nth" section (32.8%) and the "Bungelup Nth- Bungelup Sth" (27.0%). Green turtle activity was minimal within the Cape Range division (Figure 7).

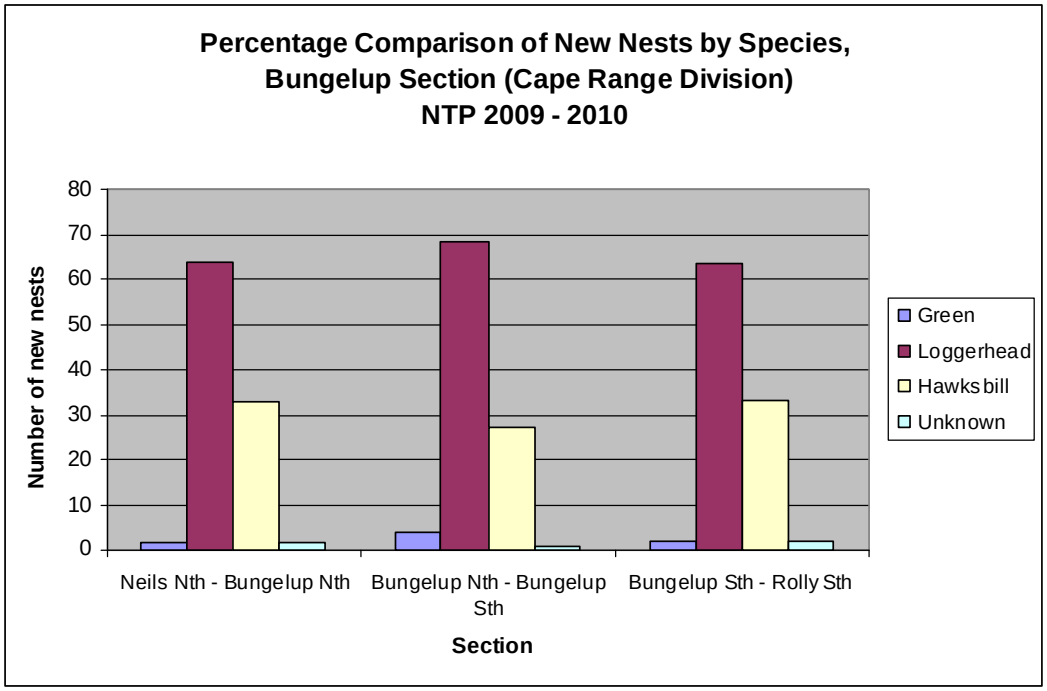



**Figure 7: Percentage comparison of total new nests by species within each Cape Range division (Bungelup section), NTP 2009-2010.**

## 6.3 Summary of Turtle Activity, Ningaloo Region 2002-2010

The NTP has recorded 31787 new nests and 69746 false crawls since commencement of the program (2002) within the Ningaloo Region (including all divisions). The combined survey effort (2002-2010) for the number of sub-sections surveyed is 8859. A total of 777 days has been collated for when monitoring actually occurred. For a breakdown of season survey effort and turtle activity see Appendix 11.11

## 6.4 Summary of Nest Disturbance

### Nest Disturbance 2009-2010

A total of 39 nests were recorded as disturbed in the Ningaloo Region, 35 of which were located in the NW Cape division - Graveyards section (23), Hunters section (9), Tantabiddi section (2), and Lighthouse section (1). 4 nests were recorded as damaged in the Cape Range division (Bungelup) (Table 5). This equates to 3.64% of the total nests recorded for the 2009-2010 season (Table 3).

The majority of nests were disturbed by foxes (38.5 %), followed by goannas (10.3%), dogs (5.1%) The cause of damage was either not possible to determine or not recorded for 15 nests in the region (38.5 %) (Figure 8).

**Table 5: The total number of disturbed nests and cause, NTP 2009-2010.**

| | Cause of Disturbance | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Unknown | Cat | Dog | Fox | Ghost Crab | Goanna | Human | Seagull | Tide | Another Turtle | Vehicle | Total |
| **NORTH WEST CAPE DIVISION** | | | | | | | | | | | | |
| Lighthouse Bay Section | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** |
| Hunters Section | 4 | 0 | 0 | 2 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | **9** |
| Graveyards Section | 8 | 0 | 2 | 9 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | **23** |
| Tantabiddi Section | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **2** |
| **CAPE RANGE DIVISION** | | | | | | | | | | | | |
| Bungelup | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **4** |
| **TOTAL** | **15** | **0** | **2** | **15** | **2** | **4** | **1** | **0** | **0** | **0** | **0** | **39** |

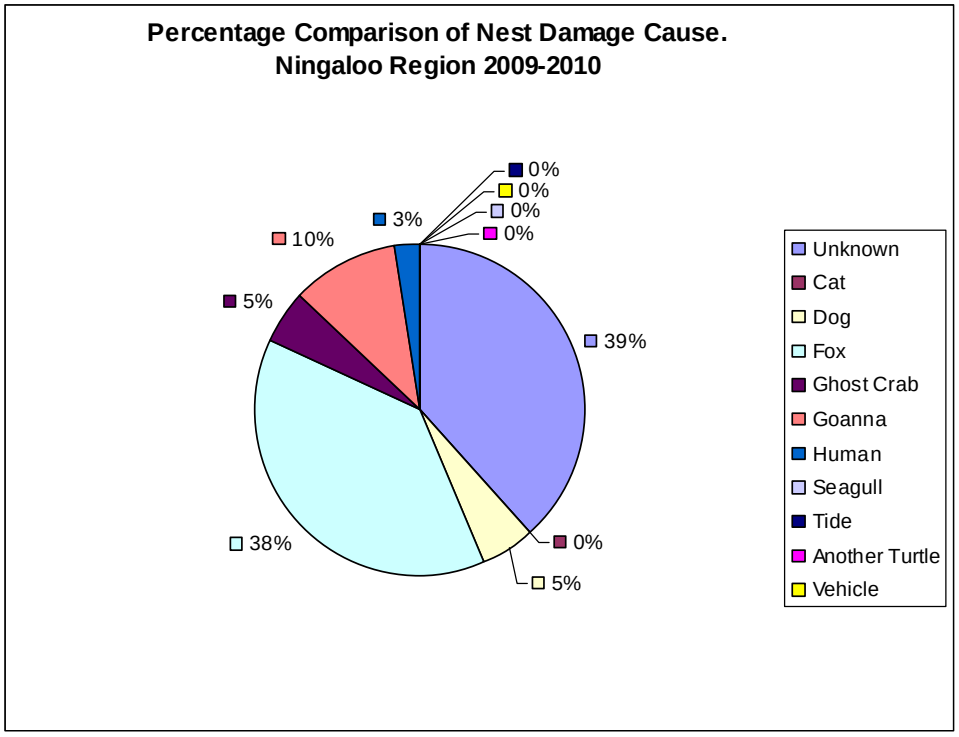



**Figure 8: Percentage comparison of nest damage cause. Ningaloo Region 2009-2010 (Note the 2009-10 Season survey effort included the NW Cape and Bundera divisions ONLY).**

### Nest Disturbance 2002-2010

Since monitoring began in 2002 a total of 718 nests have been recorded as disturbed within the Ningaloo Region. This equates to 2.26% of total nests recorded within the Ningaloo Region 2002-2010 (Table 15). (Note that survey effort within the region varies for each NTP season see Appendix 11.11).

**Table 6: Total number of disturbed nests and cause per season NTP 2002-20010. (Note there is error with disturbance figures previously stated for 2008-2009. All figures below are adapted from the NTP database and are correct.**

| Season | Unknown | Cat | Dog | Fox | Ghost Crab | Goanna | Human | Seagull | Tide | Another Turtle | Vehicle | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2002-2003 | 14 | 0 | 0 | 57 | 14 | 3 | 9 | 2 | 2 | 3 | 0 | **104** |
| 2003-2004 | 53 | 0 | 0 | 95 | 4 | 2 | 11 | 2 | 4 | 2 | 0 | **173** |
| 2004-2005 | 10 | 0 | 0 | 26 | 2 | 1 | 1 | 0 | 2 | 1 | 2 | **45** |
| 2005-2006 | 0 | 0 | 0 | 4 | 12 | 0 | 0 | 2 | 2 | 4 | 1 | **25** |
| 2006-2007 | 5 | 0 | 5 | 30 | 22 | 1 | 0 | 0 | 1 | 13 | 0 | **77** |
| 2007-2008 | 9 | 0 | 9 | 13 | 96 | 4 | 2 | 3 | 9 | 13 | 0 | **158** |
| 2008-2009 | 31 | 0 | 7 | 57 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | **97** |
| 2009-2010 | 15 | 0 | 2 | 15 | 2 | 4 | 1 | 0 | 0 | 0 | 0 | **39** |
| **Total** | **137** | **0** | **23** | **297** | **153** | **15** | **24** | **9** | **20** | **37** | **3** | **718** |

## 6.5 Summary of Nest Predation

### Nest Predation 2009-2010

***Predation of nests by foxes and dogs***

Damage by foxes/dogs has accounted for 43.5% of disturbed nests 2009-2010 and 1.6% of the total new nests in the 2009-2010 NTP (Table 5). The level of disturbance recorded (2009-2010) has remained below 5% (Figure 9).

### Nest Predation 2002-2010

***Predation of nests by foxes and dogs***

Damage by foxes and dogs has accounted for 39.9% of the total disturbed nests recorded (2002-2010). Nest predation by foxes/dogs has remained below 5% for all recorded nests (2002-2010). The highest record of nest predation is 4.6% (2003-2004) (Figure 9).

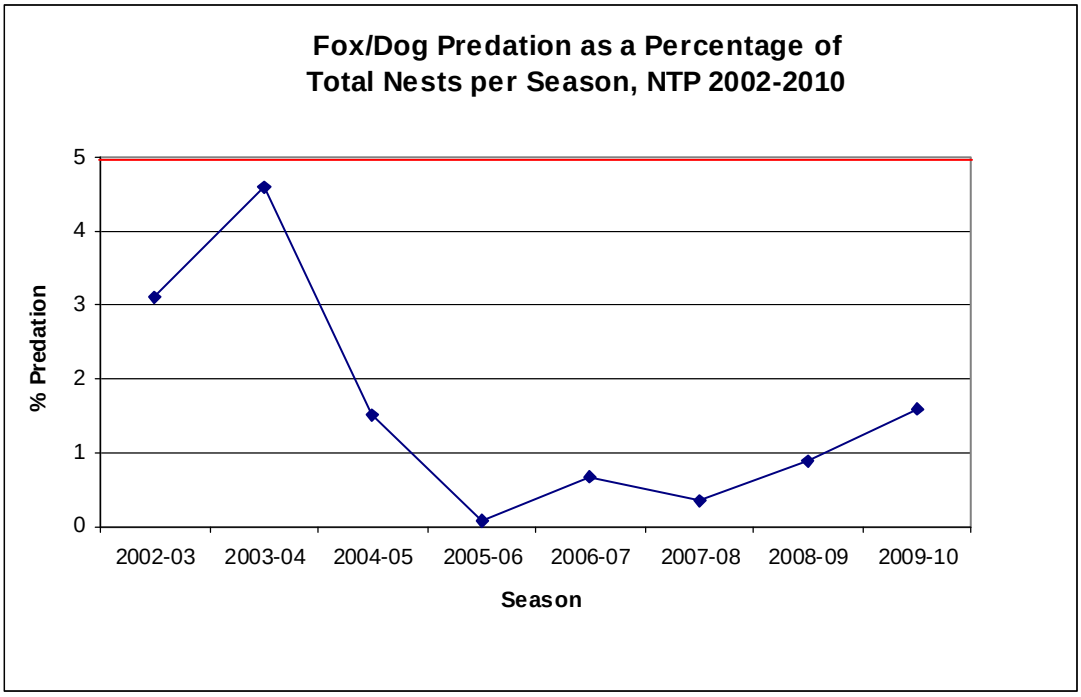



**Figure 9: Fox/dog predation as a percentage of total nests per season, NTP 2002-2010 (Note 2009-10 season data includes NW Cape and Bundera division only, other seasons include additional divisions- please see Table 15. Note: fox and dog prints have been totalled together to minimize error in identification of animal tracks.**

## 6.6 Summary of Turtle Rescues

### Turtle Rescues 2009-2010

4 successful turtle rescues carried out during the 2009-2010 NTP season. Majority rescued were female green turtles within the North West Cape division with 1 hawksbill turtle rescued within the Cape Range division (Table 7).

**Table 7: The number of turtles and location rescued, in 2009-2010.**

| Division | Subsection | Species | Maturity | Sex | Number |
|---|---|---|---|---|---|
| North West Cape | Jacobsz South - Wobiri | Green | Adult | Female | 1 |
| North West Cape | 5M - 5MN | Green | Adult | Female | 1 |
| North West Cape | Brookes - Graveyards | Green | Adult | Female | 1 |
| Cape Range | Neils Nth - Bungelup Nth | Hawksbill | Juvenile | Unknown | 1 |
| **Total** | | | | | **4** |

### Turtle Rescues 2002-2010

NTP volunteers have rescued a total of 179 stranded marine turtles from 2002-2010. The number of turtles rescued has fluctuated over the seasons, with the highest number of turtles rescued in 2005-2006 (40) (Figure 10).

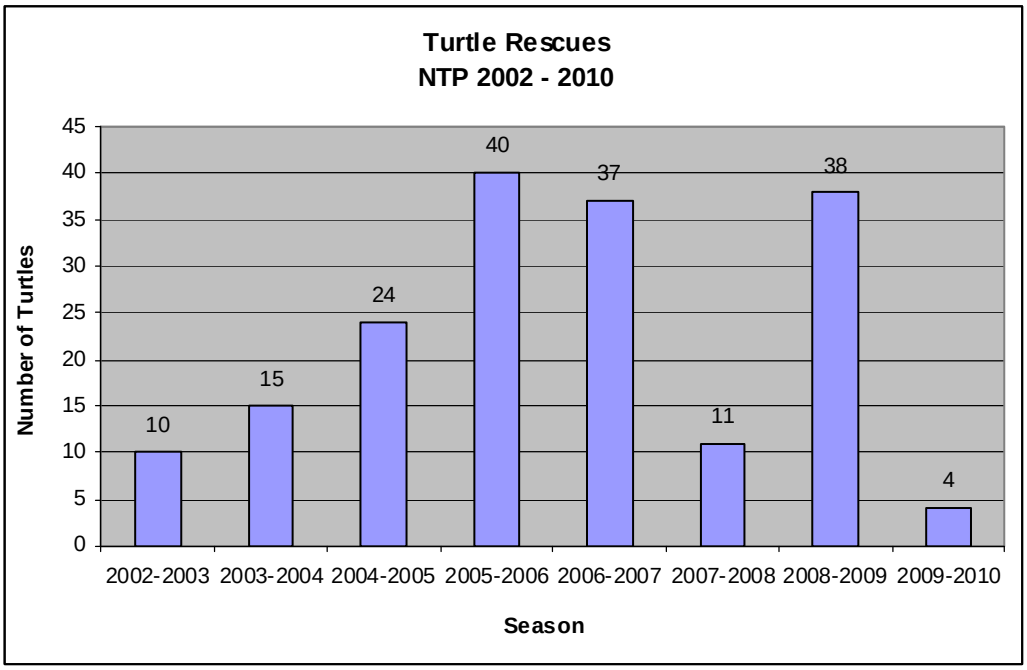



**Figure 10**: **The number of turtles rescued in each season, NTP 2002-2010. Note seasonal variation in survey effort.**

## 6.7 Turtle Mortalities 2009-2010

A total of 9 turtle mortalities were recorded during the 2009-2010 season. Majority found were juveniles turtles within the North West Cape (Table 9). Mortality reports can be obtained from the DEC Exmouth District.

**Table 8: The location, species and number of deceased turtles recorded in the Ningaloo Region 2009-2010.**

| Division | Subsection | Species | Maturity | Sex | Number |
|---|---|---|---|---|---|
| North West Cape | Surf Beach - Hunters | Green | Juvenile | Unknown | 1 |
| North West Cape | 5M - Trisel | Hawksbill | Unknown | Unknown | 1 |
| North West Cape | 5M - Trisel | Hawksbill | Juvenile | Unknown | 1 |
| North West Cape | 5M - Trisel | Green | Juvenile | Unknown | 1 |
| North West Cape | Graveyards - Burrows | Green | Juvenile | Unknown | 1 |
| North West Cape | Graveyards - Burrows | Loggerhead | Juvenile | Unknown | 1 |
| North West Cape | Burrows - Jurabi Point | Unknown | Unknown | Unknown | 1 |
| North West Cape | Burrows - Jurabi Point | Green | Adult | Unknown | 1 |
| Cape Range | Bungelup Sth - Rolly Sth | Hawksbill | Adult | Unknown | 1 |
| **Total** | | | | | **9** |

## 6.8 Weather Events 2009-2010

No cyclone events or major tidal activity were recorded within the areas the NTP operates during the 2009-2010 season.

## 6.9 Tagged turtle re-sights 2009-2010

One tagged turtle was sighted during the 2009-10 season. It was a green turtle which now has a 16 year record. She was originally tagged on a neighbouring beach and was observed in January this season covering her nest.

# 7.0 TURTLE NESTING WITHIN THE NINGALOO REGION, 2009-10: STATISTICAL ANALYSES AND GRAPHICAL PRESENTATION OF DATA

By Andrea Whiting

The following section is an extract of a commissioned report prepared by Andrea Whiting for the Ningaloo Turtle Program. The report was produced with the understanding that any part of it can be reproduced by the Ningaloo Turtle Program for any purpose. All graphs and text in this report can be used by the Ningaloo Turtle Program for any purpose, and can be copied into other reports. The report provides a summary of nesting statistics for the Ningaloo Region for 2002-2010.

## 7.1 Introduction

In 2008, survey methodology, seasonality and distribution of nesting were reviewed using data collected since 2001-02 and a report was produced entitled "Consolidation of the Ningaloo Turtle Program: Development of a statistically robust and cost efficient survey design". Modelling in the 2008 report indicated the amount of error associated with surveys spanning a shorter time frame. In 2009-10, monitoring was shortened to 3½ weeks of intensive monitoring during January. This report provides statistical analyses and graphical presentation of data for turtle nesting activity in the Ningaloo Region during the 2009-10 nesting turtle season, and estimates full-season nesting activity so the 2009-10 data can be compared with other years and sites.

## 7.2 Methods

Surveys occurred during the estimated peak in nesting activity (see Figure 11 ), but were skewed towards the right hand side of nesting activity. To centre surveys during the peak of the season and maximize the number of nesting activities seen, surveys would also need to include nesting in mid-late December.

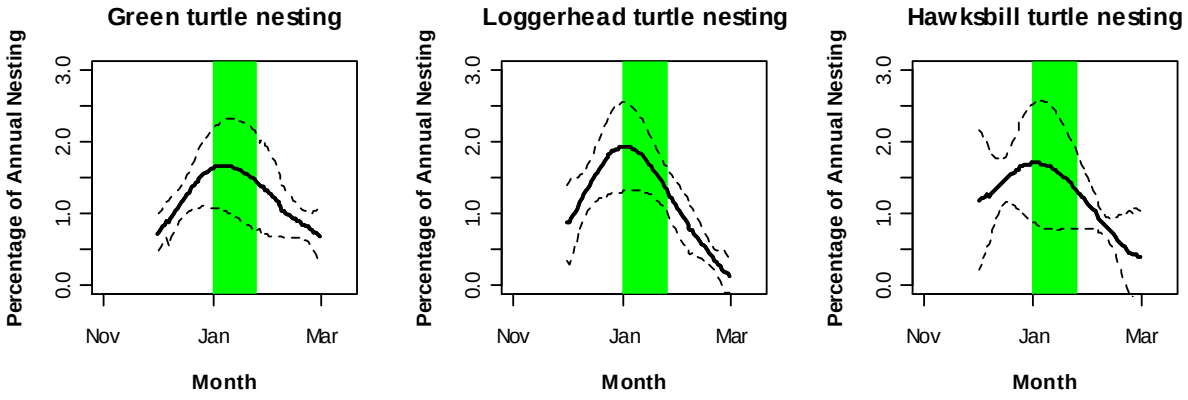



**Figure 11: Seasonal distribution in nesting for green, loggerhead and hawksbill turtles at North West Cape using mean gam smoothing spline from 2003-04 to 2008-09. Green shaded area shows the intensive survey period during the 2009-10 season.** Dashed lines refer to 95% confidence intervals.

## Estimating annual number of tracks and clutches

The annual nesting abundance was estimated using two methods: a) a linear regression model correlating nesting abundance between 1 January 2010 and 24 January 2010 with annual nesting abundance (nesting between 15-November and 15-March); and b) a generalized additive model used to predict the annual nesting abundance throughout the season.

The functions used for the linear regression models were calculated from analyses of six years of data (see Figure 12). Estimated sampling error was calculated using regression equations for track counts at North West Cape only as data were not sufficient at Cape Range to gain an accurate indication of sampling error. Extrapolation to full-season monitoring was calculating from Whiting (2008), assuming the full-season extends from 15 November to 15 March (see Table 9).

**Table 9: Linear regression equations and extrapolation of linear regression modelling to full season counts**

| Species | Linear Regression Equation | Extrapolation to Full Season |
|---|---|---|
| Green | $No.Tracks_{(1-24\ Jan)} = 2.6745 * No.Tracks_{(Partial)}$ | $No.Tracks_{(Annual)} = No.Tracks_{(1-24\ Jan)}/0.930$ |
| Loggerhead | $No.Tracks_{(1-24\ Jan)} = 2.5295 * No.Tracks_{(Partial)}$ | $No.Tracks_{(Annual)} = No.Tracks_{(1-24\ Jan)}/0.924$ |
| Hawksbill | $No.Tracks_{(1-24\ Jan)} = 2.5753 * No.Tracks_{(Partial)}$ | $No.Tracks_{(Annual)} = No.Tracks_{(1-24\ Jan)}/0.937$ |

Generalized additive models were used to fit a cubic smoothing spline with 4 degrees of freedom to the daily track count data using the *mgcv*package in R (Bjorndal, Wetherall *et al.* 1999; Hastie and Tibshirani 1990; Wood 2006). Generalized additive models were fit to the available data, using start (15 November) and endpoints (15 March) weighted by 100 with all other data weighted by 0.1. The fitted function was then used to predict the number of nesting attempts throughout the season, and was summed to give an estimate of the annual number of tracks per year.

Confidence limits for annual abundance estimates were predicted using errors from 2003-2007 data (Whiting 2008). Monitoring during the 2008-09 and 2009-10 seasons were shortened and therefore not used to estimate error. The error in abundance estimates underestimates the total sampling error as error associated with extrapolating the counts between 1 December and 28 February to counts for the

full season (15 November and 15 March) are unknown as full season track counts have not previous been conducted.

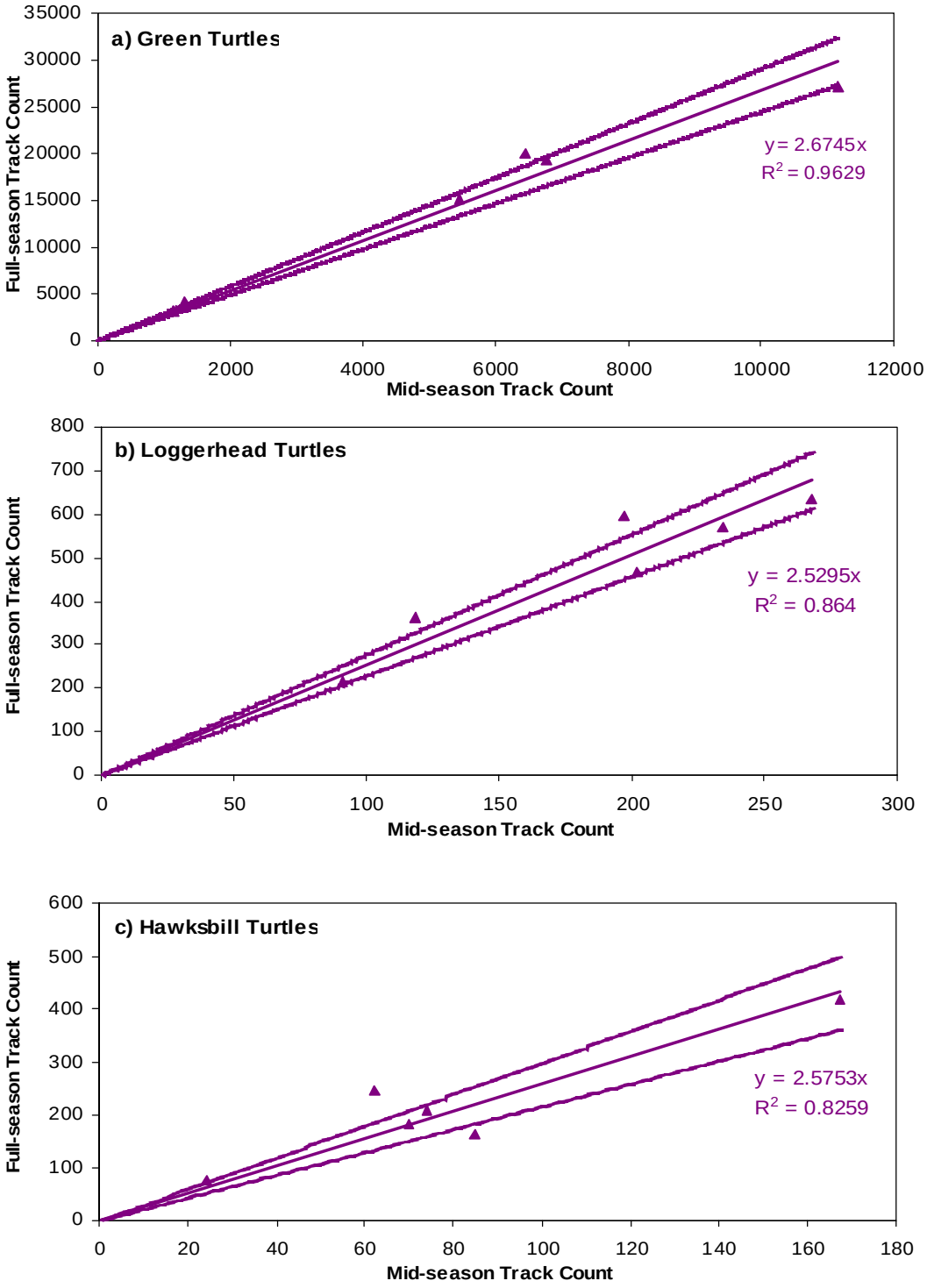



**Figure 12: Regression plots showing the relationship between mid-season and full-season track counts using 2003-04, 2004-05, 2005-06, 2006-07, 2007-08, and 2008-09 seasons. Mid-season track counts refer to counts between 1 and 24 January; Full-season track counts refer to counts between 1 December and 28 February.**

### Estimating the annual number of turtles nesting

As turtles generally lay several clutches of eggs within a season, conversion factors are needed to estimate the number of turtles nesting each year from track count censuses (see Figure 13). As the number of clutches laid per female per year is unknown for the Ningaloo Region population of turtles, the conversion factors were estimated using data from the literature (see Bool *et al.* 2009 for details). Estimated abundance for turtles within the Ningaloo Region used the following steps:

1. The number of tracks counted was converted to the number of clutches laid using the values recorded from visual observation of the nests.
    - This conversion has a substantial source of error in estimating nesting abundance, but the size of the error cannot be estimated, as accuracy was not tested using night time studies watching turtles. The amount of error will vary between individuals (based on the experience and ability of the observer) and will vary between locations (based on beach strata and vegetation; as determining nesting success in open sand areas is often easier than areas where the nest is partially covered in vegetation or debris).
2. The number of nesting turtles was estimated using the mean number of clutches laid per female per year from 12 populations of green turtles, 14 populations of loggerhead turtles and 8 populations of hawksbill turtles (see Bool *et al.* 2009 for details).
    - There is considerable error in this conversion as clutch frequencies vary considerably between populations. A range is shown instead of an estimate with confidence limits.
3. Conversion from the number of estimated females to the number of adult females in the population was not attempted as 1) there were too few years of monitoring (n= 7) to get a reasonable estimate; and 2) remigration intervals for the populations are unknown.

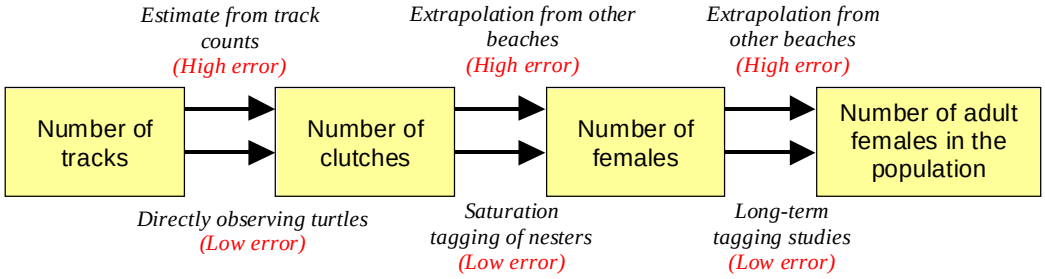



**Figure 13: Factors used in population modeling of nesting sea turtles to estimate nesting abundance of sea turtles. Figure reproduced from Whiting (2008).**

### Calculating nesting success

Nesting success was calculated using visual assessment of the nest after the turtle left the beach. This is not a very accurate method of determining nesting success. Quantifying nesting success by watching a sample of nesting turtles at night would substantially reduce error in clutch counts and total turtle estimates.

## 7.3 Results & Discussion

### Estimating annual number of tracks and clutches

Nesting occurred throughout the monitored period (FiguresFigure 14,Figure 15, Figure 16). The total track counts early in the season prior to the intensive monitoring period and late in the season after the intensive monitoring period were higher than expected (see seasonal trend and track count data in Figure 14,Figure 15). The higher than expected track counts could be due to: 1) survey methodology, where counts of tracks are not limited to the previous night's nesting; or 2) the seasonal distribution in nesting during the 2009-10 season may be different to previous year's nesting.

Nesting abundance during the 2009-10 season was the lowest for green and loggerhead turtles since intensive monitoring began in 2003 (see Figures Figure 17,Figure 18,Figure 19,Figure 20). Nesting abundance for hawksbill turtles was similar in magnitude to nesting between the 2003-04 and 2007-08 seasons (FiguresFigure 17,Figure 18,Figure 19,Figure 20). This is not indicative of a decline in the population, as sea turtle populations fluctuate considerably between years (see Broderick *et al.* 2001) due to the non-annual breeding behaviour of sea turtles (See Miller 1997; Plotkin 2003). During the 2009-10 season there were two records of nesting activity for flatback turtles.

The apparent upward trend in nesting abundance for green turtles shown for the 2003-2008 data (see Bool *et al.* 2009) did not continue during the 2009-10 season, indicating that this upward trend may have been due to the relatively short-term monitoring of the population (n= 7 years). The upward trend in hawksbill turtle nesting is still apparent for the North West Cape (see Figure 20), although the confidence limits in predicting this trend are much broader and the magnitude of the trend is lower. Hawksbill turtle nesting at Cape Range still appears to show an upward increase (see Figure 18), although whether this is real or artifact of survey error or short term monitoring is unknown.

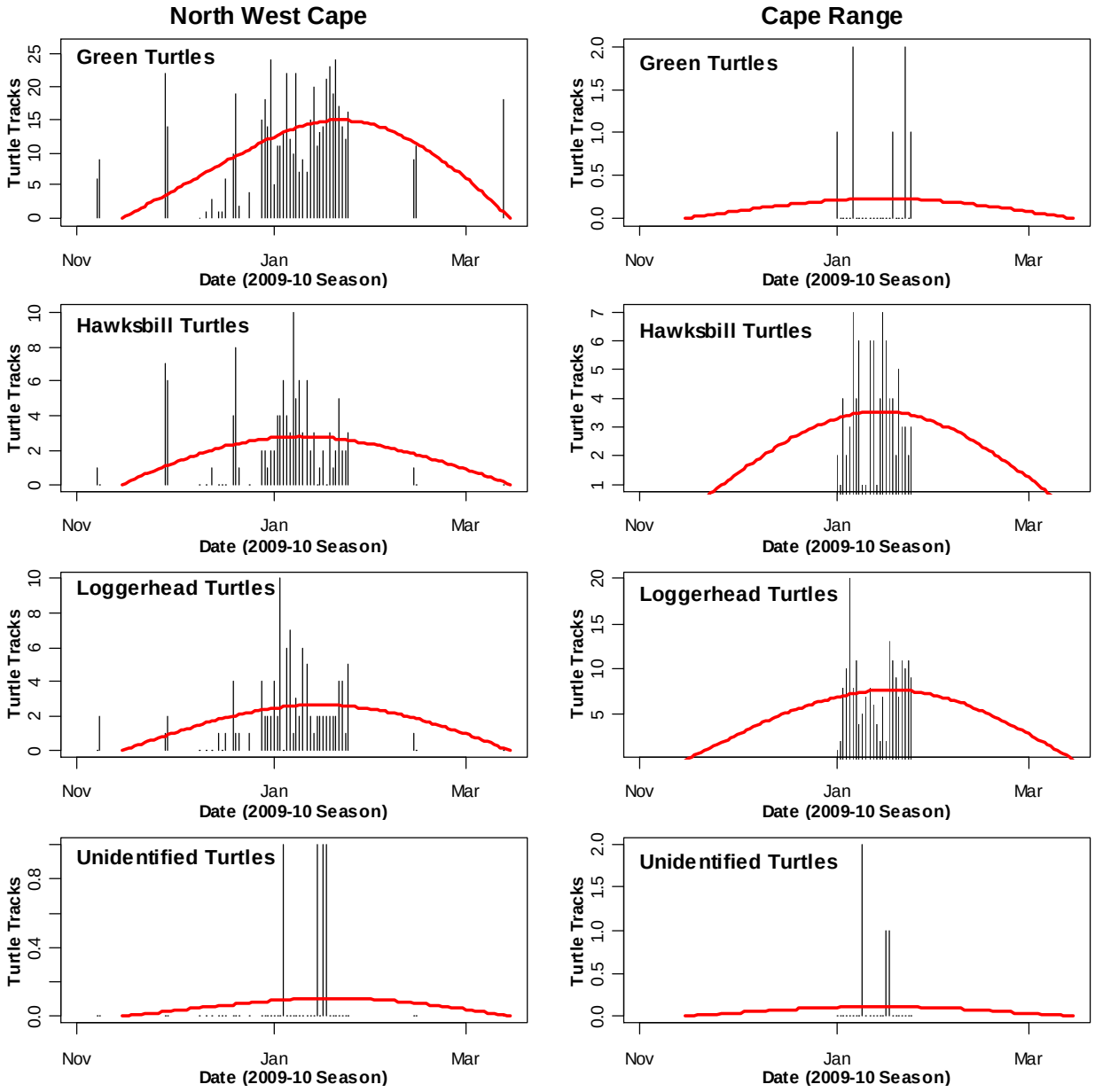



**Figure 14: Nesting abundance and seasonal distribution fit for green, hawksbill, loggerhead and unidentified turtle species during 2009-10. Red line refers to generalized additive model fit with null endpoints of 15-November and 15-March weighted at 1.0 and all other data weighted at 0.1.**

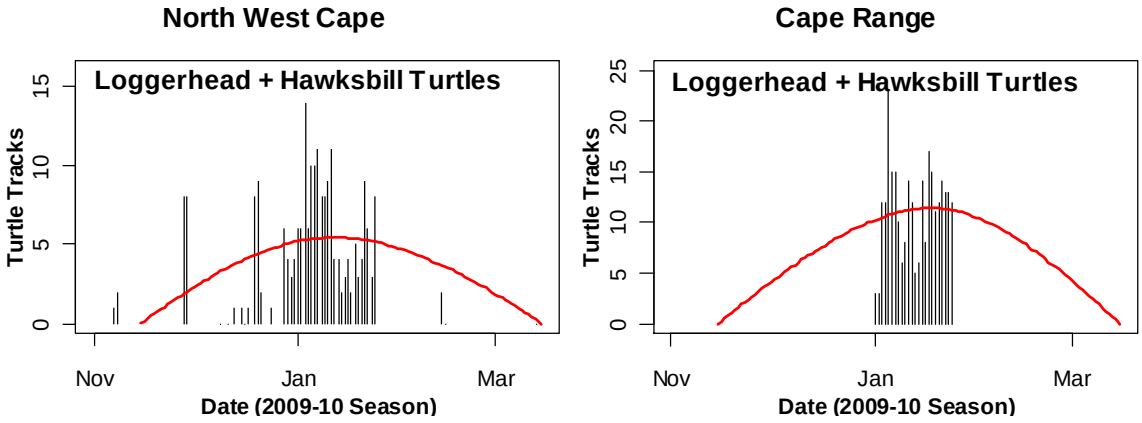



**Figure 15. Nesting abundance and seasonal distribution fit for hawksbill and loggerhead turtles combined during 2009-10.** Red line refers to generalized additive model fit with null endpoints of 15-November and 15-March weighted at 1.0 and all other data weighted at 0.1.

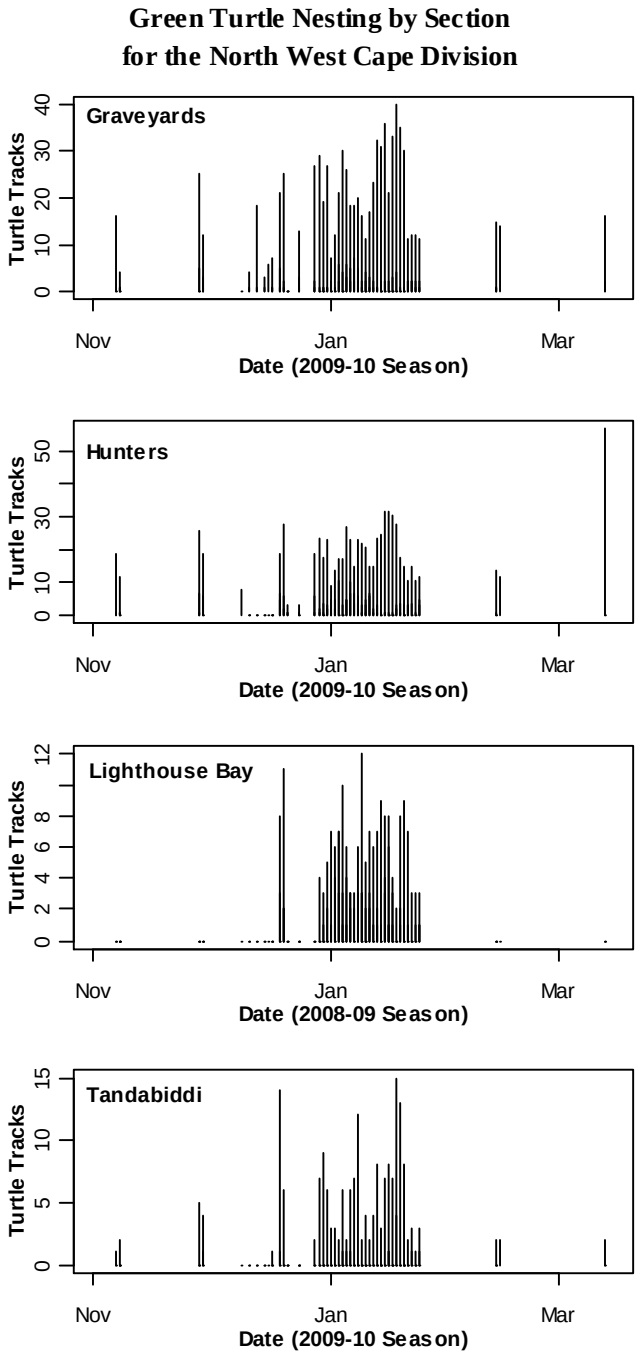



**Figure 16: Nightly nesting abundance for green turtles during the 2009-10 season shown by sections within the North West Cape division.**

**Total number of nesting turtle tracks for green, loggerhead and hawksbill turtles**

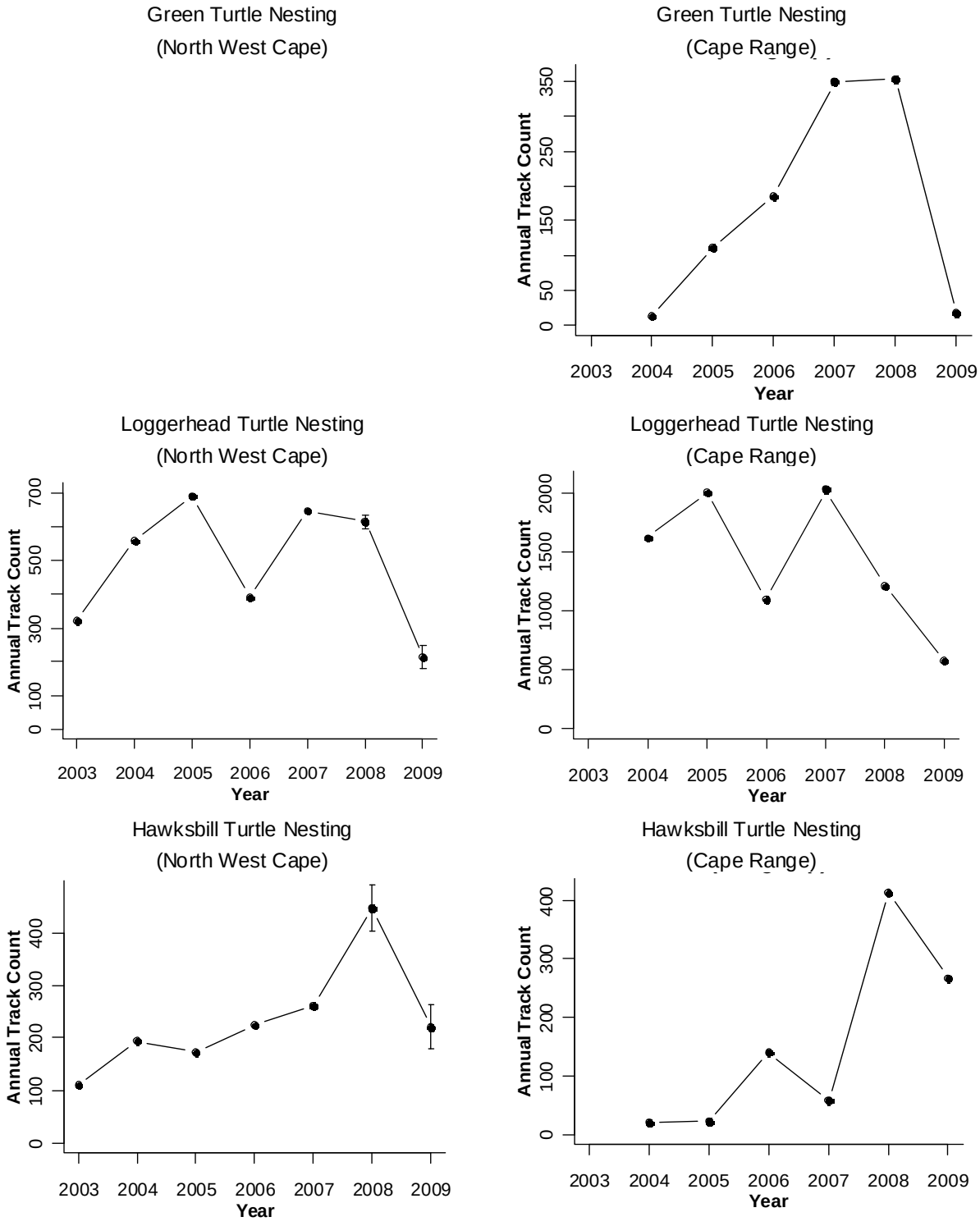



**Figure 17: Number of turtle tracks for turtles nesting at North West Cape and Cape Range divisions within the Ningaloo Region.** Annual abundance data were estimated for the entire years nesting assuming the season is mostly restricted to between 15 November and 15 March. Data for 2008-09 and 2009-10 were estimated using linear regression models and generalized additive models and the means of both methods are displayed with estimated sampling error in predicting nesting between 1 Dec and 28 Feb. Year refers to the year in which the season started.

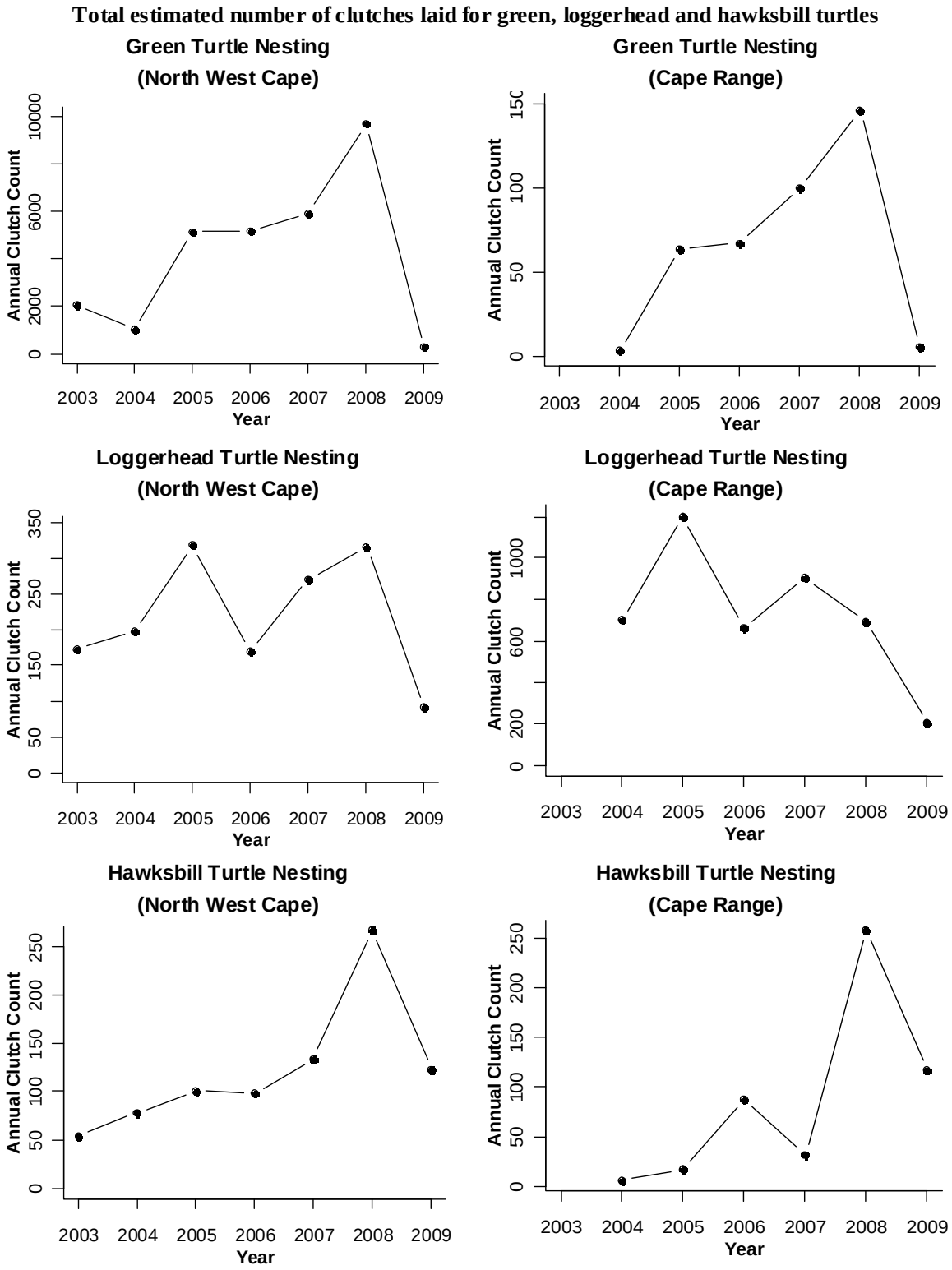
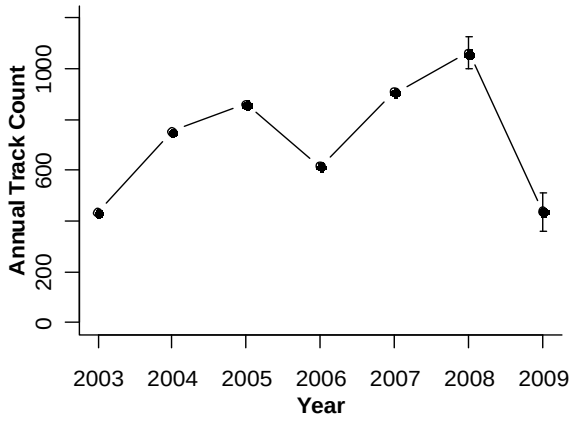
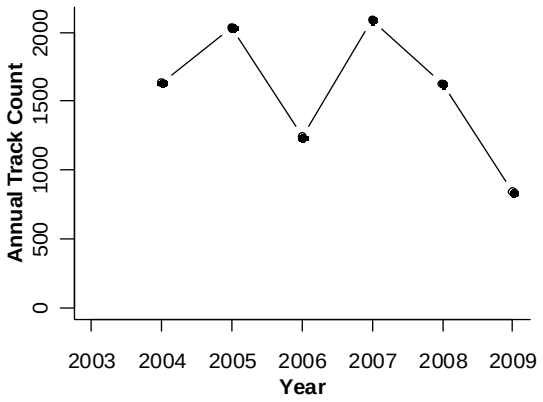



**Figure 18. Number of clutches laid for turtles nesting at North West Cape and Cape Range divisions within the Ningaloo Region.** Annual abundance data were estimated for the entire years nesting assuming the season is mostly restricted to between 15 November and 15 March. Data for 2008-09 and 2009-10 were estimated using linear regression models and generalized additive models and the means of both methods are displayed. Year refers to the year in which the season started. Year refers to the year in which the season started.

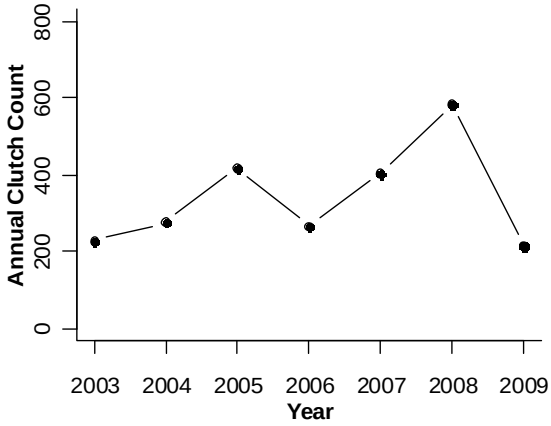
Combined Hawksbill and Loggerhead Turtle estimated track counts (North West Cape)




**Combined Hawksbill** and **Loggerhead Turtle estimated track counts (Cape Range)**




Combined Hawksbill and Loggerhead Turtle estimated clutch counts (North West Cape)




Combined Hawksbill and Loggerhead Turtle estimated clutch counts (Cape Range)

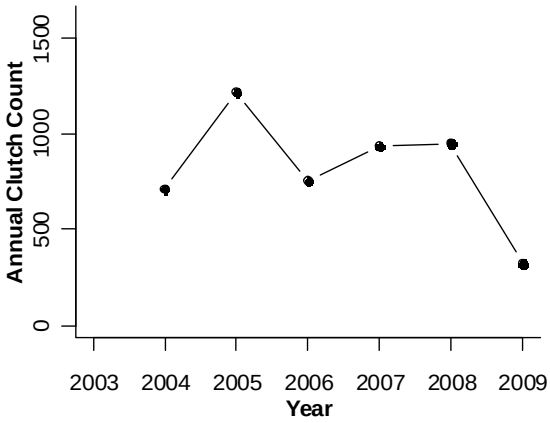



**Figure 19. Number of total tracks and clutches laid for turtles nesting at North West Cape and Cape Range divisions within the Ningaloo Region.** Annual abundance data were estimated for the entire years nesting assuming the season is mostly restricted to between 15 November and 15 March. Data for 2008-09 and 2009-10 were estimated using linear regression models and generalized additive models and the means of both methods are displayed. Year refers to the year in which the season started.

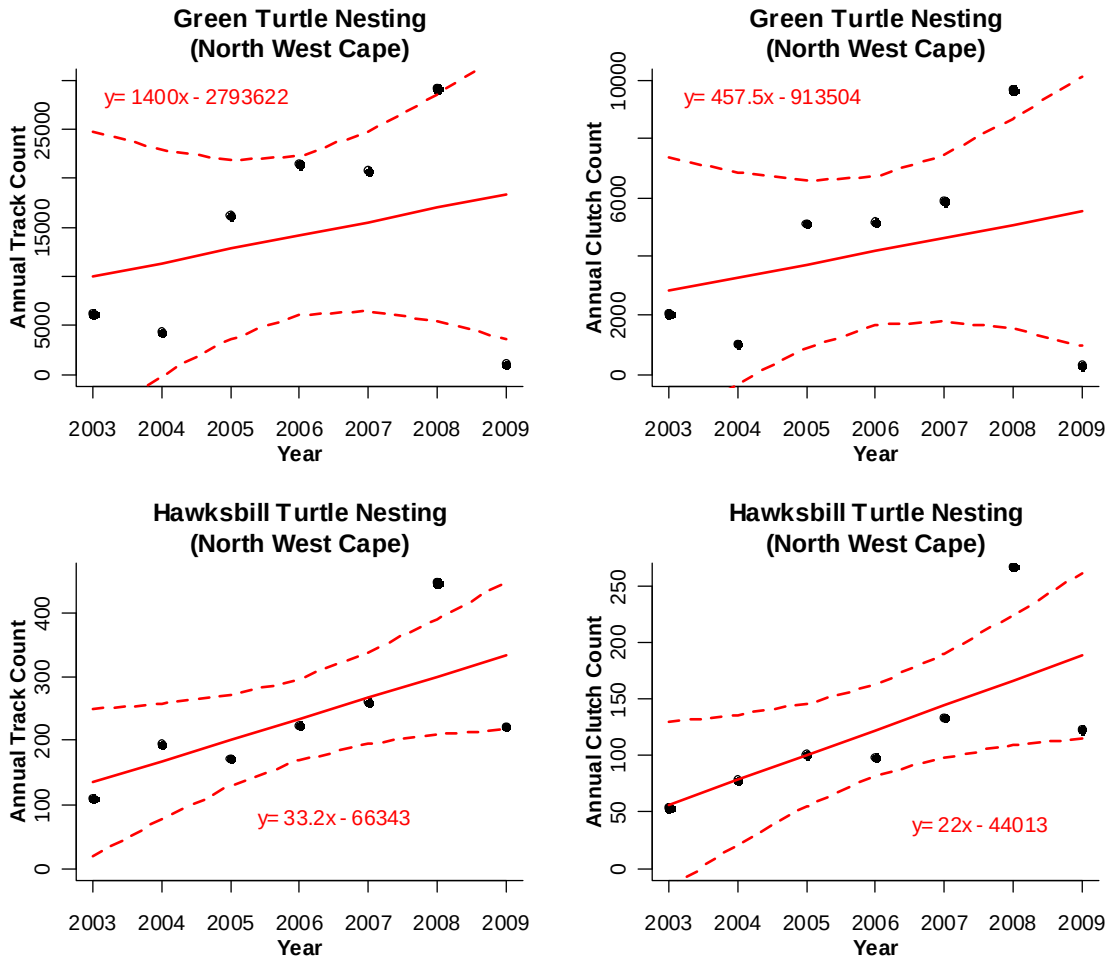



**Figure 20. Linear regression between annual track counts and year, showing positive trends for green and hawksbill turtles nesting at North West Cape. Dashed line refers to 95% confidence intervals of trend line.** Year refers to the year in which the season started.

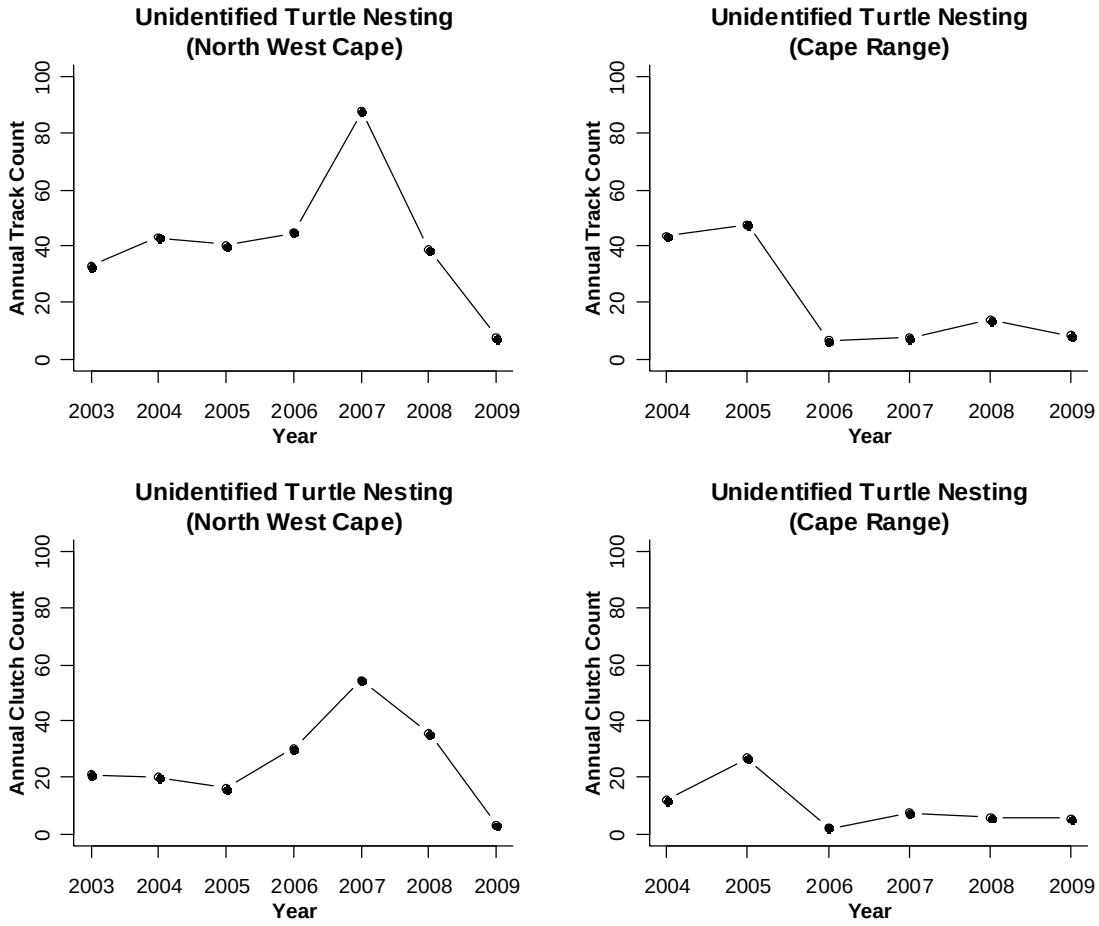



**Figure 21. Number of tracks and number of clutches laid for unidentified turtle species nesting at North West Cape and Cape Range divisions within the Ningaloo Region.** These are absolute counts rather than counts using modeling, and reflects the trend in nesting rather than estimated abundance. Year refers to the year in which the season started.

Table 10 shows a summary of recorded turtle nesting activity during the 2009-10 nesting season.

**Table 10: Total numbers of turtle tracks recorded for each section of beach for green, loggerhead, hawksbill, flatback and unidentified turtles.** Note- These values differ from estimated annual abundance due to survey coverage on the nesting beach.

| *Division* | *Section* | Green Laid | Green Didn't Lay | Loggerhead Laid | Loggerhead Didn't Lay | Hawksbill Laid | Hawksbill Didn't Lay | Flatback Laid | Flatback Didn't Lay | Unidentified Laid | Unidentified Didn't Lay |
|---|---|---|---|---|---|---|---|---|---|---|---|
| North West | Graveyards | | | | | | | | | | |
| Cape | | 273 | 564 | 32 | 36 | 35 | 31 | 0 | 2 | 0 | 3 |
| | Hunters | 181 | 610 | 53 | 57 | 57 | 38 | 0 | 0 | 1 | 2 |
| | Lighthouse Bay | 41 | 136 | 14 | 37 | 22 | 22 | 0 | 0 | 2 | 0 |
| | Tandabiddi | 69 | 125 | 3 | 6 | 1 | 1 | 0 | 0 | 1 | 1 |
| | ***Sub-Total*** | **564** | **1435** | **102** | **136** | **115** | **92** | **0** | **2** | **4** | **6** |
| Cape Range | Bungelup | 7 | 16 | 186 | 335 | 87 | 110 | 0 | 0 | 4 | 2 |
| | ***Sub-Total*** | **7** | **16** | **186** | **335** | **87** | **110** | **0** | **0** | **4** | **2** |

## Annual number of nesting turtles

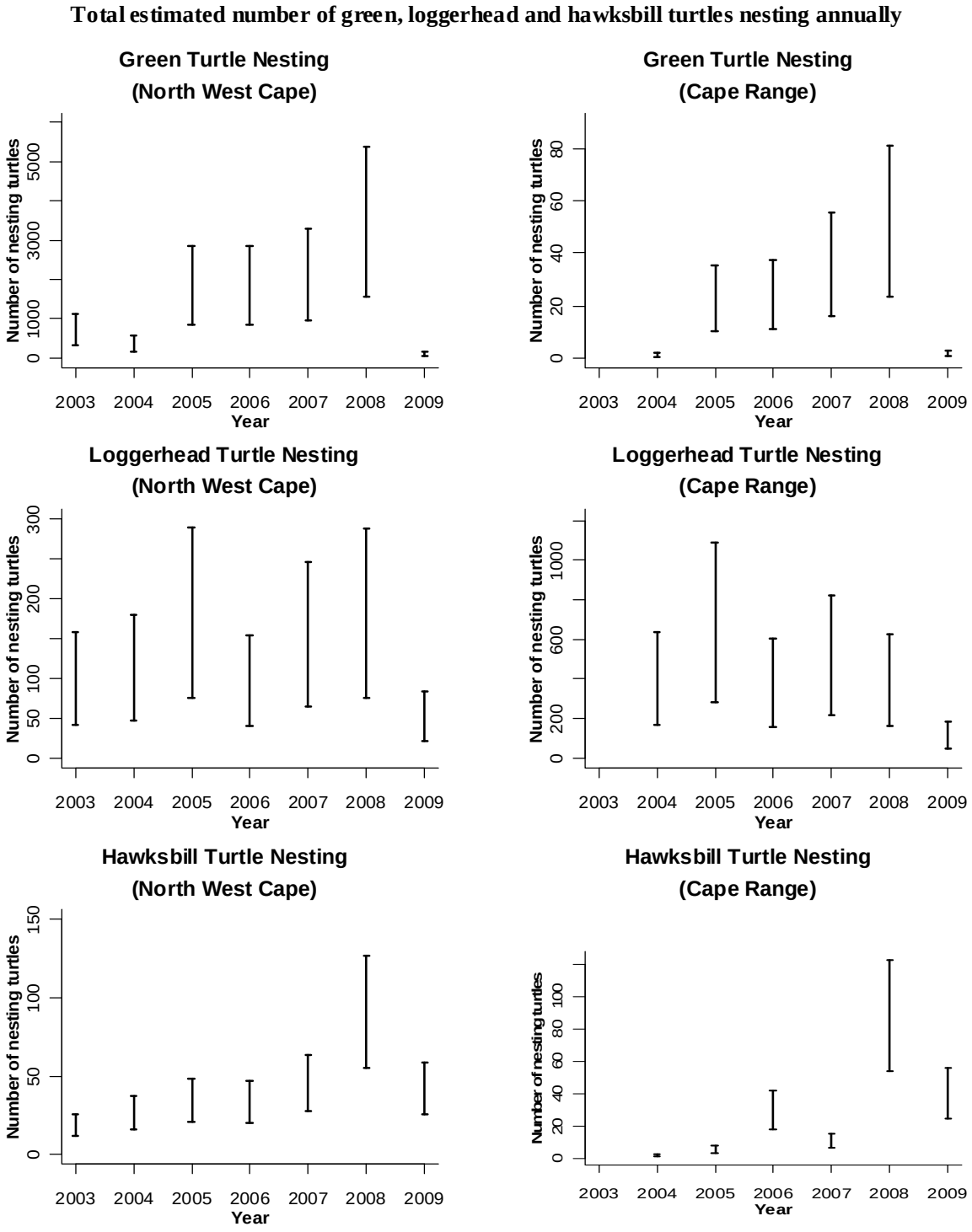



**Figure 22. Estimated annual number of turtles nesting at the North West Cape and Cape Range divisions within the Ningaloo Region.** Annual abundance data were estimated for the entire years nesting assuming the season is mostly restricted to between 15 November and 15 March. Data for 2008-09 and 2009-10 were estimated using linear regression

models and generalized additive models and the means of both methods are displayed. The range shows the minimum and maximum expected number of turtles using clutch frequencies from populations in Bool *et al.* 2009.

## Nesting success

Nesting success was similar during the 2009-10 season to the mean values from 2002-2009 (Figure 23; Table 11). Nesting success for loggerhead and unidentified turtles was lower than mean values, whereas nesting success for hawksbill and green turtles were equal to mean values from 2002-2009 seasons (Figure 23).

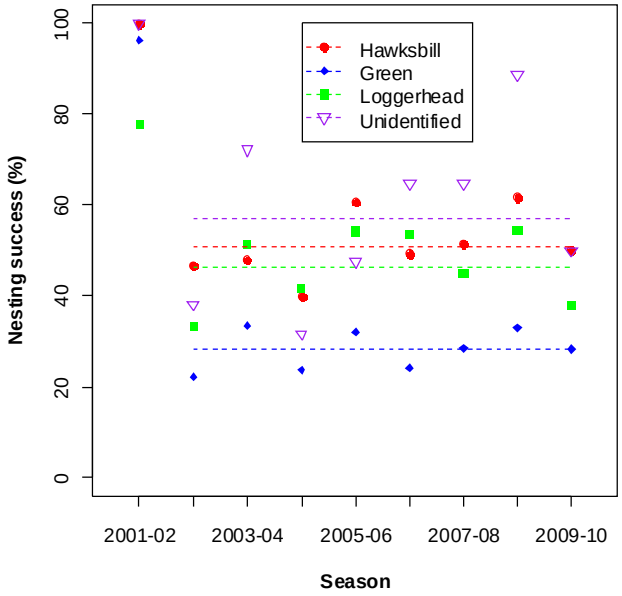



**Figure 23. Nesting success for green, loggerhead, hawksbill and unidentified turtle species for North West Cape and Cape Range divisions. Dashed lines show mean values from 2002-2009.** The 2001 year was not included when calculating the mean due to the disparity with the other data. This disparity may have been caused by survey error, as it was the first year of monitoring.

Nesting success was lowest for green turtles, with similar nesting success occurring for hawksbill, loggerhead and unidentified turtles (Figure 24).

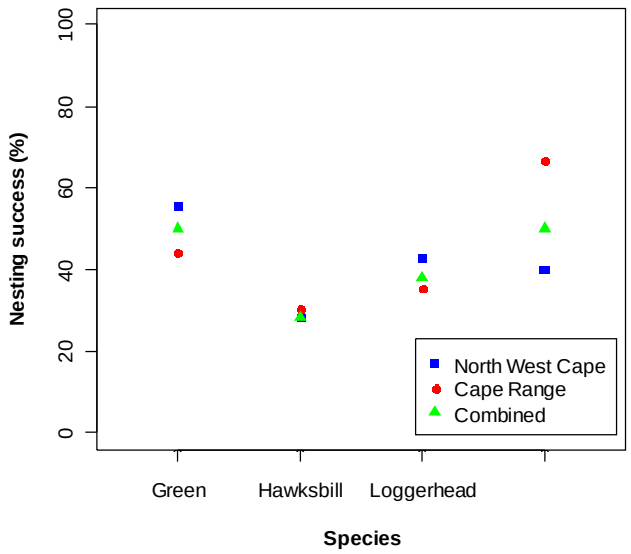



**Figure 24. Nesting success for green, loggerhead, hawksbill and unidentified turtle species within each division.**

**Table 11: Nesting success determined by visual assessment of tracks for green, loggerhead and hawksbill turtles.**

| Species | Division | Year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 2001-02 | 2002-03 | 2003-04 | 2004-05 | 2005-06 | 2006-07 | 2007-08 | 2008-09 | 2009-10 |
| Green | | | | | | | | | | |
| | North West Cape | 100.0 | 22.3 | 33.4 | 23.5 | 32.0 | 23.9 | 28.5 | 33.2 | 28.2 |
| | Cape Range | 27.3 | 9.5 | 50.0 | 34.7 | 47.0 | 31.0 | 28.5 | 41.0 | 30.4 |
| Loggerhead | | | | | | | | | | |
| | North West Cape | 100.0 | 33.3 | 51.1 | 35.5 | 46.1 | 43.2 | 42.3 | 51.6 | 42.9 |
| | Cape Range | 48.9 | 33.0 | 51.2 | 43.7 | 58.0 | 59.4 | 46.4 | 56.4 | 35.7 |
| Hawksbill | | | | | | | | | | |
| | North West Cape | 100.0 | 45.0 | 50.0 | 41.2 | 58.1 | 43.4 | 50.6 | 60.5 | 55.5 |
| | Cape Range | 66.7 | 30.0 | 31.3 | 86.7 | 63.8 | 58.1 | 63.0 | 63.0 | 44.2 |
| Unidentified | | | | | | | | | | |
| | North West Cape | 100.0 | 35.0 | 68.4 | 46.5 | 40.0 | 67.4 | 63.3 | 90.0 | 40.0 |
| | Cape Range | 100.0 | 100.0 | 81.3 | 23.4 | 54.8 | 50.0 | 75.0 | 42.9 | 66.7 |

Nesting success fluctuated within the season, but there was no apparent overall seasonal trend across the divisions for each species (Figure 25).

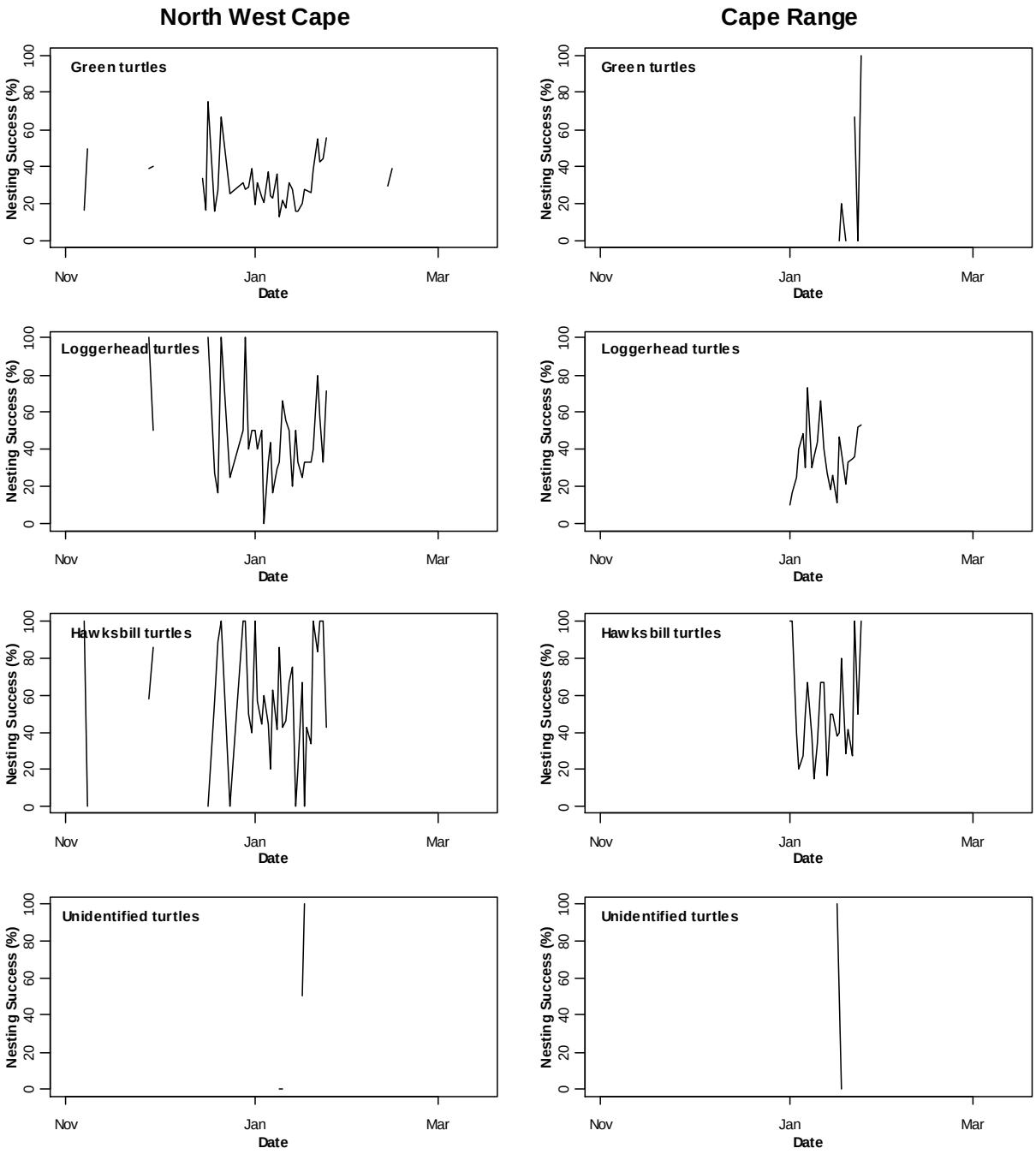



**Figure 25. Time-series plot for nesting success for green, loggerhead, hawksbill and unidentified turtles at North West Cape and Cape Range during 2009-10.**

## 7.4 Recommendations for future research

- Determine nesting success for a sample of turtles using night time surveys observing turtles. Nesting success has previously been calculated using visual assessment of the nest after the turtle left the beach, which is not a very accurate method of determining nesting success. Quantifying true nesting success will give an indication of the accuracy in assessing nesting success from morning track counts and will reduce error in converting between track counts and clutch counts.

- Centre monitoring over the peak of the nesting season by including monitoring during mid-late December. This will maximize the number of clutches encountered and reduce error in estimating the annual number of tracks and clutches laid.

- Ensure track counts outside of the intensive period are only counting the tracks from the previous night's nesting. To accurately ensure only the previous night's tracks are counted, this involves walking the length of the beach and crossing all tracks on the day prior to the census day.

# 8.0 NTP 2009-2010 SUMMARY

## 8.1 Volunteer Participation

The introduction of a financial cost associated with program participation in 2009-2010 increased the cost effectiveness of the NTP. The fee associated covered majority of the costs including accommodation, food, transport to and from monitoring and NTP social activities for the full four week period. Some additional cost were not accounted for I original setting of the program fee. The NTP 2009-2010 cost recovery assists with the financial sustainability of the program and subsequently the longevity of the program.

Since commencement of the program in 2002, volunteers have contributed **40563** hours towards the NTP. This figure alone demonstrates the importance of volunteers for the continuation and sustainability of the community program. Over the years there has been a noticeable reduction in volunteer contribution. This can be attributed to the reduction in NTP survey effort both spatially and temporally (Figure 1) and the discontinuation of the Jurabi Turtle Centre Program as an element of NTP operations from 2007-2008.

## 8.2 Survey Effort

Since the commencement of the NTP in 2002, there has been a steady reduction in the program survey area. This can be attributed to changes in stakeholder support and funding availability. In 2008, research was also undertaken to consolidate the NTP. Based on these findings (Whiting, 2008) the 2009-2010 NTP survey period was reduced to a period of intensive block monitoring during peak nesting and intermittent monitoring outside of this period during the nesting season.

The 2009-2010 NTP included both the NW Cape and Cape Range divisions only. Monitoring within the NW Cape occurred between 7 November 2009 and 27 March 2010 and included an intensive block period of monitoring between 28 December 2009 and 24 January 2010 and intermittent monitoring Outside of this period. Monitoring for Cape Range occurred between 1 January 2010 and the 24 January 2010 as an intensive block period. The 2009-2010 NTP operations did not include monitoring within both the Bundera/Ningaloo and Coral Bay divisions due to the considerable reduction the NTP survey area.

## 8.3 Nesting Abundance 2002-2010

### Objective 1: Determine the abundance of nests on specific sections of beach over specified time intervals for each species

Building on data previously collected for the NTP (2002-2010), a number of trends have been identified for turtle nesting activity within the Ningaloo region. It is important to note that full-season nesting activity NTP (2008/09-2009/10) has been estimated so the data can be compared with previous years and sites. Modelling reports have indicated there is an amount of error associated with surveys spanning a shorter time frame. For the 2009-2010 NTP, monitoring was shortened to 3½

weeks of intensive monitoring during January, lower than what is considered adequate to provide results with a reasonable level of error (Whiting, 2010), (see Section 7.0).

***Nesting Abundance***

- Nesting abundance during the 2009-2010 season was the lowest for green and loggerhead turtles since monitoring began in 2002-2003 (Figure 17, Figure 18,Figure 19,Figure 20). Nesting abundance for hawksbill turtles was recorded at a similar level to nesting during the 2003-2004 and 2007-2008 seasons (Figure 17,Figure 18,Figure 19,Figure 20). This is not however indicative of a decline in population, as marine turtle populations fluctuate considerably between years (see Broderick et al. 2001) due to the non-annual breeding behaviour of marine turtles (Miller 1997; Plotkin 2003).

- Nesting occurred throughout the monitored period (Figures Figure 14, Figure 15, Figure 16). The total track counts early in the season prior to the intensive monitoring period and late in the season after the intensive monitoring period were higher than expected (see seasonal trend and track count data in Figure 14, Figure 15). The could be due to:
    - survey methodology, where counts of tracks are not limited to the previous night's nesting;
    - the seasonal distribution in nesting during the 2009-10 season may be different to previous year's nesting

***Nesting Success***

- Nesting success was calculated using visual assessment of the nest after the turtle left the beach. This is not a very accurate method of determining nesting success. Quantifying nesting success by watching a sample of nesting turtles at night would substantially reduce error in clutch counts and total turtle estimates.
- Nesting success was similar during the 2009-2010 season to the mean values from 2002-2009 (Figure 23; Table 11). Nesting success for loggerhead and unidentified turtles was lower than mean values, whereas nesting success for hawksbill and green turtles were equal to mean values from 2002-2009 seasons (Figure 23). Nesting success was lowest for green turtles, with similar nesting success occurring for hawksbill, loggerhead and unidentified turtles (Figure 24). Nesting success fluctuated within the season, but there was no apparent overall seasonal trend across the divisions for each species (Figure 25).

***Nesting Trends***

- The apparent upward trend in nesting abundance for green turtles shown for the 2003-2008 data (Bool et al. 2009) did not continue during the 2009-10 season, indicating that this upward trend may have been due to the relatively short-term monitoring of the population.
- The upward trend in hawksbill turtle nesting is still apparent for the NW Cape division (Figure 20), although the confidence limits in predicting this trend are much broader and the scale of the trend is lower.
- Hawksbill turtle nesting within the Cape Range division still appears to show an upward trend (Figure 18), although this could as a result of either survey error or short term monitoring.

***Data Collation***

The NTP has recorded 31787 new nests and 69746 false crawls since commencement of the program (2002) within the Ningaloo Region (including all divisions). However over the years there has been a reduction in both survey area with current only the NW Cape and Cape Range divisions surveyed. For a breakdown of survey effort and turtle activity for each NTP season see Appendix 11.11

## 8.4 Nesting Locations

### Objective 2: Identify the relative significance of specific nesting beaches to each species

At the commencement of the program significant turtle nesting locations found along the Ningaloo coastline were identified. NTP data (2002-2010) indicates that the turtle nesting locations originally identified remain important within the region:

- The NW Cape division is an important rookery for the Green and Hawksbill turtles.
- The Cape Range division is the most significant mainland rookery for the Loggerhead turtle followed by Jane's Bay (Bundera/Ningaloo division) and the Coral Bay division.
- Gnaraloo Bay is also considered a significant loggerhead rookery. The Gnaraloo Bay Marine Turtle Survivorship Project has adapted the NTP monitoring procedures to collect nesting abundance and nest disturbance data. 2009-2010 data is to be provided to the NTP for comparison.
- No research was carried out during 2009-2010 NTP to identify additional significant turtle nesting locations within the Ningaloo region.

## 8.5 Nest Disturbance

### Objective 3: Establish the level of disturbance on nests

***Summary of nest disturbance 2002-2010***

Since NTP monitoring began in 2002, 2.3 percent of the total nests recorded have been recorded as disturbed within the Ningaloo region (2002-2010) (Table 15). However with the considerable reduction in survey effort over the years this figure could potentially be much higher (see Appendix 11.11).

### *The level of predation on turtle nests by the European red fox*

Foxes have been present along the beaches of the Ningaloo coastline since the 1960s and have the potential to destroy a large percentage of turtle nests each nesting season (Limpus 2002; Dean 2003; Mckinna Jones 2005). Consequently, the implementation of fox control programs has been flagged as a key management strategy under the Ningaloo Marine Park and Muiron Island Management Plan 2005-2015. This includes the controlled distribution of 1080 poison (sodium fluoroacetate) in the form of dried meat baits. The aim is to reduce the number of foxes within the area subsequently reducing the number of nests predated by foxes, and therefore increasing nest success within the area. Nest disturbance data collected by the NTP assists DEC to target fox control in areas of high nest predation.

Loss of up to 5 percent of nests to foxes and dogs/dingoes is considered sustainable to the overall production of nests (Flakus 2002). Based on such research findings and agreement between

departmental management, at the commencement of the program the Exmouth district established a threshold of 5 percent for nest predation within the Ningaloo region.

During the 2009-2010 NTP foxes/dogs were recorded as accounting for 43.5 percent of all damaged nests within NW Cape and Cape Range divisions (38.5 percent and 5.1 percent respectively). An additional 38.5 percent of damaged nests were recorded where the actual cause of predation could not be identified (predator print unknown). (Table 5: The total number of disturbed nests and cause, NTP 2009-2010. This indicates that fox predation percentage could potentially be much higher for this season.

Since monitoring began in 2002, foxes and dogs have damaged 39.9 percent of the total disturbed nests recorded within the Ningaloo region. However, fox/dog predation as a percentage of the total nests recorded (2002-2010) has remained below the 5 percent threshold (Table 6). Results also show that 1.0 percent of the total number of nests recorded within the region has been predated by foxes/dogs since monitoring began in 2002.

It is important to note however that during the 2003-2004 season fox predation along the 5 Mile Beach sub-section (NW Cape division) was at its highest during March (McKinna Jones 2005). Over the past six seasons (2004/05-2009/10) monitoring has not been carried out during March (with the exception of 2004-2005 which finished mid March and 2009-2010 which had intermittent monitoring end of March) (Table 15). This indicates that the level of predation may in fact be higher than the 5 percent for some or all of the previous seasons.

### *Ghost crabs: natural predators of marine turtle eggs*

The level of predation by ghost crabs and the impact on clutch success are not known within the Ningaloo region. Determining ghost crab predation by visual assessment of a nest alone is prone to uncertainty, as the presence of a ghost crab hole into the egg chamber does not necessarily indicate that ghost crabs depredated the nest, nor does it give an indication if predation has occurred how many eggs within a clutch were depredated. For this season crab damage to a nest was determined by: the evidence of several crab holes in the egg chamber and the presence of fresh shells and or eggs at the surface of the nest; and visually seeing a ghost crab carrying an egg to its burrow from the damaged nest. Ghost crabs are natural predators within the area and research is required to determine the dynamics of ghost crab predation and nesting turtle populations at Ningaloo over space and time.

## 8.6 Human Interaction with Nesting Turtles

### Objective 4: Determine the impact of human interaction on nesting success of each species

Since the commencement of the NTP (2002-2003), human disturbance to nests has been recorded as minimal (Table 6). This is done through volunteers recording human prints within a 5 metre radius of the nest. The data however does not necessarily indicate the level of disturbance to nesting female turtles by human interactions, because it does not include visual observation of visitor interacting with nesting turtles. The presence of people on nesting beaches are likely to cause disturbance to nesting females and hatchlings if they do not follow appropriate interaction protocols (Waayers 2003; Johnson et al. 1996; Lorne & Salmon 2007). Disturbance by humans can lead to the female

abandoning her nesting attempt (prior to the laying of eggs) and returning to the ocean, resulting in a failed nesting attempt. Further research into visual assessments of turtle-visitor interactions is required to determine the level of impact on successful nests within the Ningaloo region and subsequent impact on local turtle populations.

The development of the DEC Jurabi Turtle Centre program in 2008-2009 was supported by Woodside Energy Ltd and Mitsui Ltd (2009 to 2011) through the Community Partnerships Program. The program operates along the NW Cape and provides a supervised interaction experience with nesting female turtles using TAFE accredited turtle tour guides. Visitors have an opportunity to observe turtles nesting in their natural environment and contribute to turtle conservation within the region.

## 8.7 Turtle Rescues and Mortalities

Each season a number of the female turtles that come ashore to lay their eggs become either stranded in amongst the rocky shoreline or disorientated behind the sand dunes, finding it difficult to navigate their way back to the ocean. With such extreme temperatures occurring during the summer months female stranded turtles can quickly become dehydrated and overheat leading to death within a few hours following sunrise.

For the 2009-2010 NTP there was a significant decrease in the number of turtles stranded on land from 39 in 2008-2009 NTP to a total of 4 turtles this season (Table 7). The can be attributed to the considerable reduction in survey effort and reduction in nesting abundance. The number of deceased turtles found this season has also reduced (9 turtles) compared with 27 in the 2008-2009 NTP (Table 8). Even though only a small number of turtle mortalities are recorded in the Ningaloo region each year, on-shore deaths are not representative of the total number of mortalities as turtles are aquatic animals.

## 8.8 Additional Achievements NTP 2002-2010

- Ongoing distribution of the NTP monitoring field guide and monitoring training videos to community turtle projects worldwide.
- Continual support for marine turtle monitoring programs throughout Western Australia.
- Continual collection of nesting data to assist with the implementation of beach access and 4WD vehicle restrictions.
- Continual collection of nest distribution data to assist government agencies in future tourism development planning.
- Continual collection of nesting habitat locations to improve Oil Spill Contingency Atlas (OSRA) information and support potential oil spill response planning.
- Continual collection of nesting habitat encroachment data to assist in the removal of existing car parks within the Jurabi Coastal Park.
- The rescue of 179 stranded female turtles within the Ningaloo region (2002-2010).

In the coming years the program will continue to collect data on nesting female turtles within the Ningaloo region and continue to predict long term trends in turtle populations. This will assist management in identifying turtle population recovery targets within the region.

# 9.0 KEY PROGRAM RECOMMENDATIONS

## 9.1 Volunteer Coordination

***Volunteer Participation***

- Continue to build capacity among the local community and promote local program participation. Encourage greater local participation in the program prior to the commencement of the 2010-2011 NTP. Local volunteer involvement outside of the block monitoring period and with NTP social activities remains limited despite all efforts.
- Ensure external volunteers are provided with detailed accommodation information for the duration of the program prior to them accepting the positions. In particular, housing remoteness and distance from Exmouth Township and swimming beaches.
- Improve the level of interaction between external volunteers and local volunteers, the NTPSC and DEC staff throughout the program. Address issues associated with distances between volunteer accommodation and local community members, and location of NTP social activities.

***Occupational Health and Safety***

- Continue to improve occupational health and safety standards for volunteer accommodation.
- Continue to improve communication procedures between volunteer accommodation and NTP quarters (located in Exmouth Township).
- Consider a full manual license and senior first aid certificate as prerequisites for the external volunteer selection process. These qualifications are required for participation in Bungelup camp.

***Field Data Collection***

- Continue to ensure volunteer accuracy in track and nest identification by carrying out concurrent cross-checks of beach surveys and data collection comparison. Ensure volunteers fill in data sheets accurately, cross-check data sheets on a daily basis and maintain daily communication with volunteers regarding data recording issues. Continue to update the "Data Recording: common mistakes register" located on the DEC server.
- Improve monitoring techniques and data collection methods with all trainers and volunteers prior to the start of the monitoring. This will provide consistent methodology and accurate data collection.
- Provide additional volunteer training on species specific track identification - how to distinguish between loggerhead and hawksbill turtle tracks or green and flatback turtle tracks. To assist with this identification a "tracks tutorial" training session was held this season and was well received. Utilise Bungelup research station to expand knowledge base of loggerhead track identification.
- Encourage volunteers to use their own digital cameras to take photos of turtle tracks, deceased and stranded turtles.

***Organisation and Procedures***

- Continue to build and expand on the current email enquiry list for the NTP. It is recommended that in the years to come the professional relations between the universities and NTP staff are taken to a higher level to encourage student research projects.
- Consider past experience with the program a pre-requisite for both the Volunteer Coordinator and Team Leader positions, to assist in streamlining NTP procedures and maintaining consistency with NTP operations.
- Continue to rotate the Volunteer Coordinator and Team Leaders through both the Cape Range research camps.

***Data Management***

- Carry out intermittent checks of GPS waypoints during the season as they can be accidentally changed by volunteers.
- Reinforce the importance of accurate data entry to those entering the data: Consider a data entry roster to ensure data is entered daily, always check data accuracy and make clear, consistent instructions for data entry e.g. protocol for mistakes.
- Ensure weekly cross-checking of the data base by Volunteer Coordinator. Discontinue to cross-check data using additional Microsoft Excel spreadsheet to improve efficiency in time management for NTP staff.
- Ensure weekly cross-checking of the data base by Volunteer Coordinator.
- Discontinue to cross-check data entered in the database using a Microsoft Excel spreadsheet. This will improve efficiency in time management for the Volunteer Coordinator.

***Volunteer Education, Information and Communication***

- Encourage local participation in social activities prearranged for external volunteers.
- Continue with general turtle biology and conservation presentations to external and local volunteers.
- Organise for DEC staff to conduct a presentation on wildlife management within the area.
- Encourage local volunteers to give presentations relating to the Ningaloo region and their NTP experiences.
- Invite local Indigenous council members (Park Council) to provide information of Indigenous history in the area.
- Continue with program progress updates to all volunteers throughout the season.
- Continue with the seasonal photo competition for NTP volunteers.

## 9.2 Field Monitoring

***Survey Effort and Nesting Abundance***

- Continue to monitor turtle activity along the NW Cape and Cape Range divisions. Opportunistic monitoring should continue within the Bundera/Ningaloo and Coral Bay divisions where possible to provide ongoing data collection.
- Continue with current reductions in the NTP survey period - an intense block period of monitoring with intermittent monitoring outside of this period.
- Increase the block period to a five week period to include one week of training and four weeks intensive monitoring. This will alleviate volunteer availability and logistical issues in covering all sub-sections, while also providing a full four week period of data collection for

Bungelup (Cape Range division). Opportunistic monitoring can be incorporated into training sessions for the training week to provide additional data collection.

- Centre the block period of monitoring to cover mid December to capture the peak of nesting and alleviate trainer availability issues.
- Determine nesting success for a sample of turtles using night time surveys observing turtles. Nesting success has previously been calculated using visual assessment of the nest after the turtle left the beach, which is not a very accurate method of determining nesting success. Quantifying true nesting success will give an indication of the accuracy in assessing nesting success from morning track counts and will reduce error in converting between track counts and clutch counts.
- Ensure track counts outside of the intensive period are only counting the tracks from the previous night's nesting. I.e. turtle tracks are crossed off prior to the census day.

***Training***

- Continue to expand local trainer and assessor capacity prior to the arrival of the external volunteers. This will greatly reduce the work load of the coordinator and the other key trainers. Provide more encouragement to new local volunteers to work towards this.
- Ensure a "trainer calibration and refresher meeting" is held prior to commencement of monitoring. This will improve consistency in training information and techniques.
- Provide a glossary of training terms to volunteer induction pack. E.g. costal scales, prefrontal scales and false crawl definitions.
- Utilize training week to gain as much practical experience in track monitoring including identifying loggerhead and hawksbill tracks and night time beach-based nesting observations with qualified DEC staff.
- Ensure a minimum of two seasons experience as prerequisite to train volunteers in monitoring techniques to ensure accurate and consistent methods.
- Ensure smaller training and assessment groups where possible. Ideally, four volunteers per trainer/assessor.

## 9.3 Predation Control

- Continue with the current DEC fox control program within the four divisions - NW Cape, Cape Range, Bundera/Ningaloo and Coral Bay. This will assist in maintaining the current level of fox predation on nests within the Ningaloo region.
- Ensure fox control within Cape Range division (Bungelup section) is adequate to reduce predation levels to less than 5 percent of recorded nests.
- Determine nest predation levels during the peak period: mid February to mid March. This will allow for comparison with previous seasons and will provide a more accurate result of nest predation within the Ningaloo region.
- Further investigate the impacts of ghost predation on nesting success within the Ningaloo region.

## 9.4 Turtles Rescues

- Continue to conduct opportunistic turtle rescues when necessary.

- Prioritise areas with considerable numbers of turtle strandings and deaths recorded within previous seasons. These include “Brookes to Graveyards”, “Jacobs South to Wobiri, “5 Mile to Trisel” and “Burrows to Jurabi Point” sub-sections (NW Cape division).
- Consider listing turtle stranding rescues as a program objective.
- Incorporate ‘rescue’ observation points into the DEC operational staff works program. This will increase the likelihood of DEC staff finding stranded turtles and subsequently rescuing them outside of the block monitoring period.

## 9.5 General Recommendations

- Continue to investigate funding opportunities for the program.
- Compile a report over outlining NTP achievements, monitoring amendments, and research conducted over the past eight years and future research goals.
- Review and update the NTP overarching goals and objectives to reflect the progression of the program and changes which have occurred since the commencement of the program in 2002.
- Continue to develop the NTP to match current environmental conditions and resource demands through the Ningaloo Turtle Program Steering Committee.

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# 11.0 APPENDIX

## 11.1 NW Cape Division

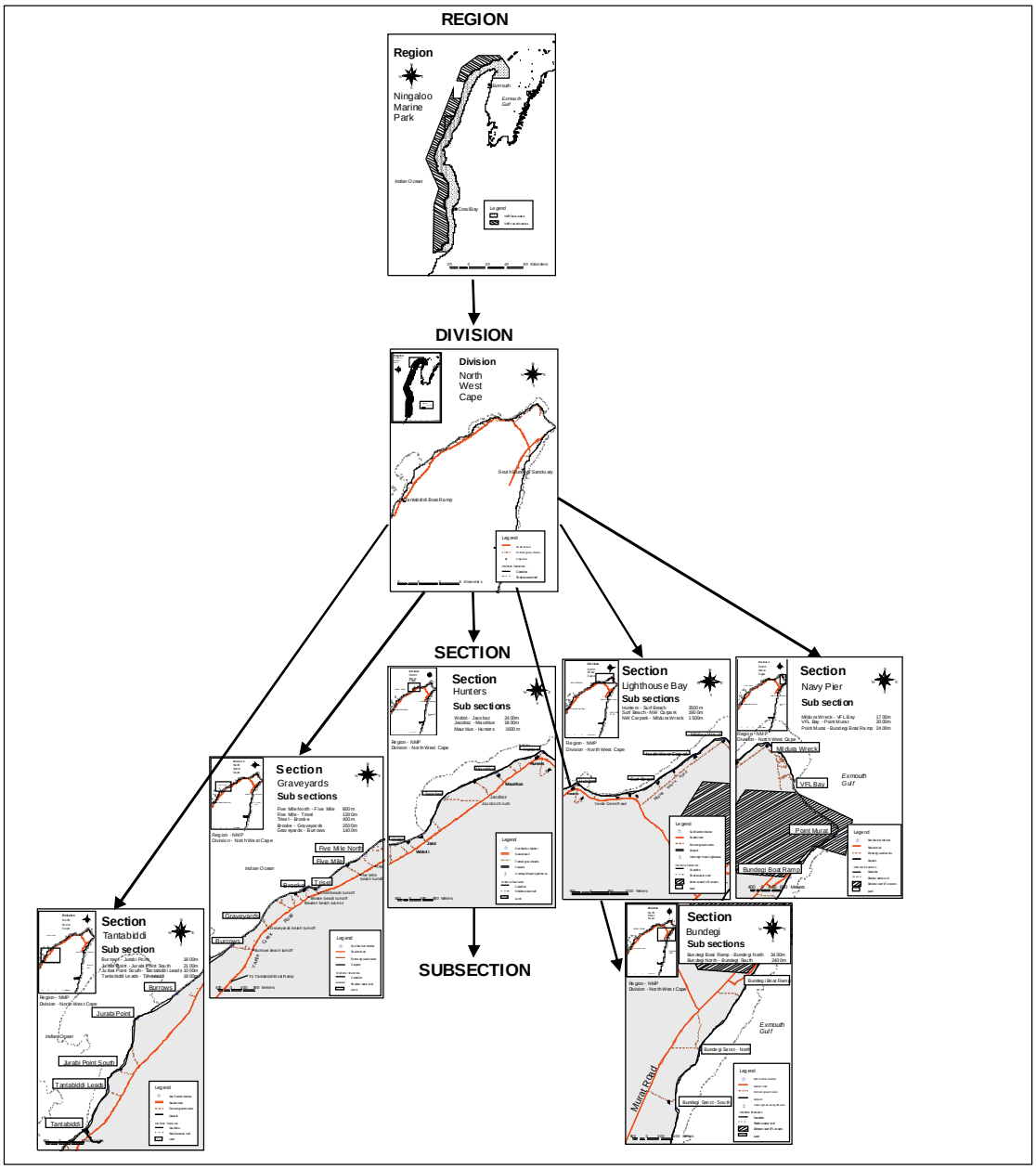


**Figure 26: Hierarchical representation of the NW Cape division.**

**Table 12: Location and distance of each sub-section within NW Cape division.**

| Sub-section | Location of northern totem | Location of southern totem | Distance (m) |
|---|---|---|---|
| **Mildura Wreck - North West car park** | 21.78568 S; 114.16518 E | 21.79174 S; 114.15402 E | 1500 |
| **North West car park - Surf Beach** | 21.79174 S; 114.15402 E | 21.81590 S; 114.13930 E | 1900 |
| **Surf Beach - Hunters** | 21.81590 S; 114.13930 E | 21.80287 S; 114.10873 E | 3500 |
| **Hunters - Mauritius** | 21.80287 S; 114.10873 E | 21.80938 S; 114.09532 E | 1600 |
| **Mauritius - Jacobsz South** | 21.80938 S; 114.09532 E | 21.81638 S; 114.07927 E | 1800 |
| **Jacobsz South - Wobiri** | 21.81638 S; 114.07927 E | 21.83038 S; 114.06505 E | 2400 |
| **Five Mile North - Five Mile** | 21.83485 S; 114.05431 E | 21.83928 S; 114.04766 E | 800 |
| **Five Mile - Trisel** | 21.83928 S; 114.04766 E | 21.84658 S; 114.03836 E | 1300 |
| **Brooke - Graveyards** | 21.84733 S; 114.03389 E | 21.85660 S; 114.02085 E | 2000 |
| **Graveyards - Burrows** | 21.85660 S; 114.02085 E | 21.86595 S; 114.01052 E | 1400 |
| **Burrows - Jurabi Point** | 21.86595 S; 114.01052 E | 21.87348 S; 113.99803 E | 1800 |

## 11.2 Cape Range Division

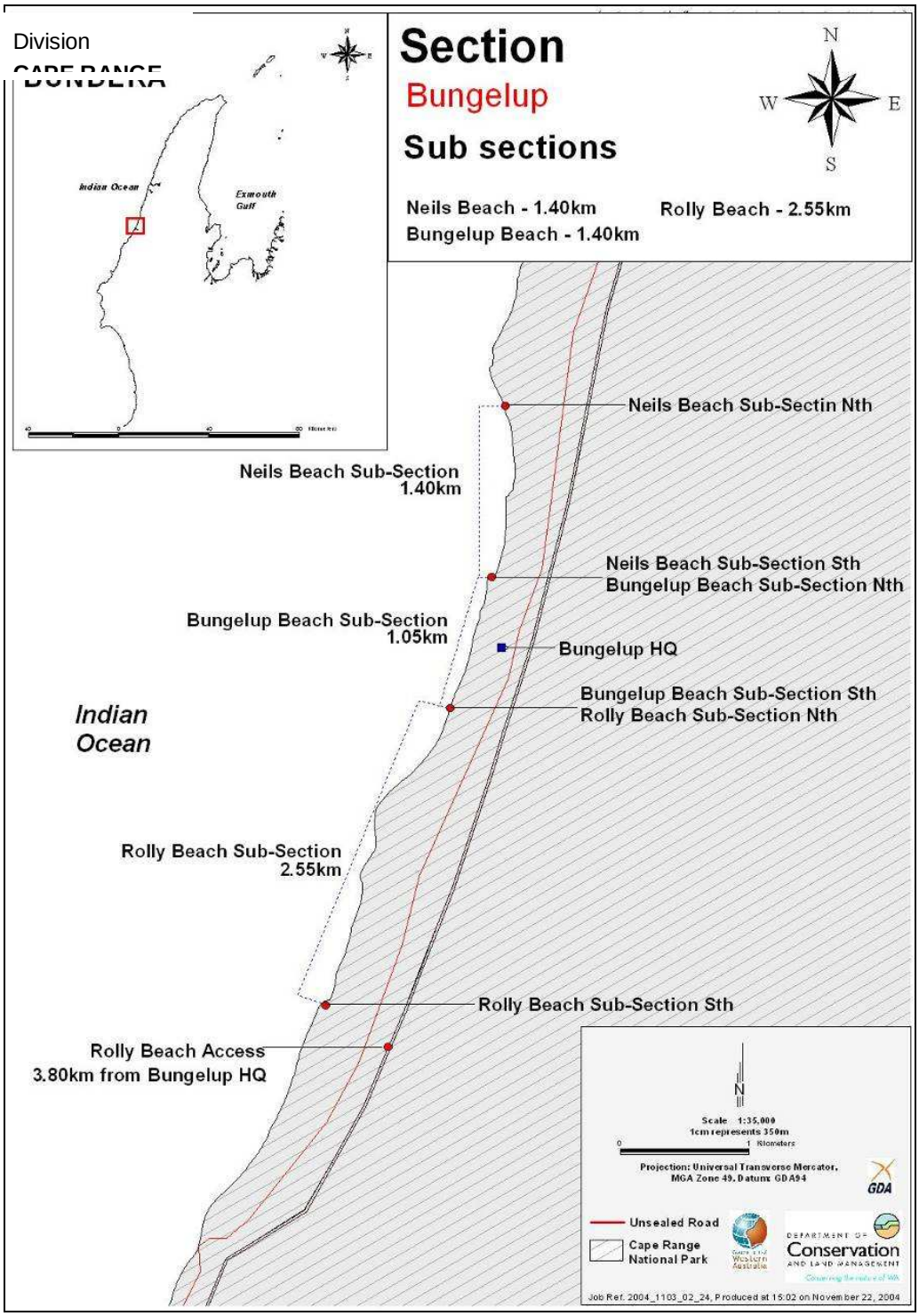


**Figure 27: Location of sub-sections within Bungelup section (Cape Range division).**

**Table 13: Location and distance of each sub-section within Cape Range division.**

| Sub-section | Location of northern totem | Location of southern totem | Distance (m) |
|---|---|---|---|
| **Neils North - Bungelup North** | 22.26489 S; 113.83277 E | 22.27674 S; 113.83231 E | 1400 |
| **Bungelup North - Bungelup South** | 22.27674 S; 113.83231 E | 22.28613 S; 113.8292 E | 1400 |
| **Bungelup South - Rolly's** | 22.28613 S; 113.8292 E | 22.30650 S; 113.82062 E | 2550 |

## 11.3 Coral Bay Division

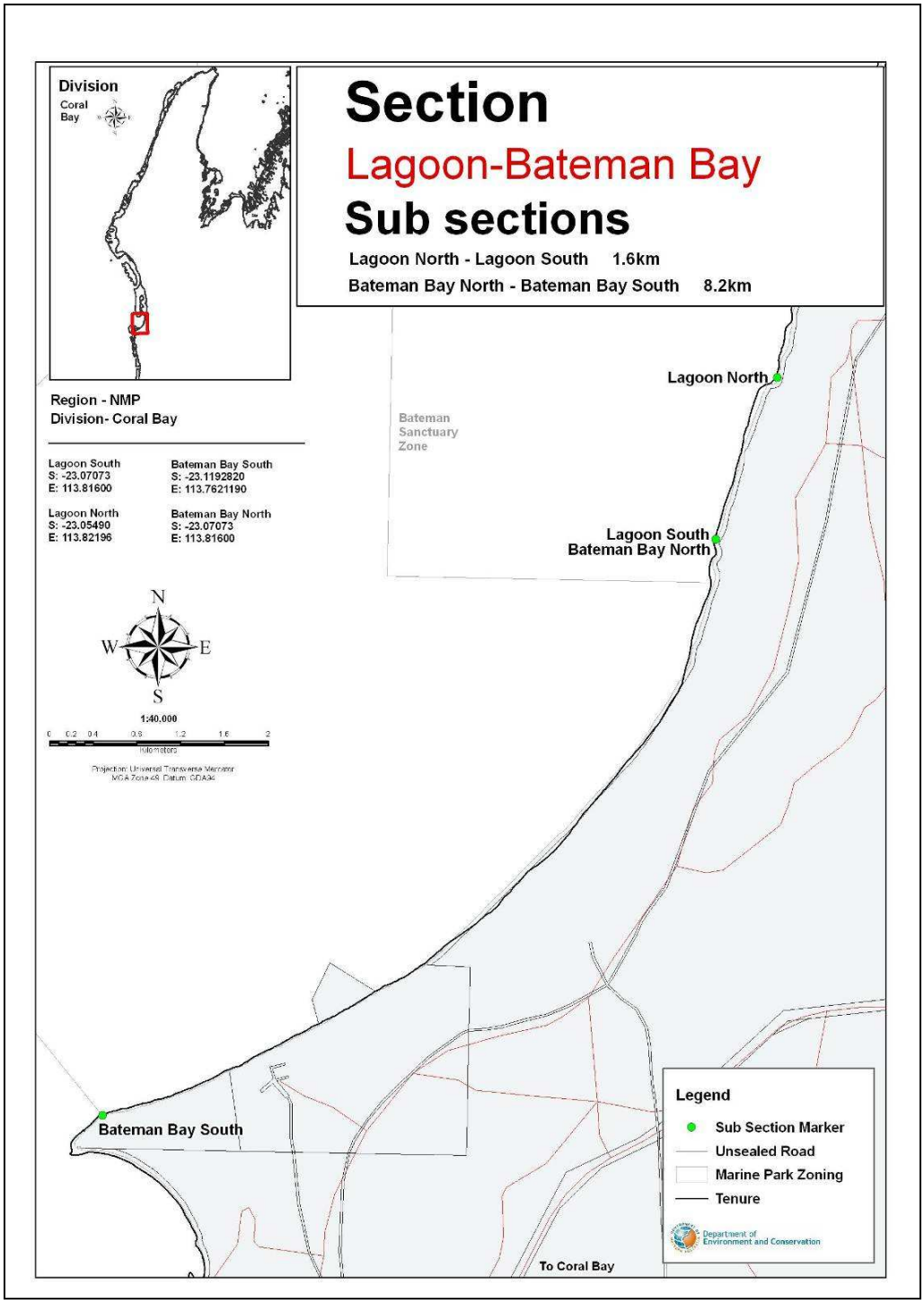


**Figure 28: Location of sub-section within the Lagoon-Bateman Bay section (Coral Bay division), (Lagoon South - Lagoon North; Batemans South – Batemans North).**

**Table 14: Location and distance of each sub-section within the Coral Bay division.**

| Sub-section | Location of northern totem | Location of southern totem | Distance (m) |
|---|---|---|---|
| **Batemans South - Batemans North** | 23.07073 S; 113.81600 E | 23.11928 S; 113.76211 E | 8200 |
| **Batemans North – Lagoon North** | 23.05490 S; 113.82196 E | 23.07073 S; 113.81600 E | 1500 |

## 11.4 NTP Data Sheet

***Ningaloo Community TURTLE MONITORING PROGRAM DATASHEET*** ***Daily Report*** ***Page…..of……***

Starting

Date: Sub/Section:

Finishing

Recorder: Sub/Section:

Start Time Finish Time:

GPS No Camera No/s:

**TABLE A: FALSE CRAWLS / NON-NESTING EMERGENCES TALLY**

| | Green | Loggerhead | Hawksbill | Unknown | Fox/Dog Prints (Y/N) |
|---|---|---|---|---|---|
| | | | | | **F** **D** |
| Total | | | | | |

**TABLE B: NESTS**

| Species Type G/L/H/U | ~GPS Position (Datum WGS84) latitude (S) | longitude (E) | New (N) / Old* (O) | Pos. of Nest | Is Nest Damaged? Y/ N / U | Any Prints? D/ F/ G/ H | Photo Frame No. | Any Other Observations? |
|---|---|---|---|---|---|---|---|---|
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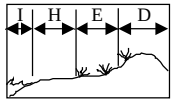



**Comments:**

## 11.5 “Marine Turtle Stranding and Mortality Datasheet”

# MARINE TURTLE STRANDING AND MORTALITY DATASHEET – Pilbara Region

Please record the following information for all sick, injured or dead marine turtles and send it to the nearest Department of Environment and Conservation office (see overleaf for addresses).

**DATE: _____(DD/MM/YYYY)** **TIME: _____ (24 hour)**

**LOCATION: _____**

**Latitude: _____º_____S**

**Longitude: _____º_____E**

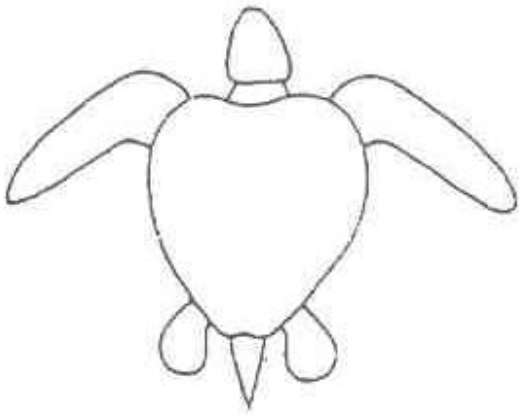
**STATUS:** ☐ Alive **Condition/Behaviour: _____**

☐ Dead **The following coding can be used to code beach washed carcasses:**

☐ Live but subsequently died
☐ Carcass in good condition (fresh/edible)
☐ Carcass fair (decomposed but organs intact)
☐ Carcass poor (advanced decomposition)
☐ Mummified carcass (skin holding bones)
☐ Disarticulated bones (no soft tissue remaining)

**SPECIES (see key overleaf):**
☐ Green
☐ Loggerhead
☐ Flatback
☐ Hawksbill
☐ Olive Ridley
☐ Leatherback
☐ Unknown

**DISTINGUISHING FEATURES: (please also indicate on diagram)**
☐ Obvious damage/injuries
☐ Missing limbs
☐ Barnacles
☐ Algal growth on carapace
☐ Tagging scars



**TAG NUMBERS: Left flipper _____**

**Right flipper _____**

**MEASUREMENTS:**

| | | | |
|---|---|---|---|
| **Curved Carapace Length:** | _____ mm | ☐ Measured | ☐ Estimated |
| **Curved Carapace Width:** | _____ mm | ☐ Measured | ☐ Estimated |
| **Tail Length (from Carapace):** | _____ mm | ☐ Measured | ☐ Estimated |
| **Maximum Head Width:** | _____ mm | ☐ Measured | ☐ Estimated |

**SEX:** ☐ Male ☐ Female ☐ Unknown

**MATURITY:** ☐ Juvenile ☐ Adult ☐ Unknown

**PHOTOGRAPHS* (see overleaf): _____**

**SECURITY/DISPOSAL/RELEASE of turtle: _____**

**NOTES: _____**

_____

**CONTACT DETAILS:**

Name: _____ Phone number: _____

Address: _____ Email:_____

*** PHOTOGRAPHS are extremely important as an aid to identification.**

Please take the following photographs if possible:

1. A full-frame photo of the carapace (shell) taken from one side, clearly showing the costal scale pattern;

2. A close-up of the head from in front and above, clearly showing the prefrontal scale pattern (between nostrils and eyes;

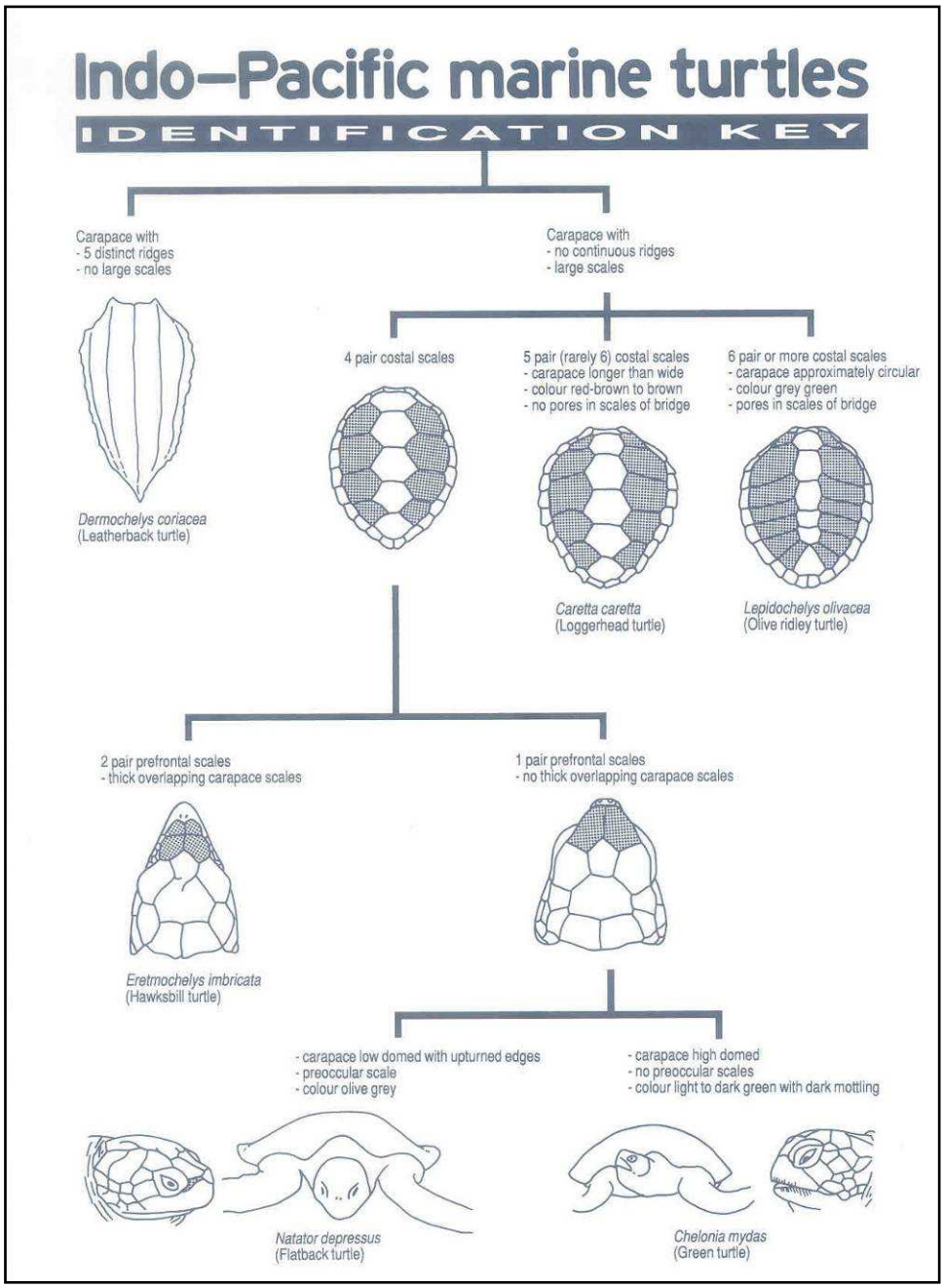
3. Any injuries, possible causes of death (ropes, nets etc).

**PILBARA REGIONAL OFFICES FOR DEC:**

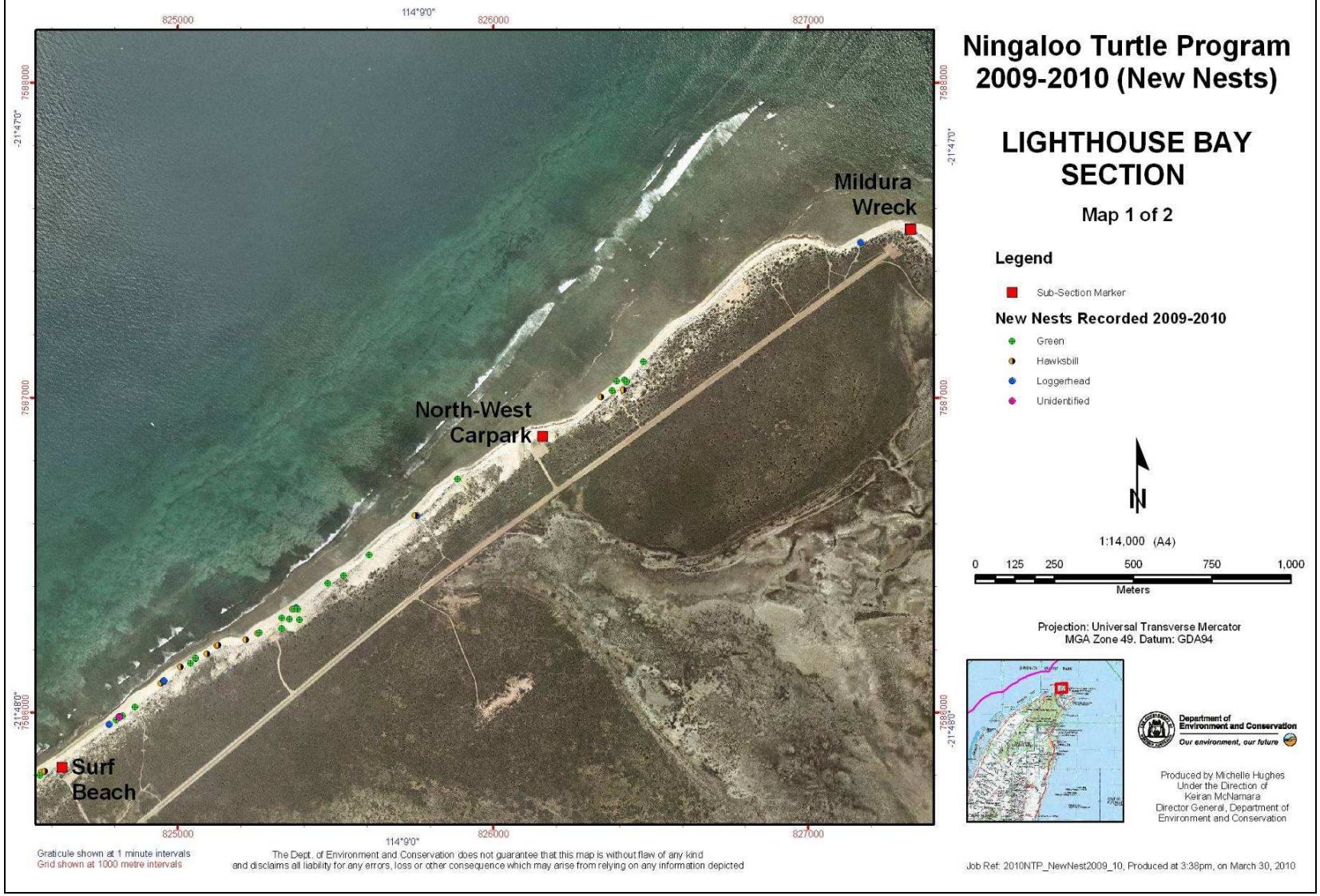
**KARRATHA**

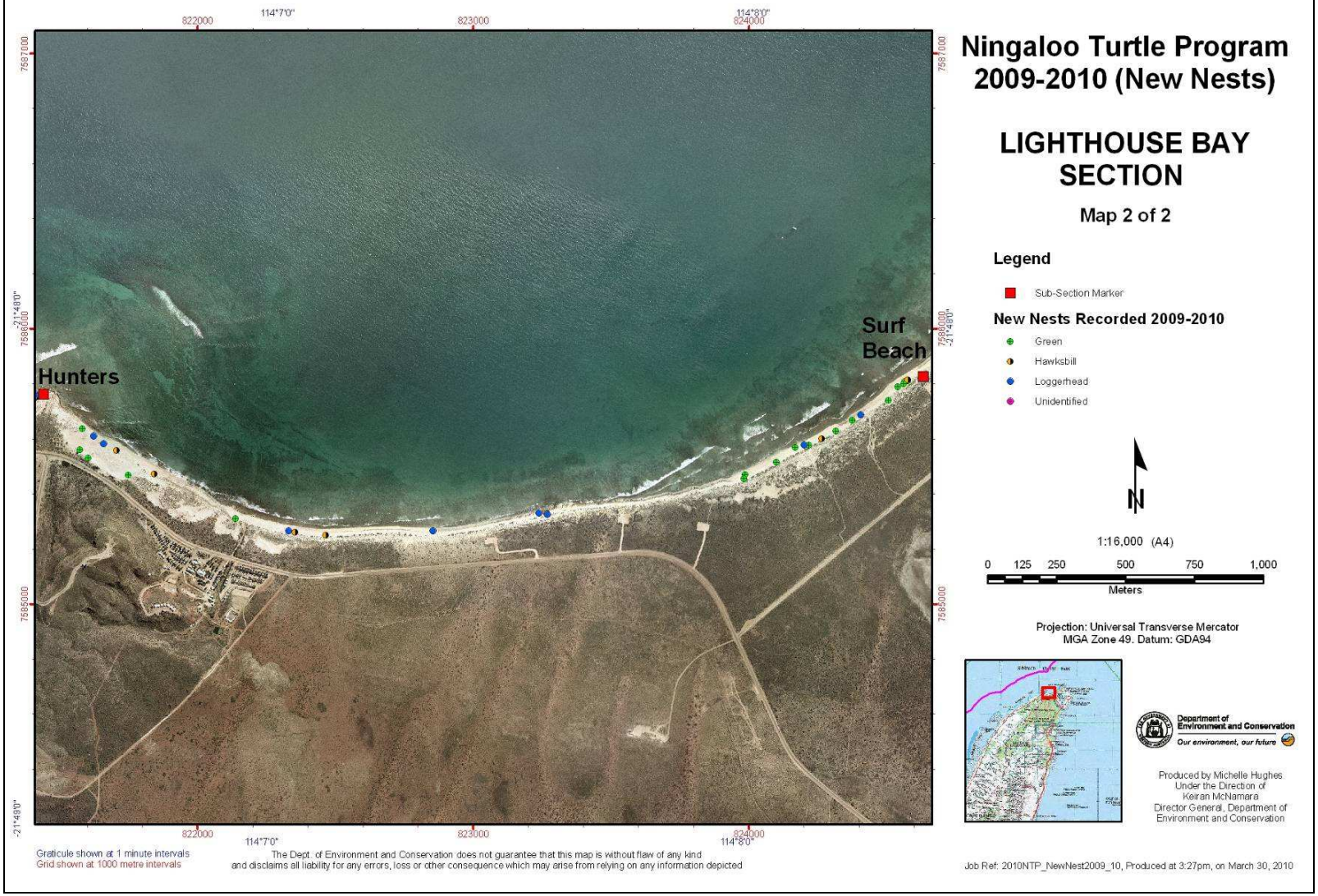
Lot 3 Mardie/Anderson Road (PO Box 835)
Karratha WA 6714
Phone: (08) 9182 2000 Fax: (08) 9144 1118

**EXMOUTH**
20 Nimitz Street (PO Box 201)
Exmouth WA 6707
Phone: (08) 9947 8000 Fax: (08) 9947 8050



## 11.6 Lighthouse Bay Section: Location of New Nests (NTP 2009-2010) Map 1 & 2


114°9'0"
825000
826000
827000
7588000
7587000
7586000
-21°4'70"
-21°4'80"
Mildura Wreck
North-West Carpark
Surf Beach
Graticule shown at 1 minute intervals
Grid shown at 1000 metre intervals
The Dept. of Environment and Conservation does not guarantee that this map is without flaw of any kind and disclaims all liability for any errors, loss or other consequence which may arise from relying on any information depicted
Ningaloo Turtle Program 2009-2010 (New Nests)
LIGHTHOUSE BAY SECTION
Map 1 of 2
Legend
Sub-Section Marker
New Nests Recorded 2009-2010
Green
Hawksbill
Loggerhead
Unidentified
N
1:14,000 (A4)
0 125 250 500 750 1,000
Meters
Projection: Universal Transverse Mercator
MGA Zone 49. Datum: GDA94
Department of Environment and Conservation
Our environment, our future
Produced by Michelle Hughes
Under the Direction of
Keiran McNamara
Director General, Department of Environment and Conservation
Job Ref: 2010NTP_NewNest2009_10, Produced at 3:38pm, on March 30, 2010


Ningaloo Turtle Program
2009-2010 (New Nests)
LIGHTHOUSE BAY
SECTION
Map 2 of 2
Legend
Sub-Section Marker
New Nests Recorded 2009-2010
Green
Hawksbill
Loggerhead
Unidentified
Hunters
Surf
Beach
N
1:16,000 (A4)
0 125 250 500 750 1,000
Meters
Projection: Universal Transverse Mercator
MGA Zone 49. Datum: GDA94
Department of
Environment and Conservation
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Under the Direction of
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Director General, Department of
Environment and Conservation
Graticule shown at 1 minute intervals
Grid shown at 1000 metre intervals
The Dept. of Environment and Conservation does not guarantee that this map is without flaw of any kind
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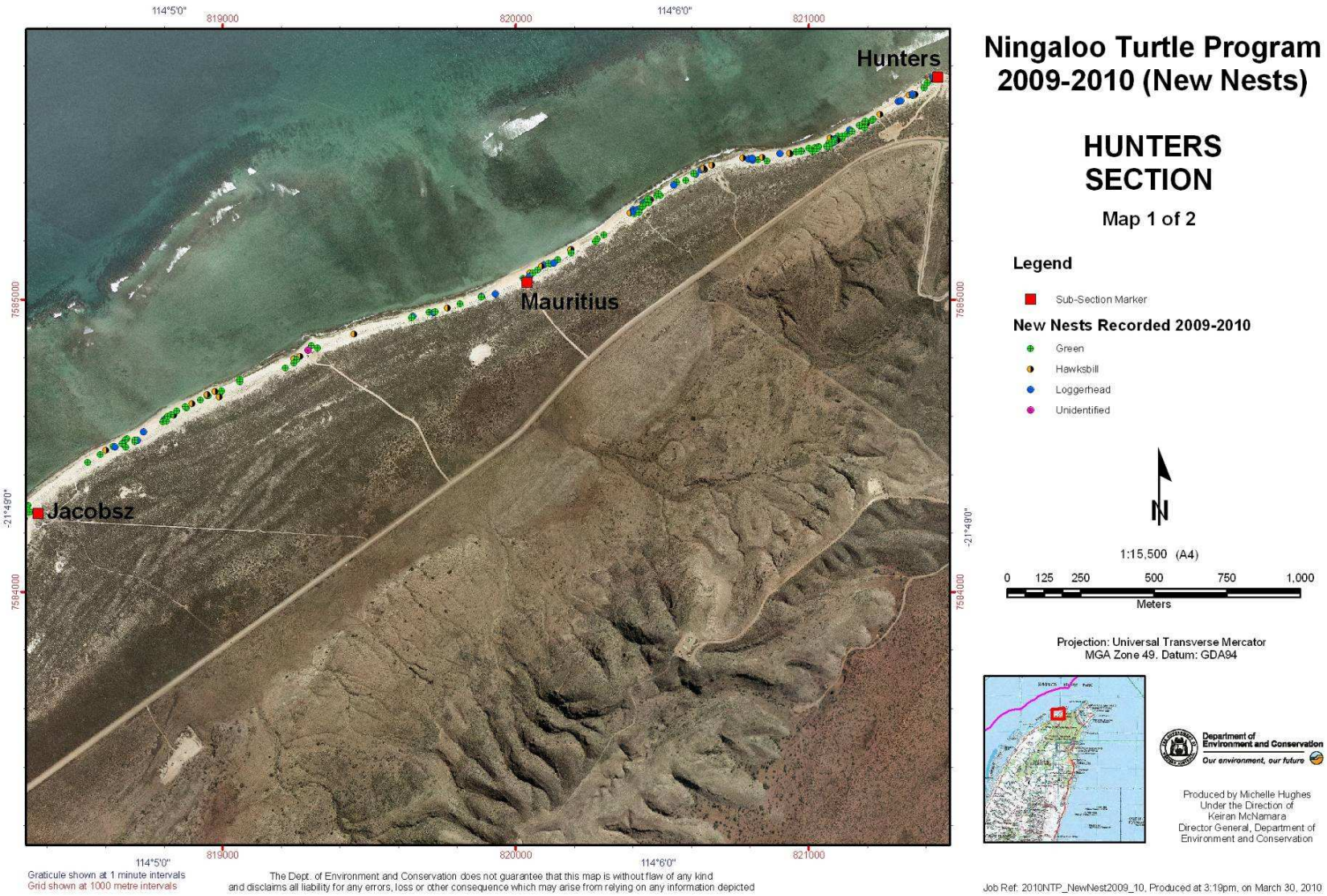
Job Ref: 2010NTP_NewNest2009_10, Produced at 3:27pm, on March 30, 2010

## 11.7 Hunters Section: Location of New Nests (NTP 2009-2010) Map 1 & 2


114°5'0"
819000
820000
114°6'0"
821000
7585000
7584000
-21°49'0"
Hunters
Mauritius
Jacobsz
Ningaloo Turtle Program
2009-2010 (New Nests)
HUNTERS
SECTION
Map 1 of 2
Legend
Sub-Section Marker
New Nests Recorded 2009-2010
Green
Hawksbill
Loggerhead
Unidentified
N
1:15,500 (A4)
0 125 250 500 750 1,000
Meters
Projection: Universal Transverse Mercator
MGA Zone 49. Datum: GDA94
Department of Environment and Conservation
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Under the Direction of
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Director General, Department of
Environment and Conservation
Graticule shown at 1 minute intervals
Grid shown at 1000 metre intervals
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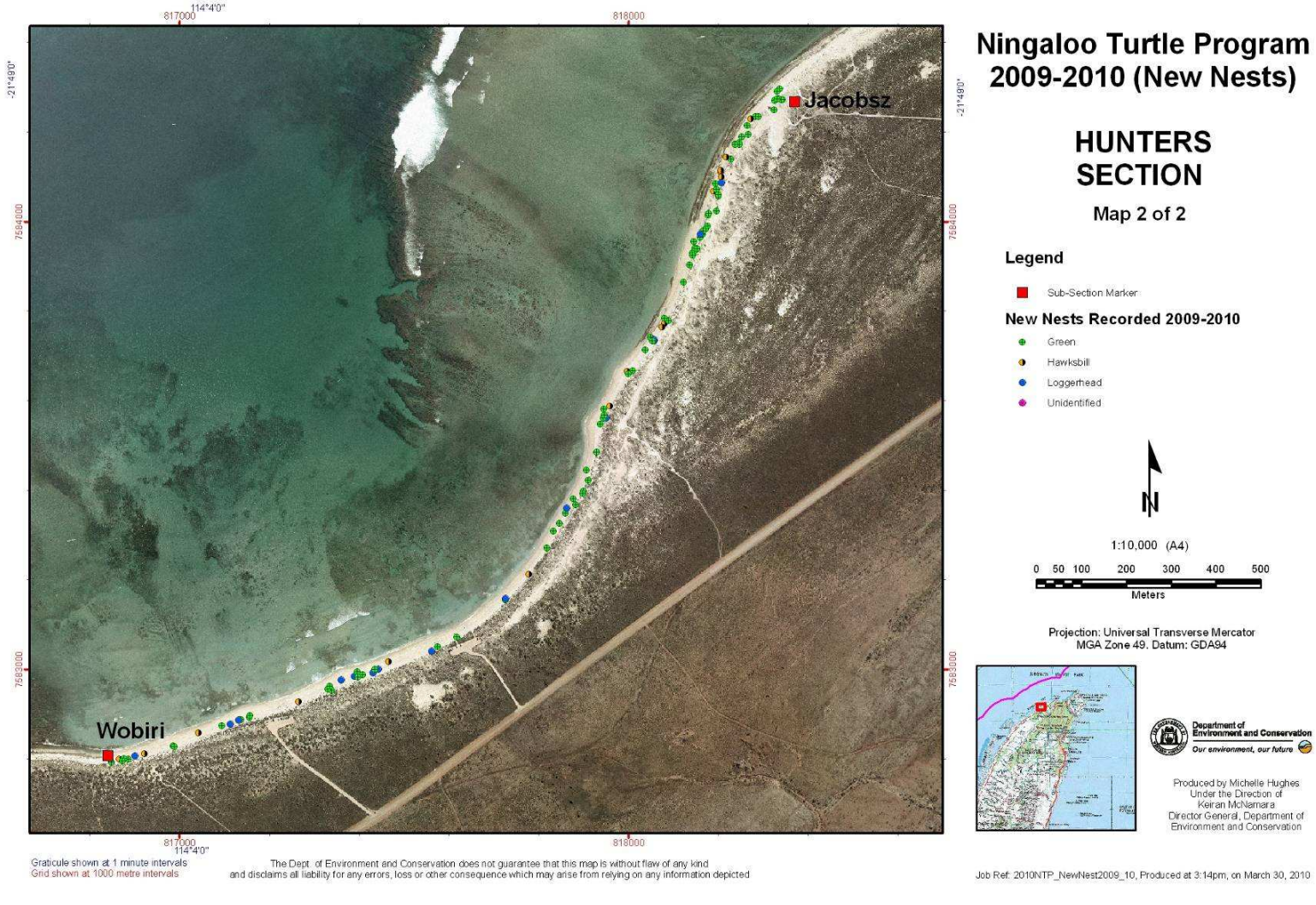
Job Ref: 2010NTP_NewNest2009_10, Produced at 3:19pm, on March 30, 2010


Ningaloo Turtle Program
2009-2010 (New Nests)
HUNTERS
SECTION
Map 2 of 2
Legend
Sub-Section Marker
New Nests Recorded 2009-2010
Green
Hawksbill
Loggerhead
Unidentified
Jacobsz
Wobiri
N
1:10,000 (A4)
0 50 100 200 300 400 500
Meters
Projection: Universal Transverse Mercator
MGA Zone 49. Datum: GDA94
Department of Environment and Conservation
Our environment, our future
Produced by Michelle Hughes
Under the Direction of
Keiran McNamara
Director General, Department of
Environment and Conservation
114°4'0"
817000
818000
-21°4'0"
7684000
7680000
Graticule shown at 1 minute intervals
Grid shown at 1000 metre intervals
The Dept. of Environment and Conservation does not guarantee that this map is without flaw of any kind
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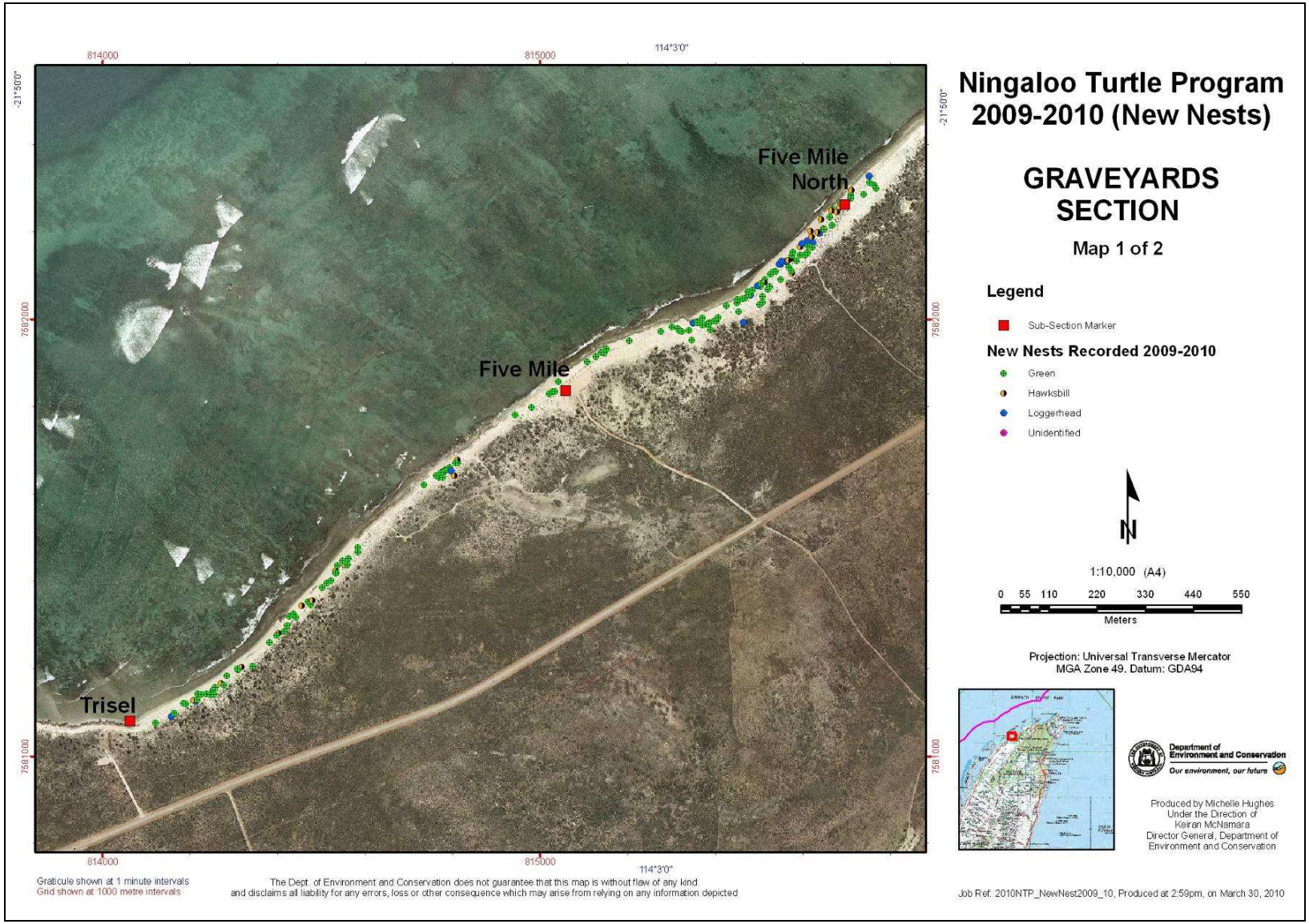
Job Ref: 2010NTP_NewNest2009_10, Produced at 3:14pm, on March 30, 2010

## 11.8 Graveyards Section: Location of New Nests (NTP 2009-2010) Map 1 & 2


814000
815000
114°3'0"
-21°50'0"
7582000
7581000
Five Mile North
Five Mile
Trisel
Ningaloo Turtle Program
2009-2010 (New Nests)
GRAVEYARDS
SECTION
Map 1 of 2
Legend
Sub-Section Marker
New Nests Recorded 2009-2010
Green
Hawksbill
Loggerhead
Unidentified
N
1:10,000 (A4)
0 55 110 220 330 440 550
Meters
Projection: Universal Transverse Mercator
MGA Zone 49. Datum: GDA94
Department of
Environment and Conservation
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Graticule shown at 1 minute intervals
Grid shown at 1000 metre intervals
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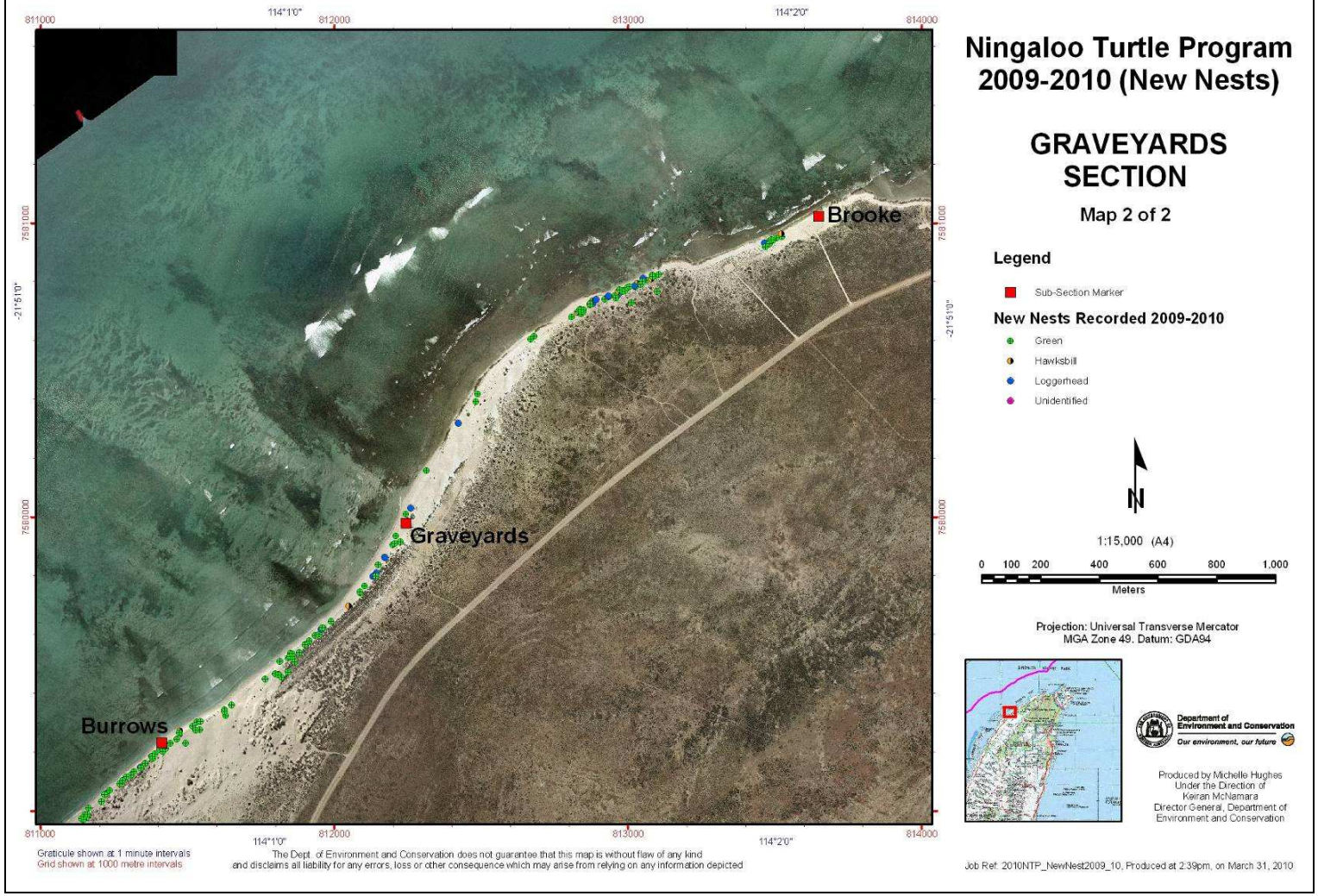
Job Ref: 2010NTP_NewNest2009_10, Produced at 2:59pm, on March 30, 2010


811000
114°1'0"
812000
813000
114°2'0"
814000
7581000
7580000
-21°5'10"
Brooke
Graveyards
Burrows
Graticule shown at 1 minute intervals
Grid shown at 1000 metre intervals
The Dept of Environment and Conservation does not guarantee that this map is without flaw of any kind and disclaims all liability for any errors, loss or other consequence which may arise from relying on any information depicted
Ningaloo Turtle Program 2009-2010 (New Nests)
GRAVEYARDS SECTION
Map 2 of 2
Legend
Sub-Section Marker
New Nests Recorded 2009-2010
Green
Hawksbill
Loggerhead
Unidentified
N
1:15,000 (A4)
0 100 200 400 600 800 1,000
Meters
Projection: Universal Transverse Mercator
MGA Zone 49. Datum: GDA94
Department of Environment and Conservation
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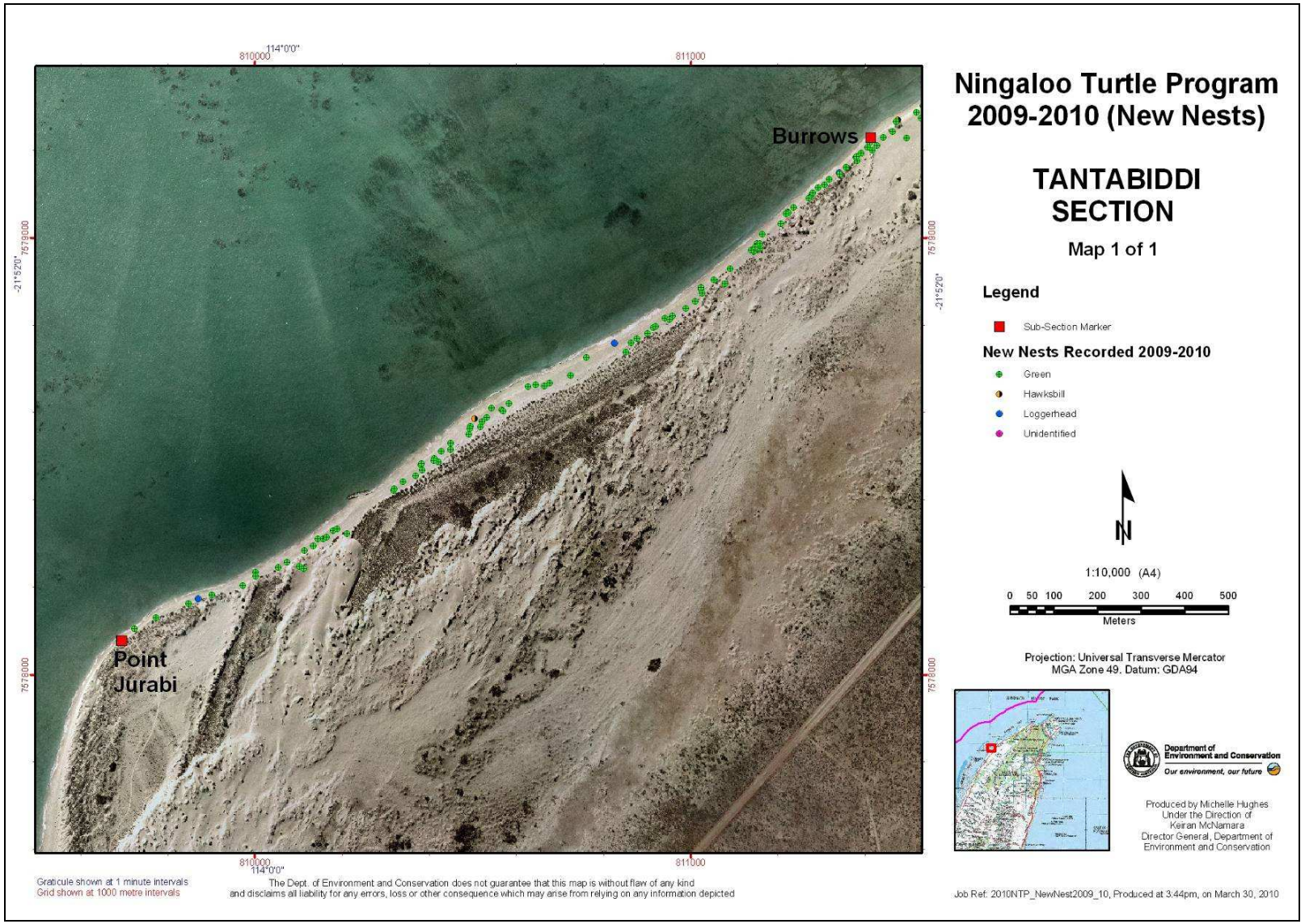
Job Ref: 2010NTP_NewNest2009_10, Produced at 2:39pm, on March 31, 2010

## 11.9 Tantabiddi Section: Location of New Nests (NTP 2009-2010) Map 1


114°0'0"
810000
811000
Burrows
Point
Jurabi
7579000
7578000
-21°5'20"
Graticule shown at 1 minute intervals
Grid shown at 1000 metre intervals
The Dept. of Environment and Conservation does not guarantee that this map is without flaw of any kind
and disclaims all liability for any errors, loss or other consequence which may arise from relying on any information depicted
Ningaloo Turtle Program
2009-2010 (New Nests)
TANTABIDDI
SECTION
Map 1 of 1
Legend
Sub-Section Marker
New Nests Recorded 2009-2010
Green
Hawksbill
Loggerhead
Unidentified
N
1:10,000 (A4)
0 50 100 200 300 400 500
Meters
Projection: Universal Transverse Mercator
MGA Zone 49. Datum: GDA94
Department of
Environment and Conservation
Our environment, our future
Produced by Michelle Hughes
Under the Direction of
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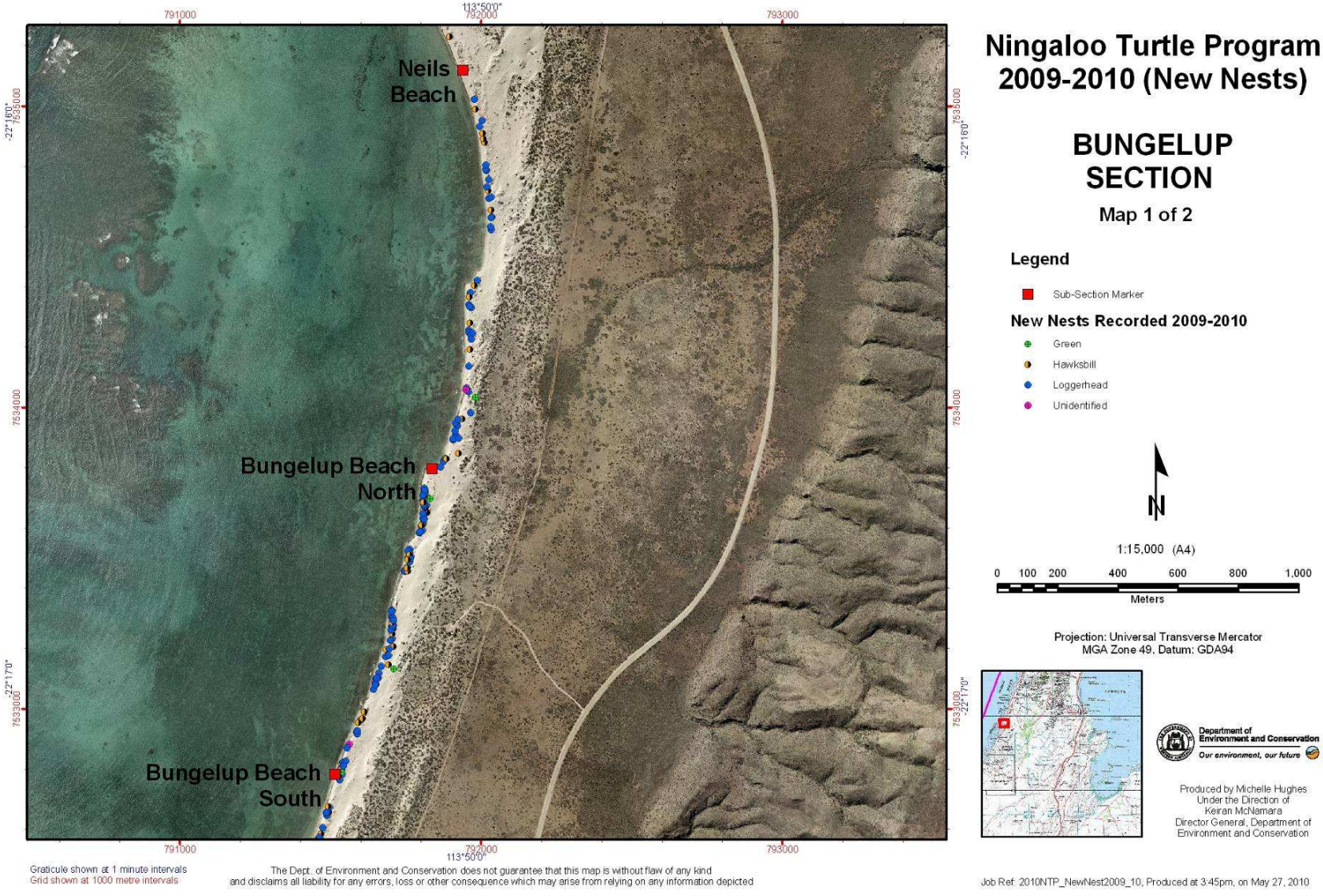
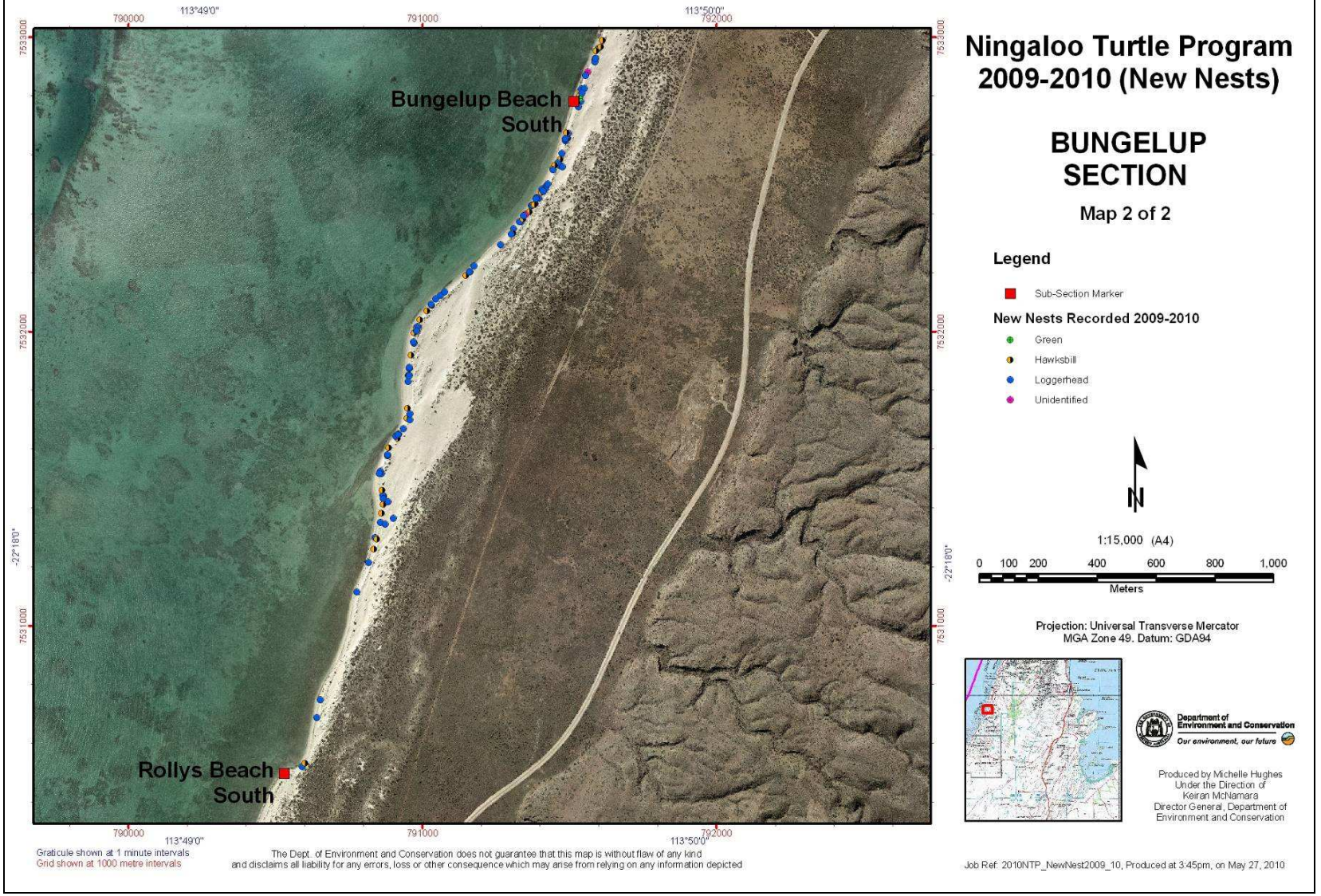
Environment and Conservation
Job Ref: 2010NTP_NewNest2009_10, Produced at 3:44pm, on March 30, 2010

## 11.10 Bungelup Section: Location of New Nests (NTP 2009-2010) Map 1 & 2


Neils Beach
Bungelup Beach North
Bungelup Beach South
791000
792000
793000
113°50'0"
-22°16'0"
-22°17'0"
7535000
7534000
7533000
Graticule shown at 1 minute intervals
Grid shown at 1000 metre intervals
The Dept. of Environment and Conservation does not guarantee that this map is without flaw of any kind and disclaims all liability for any errors, loss or other consequence which may arise from relying on any information depicted
Ningaloo Turtle Program 2009-2010 (New Nests)
BUNGELUP SECTION
Map 1 of 2
Legend
Sub-Section Marker
New Nests Recorded 2009-2010
Green
Hawksbill
Loggerhead
Unidentified
N
1:15,000 (A4)
0 100 200 400 600 800 1,000
Meters
Projection: Universal Transverse Mercator
MGA Zone 49. Datum: GDA94
Department of Environment and Conservation
Our environment, our future
Produced by Michelle Hughes
Under the Direction of
Keiran McNamara
Director General, Department of Environment and Conservation
Job Ref: 2010NTP_NewNest2009_10, Produced at 3:45pm, on May 27, 2010


Ningaloo Turtle Program
2009-2010 (New Nests)
BUNGELUP
SECTION
Map 2 of 2
Legend
Sub-Section Marker
New Nests Recorded 2009-2010
Green
Hawksbill
Loggerhead
Unidentified
Bungelup Beach South
Rollys Beach South
N
1:15,000 (A4)
0 100 200 400 600 800 1,000
Meters
Projection: Universal Transverse Mercator
MGA Zone 49. Datum: GDA94
Department of Environment and Conservation
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Produced by Michelle Hughes
Under the Direction of
Keiran McNamara
Director General, Department of
Environment and Conservation
Graticule shown at 1 minute intervals
Grid shown at 1000 metre intervals
The Dept. of Environment and Conservation does not guarantee that this map is without flaw of any kind
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Job Ref: 2010NTP_NewNest2009_10, Produced at 3:45pm, on May 27, 2010

## 11.11 NTP Survey Effort and Turtle Activity 2002-2010

**Table 15: NTP survey effort (divisions, sections and sub-sections) and turtle activity, 2002-2010.**

| NTP Season | | 2002-2003 | 2003-2004 | 2004-2005 | 2005-2006 | 2006-2007 | 2007-2008 | 2008-2009 | 2009-2010 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| Survey Date | | 18/11/2002 - 16/04/2003 | 11/11/2003 -30/03/2004 | 03/11/2004 -18/03/2005 | 21/11/2005 -28/02/2006 | 01/12/2006 -28/02/2007 | 01/12/2007 -- 28/02/2008 | 07/12/2008 -01/03/2009 | 07/11/2009 -27/03/2010 | |
| **Divsion** | **Section** | | | | | | | | | |
| **North West Cape** | Unknown | | | | | | | 1 | | **1** |
| | Graveyards | 165 | 376 | 374 | 368 | 341 | 336 | 234 | 160 | **2354** |
| | Hunters | 248 | 263 | 271 | 271 | 256 | 252 | 173 | 117 | **1851** |
| | Lighthouse Bay | 127 | 137 | 215 | 260 | 222 | 251 | 147 | 83 | **1442** |
| | Navy Pier | 1 | 86 | | | | | | | **87** |
| | Tandabiddi | 115 | 3 | | 85 | 86 | 84 | 58 | 38 | **469** |
| **Cape Range** | Bloodwood | | 4 | | | | | | | **4** |
| | Bungelup | | | | | | | 124 | 72 | **196** |
| | Turquiose Bay | | 16 | | | | | | | **16** |
| **Bundera/Ningaloo** | Boat Harbour | | | 203 | | | | | | **203** |
| | Bungelup | 1 | 49 | 152 | 114 | 120 | 140 | | | **576** |
| | Carbaddaman | 7 | | 204 | | | | | | **211** |
| | Janes Bay | 13 | 24 | 12 | 29 | 22 | 5 | | | **105** |
| | Norwegian Bay | 2 | 1 | | | | | | | **3** |
| | Whaleback Beach | | 7 | 8 | | | | | | **15** |
| **Coral Bay** | Batemans Bay | 103 | 100 | 117 | 51 | 76 | 47 | 34 | | **528** |
| | Lagoon | 103 | 100 | 116 | 51 | 76 | 47 | 34 | | **527** |
| | Turtle Beach | 56 | 100 | 66 | 49 | | | | | **271** |
| **Total Survey Effort** | | **941** | **1266** | **1738** | **1278** | **1199** | **1162** | **805** | **470** | **8859** |
| **Number of Sub-sections Monitored** | | 22 | 29 | 28 | 20 | 19 | 19 | 18 | 14 | **169** |
| **Number of Days Where Monitoring Occured** | | 132 | 147 | 124 | 97 | 87 | 84 | 66 | 40 | **777** |
| **New Nests** | | 1904 | 2180 | 1724 | 5913 | 5479 | 6266 | 7252 | 1069 | **31787** |
| **False Crawls** | | 5925 | 3536 | 3794 | 10989 | 15766 | 14288 | 13314 | 2134 | **69746** |