Ningaloo TURTLE PROGRAM

ANNUAL REPORT 2008 -2009

Natural Heritage Trust

WildlifeLink

CAPE CONSERVATION

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Department of Environment and Conservation
Our environment, our future

RANGELANDS

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

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Gnulli Working Group – The program is conducted on the traditional lands of the Jinigudira, Thalanji and Baiyungu people. We recognise their traditional custodial role and continued support for turtle conservation.

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DISCLAIMER

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GLOSSARY

Body pit	A depression dug in the sand by a turtle during successful nesting attempts and some false crawls.
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.
Effort	The number of days and subsections monitored throughout the duration of the program.
Egg chamber	A deep hole which a turtle digs into a primary body pit with her back flippers. The eggs are deposited here.
Emerging track	Track of a turtle emerging from the sea onto land.
Escarpment	The edge of a ridge which indicates a filled-in primary body pit.
False crawl	The emergence of a turtle from the water that has not resulted in the production of a nest.
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 shell.
Prefrontal scales	Situated on a turtle head, anterior to the frontal bone.
Preoccular scales	Situated on a turtle head, anterior from the eyes.
Primary body pit	May be dug as part of a nest or false crawl (in which case the pit is abandoned).
Returning track	Track of a turtle returning from the land to the sea.
Rookery	A significant breeding area for a large number of animals.
Secondary body pit	Is dug during a successful nesting attempt to cover the primary body pit and egg chamber with sand.
Successful nest	A complete turtle nest in which eggs have been deposited.
Turtle activities	Includes both turtle nests and false crawls.
Turtle tracker	Person who has gained competency in the identification of turtle species and activities observed during morning monitoring activities.

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
The Marine Park	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 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) Cape division, Cape Range division, Bundera /Ningaloo division, and Coral Bay division. Each division is then further divided into sections and subsections.

The 2008-2009 turtle monitoring season commenced on the 7 December 2008 and operated until the 1 March 2009. Intensive monitoring ceased on the 7 February 2009 and a weekend of monitoring was carried-out at the end of February to determine nesting activity at this time. No monitoring was conducted on several days within the intensive survey period.

Volunteers' monitored sections of the Ningaloo coastline within each division of the hierarchical classification (with the exception of the Bundera division), in order to identify turtle species; assess the abundance of turtle activities; record turtle mortalities; identify nest disturbance and predation; and conduct turtle rescues when necessary.

This season a total of 60 volunteers assisted with monitoring, training, data entry and office administration, contributing 4427 hours equating to $88,537 (based on a pay rate of $20/hour). Throughout the NTP operational seasons 2002-2009, volunteers have contributed at total of 38193 hours.

1.1 2008-2009 Summary

Turtle nesting within the Ningaloo Region, 2008-09 - Summary of nesting statistics

A total of 7252 successful turtle nests and 13315 false crawls were recorded for the Ningaloo region during the 2008-2009 season. This equates to an average of 752 successful nests and 1376 false crawls per week.

- ***NW Cape Division***

  A total of 6635 nests and 12818 false crawls were recorded in the NW Cape division during 2008-2009. Overall, the green turtle had the greatest number of activity recorded in the NW Cape division (96%), followed by loggerhead (2%) and hawksbill turtles (1.5%).

- ***Cape Range Division***

  A total of 550 nests and 453 false crawls were recorded in the Cape Range division during 2008-2009. The loggerhead turtle had the greatest number of turtle activities (60%), followed by hawksbill turtle activities (21%) and the green turtle (18%).

- ***Coral Bay Division***

  A total of 76 nests and 44 false crawls were recorded within the Coral Bay division during 2008-2009. The loggerhead turtle had the greatest number of turtle activities (46%), followed by hawksbill turtle activities (39%) and the green turtle (15%).

Nesting abundance during the 2008-09 season was comparatively high for green turtles and hawksbill turtles, but not for loggerhead turtles. During the 2008-09 season there were two records of nesting activity for flatback turtles. Both green turtle and hawksbill turtle nesting appear to display increasing population trends over the six-year period.

There are several potential scenarios which would explain the apparent trend in nesting abundance:

1) the apparent increase is due to an increase in the nesting turtle population;
2) the apparent increase is due to naturally fluctuating cycles in nesting abundance;
3) there is no true trend and the apparent increase is artefact of survey error; or
4) the apparent increase is due to a change in the number of clutches each female lays per year.

If the apparent increase is due to a real increasing population of nesting turtles, then this will be apparent in the following years of monitoring. However, if the apparent increase is due to either of the second or third scenarios, the estimated annual track counts are unlikely to continue to increase in the following years. The apparent increase could not be caused by a bias in the number of unidentified turtle tracks, as this was low compared to annual nesting abundance for each species, and did not show a downward trend.

Predation

A total of 98 nests were recorded as damaged in the Ningaloo region, 58 of which were located in the NW Cape division, 17 within the Cape Range division and 23 within the Coral Bay division.

The majority of nests were damaged by foxes (25%), followed by ghost crabs (11%), another turtle (10%), tidal damage (8 %) and dogs (6%). The cause of damage was either not possible to determine or not recorded for 38 nests in the region (39%).

Since monitoring began in 2002, foxes and dogs have damaged 48 percent of disturbed nests in the Ningaloo region (excluding ghost crab predation). However, overall the level of disturbance to turtle nests by foxes in the region has remained below 5 percent since the 2004-2005 season.

Turtle Stranding and Mortality

During the 2008-2009 season, 38 stranded female turtles were rescued and an additional 27 turtles were found deceased on the shoreline (of which 16 were adult female green turtles). Collectively the NTP has rescued 175 stranded turtles from 2002-2009.

Survey Effort and Long-Term Monitoring

In 2008 all NTP data across years was modelled to determine the survey effort required to detect trends in the abundance of nesting female turtles within the Ningaloo region. Andrea Whiting (2008), found that the duration of monitoring by the NTP could be reduced significantly by only carrying out monitoring over an intensive 28 day period focusing on the peak of the nesting season (early – late January) in conjunction with intermittent monitoring of 2 days in a row outside of this period. Although, there was some variation between years in the seasonal distribution of nesting, a reduction in monitoring effort would still be sufficient to detect changes in overall nesting turtle abundance across years.

1.2 NTP Objectives

The NTP was partially successful in meeting the objectives of the program in the 2008-2009 season:

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

- Green and Hawksbill turtles have shown an upward trend in nesting activity since monitoring began. However, no observable trend has been identified for Loggerhead turtles.
- Nesting success is higher for Hawksbill and Loggerhead species compared to the Green turtle. The reason for lower Green turtle nesting success is unknown.

- In general, peak nesting activity occurs from early January to late January for each of the three species.

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

- 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 within the Bundera division, then followed by the Coral Bay division.
- Gnaraloo Bay is also considered significant loggerhead rookery; quantitative data was collected by through the Gnaraloo Bay Marine Turtle Survivorship Project and will be provided to the NTP for comparison.

Objective 3: Establish the level of predation on nests

- Data collected on nest disturbance by fox's assists DEC to target fox control in areas of high nest disturbance, thereby, decreasing the number of turtle nests damaged by foxes. Disturbance to nests has been less than 5 % of the total number of nests since 2004-2005.
- Fox presence has been steadily increasing in the region since 2005.
- Predation of turtle eggs by ghost crabs (natural predator), requires further investigation to establish if it is likely to be having a negative effect on hatchling production.

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

- This objective has been addressed through the development of the Jurabi Turtle Centre Program. Funding support is provided by Woodside Energy Ltd and Mitsui Ltd (2009 to 2011) through the Community Partnerships Program to assist DEC in the development of a sustainable guided interaction experience using TAFE accredited turtle tour guides

Additional NTP Achievements 2002 - 2009

- Production of the NTP monitoring field guide and monitoring training videos. These resources were widely distributed to a range of community turtle projects around the world.
- The NTP continues to support marine turtle monitoring programs throughout Western Australia.
- Provided locations of rookeries to improve OSRA data (Oil Spill Contingency Atlas) and supported potential oil spill response planning activities.
- Provided data to implement restrictions of beach access for 4WD vehicles, in consuktation with the community.
- Data collected provides details on nest abundance and distribution that assists government agencies in planning for the future including tourism development,
- Data collected provided confirmation that existing carparks accessible to foreshore areas within the Jurabi Coastal Park were significantly encroaching on turtle nesting habitat. As a result in 2009 Jacobsz access car park was re-located to behind the fore dune area.
- The rescue of 175 stranded female turtles within the Ningaloo region (2002-2009).

1.3 Key Program Recommendations

Recommendations for the 2008-09 NTP season include aspects of monitoring, research, and issues pertaining to the program and are outlined below.

Volunteer Participation

- Consider a fee structure associated with participation in the program by external volunteers. This would provide a cost recovery for volunteer accommodation, food, transport and general administrative expenses. This would alleviate issues associated with limited funding opportunities for the NTP.
- 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 2009-2010 NTP season.

- Due to the decrease in survey effort in future monitoring seasons, allow for a reduction in the number of volunteers required to participate in the program. Twelve volunteers per group were sufficient to run the NW Cape division and the remote camp at Bungelup (Cape Range division) in the 2008-09 season. If the same monitoring activities are to take place in upcoming seasons the same number of volunteers per group should be adequate.
- Expand capacity of local trainers and assessors prior to the arrival of the external volunteers. This will greatly reduce the work load of the coordinator and the other key trainers.

Field Data Collection

- Ensure volunteer accuracy in track and nest identification by carrying out concurrent cross-checks of nesting beaches and comparisons of data sheets. Ensure volunteers fill in data sheets accurately. Crosscheck data sheets on a daily basis and hold regular meetings with the volunteers regarding data recording issues. Update the Data Recording: common mistakes register located on the DEC server.
- Clarify understanding of monitoring techniques and data collection with all trainers and volunteers to 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 camp to expand knowledge base of loggerhead track identification.
- Train volunteers on how to use clipboard sheets and laminates prior to field training. A brief introduction on this information could be conducted during the GPS and radio training session..
- Provide local volunteers with radio and GPS training as for external volunteers.
- 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 enquiry list in the NTP email account. 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 operations.
- Continue to rotate team leaders through the Bungelup remote camp.

Coral Bay Operations

- Re-consider the benefits of monitoring Coral Bay subsections in achieving the NTP goals.
- Employ a part-time Volunteer Coordinator to oversee monitoring and volunteer management in Coral Bay.
- Continue to provide adequate training for Coral Bay volunteers. For example hold a weekend training camp at Bungelup - this year's camp was very successful and proved a great team building exercise.
- In addition, all new volunteers should attend at least one training session in Exmouth and a morning of familiarisation monitoring in Coral Bay with a local trainer. This ensures that the volunteers are committed to participating on the program.

Data Management

- Redesign the NTP data sheets to include separate columns for predator tracks: one for tracks/signs pertaining to possible causes of predation or nest damage (surrounding disturbed nests), and one for potential predator tracks seen within a 5m radius of all nests. This will eliminate some of the confusion in the database and create more concise data in relation to predation issues for the analysis stage.
- Consider including damage by other turtles and tide damage as additional options in the column for causes of nest disturbance.

- 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. Make clear, consistent instructions for data entry e.g. protocol for mistakes
- Continue to cross-check data using a Microsoft Excel spreadsheet to data entered in the database.

Volunteer Education, Information and Communication

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

Field Monitoring

- Continue to monitor turtle activity along the NW Cape, Cape Range and Coral Bay divisions to indicate long-term trends. Opportunistic monitoring should continue within the Bundera division where possible.
- Base survey effort on the findings of Andrea Whiting (2008), Consolidation of the NTP.
- Include sampling in Carbaddaman and Boat Harbour, & validating nesting success by night time observations etc.

Predation Control

- Continue with the current DEC fox baiting program within the four divisions - NW Cape, Cape Range, Bundera and Coral Bay to maintain the current level of fox predation on nests within the Ningaloo region.
- Ensure fox control within the Bungelup section is adequate to reduce predation levels to less than 5% of observed nests.
- Determine nest predation levels during mid February to mid March for comparison with previous annual data collection.
- Further investigate the impacts of ghost predation on nesting success within the Ningaloo region.

Turtles Rescues

- Continue to conduct opportunistic turtle rescues (when required)
- Consider listing turtle stranding rescues as a program objective.
- Prioritise areas with significant numbers of turtle strandings and deaths recorded within previous seasons - Brookes to Graveyards, Jacobs South to Wobiri, 5 Mile to Trisel and Burrows to Jurabi Point sub-sections located in the NW Cape division.
- Incorporate rescue monitoring points into DEC operational works program

NTP Progress

- By reducing the survey effort of the program we would see a significant decrease in financial resource requirements for the duration of the program.
- Compile a report over-viewing NTP achievements, monitoring changes, and research conducted by students and other researchers that have been achieved over the past 8 years and future research goals.

- Review and update the NTP goals and objectives to reflect the progression and changes to the program which have occurred since monitoring began in 2002.

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 occur within the 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 a prime tourism and conservation location. It is considered as a popular holiday destination for Western Australians and increasingly to visitors from Australia and abroad (CALM 2005).

In recognition of the uniqueness and rich biodiversity found within the Ningaloo reef and its cultural importance to West Australians, approximately 90 percent was gazetted as a Marine Park in 1987 with the remaining area of the reef included within the Marine Park in 2004 (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 2008), which highlights the conservation significance of nesting rookeries 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

Worldwide

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, human disturbance to nesting turtles and to emerging hatchlings and egg poaching, 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 re-sighted in Arnhem Land and as far north as the Java Sea near Indonesia (Baldwin et al. 2003; Limpus 2008).

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 within Australia are also reported to have declined significantly (Environment Australia 2003).

Locally

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 2008). 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 in the Ningaloo Reef region following intensive harvesting is not known.

Post commercial harvesting, a key threat to turtle population recovery in the Ningaloo region is 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.

Growing tourism in the Ningaloo Region poses a management issue as increased numbers of people seek to view nesting female turtles and hatchlings. Marine turtles are vulnerable to human based disturbance during the nesting period as adults aggregate in shallow waters and female turtles come ashore to nest (Collins 2000). The presence of people and the use of torch light and vehicle lights on the beach all cause disturbance to nesting females and hatchlings (Waayers 2003; Johnson et al. 2006; Lorne & Salmon 2007). Female turtles are sensitive to disturbance and will abandon a nesting attempt and return to the water expending an enormous amount of wasted energy, potentially reducing their nesting success rate. Hatchlings are also easily disturbed, through disorientation from the water's edge. This can lead to dehydration and increase the risk of predation (Luctavage et al. 1997).

Another human related disturbance is the use of 4WD vehicles along nesting beaches, which lead to a compaction of the sand and the creation of wheel ruts in which hatchlings can become trapped (Limpus 2002). Increasing tourism numbers pose a significant threat to nesting marine turtles and hatchlings within the Ningaloo region, potentially reducing the chance of turtle population recovery.

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 (WWF)-Australia and 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.

The NTP is a community-based volunteer program involving local community members as well as external volunteers from throughout Australia and overseas. Volunteers are central to the operation of the program with data collected assisting managers in reducing disturbance from human activity and fox predation to turtle rookeries within the Ningaloo region. The NTP overarching goals and primary objectives are listed below:

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).

Primary objectives:

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

3.2 NTP Hierarchical Classification

The NTP has monitored turtle nesting activity within Ningaloo Marine Park for the past eight consecutive years, since establishment. Monitoring sites were established from past aerial and on ground survey data collection, 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; North West Cape Division, Cape Range Division, Bundera /Ningaloo Division, and Coral Bay Division. Each division is then further divided into sections and subsections (Appendix 12.1, 12.2, 12.3).

Beaches were originally divided into these subsections based on factors such as geographical barriers that separate beaches, the location of car parks and the distance and time required to monitor the subsections. Each subsection is defined by turtle totem markers marking the start and finish of each.

Volunteers' monitor sections of the Ningaloo coastline within each division of the hierarchical classification in order to identify turtle species, assess the abundance of turtle activities, record turtle mortalities, identify feral predation and nest disturbance and conduct turtle rescues when necessary. Monitoring techniques were 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 subsections (Figure 33). For the turtle totem locations and distance of each subsection refer to Appendix 12.1(Table 15).

Cape Range Division
The Cape Range Division encompasses the Bungelup section, which is divided into three separate subsections (Figure 34). The totem locations and distance of each subsection are provided in Appendix12.2 (

Table 16).

Bundera Division
The Bundera division encompasses six separate sections. These sections are each classified into one or more subsections. For the purpose of this report the Bundera division was not monitored throughout the 2008/09 turtle nesting season.

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 subsections (Figure 35). The totem locations and distance of each subsection monitored this season are provided in Appendix 12.3 (

Table 17).

4.0 NTP VOLUNTEER COORDINATION

4.1 2009-2010 Volunteer and Staff Participation

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. They are required to participate for a period of three months as part of a volunteer internship placement. Three team leaders were appointed for the 2008-2009 NTP. Accommodation, food and travel expenses were subsidised as part of the internship.

Indigenous Internship
The NTP has encouraged the participation of local Indigenous people within the program. This season two Indigenous Interns were recruited from Carnarvon with the assistance of the North West Cape Exmouth Aboriginal Corporation (NWCEAC). They participated in the program for five consecutive weeks, contributing in both field monitoring and data entry.

Local NTP Volunteers
The local community plays an integral role in the longevity of the NTP. Community volunteers have participated in the program for the last several seasons, through a flexible monitoring schedule.

External NTP 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 at least one month in order to ensure adequate training and assessment. For this season volunteers were separated into 2 groups to cover the duration of the program.

This season a total of 60 volunteers assisted the with monitoring, training, data entry and office administration of the NTP. They contributed 4427 hours equating to $88,537 (based on a pay rate of $20/hour) (Table 1).

Table 1: Summary of the details the number of volunteers, number of hours, days and the monetary value of the contribution of volunteers from the NTP during 2008-2009.

Volunteers	# Volunteers	Hours	Days	Volunteer Hours at $20 p/hr
Local	17	347	114	$6,940
Coral Bay	14	429	136.5	$8,581
Internship	3	1265	182	$25,299
Visiting	0	0	0	$0
Group 1	12	1135	242	$22,708
Group 2	14	1250	255	$25,009
Total	60	4427	929.5	$88,537

Volunteer Origin and Demographics
Of the 60 volunteers that participated in 2008/09 season including both local and external volunteers, 28 % originated from Exmouth, 18 % were from Coral Bay, 25 % were external volunteers from other

areas in Western Australia, 13 % came from interstate, and the remaining volunteers (15%) were from abroad (Figure 1).

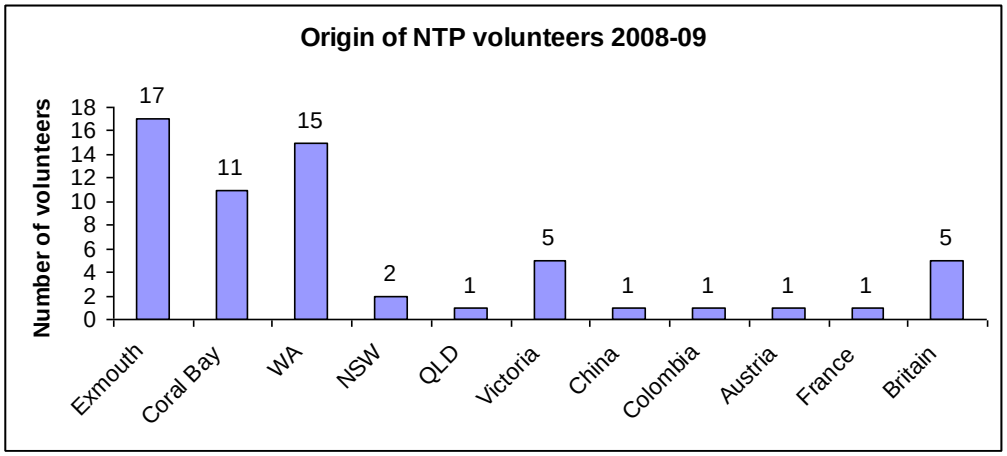


Figure 2: Origin of NTP volunteers 2008-09 season.

The age of volunteers ranged from 18 to 71 with the majority of volunteers (56 %) aged between 20-30, followed by 21-40 year olds (22 %), 41-50 years olds (9 %), under 20 and 51-60 years (5 % each), and over 60 (3 %) (Figure 3).

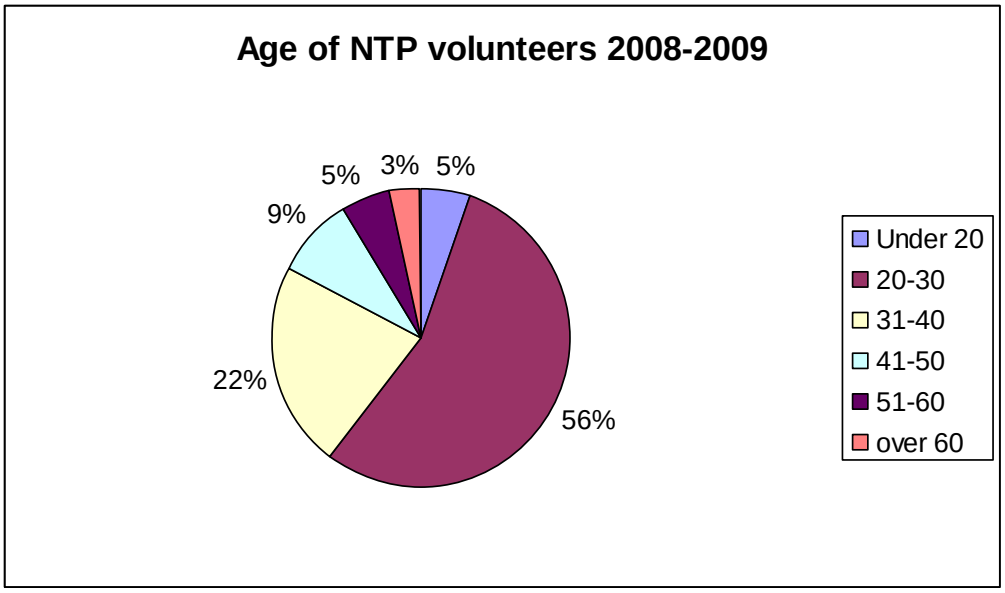


Figure 3: Percentage distribution of NTP volunteers for 2008-2009 season.

Comparison of Volunteer Numbers and Hours 2002 - 2009

From the initial 2002 NTP season to date, volunteers have contributed at total of **38193** hours. In comparison to previous seasons the number of hours contributed by volunteers has decreased in the past two seasons due to the followings reasons:

- The NTP has not incorporated the Jurabi Turtle Centre Program
- The 2008-2009 monitoring season was reduced in length (Figure 4-Figure 5).

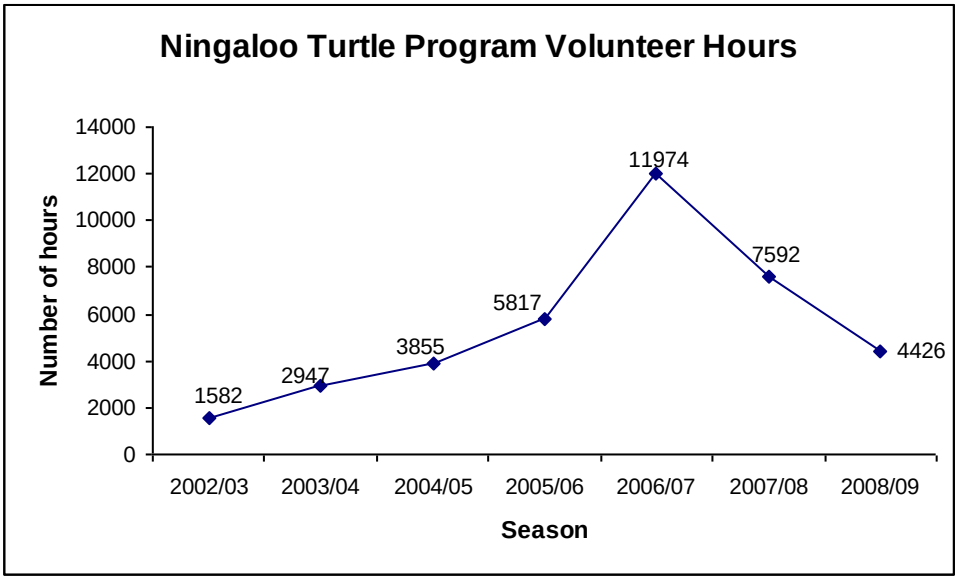


Figure 4: The number of hours contributed by NTP volunteers per year 2002 - 2009.

In comparison to previous seasons the number of volunteers that participated in the 2008-2009 season has also decreased again due to the separation of the Jurabi Turtle Centre Program and the shortened length of the 2008-2009 monitoring season, reducing the number of participants required.

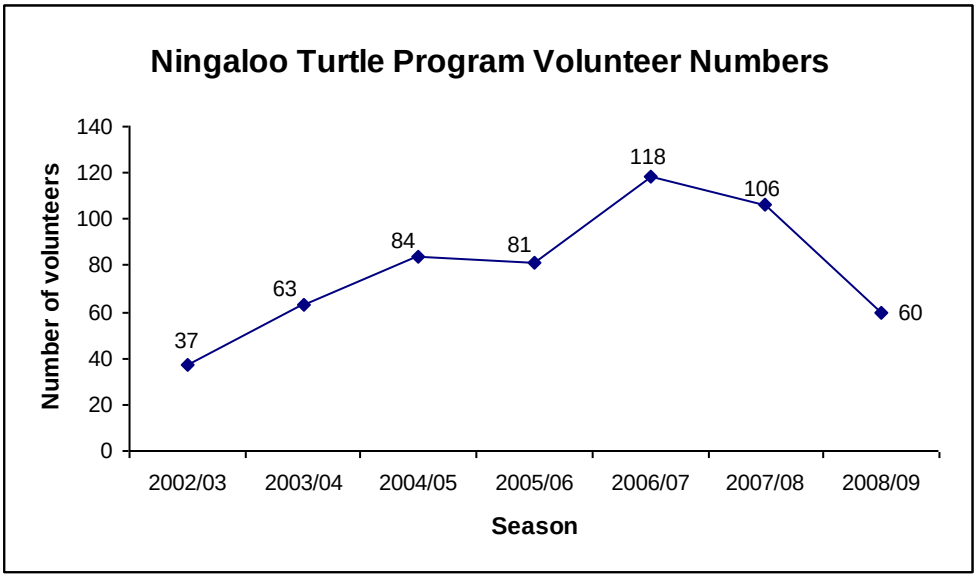


Figure 5: The number of NTP volunteers per year from 2002 – 2009.

4.2 Volunteer Recruitment and Accommodation

NTP volunteer positions are advertised through the NTP website, workshops and information days, the CCG Newsletter, Exmouth community notice boards and through the local media. Western Australian universities also provide NTP information through their newsletters and websites for external volunteers.

Previous local and external NTP volunteers were invited to participate in the 2008-2009 program. Volunteers were contacted via email prior to the commencement of the 2008-09 season. Individuals who had enquired about the program during the off-season were also contacted by email.

NTP external volunteers were provided accommodation at the Exmouth Villas at a rate of $100 per week, at there own expense. For the overlap between group 1 and group 2 external volunteers Pot Shot Hotel dormitories were available for one week. Team leaders and indigenous interns were provided separate accommodation at the Exmouth Villas, with all expenses covered by NTP.

4.3 Monitoring Operations

North West Cape Division

A minimum of twelve volunteers were used to adequately monitor each subsection with the NW Cape division. Participants included both external and local volunteers on a rotational basis.

Monitoring hours were 6:00am – approximately 10:00am between the 7th of December 2008 and the 31st of January 2009. As of the 1st of February the starting time changed to 6:30am due to limited light availability for beach monitoring.

Cape Range Division

Turtle monitoring in the Cape Range division was undertaken by volunteers participating in remote camping at the Bungelup Station Camp, located 6km north of Yardie Creek, within Cape Range National Park. A maximum of two volunteers accompanied one of the three team leaders for up to 7 days.

Coral Bay Division

Turtle monitoring within the Coral Bay division was coordinated by the Coral Bay Coordinator, a DEC casual employment position. Monitoring was conducted by residents of Coral Bay.

Volunteer Training and Assessment

All NTP volunteers were required to have a good understanding of turtle nesting activities and a thorough knowledge of monitoring techniques in order to collect adequate scientific data. Accordingly volunteers underwent an induction which included:

- an introduction to the NTP and the Exmouth area,
- occupational health and safety procedures and issues, NTP monitoring procedures.
- a showing of the Code of Conduct DVD for beach based marine turtle observation interactions,
- a temporary copy of the NTP Turtle Monitoring Field Guide (CCG 2007),
- a practical training session in correct radio etiquette and Global Positioning System (GPS) use.

The volunteers also undertook three practical training sessions and a monitoring competency based assessment during their first week. In some cases additional training sessions were found to be necessary to ensure volunteers were confident to monitor beaches unaccompanied and capable of producing reliable data. Qualified turtle trackers were given certificates and official NTP monitoring t-shirts.

<u>2008/09 Competent NTP Turtle Trackers:</u>

- 3 new local volunteers,
- 10 new volunteers from Coral Bay,
- 29 external volunteers.

NTP training and assessment was assisted by 9 trainers, 6 assessors and 2 “train-the-trainers”. However, there was a core group of 4 trainers who were responsible for carrying out the majority of volunteer training and assessment. NTP volunteers were trained throughout the turtle nesting season by at least two of the NTP trainers and assessed by one of the NTP assessors.

2008/09 Competent Trainers and Assessors:

- 3 NTP trainers
- 3 of the assessors.

Volunteer Transport

NTP hired a 12-seater minibus for the duration of the program. DEC vehicles were also used intermittently throughout the program to assist with scheduled training days and for travel to and from the Bungelup Remote Camp.

Local volunteers were given the option to use their own vehicles where monitoring times interrupted their daily work schedule. In this case, reimbursements were provided for fuel costs at a rate of 40 cents per kilometer.

5.0 MONITORING METHODS AND DATA COLLECTION

5.1 Identification of Successful Nests and False Crawls

To determine turtle nesting activity, on a given evening sections of the Ningaloo coastline were monitored at sunrise to identify the presence of turtle tracks and nests marked in the sand from the previous evening. Species-specific track markings in the sand assisted volunteers in identifying the presence of either green, loggerhead, hawksbill or flatback female turtles. Successful nesting was determined by the presence of a nest mound and additional key nest features (CCG 2007). The position of the nest was recorded using a GPS and its specific location on the beach - (I) Inter-tidal; (H) High tide area, (E) edge of vegetation, (D) dunes and beyond. If a nest was not located with the associated turtle track, and the turtle had abandoned any nesting attempt and returned to the water this activity was recorded as a false crawl. Volunteers marked off nests and false crawls, once identified and recorded, by drawing a line in the sand to avoid double counting of turtle activities on subsequent beach surveys.

Turtle activities were recorded on the NTP monitoring data sheet and subsequently entered into the NTP database. Other observations and general comments such as: a turtle still nesting on the beach; comments relating to a photograph taken; sighting of tags on a turtle; or sightings of stranded or dead turtles are recorded in the sections on the data sheet (Appendix 12.4).

5.2 Identification of Predation and Predator Prints

Evidence of damage to old and new nests and the potential cause of damage were also 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 of potential predators within a 5m radius of the nest, including dog (D), fox (F), goanna (G) or human (H) prints were recorded. Cats are generally not classified as predators of the nests because they are not known to dig up the eggs.

Any presence of foxes and dogs on a particular section of beach are also recorded. 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 Rescues and Mortalities

Volunteers occasionally encountered stranded or dead turtles within the subsection being monitored. Marine turtles stranded in either the rocky shoreline or behind the sand dunes were assisted back to the ocean by volunteers with the aid of a purpose made turtle stretcher. In either of these cases a Marine Turtle Stranding or Mortality Datasheet is completed. If other deceased wildlife is encountered - dolphins, whales, dugongs, sea birds, sharks and sea snakes, a Marine Wildlife Stranding and Mortality Datasheet is completed.

In the case where a deceased turtle is encountered the following details are recorded: the date, time and exact location of observation; the condition of the carcass, species type, distinguishing features, tag numbers if present, sex, maturity, measurements of the carapace, tail and head, photograph numbers and disposal of the turtle. The curved carapace length is measured along the midline of the shell from the anterior edge to the posterior edge; the curved carapace width is measured across the widest part of the shell; the tail length is measured from the carapace to the posterior tip of the tail; and the maximum head width is measured along the widest part of the head. If it is viable photographs are taken of any injuries, and of the carapace and head for identification of the turtle.

5.4 Tagged Turtles

During the 1986/87 turtle nesting season the Western Australian Marine Turtle Project (WAMTP) was introduced by the Department of Conservation and Land Management (now known as DEC) 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 to do so without disturbing the turtle. Tagged turtles are recorded on the Tagged Turtle Resights datasheet for the 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.

5.5 Data Entry

All data recorded on the 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. The presence of fox and dog tracks is entered if appropriate, the number of false crawls is entered, and then all nesting details are entered including species type, nest location coordinates and the associated confidence level, nest.

6.0 MONITORING RESULTS

The results of the 2008-2009 NTP are detailed in the sections below. Turtle activity data is classified as successful nesting or false crawls.

6.1 Survey Effort

Overall, monitoring was conducted in the North West division (50-60 days), Cape Range division (40-41days) and Coral Bay division (34 days) (Table 2). No monitoring was conducted on several days within the intensive survey period. The days and sections when monitoring was not conducted are listed in Table 10.

North West Cape Division
The NTP monitored turtle activity from 7 December 2008 to March 1 2009. Intensive monitoring ceased on 7 February 2009 and a weekend of monitoring was carried out at the end of February to determine nesting activity at this time.

Cape Range Division
During the 2008-09 season a total of 8 camps operated out of Bungelup between the 15 December 2008 - 6 February 2009. Camps did not operate between 25 December – 29 January, nor 1 – 4 January. Monitoring was not carried out between 19 January – 25 January 2009 due to unforeseen circumstances with DEC's vehicle and equipment availability.

Coral Bay Division
During the 2008-09 season both the Batemans Bay and Lagoon subsections were monitored. It was not considered logistically profitable to monitor the turtle beach subsection, due to the small number of nests that have been recorded within this subsection in previous seasons.

Table 2: Survey Effort for the Ningaloo Turtle Program 2008-2009 season.

Division	Section	Sub-Section	Number of Days Monitored
North West Cape	Light house	Mildura Wreck - NW Car Park	50
		NW Car Park - Surf Beach	50
		Surf Beach - Hunters	50
	Hunters	Hunters - Mauritius	59
		Mauritius - Jacobsz Sth	59
		Jacobsz Sth - Wobiri	59
	Graveyards	Five Mile N - Five Mile	59
		Five Mile - Trisel	60
		Brooke - Graveyards	59
		Graveyards - Burrows	60
	Tantabiddi	Burrows-Jurabi Pt	59
Cape Range	Bungelup	Bungelup Nth - Neils Nth	41
		Bungelup Sth - Bungelup Nth	40
		Bungelup Sth - Rolly's	40
Coral Bay	Batemans Bay	Batemans Bay	34
		Batemans North-Lagoon	34

6.2 Ningaloo Regional Turtle Activity Data 2008-2009

A total of 7252 successful turtle nests and 13315 false crawls were recorded for the Ningaloo region during the 2008-2009 season (Table 4). This equates to an average of 752 successful nests and 1376 false crawls per week (Table 4).

Table 3: Number of nests recorded for each species in the Ningaloo Region 2008-2009 (survey days NW Cape n=60, Bundera n=40, Coral Bay n=34).

	Turtle Species			
Division	**Green**	**Logger Head**	**Hawksbill**	**Unidentified**
North West Cape	6215	214	178	28
Bundera	73	340	131	6
Coral Bay	9	26	27	5
Total	6297	580	336	39

(Note: Survey days NW Cape n=60, Bundera n=40, Coral Bay n=34)

Table 4: Number of false crawls recorded for each species in the Ningaloo Region 2008-2009

	Turtle Species			
Division	**Green**	**Logger Head**	**Hawksbill**	**Unidentified**
North West Cape	12496	201	116	5
Bundera	107	262	77	7
Coral Bay	7	22	14	1
Total	12610	485	207	13

(Note: Survey days NW Cape n=60, Bundera n=40, Coral Bay n=34)

6.3 Summary of Turtle Activity within the Ningaloo Region 2008-2009

NW Cape Division

A total of 6635 nests and 12818 false crawls were recorded in the NW Cape division during 2008-2009. Overall, the green turtle had the greatest number of activity recorded in the NW Cape division (96%), followed by loggerhead 2 % and hawksbill turtles 1.5 %.

Turtle activities by section – NW Cape division

Overall turtle activity was greatest in the Hunters section of the NW Cape division, followed by the Graveyards section. Please note results are based on data recorded between 14 December 2008 to 7 February 2009, the first and last week of monitoring are not displayed because of differences in survey effort across sections during that period (Figure 6).

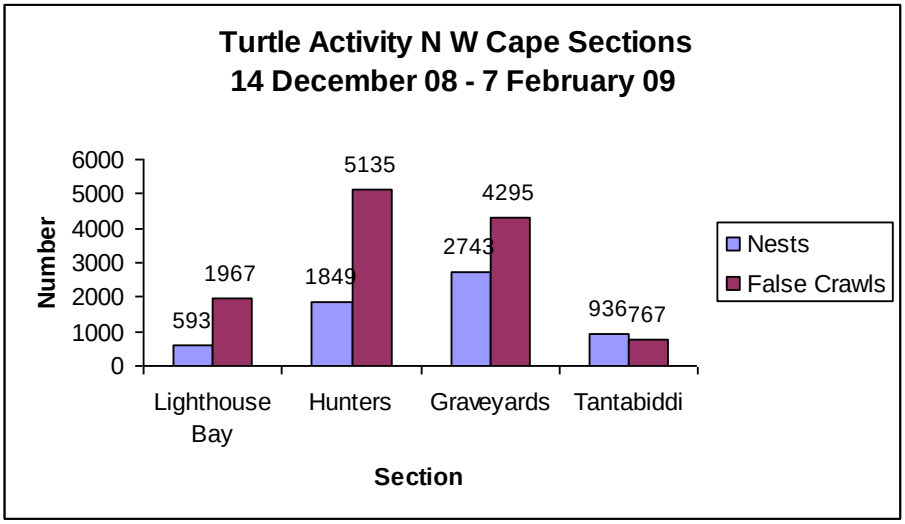


Figure 6: **Combined number of nests and false crawls recorded in each section in the NW Cape 14 December 08 – 7 February 09.**

Percentage of nests laid for each species of turtle in each section -NW Cape division

The greatest percentage of green turtle nests were laid in the Graveyards section (47 %), Hunters (29 %), Tantabiddi (16 %) and Lighthouse Bay (8 %). Whereas 47 % of hawksbill nests were laid in the Hunters section, Graveyards Section (32 %), Lighthouse Bay Section (20.5 %), Tantabiddi Section (0.5 %). 50 % of loggerhead nests were recorded in the Hunters section, followed by Graveyards(32 %), Lighthouse Bay (15%), and Tantabiddi (3 %) (Figure 7).

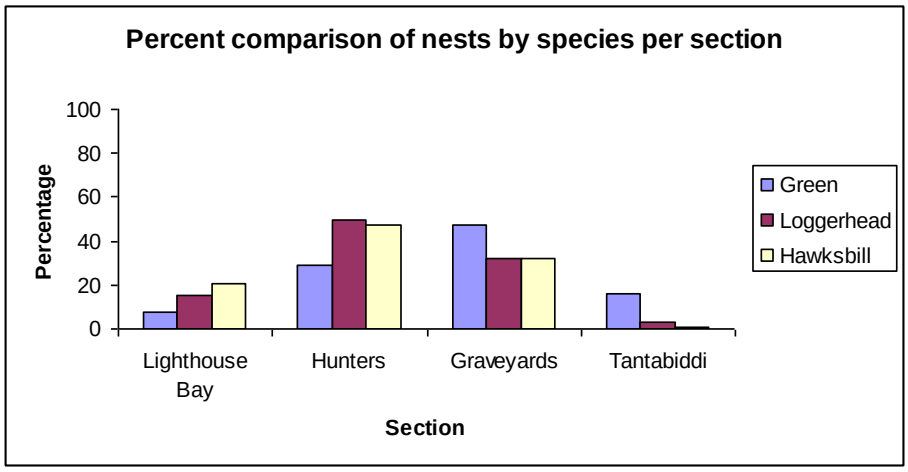


Figure 7: **The percentage of nests laid for each species within each section in the N W Cape sections 2008-009.**

Cape Range Division

A total of 550 nests and 453 false crawls were recorded in the Cape Range division during 2008-2009. The loggerhead turtle had the greatest number of turtle activities (60 %), followed by hawksbill turtle activities (21 %) and the green turtle (18 %). The distribution of turtle activities was relatively even across the three sub-sections (Figure 8).

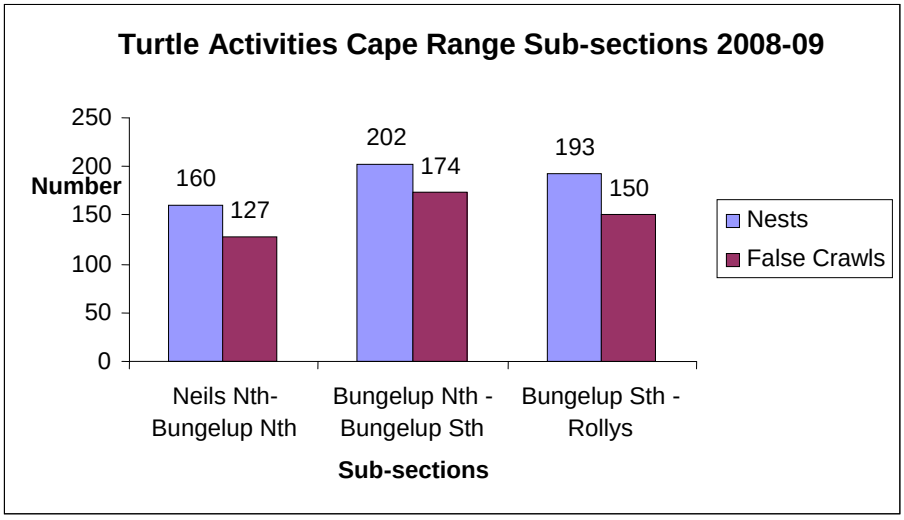


Figure 8: **The total number of nests and false crawls recorded in Bungelup sections.**

Coral Bay Division

A total of 76 nests and 44 false crawls were recorded within the Coral Bay division during 2008-2009. The loggerhead turtle had the greatest number of turtle activities (46 %), followed by hawksbill turtle activities (39 %) and the green turtle (15 %). The Batemans South to Batemans North sub-section had slightly more recorded turtles activities than Batemans North to Lagoon sub-section (Figure 9).

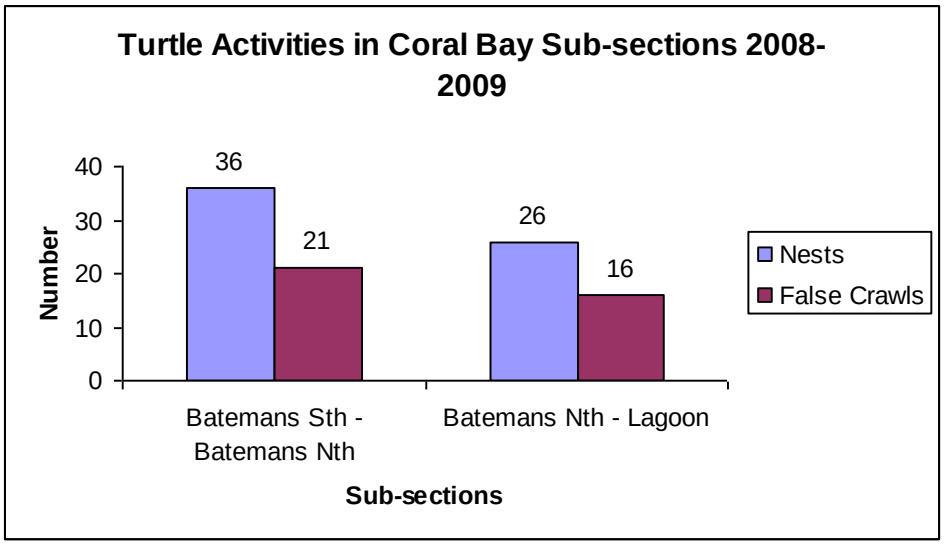


Figure 9: **The total number of nests and false crawls recorded in the Coral Bay sections.**

Comparison of nests per week by species

Green turtles accounted for 92 % of recorded turtle activities in the Ningaloo region, followed by loggerhead (5 %) and hawksbills (2 %) of activities. Green turtles consistently laid more nests per week within the region than both loggerhead and hawksbill turtles. Flat back activity was recorded on two occasions in the NW Cape division.

6.4 Ningaloo Region Turtle Activities 2002-2009

Surveyed turtle activity within Ningaloo Marine Park from 2002-2009 is outlined below (Table 5).

Table 5: Details of survey effort and turtle activities from 2002-2009.

Season	Dates	Number of days where monitoring occurred	Survey effort	Number of subsections monitored	Nests	False crawls
2002-03	18/11/2002 - 16/04/2003	132	941	22	1871	5920
2003-04	11/11/2003 - 30/03/2004	147	1291	29	2062	3587
2004-05	03/11/2004 - 18/03/2005	124	1738	28	1710	3785
2005-06	21/11/2005 - 28/02/2006	97	1278	20	5908	10972
2006-07	01/12/2006 - 28/02/2007	87	1213	19	5252	14960
2007-08	01/12/2007 - 28/02/2008	84	1158	19	6276	14230
2008-09	7/12/2008 - 1/03/2009	66	813	18	7252	13315

Distribution of turtle nesting activities across divisions and years
NW Cape has consistently had the greatest level of nesting activity in the region (Figure 10).

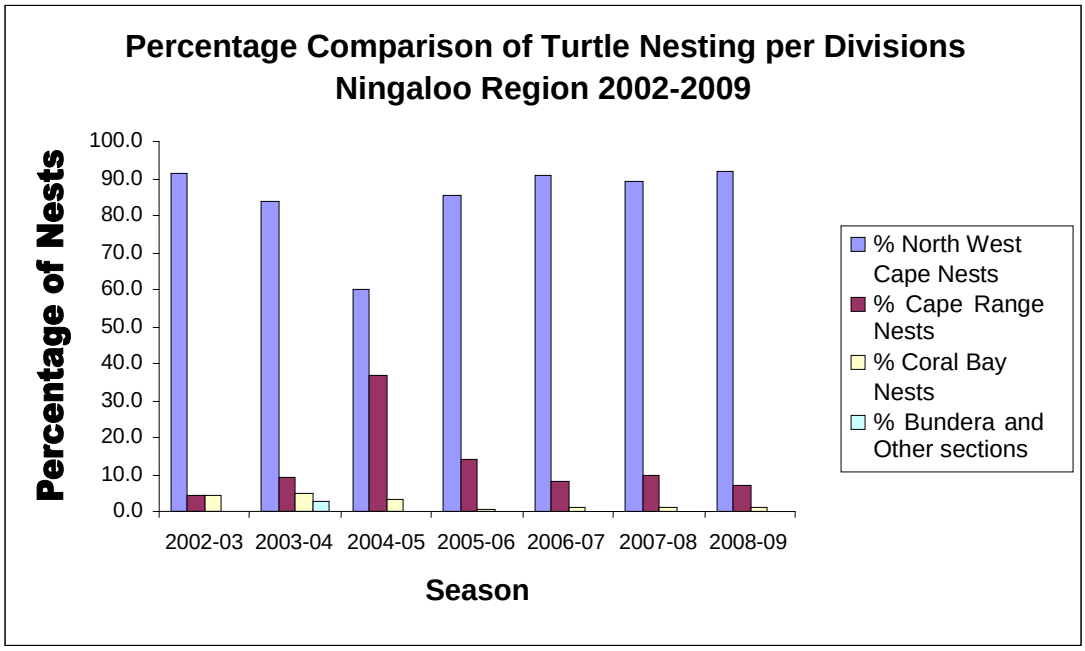


Figure 10: Percentage abundance of nesting activity in the Ningaloo region 2002-2009.

6.5 Predation

Predation of nests in the Ningaloo region 2008-2009

A total of 98 nests were recorded as damaged in the Ningaloo Region, 58 of which were located in the NW Cape division - 27 damaged nests recorded in the Graveyards section, 17 in the Hunters section, 5 in the Lighthouse section, and 9 in the Tantabiddi section. In addition, 17 nests in the Cape Range division and 23 in the Coral Bay division were damaged (
Table 6).

A range of 0-13 nests and an average of 9.7 nests were recorded as damaged per week in the Ningaloo Region accounting for 1.7 % of the total number of nests recorded for the region. When the percentage of nests is broken down per division 0.8 % of nests were damaged in the NW Cape, 3 % of nests were damaged in Cape Range and 34 % of nests were damaged in Coral Bay.

The majority of nests were damaged by foxes (25 %), followed by ghost crabs (11%), another turtle (10%), tidal damage (8 %) and dogs (6%). The cause of damage was either not possible to determine or not recorded for 38 nests in the region (39 %). Table 10 displays the number of nests damaged for the Ningaloo Region and the cause of damage to the nests.

Table 6: The number of damaged nests in the Ningaloo Region and the causes of nest damage.

	Fox	Dog	Turtle	Ghost Crab	Unknown	Tide	Total
Graveyards	4	0	6	4	7	6	27
Hunters	4	0	2	3	8	0	17
Lighthouse	3	0	0	0	0	2	5
Tantabiddi	3	0	2	1	3	0	9
Bungelup	8	0	0	3	6	0	17
Coral Bay	3	6	0	0	14	0	23
Total	25	6	10	11	38	8	**98**

Trends in predation in the Ningaloo region 2002-2009

Damage by foxes and dogs

Since monitoring began in 2002 a total of 680 nests have been recorded as damaged in the Ningaloo Region. Damage by foxes accounted for 37 % of all nests damaged from 2002-2009 (when damage by ghost crabs is included). The greatest number of nests damaged by foxes per unit effort was in the 2003-2004 season with 54 % of nests damaged by foxes (Figure 11).

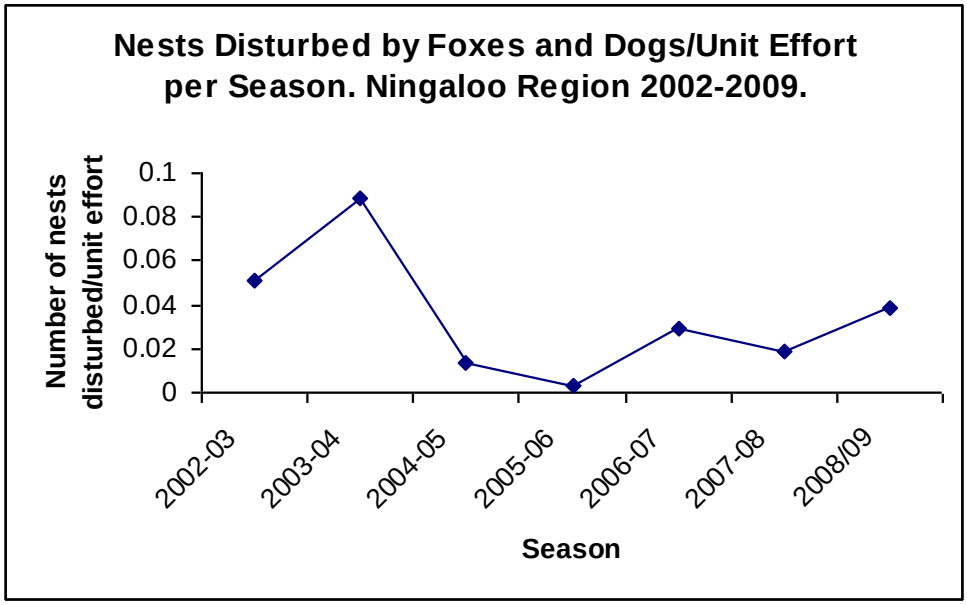


Figure 11: **Percentage of nests disturbed by foxes and dogs according to unit effort from 2002-2009.**

When nests damaged by ghost crabs are excluded from analyses, foxes were responsible for damaging 48 % of nests. Damage from ghost crabs was excluded because of the difficulty in determining whether the presence of ghost crab holes in the egg chamber indicates ghost crab predation and the differences in survey method concerning ghost crab predation across years. Other causes of damage to nests were another turtle 9 %, tides 5 %, dog 4 %, humans 4 %, sea gulls 2 %, vehicles 0.6 %. In addition, a further 25 % of damaged nests the cause of damage is unknown (Figure 12).

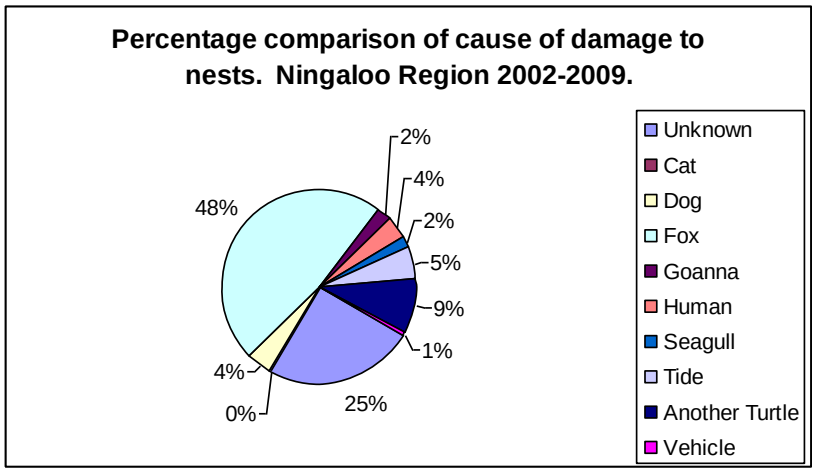


Figure 12: Displays the percentage comparison of the cause of nest damage, excluding potential damage by ghost crabs.

6.6 Turtle Rescues

Turtle Rescues 2008-2009

There were 38 turtle rescues carried out during the 2008-2009 NTP season. All of the turtles rescued were adult female green turtles, either wedged in rocks or stranded behind the dunes. Details of the locations and the number of turtles rescued at each site are shown in Table 7.

Table 7: The location, species and number of turtles rescued in 2008-2009.

Location	Species	Number
MW-NW Carpark		0
NW Carpark- Surf Beach	Green	1
Surf Beach - Hunters	Green	1
Hunters-Mauritius	Green	2
Mauritius-Jacobsz Sth	Green	2
Jacobsz Sth-Wobiri	Green	4
5M -5MN	Green	3
5M-Trisel	Green	4
Brookes -Graveyards	Green	18
Graveyards-Burrows	Green	1
Burrows-Jurabi Pt	Green	2
Total		**38**

Number of Turtles Rescued from 2002-2009

NTP volunteers have rescued a total of 175 stranded marine turtles from 2002-2009. The number of turtles rescued has fluctuated over the seasons, with the highest number of turtles rescued in a season 40, in 2005-2006 (Figure 13).

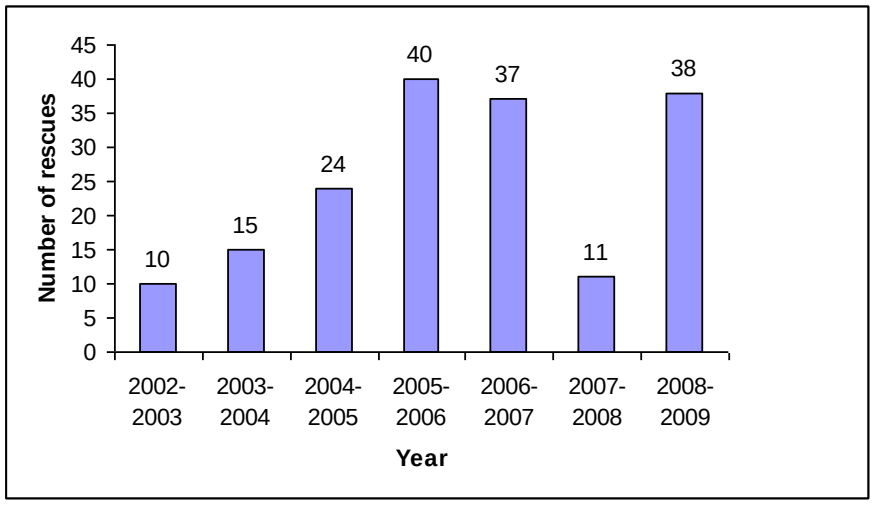


Figure 13: **The number of turtles that were rescued in each season from 2002-2009.**

6.7 Turtle Mortalities 2008-2009

A total of 27 turtle mortalities were recorded during the 2008-2009 season (Table 8). Consisting of 16 adult female green turtles, 5 juveniles (sex not determined), 2 adult males, and 3 unsexed adults and 1 Hawksbill of undetermined sex and age. 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 2008-2009.

Location	Species	Number
MW-NW Carpark		0
NW Carpark- Surf Beach		0
Surf Beach - Hunters		0
Hunters-Mauritius	Green	1
Mauritius-Jacobsz Sth	Green	2
Jacobsz Sth-Wobiri	Green	7
5M -5MN	Green	0
5M-Trisel	Green	2
Brookes -Graveyards	Green	1
Graveyards-Burrows	Green	0
Burrows-Jurabi Pt	Green	6
South Mandu	Green	1
Janes Bay	Green	6
Janes Bay	Hawksbill	1
Total		**27**

6.8 Weather Events

No cyclone events or major tidal activity were recorded within the areas the NTP operates during the 2008-2009 season.

6.9 Tagged turtle re-sights

A total of 14 tagged turtles were sighted during the 2008-2009 season, one of which was found deceased. Due to observer error only 11 of the tags observed in the 2008-2009 season could be matched to turtles tagged in Western Australia. One turtle was observed on two occasions when she had at both times been stranded in rocks. An additional four of the tagged turtles that were resighted this season were stranded on land (Appendix12.5).

7.0 TURTLE NESTING WITHIN THE NINGALOO REGION, 2008-09 - SUMMARY OF NESTING STATISTICS

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 the 2008-09 nesting turtle season.

7.1 Methods

Survey effort

Monitoring was conducted between 7 December 2008 and 1 March 2009, with consistent daily monitoring occurring between 7 December and 7 February. Monitoring was conducted for sections and sub-sections within the North West Cape, Cape Range and Coral Bay divisions shown in Table 9. No monitoring was conducted on several days within the intensive survey period (Table 10), and survey effort was higher within the North West Cape division than either Cape Range or Coral Bay divisions (Table 12). For days with no surveys, data were interpolated for the North West Cape Division data using the mean of the proceeding and preceding 2 days. Missing data was not interpolated for Cape Range or Coral Bay divisions as this is not considered an accurate method because of the higher number of consecutive days of monitoring that were missed.

Due to the higher and more consistent survey effort over the past 6 years within the North West Cape division, it would be desirable to use this as an index beach rather than obscure potential trends by grouping data with divisions where less intensive monitoring has occurred. For this reason, the North West Cape, Cape Range and Coral Bay divisions have been treated separately within this summary.

Table 9: Divisions, Sections and Sub-Sections within the Ningaloo Region where monitoring of turtles was conducted in 2008-09.

Division	Section(s)	Sub-Section(s)
North West Cape	Graveyards	Brooke – Graveyards
	Graveyards	Five Mile North – Five Mile Carpark
	Graveyards	Graveyards – Burrows
	Graveyards	Trisel – Five Mile Carpark
	Hunters	Hunters – Mauritius
	Hunters	Jacobsz South – Wobiri
	Hunters	Mauritius – Jacobsz South
	Lighthouse Bay	Mildura Wreck – North West Carpark
	Lighthouse Bay	North West Carpark – Surf Beach
	Lighthouse Bay	Surf Beach – Hunters
	Tandabiddi	Burrows – Jurabi Point
Cape Range	Bungelup	Bungelup Beach
	Bungelup	Neils Beach
	Bungelup	Rolly Beach
Coral Bay	Batemans Bay	Batemans Bay
	Lagoon	Lagoon

Reference to the Cape Range Division in this report refers only to the Bungelup section; while reference to the North West Cape Division refers to Graveyards, Hunters, Lighthouse Bay and Tandabiddi sections.

Table 10: Missing data where no surveys were conducted between 7 December 2008 and 7 February 2009.

Date	Division	Section	Subsection(s)
7 – 13 Dec 08	North West Cape	Lighthouse Bay	All
9 Dec 08	North West Cape	Tandabiddi	All
25 – 26 Dec 08; 1 – 2 Jan 09; 26 – 28 Jan 09	North West Cape	All	All
7 – 12 Dec 08; 14 Dec 08; 25 – 28 Dec 08; 1 – 4 Jan 09; 20 – 25 Jan 09	Cape Range	Bungelup	All
13 Dec 08	Cape Range	Bungelup	Neils Beach & Rolly Beach
7 – 14 Dec 08; 20 – 21 Dec 08; 25 – 28 Dec 08; 1 – Jan 09; 3 – 4 Jan 09; 6 – 16 Jan 09; 7 – Feb 09	Coral Bay	All	All

Estimating annual nesting abundance

The annual nesting abundance was estimated using two methods: a) a linear regression model correlating nesting abundance between 7 December and 7 February 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 five years of data and taken from Whiting (2008) (

Table **11**). Estimated sampling error was calculated using regression equations from Whiting (2008) for track counts at North West Cape only as the data missing for Cape Range region would underestimate true sampling error.

Table 11: Linear regression equations and extrapolation of linear regression modelling to full season counts.

Species	Linear Regression Equation	Extrapolation to Full Season
Green	$No.Tracks_{(1\ Dec\text{-}28\ Feb)} = 1.2732 * No.Tracks_{(Partial)}$	$No.Tracks_{(Annual)} = No.Tracks_{(1\ Dec\text{-}28\ Feb)}/0.930$
Loggerhead	$No.Tracks_{(1\ Dec\text{-}28\ Feb)} = 1.1589 * No.Tracks_{(Partial)}$	$No.Tracks_{(Annual)} = No.Tracks_{(1\ Dec\text{-}28\ Feb)}/0.924$
Hawksbill	$No.Tracks_{(1\ Dec\text{-}28\ Feb)} = 1.2177 * No.Tracks_{(Partial)}$	$No.Tracks_{(Annual)} = No.Tracks_{(1\ Dec\text{-}28\ Feb)}/0.937$

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 1.0 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.

For 2003-2007 data, annual abundance estimates were based on track count surveys between 1 December and 28 February. Error in predicting nesting between 1 December and 28 February could be calculated for the 2008-09 nesting season. However, this is likely to underestimate total sampling error as it does not account for error in extrapolating to nesting between 15 November and 15 March. Error in predicting nesting between 15 November and 15 March cannot be determined for any years due to the lack of previous full-season censuses.

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 nesting turtles each year from track count censuses. As the number of clutches laid per female per year is unknown for the Ningaloo Region population of turtles, the conversion was estimated using data from the literature. Firstly, the number of tracks counted was converted to the number of clutches laid using the values recorded from visual observation of the nests. Secondly, 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 (Table 14). Although error could not be obtained as the error in the first conversion is unknown, I used the range in mean clutch frequencies as an indication of the possible range in the estimated number of nesting turtles.

Estimating seasonal distribution of nesting

The seasonal distribution in nesting was estimated for green, loggerhead and hawksbill turtles nesting at the North West Cape division between 1 December and 28 February between 2003-04 and 2008-09. This was calculated using the mean of the fitted generalized additive models (with 4 degrees of freedom) for nesting abundance for each year and is plotted with 95% confidence intervals.

Calculating nesting success

Nesting success was calculated using visual assessment of the nest after the turtle left the beach.

7.2 Results and Discussion

Nesting abundance

Nesting occurred throughout the monitored period, and was relatively low but still occurring during the early March surveys (Figure 14-Figure 17).

Nesting abundance during the 2008-09 season was comparatively high for green turtles and hawksbill turtles, but not for loggerhead turtles (Figure 21Figure 22). During the 2008-09 season there were two records of nesting activity for flatback turtles.

Both green turtle and hawksbill turtle nesting appear to display increasing population trends over the six-year period (Figure 24). The linear trend is significant for both species at North West Cape and has high power (>0.95) of detection within the timeframe. Linear regression was not significant for hawksbill turtles nesting within the Bungelup section, which appears to display more of an exponential increase. Linear regression did not show a significant trend for loggerhead turtle nesting within either the North West Cape division (P= 0.29) or the Bungelup section (P= 0.64). Linear regression did not show a significant trend for turtle nesting when loggerhead and hawksbill nesting was combined for either the North West Cape division (P= 0.06) or the Bungelup section (P=0.06).

There are several potential scenarios which would explain the apparent trend in nesting abundance: 1) the apparent increase is due to an increase in the nesting turtle population; 2) the apparent increase is due to naturally fluctuating cycles in nesting abundance; 3) there is no true trend and the apparent increase is artefact of survey error; or 4) the apparent increase is due to a change in the number of clutches each female lays per year.

If the apparent increase is due to a real increasing population of nesting turtles, then this will be apparent in the following years of monitoring. However, if the apparent increase is due to either of the second or third scenarios, the estimated annual track counts are unlikely to continue to increase in the following years.

The apparent increase could not be caused by a bias in the number of unidentified turtle tracks, as this was low compared to annual nesting abundance for each species, and did not show a downward trend (Figure 25). For the North West Cape division, it is unlikely that the apparent increase in nesting activity is artefact of survey error associated with track counts due to the high survey coverage since the 2003-04 nesting season. Survey error associated with converting from the number of tracks to the number of clutches laid may still be present within the North West Cape division, but would require an opposing downward trend in nesting success if the apparent trend in nesting abundance is artefact of survey error.

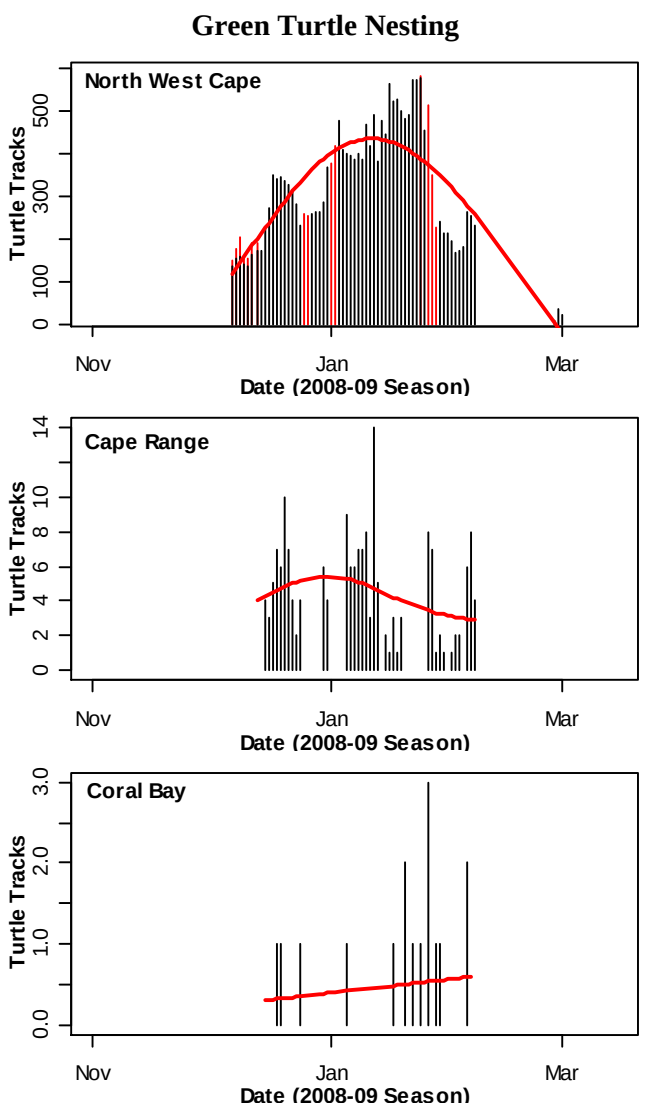


Figure 14. Nesting abundance and seasonal distribution fit for green turtles during 2008-09.
Data shown in red are interpolated as no data were available. Red line refers to generalized additive model fit with 4 degrees of freedom and no seasonal constraints.

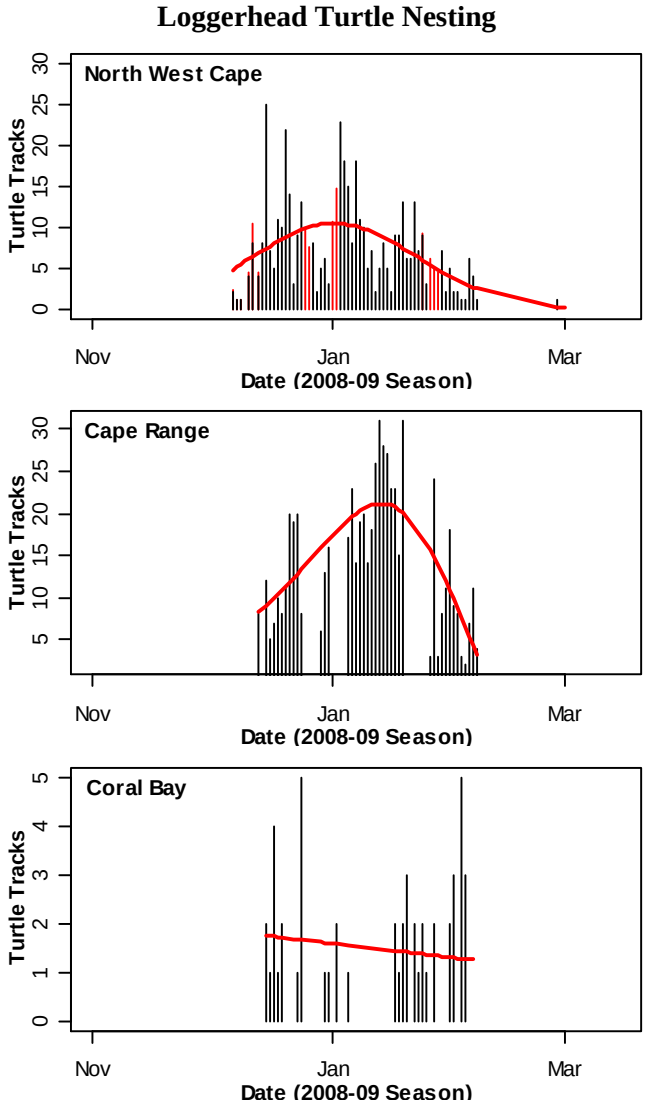


Figure 15. Nesting abundance and seasonal distribution fit for loggerhead turtles during 2008-09.
Data shown in red are interpolated as no data were available. Red line refers to generalized additive model fit with 4 degrees of freedom and no seasonal constraints.

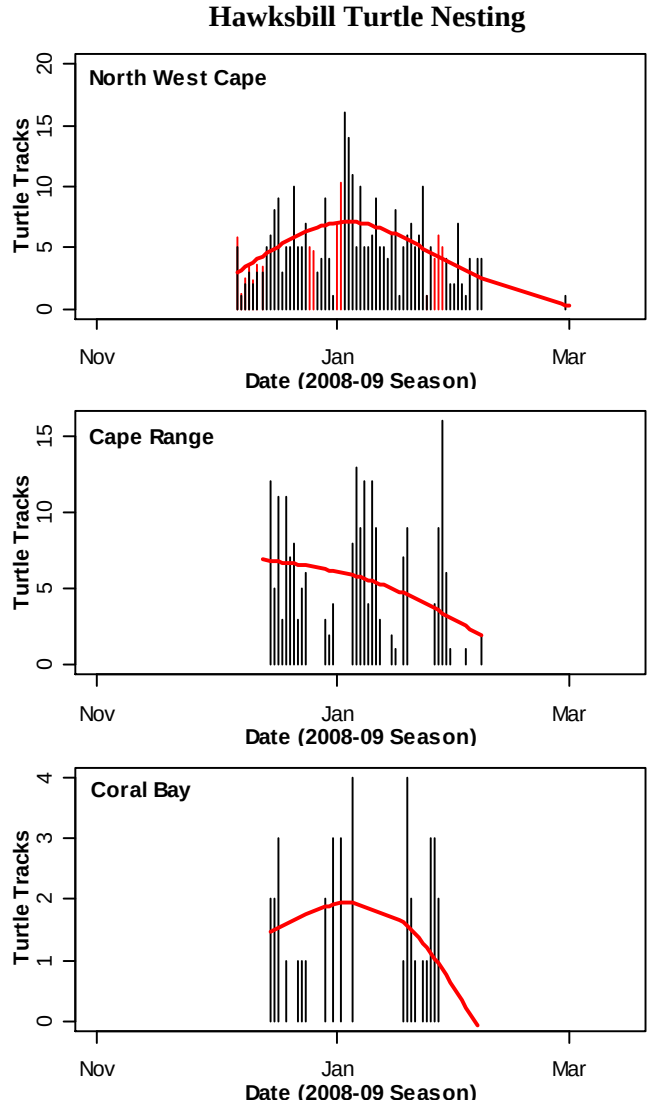


Figure 16: Nesting abundance and seasonal distribution fit for hawksbill turtles during 2008-09.
Data shown in red are interpolated as no data were available. Red line refers to generalized additive model fit with 4 degrees of freedom and no seasonal constraints.

Unidentified Turtle Species Nesting

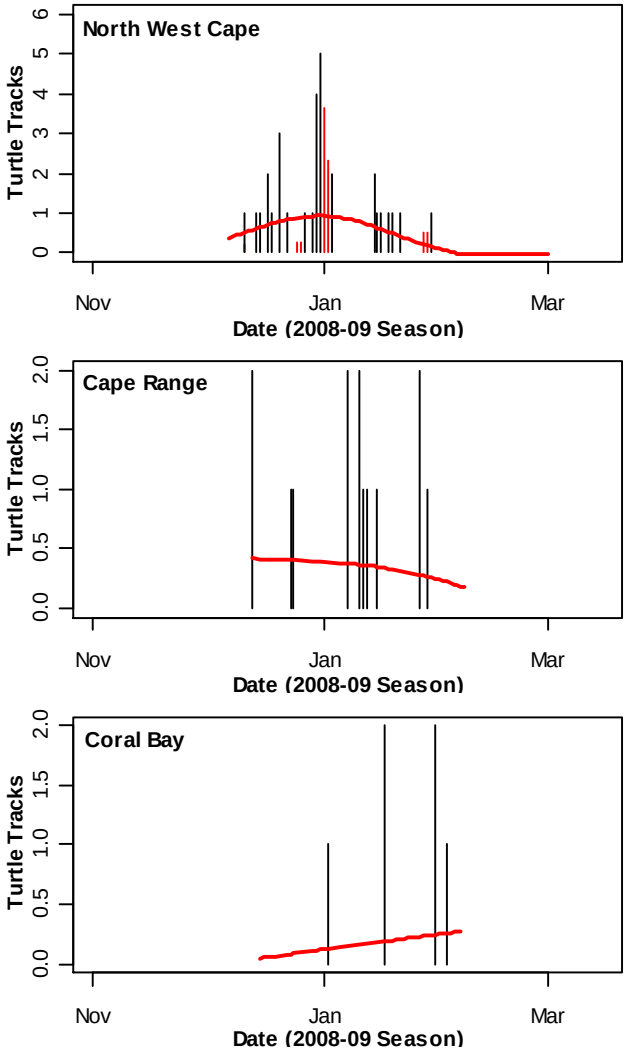


Figure 17: Nesting abundance and seasonal distribution fit for unidentified turtle species during 2008-09.
Data shown in red are interpolated as no data were available. Red line refers to generalized additive model fit with 4 degrees of freedom and no seasonal constraints.

Green Turtle Nesting by Section for the North West Cape Division

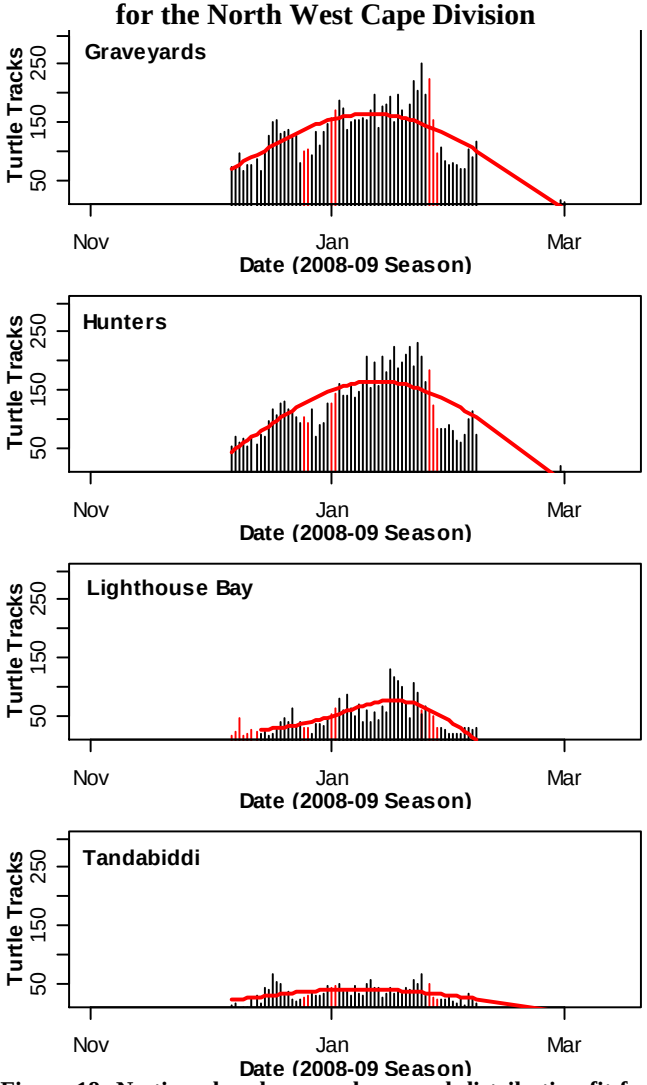


Figure 18: Nesting abundance and seasonal distribution fit for green turtles by section during 2008-09.
Data shown in red are interpolated as no data were available. Red line refers to generalized additive model fit with 4 degrees of freedom and no seasonal constraints.

Loggerhead & Hawksbill Turtle Nesting (Combined)

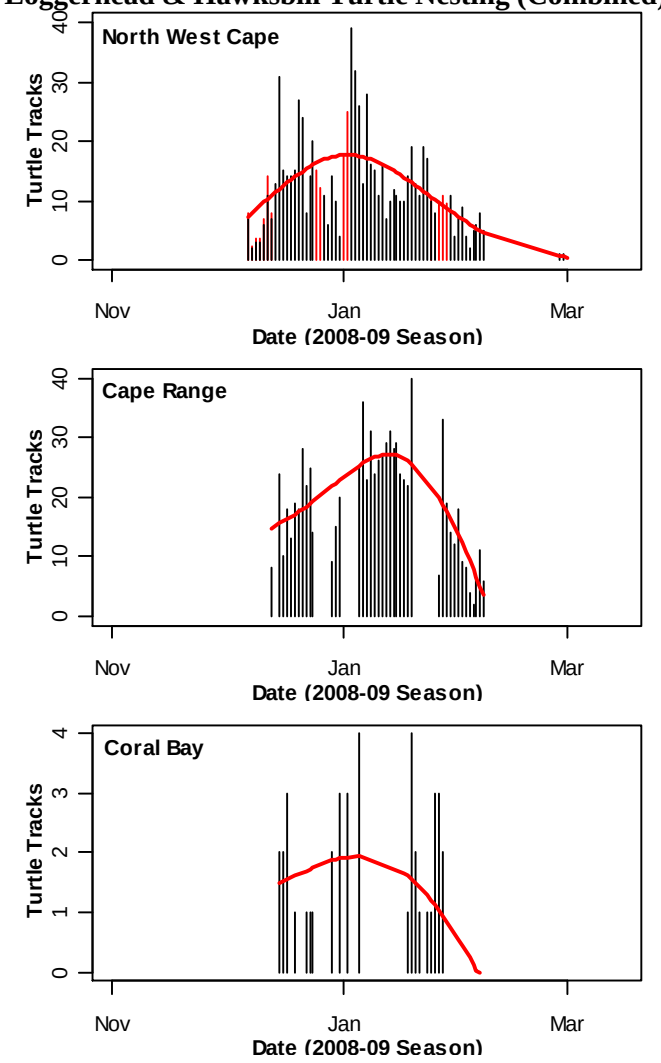


Figure 19. Nesting abundance and seasonal distribution fit for loggerhead and hawksbill turtle species during 2008-09. Data shown in red are interpolated as no data were available. Red line refers to generalized additive model fit with 4 degrees of freedom and no seasonal constraints.

Seasonal distribution in nesting (total tracks) for green, loggerhead and hawksbill turtles nesting at North West Cape within the Ningaloo Region

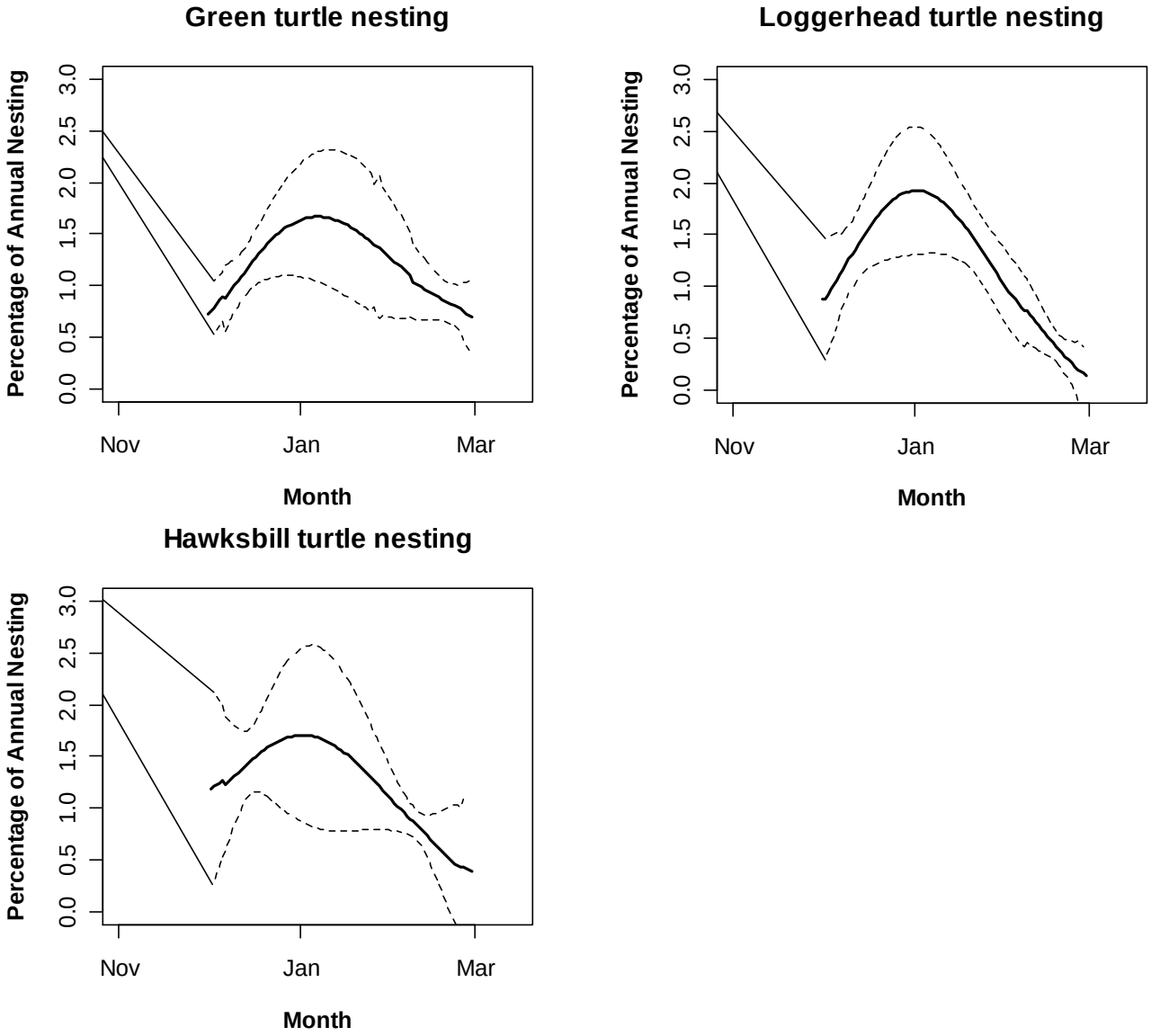


Figure 20: Seasonal distribution in nesting for green, loggerhead and hawksbill turtles at North West Cape using mean gam smoothing spline from 2003-04 to 2008-09. Dashed lines refer to 95% confidence intervals.

Total number of turtle tracks for green, loggerhead and hawksbill turtles nesting at North West Cape and Cape Range divisions within the Ningaloo Region

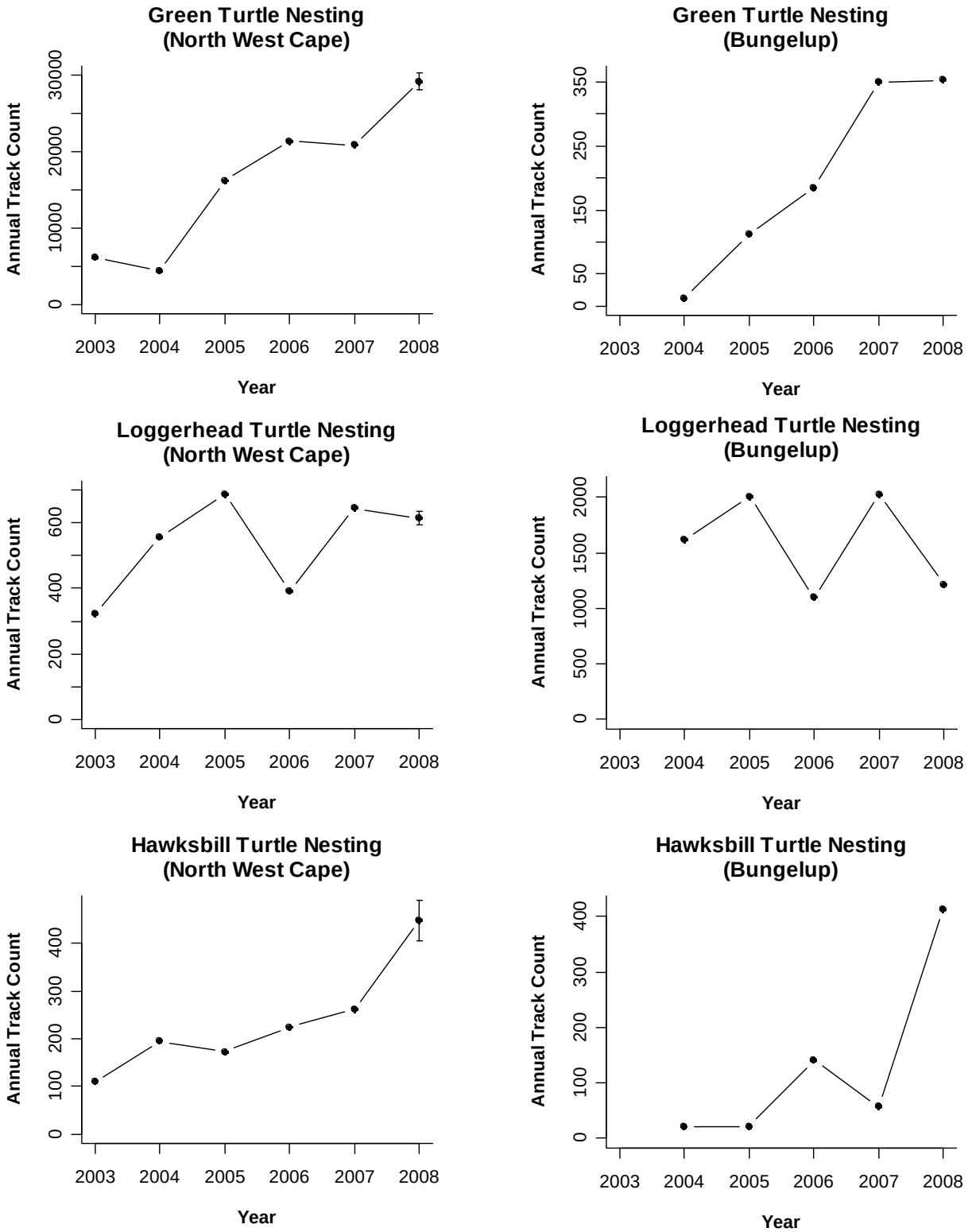
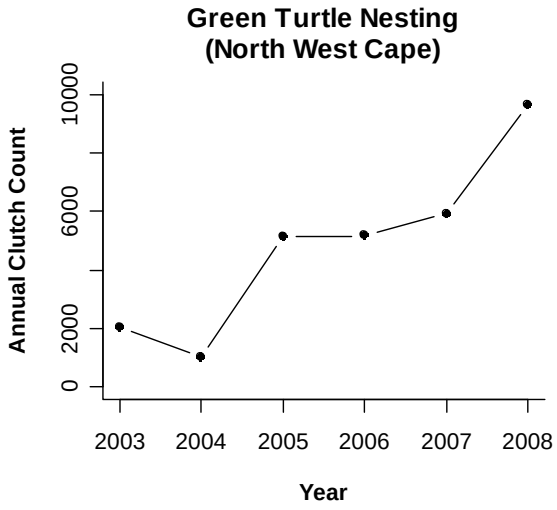
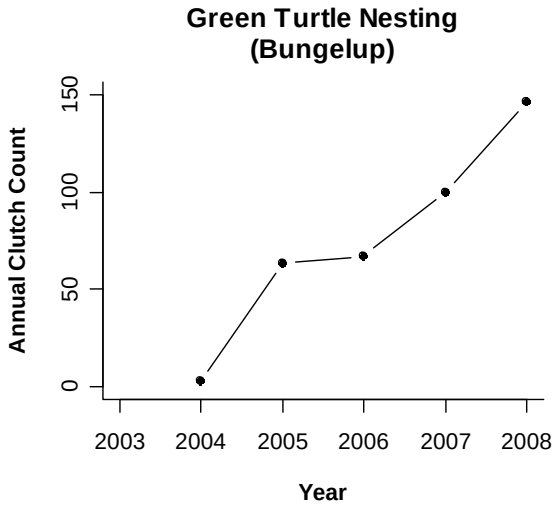


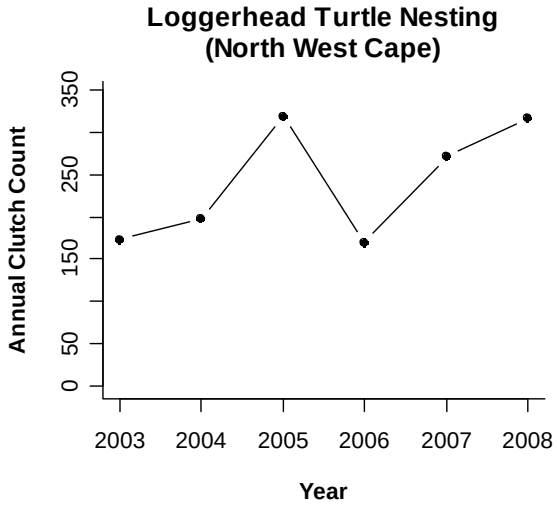
Figure 21: Number of turtle tracks for turtles nesting at North West Cape and Cape Range divisions within the Ningaloo Region. Annual abundance data were estimated for the entire years nesting assuming the season is mostly restricted to between 15

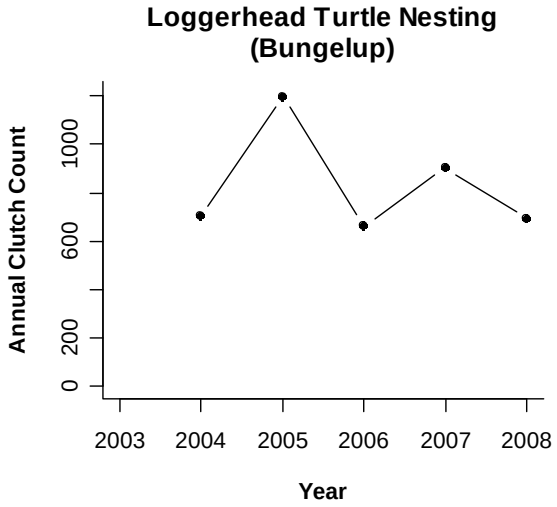
November and 15 March. Data for 2008-09 were estimated using linear regression models and generalized additive models and the mean of both methods is displayed with estimated sampling error in predicting nesting between 1 Dec and 28 Feb.

Total number of clutches laid for green, loggerhead and hawksbill turtles nesting at North West Cape and Cape Range divisions within the Ningaloo Region









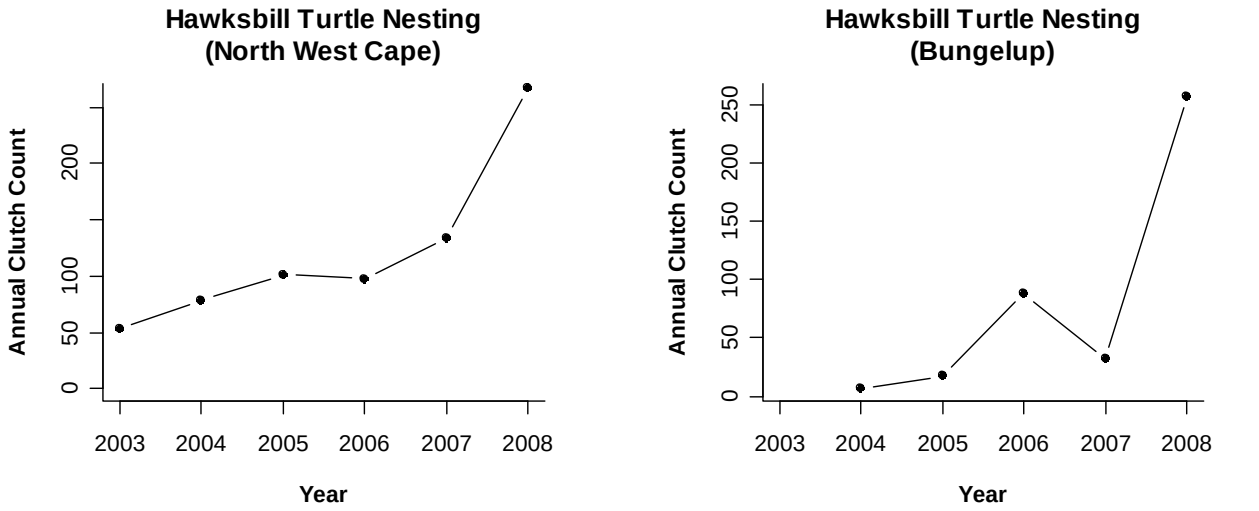
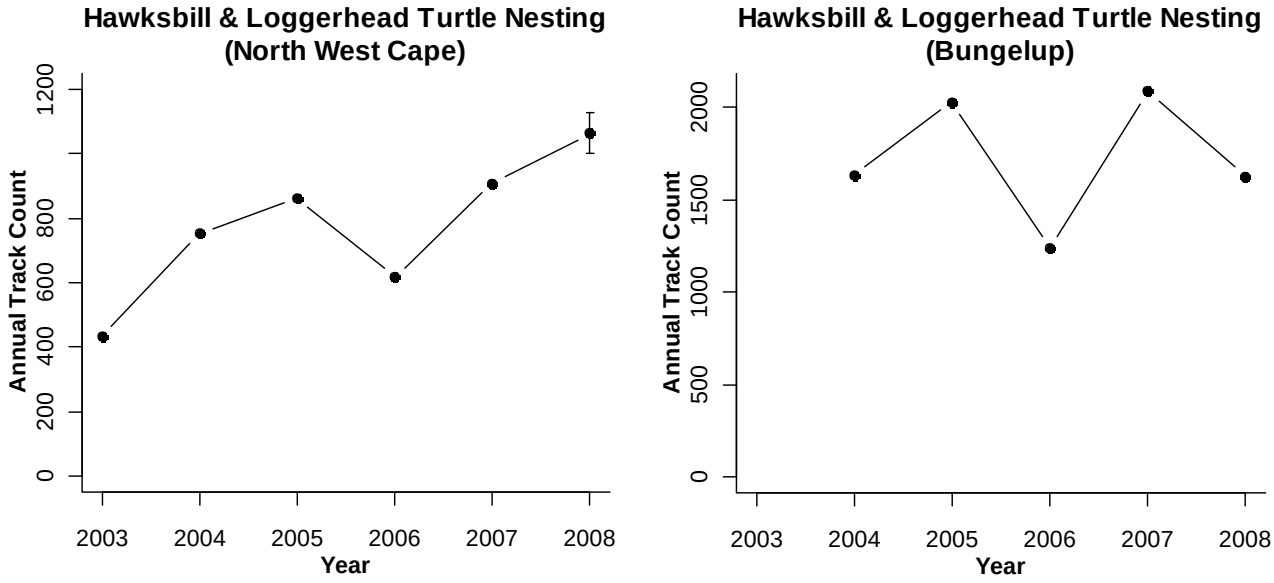


Figure 22: Number of clutches laid for turtles nesting at North West Cape and Cape Range divisions within the Ningaloo Region. Annual abundance data were estimated for the entire years nesting assuming the season is mostly restricted to between 15 November and 15 March. Data for 2008-09 were estimated using linear regression models and generalized additive models and the mean of both methods is displayed.



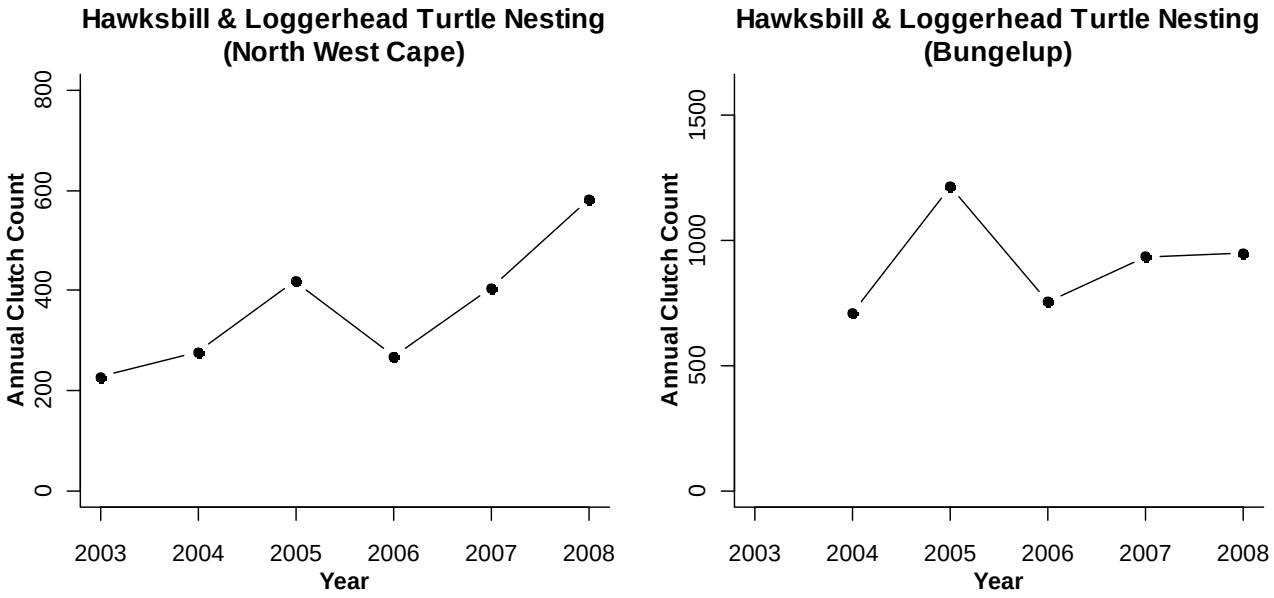


Figure 23: Number of total tracks and clutches laid for turtles nesting at North West Cape and Cape Range divisions within the Ningaloo Region. Annual abundance data were estimated for the entire years nesting assuming the season is mostly restricted to between 15 November and 15 March. Data for 2008-09 were estimated using linear regression models and generalized additive models and the mean of both methods is displayed.

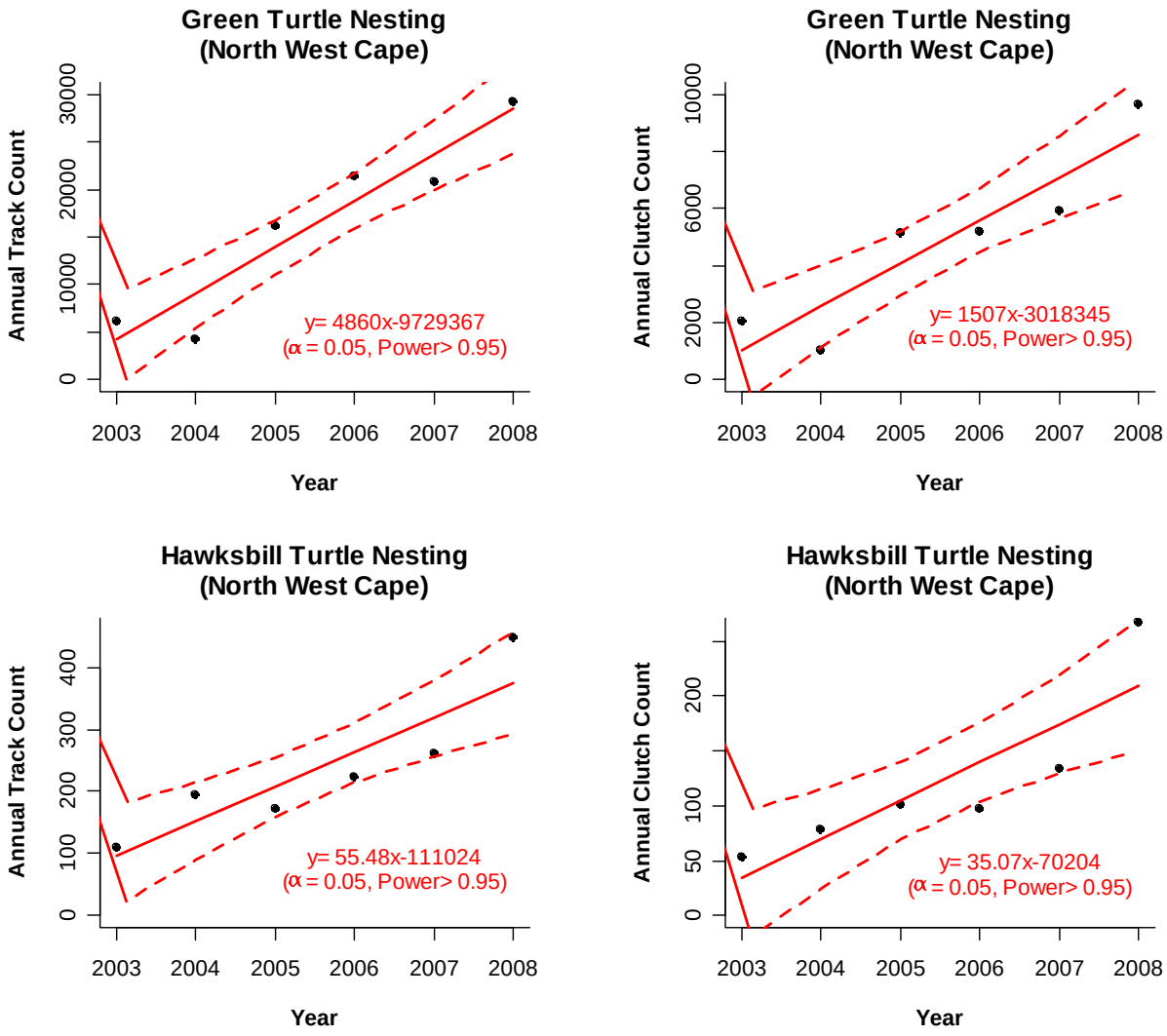


Figure 24: Linear regression between annual track counts and year, showing positive trends for green and hawksbill turtles nesting at North West Cape. Dashed line refers to 95% confidence intervals of trend line.

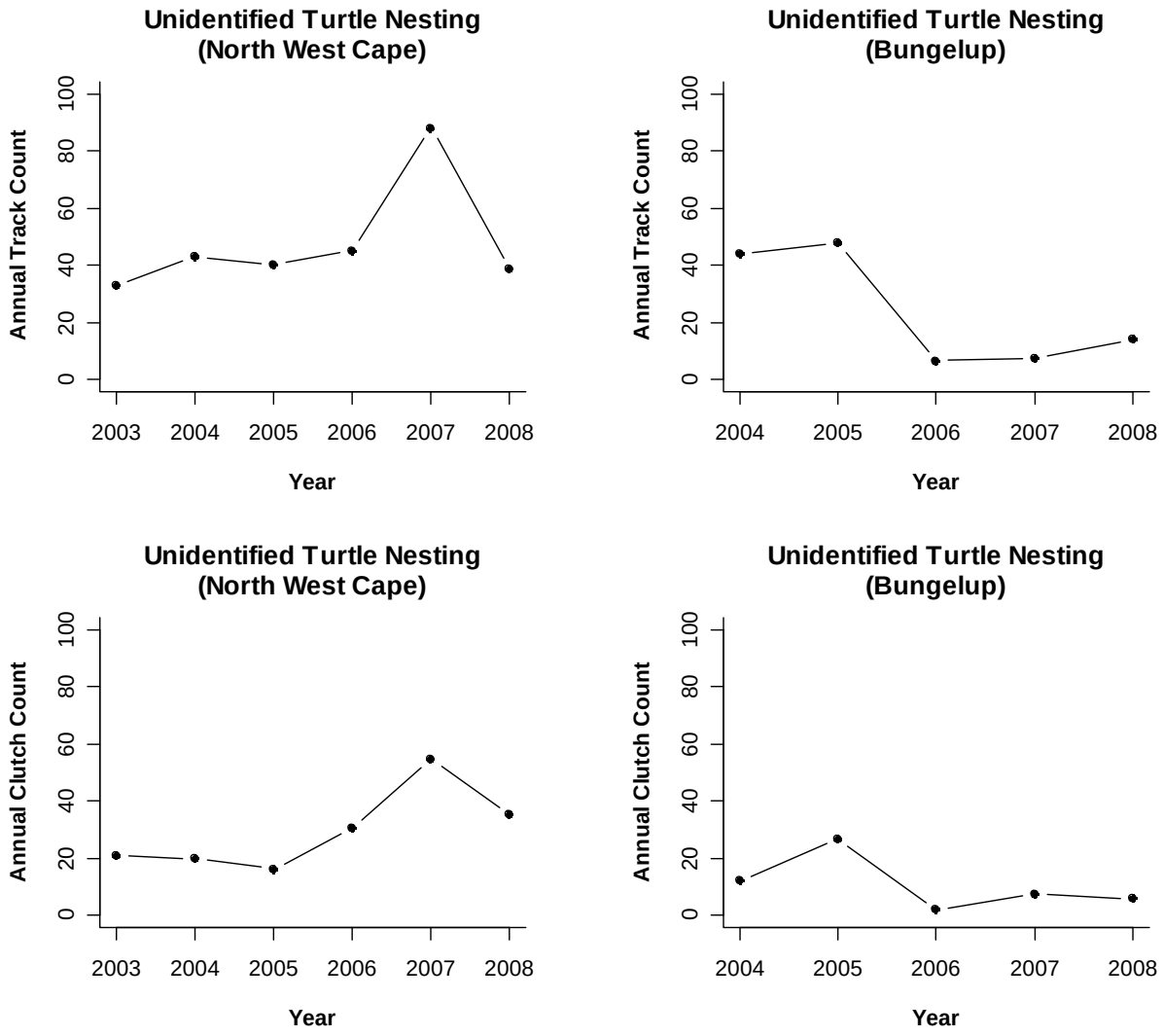


Figure 25: Number of tracks and number of clutches laid for unidentified turtle species nesting at North West Cape and Cape Range divisions within the Ningaloo Region. These are absolute counts rather than counts using modeling, and reflects the trend in nesting rather than estimated abundance.

Table 12 shows a summary of recorded turtle nesting activity during the 2008-09 nesting season.

Table 12: Total numbers of turtles 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 Cape	Graveyards	2898	4530	67	45	57	27	0	0	9	2
	Hunters	1809	5266	110	115	84	64	1	1	10	0
	Lighthouse Bay	516	1901	31	41	36	23	0	0	8	1
	Tandabiddi	992	799	6	0	1	2	0	0	0	0
		6215	12496	214	201	178	116	1	1	27	3
7.2.1.1.2	*7.2.1.1.3 Sub-Total*										
Cape Range	Bungelup	73	105	340	263	131	77	0	0	6	8
		73	105	340	263	131	77	0	0	6	8
	7.2.1.1.3.1.1.										
Coral Bay	Batemans Bay	5	3	17	13	16	8	0	0	1	0
	Lagoon	4	4	9	9	11	6	0	0	4	1
		9	7	26	22	27	14	0	0	5	1
	7.2.1.1.3.1.1.										

Total **7.2.1.1.3.1.1.**	6297	12608	580	486	336	207	1	1	38	12

Nesting success

Nesting success was higher for all species during the 2008-09 season than the average values from 2002-2008 (Figure 26; Table 12).

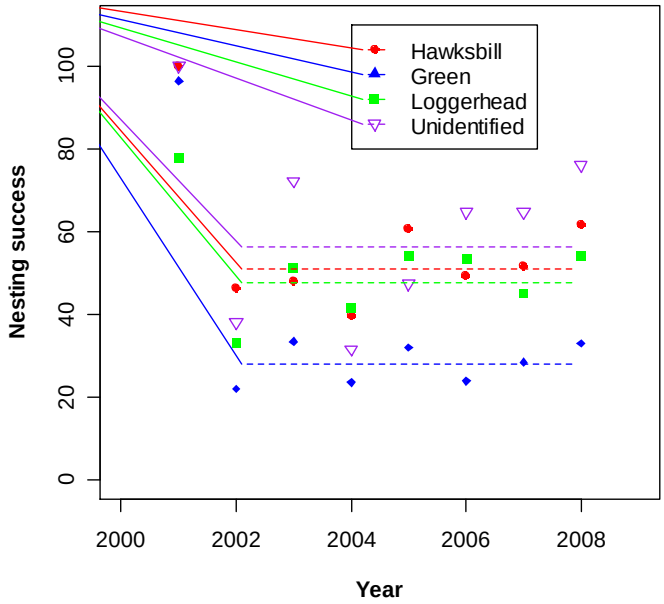


Figure 26: Nesting success for green, loggerhead, hawksbill and unidentified turtle species for North West Cape and Cape Range divisions. Dashed lines show mean values from 2002-2008.

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 for green turtles was lower than for hawksbill or loggerhead turtles (Figure 27).

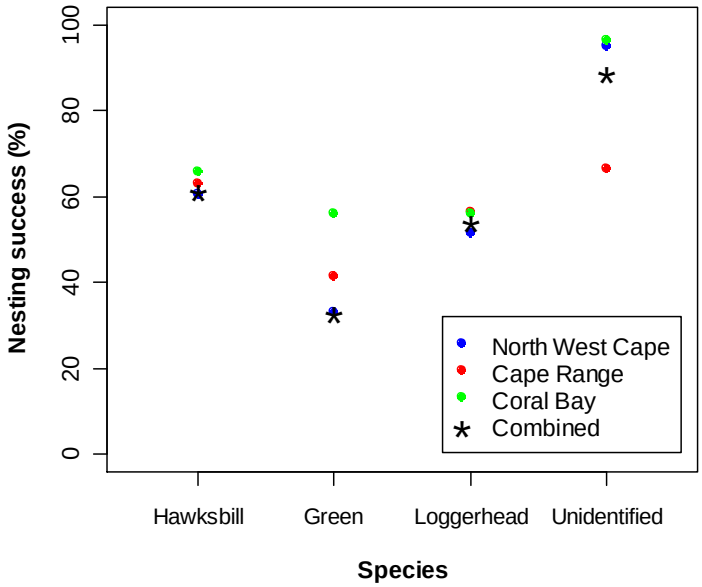


Figure 27: Nesting success for green, loggerhead, hawksbill and unidentified turtle species within each division.

Table 13: 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
Green									
	North West Cape	100.0	22.3	33.4	23.5	32.0	23.9	28.5	33.2
	Cape Range	27.3	9.5	50.0	34.7	47.0	31.0	28.5	41.0
	Coral Bay	-	40.0	40.0	20.0	36.4	20.0	56.8	56.3
Loggerhead									
	North West Cape	100.0	33.3	51.1	35.5	46.1	43.2	42.3	51.6
	Cape Range	48.9	33.0	51.2	43.7	58.0	59.4	46.4	56.4
	Coral Bay	-	54.2	57.1	62.3	27.8	48.8	57.8	54.2
Hawksbill									
	North West Cape	100.0	45.0	50.0	41.2	58.1	43.4	50.6	60.5
	Cape Range	66.7	30.0	31.3	86.7	63.8	58.1		63.0
	Coral Bay	-	100.0	90.6	53.3	50.0	59.3	54.1	65.9
Unidentified									
	North West Cape	100.0	35.0	68.4	46.5	40.0	67.4	63.3	90.0
	Cape Range	100.0	100.0	81.3	23.4	54.8	50.0	75.0	42.9
	Coral Bay	-	50.0	100.0	100.0	50.0	0.0	-	83.3

Nesting success fluctuated within the season, but there was no apparent overall seasonal trend across the divisions for each species (Figure 26Figure 27Figure 28Figure 29; Figure 30Figure 31).

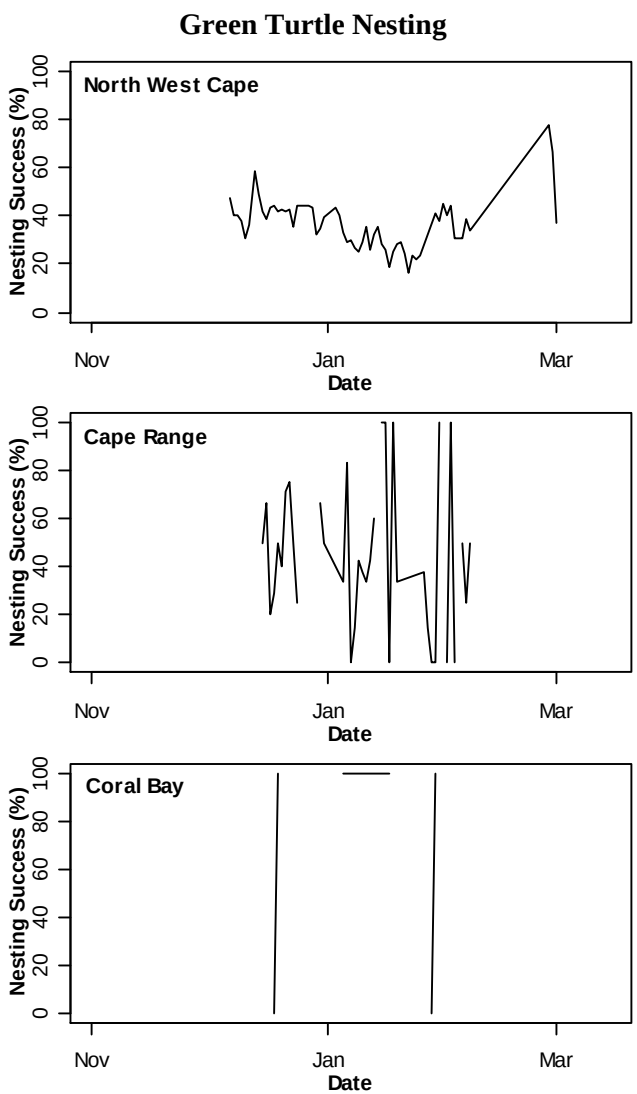


Figure 28: Nesting success for green turtles during 2008-09.

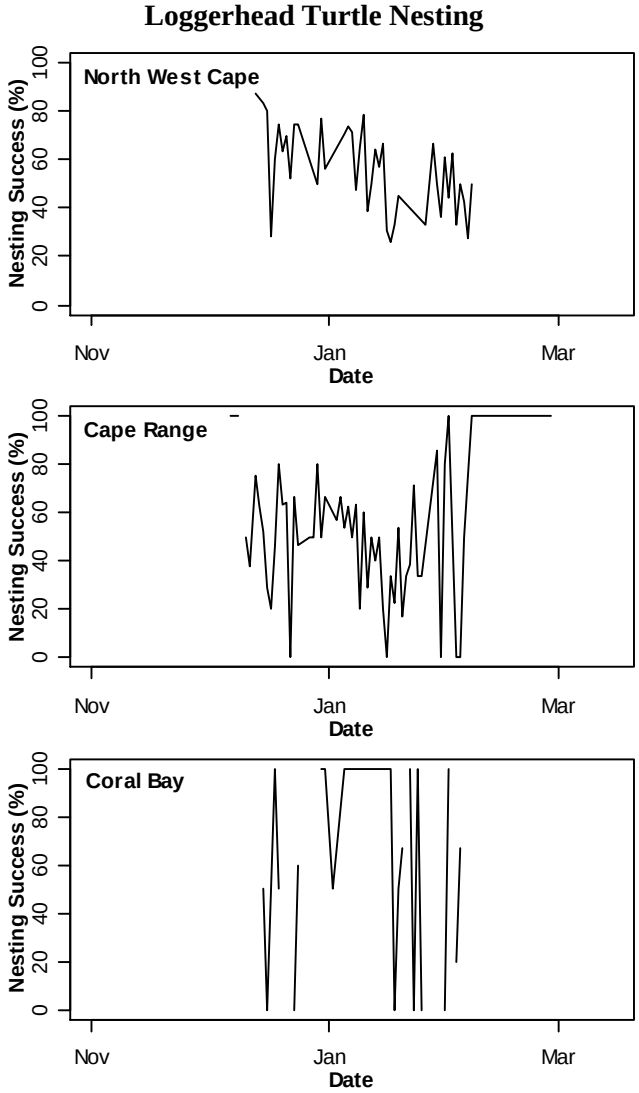


Figure 29. Nesting success for loggerhead turtles during 2008-09.

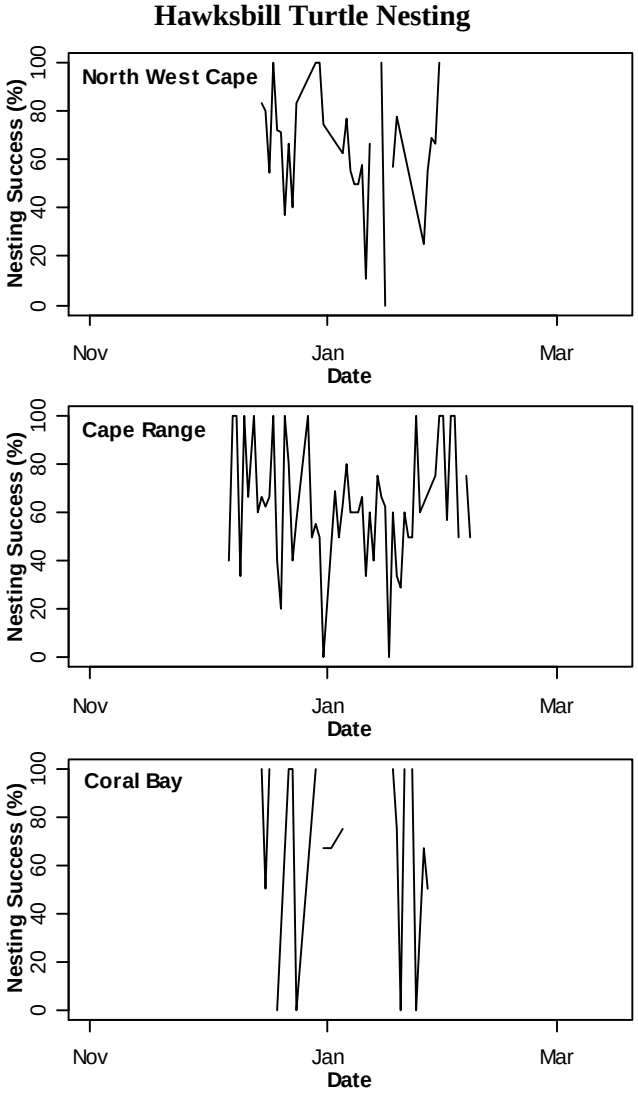


Figure 30. Nesting success for hawksbill turtles during 2008-09.

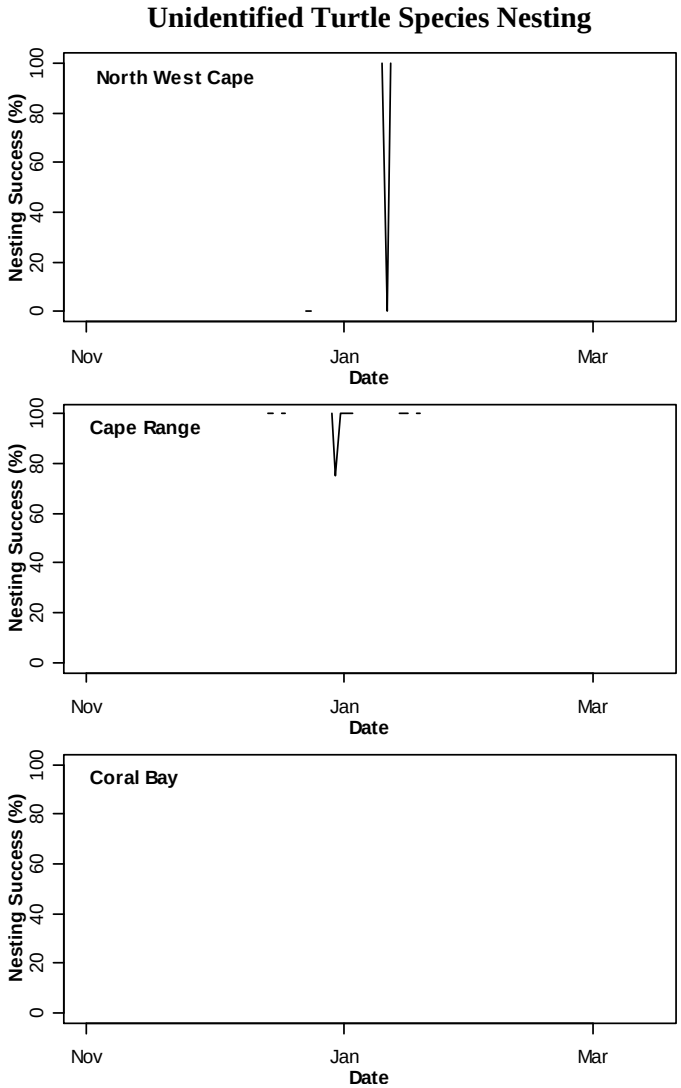


Figure 31: Nesting success for unidentified turtle species during 2008-09.

Annual number of nesting turtles

Total estimated number of green, loggerhead and hawksbill turtles nesting annually at North West Cape and Cape Range divisions within the Ningaloo Region

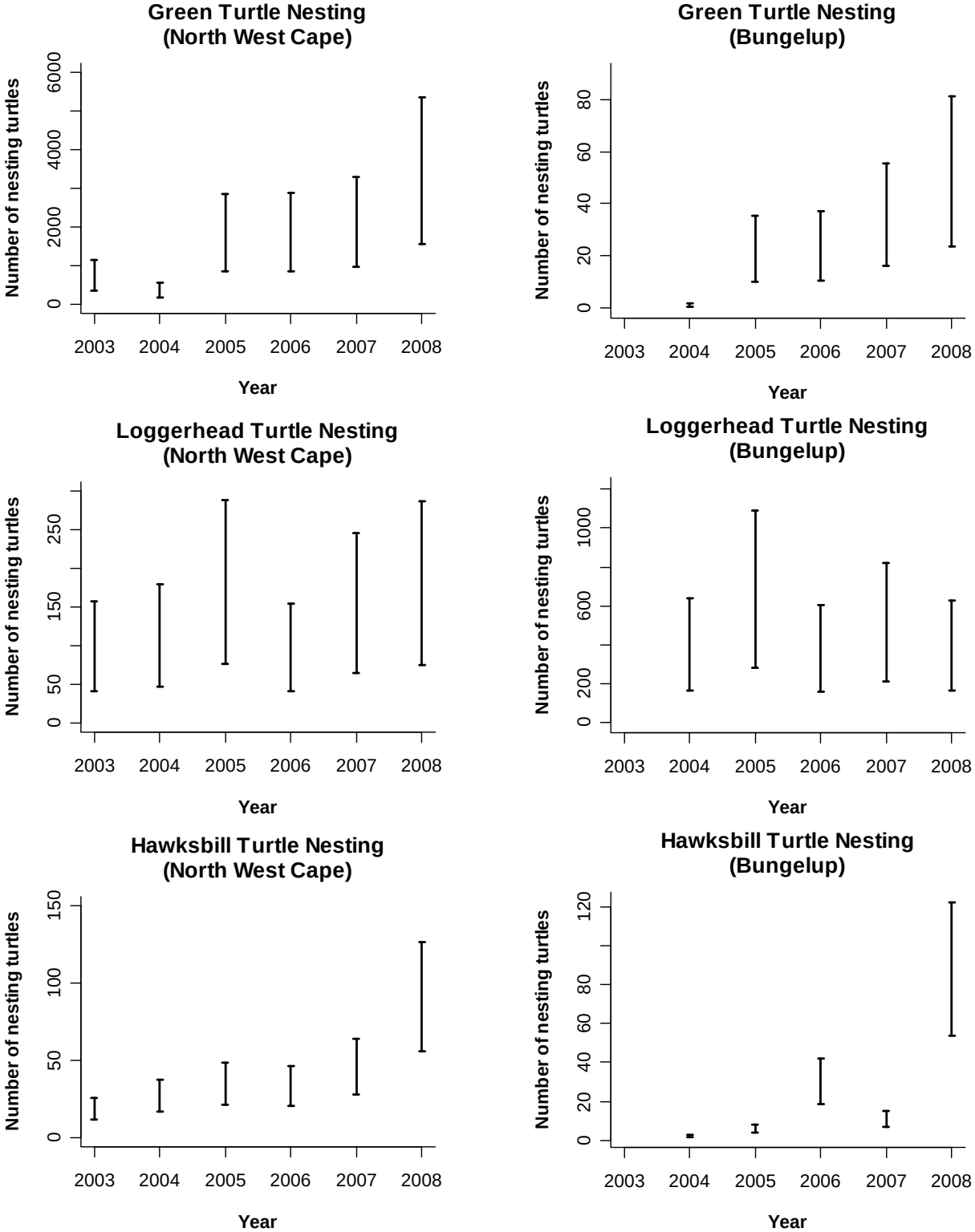


Figure 32: Number of turtle tracks for turtles nesting at North West Cape and Cape Range divisions within the Ningaloo Region. Annual abundance data were estimated for the entire years nesting assuming the season is mostly restricted to between 15 November and 15 March. Data for 2008-09 were estimated using linear regression models and generalized additive models and the mean of both methods is displayed. The range shows the minimum and maximum expected number of turtles using clutch frequencies from populations in Table 14.

Table 14: Estimated clutch frequencies (ECF; number of clutches per female per year) for populations of green, loggerhead and hawksbill turtles.

Species	*7.2.1.1.3.1.1.2 Location*	ECF (mean ± SD)	N	Reference
7.2.1.1.3.1.1.3 Green	Ascension Island	3.0		van Buskirk and Crowder (1994)
	Aves Island, Virgin Islands	2.61		van Buskirk and Crowder (1994)
	Bramble Cay, Torres Strait	6.2 ± 2.1	684 turtles; 1 yr	Limpus *et al.* (2001)
	Florida USA	3.0		Johnson and Ehrhart (1996)
	French Frigate Shoals, Hawaii	1.8		van Buskirk and Crowder (1994)
	Heron Island, Queensland	5.1 ± 2.0	878 turtles	Limpus (2007)
	Mediterranean	2.9 – 3.1		Broderick *et al.* (2002)
	Michoacán, México	3.1		Alvarado-Diaz *et al.* (2003)
	Northern Cyprus	3.0 ± 1.4	6 years	Broderick *et al.* (2003)
	Sarawak Malaysia	4.1		Hendrickson (1958)
	Surinam	2.9		Schultz (1975)
	Tortuguero, Costa Rica	2.8		van Buskirk and Crowder (1994)
	Range	**1.8 – 6.2**		
7.2.1.1.3.1.1.4 Loggerhead	Bald Head Island USA	2.1 ± 0.2	13 years	Hawkes *et al.* (2005)
	Cape San Blas, Florida USA	1.35	111 turtles	M.M. Lamont (unpublished data) in Schroeder *et al.* (2003)
	Colombia	1.12	80 turtles	Kaufmann (1975)
	Georgia, USA	2.81 – 4.18	10 years	Frazer and Richardson (1985)
	Georgia, USA	4.1	427	Murphy and Hopkins (1984) in Schroeder *et al.* (2003)
	Key Island Florida USA	3.9	521	Addison
	Mediterranean	1.8 – 2.2		Broderick *et al.* (2002)
	Miyazaki, Japan	1.1	199 turtles	Iwamoto *et al.*(1985)
	Mon Repos, Queensland	3.4 ± 1.2	1207 turtles	Limpus (1985)
	Northern Cyprus	1.9 ± 1.2	6 years	Broderick *et al.* (2003)
	South Brevard County	3.24	236 turtles	L.M. Ehrhart (unpublished data) in Schroeder *et al.* (2003)
	Tongaland, Africa	3.65-4.21	241-321 turtles	Hughes (1974) in Schroeder *et al.* (2003)
	Yakushima, Japan	2.1	358 turtles	Nishimura (1994)
	Zakynthos, Greece	1.18	148 turtles	Margaritoulis (1982); Margaritoulis (1983) in

				Schroeder *et al.* (2003)
7.2.1.1.3.1.1.5		***Range***	**1.1 – 4.21**	
7.2.1.1.3.1.1.6 Hawksbill	Buck Island, Virgin Islands	3.1		van Buskirk and Crowder (1994)
	Campbell Island Queensland	~ 3		Limpus *et al.* (1983)
	Campeche, México	3.1		Guzmán *et al.* (1996) in Garduño-Andrade *et al.* (1999)
	Cousin Island, Seychelles	~ 3.6		Mortimer and Bresson (1999)
	Jumby Bay, Antigua	4.5; 3.0 – 4.8		Hoyle and Richardson (1993); Richardson *et al.* (1999)
	Milman Island Queensland	>2.4 ± 1.4	2731 turtles	Loop *et al.* (1995); Dobbs *et al.* (1999); Miller *et al.* (2008);
	Tortuguero, Costa Rica	2.1		van Buskirk and Crowder (1994)
	Yucatán, México	2.1		Garduño (1998) in Garduño-Andrade *et al.* (1999)
		Range	**2.1 – 4.8**	

8.0 NTP SUMMARY

8.1 Volunteer Participation

The NTP provides the opportunity for members of the local community and visitors from Australia and abroad to actively take part in turtle conservation. As such the program has been very effective in raising the local community's awareness of turtle conservation. Similarly, the development of the NTP website has helped to inform people worldwide about the NTP, with emails received daily from people internationally, interested in participating in the program.

Participation with the NTP gives volunteers the opportunity to undertake scientific monitoring, contribute to turtle conservation, meet likeminded people and gain practical experience to further advance their passion or career. Since commencement of the NTP, a total of 38, 913 hours have been contributed by volunteers. This figure alone demonstrates the significance of volunteers for sustainability of the program.

8.2 Survey Effort and Long-Term Monitoring

In 2008 all NTP data across years was modelled to determine the survey effort required to detect trends in the abundance of nesting female turtles. Andrea Whiting (2008), found that the duration of monitoring by the NTP could be reduced significantly by only carrying out monitoring over an intensive 28 day period focusing on the peak of the nesting season (early – late January) in conjunction with intermittent monitoring of 2 days in a row outside of this period. Although, there was some variation between years in the seasonal distribution of nesting, a reduction in monitoring effort would still be sufficient to detect changes in overall nesting turtle abundance across years.

8.3 Predation

The presence and level of predation by the European red fox

Foxes have been present on the beaches within the Ningaloo region since the 1960s and without the implementation of fox control programs they could potentially destroy a large percentage of turtle nests (Limpus 2002; Dean 2003; Mckinna Jones 2005). Consequently, fox control has been flagged as a key management strategy under the Ningaloo Marine Park Management Plan 2005-2015. This involves the controlled distribution of 1080 poison (sodium fluoroacetate) in the form of dried meat baits, which aims at reducing the amount of foxes within the area and subsequently reducing nest damage.

During the 2008-2009 NTP season foxes were recorded as accounting for 25 % of all damaged nests within the Ningaloo region. An additional 39 % of damaged nests recorded, where the actual cause of predation could not be identified (predator print unknown), indicating that fox predation percentage was most likely higher that result stated.

Since monitoring began in 2002, foxes and dogs have damaged 48 % of disturbed nests in the Ningaloo region (excluding ghost crab predation, see Figure 12). However, overall the level of disturbance to turtle nests by foxes in the region has remained below 5 percent since the 2004-2005 season. Loss of up to 5 % of nests to foxes and dogs/dingoes is considered sustainable to the overall production of nests (Flakus 2002) demonstrating that the NTP has achieved a reduction of fox predation to a sustainable level. However, it is important to note that during the 2003-2004 season fox predation along the 5 Mile Beach subsection (within the NW Cape division) was at its highest during March (McKinna Jones 2005). Over the past four seasons (2004/05-2007/08) monitoring of turtle nesting beaches has not been carried out during March. For the 2008-2009 season, this included majority of February as well.

The presence of foxes has been steadily increasing since 2005-2006 in all divisions within the Ningaloo region. Dog presence recorded in the 2008-2009 season showed a slight decrease when compared to previous seasons with Coral Bay being the only division where nests were disturbed by dogs.

Ghost crabs: natural predators of marine turtle eggs and hatchlings in the Ningaloo region.

Ghost crabs (*Ocypode* spp) are known natural predators of marine turtle eggs (Hitchins *et al*.2004; Barton & Roth 2008). 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. Complicating the matter, research in the Seychelles found that ghost crab predation is not necessarily obvious at the surface of a nest and it was found by nest excavation that eggs had been depredated by crabs even though a crab hole had not been observed prior to the nest excavation (Hitchins *et al*.2004).

During the 2008-2009 season 11 percent of disturbed nests were recorded as being damaged by ghost crabs. 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. However due to difficulty in visually assessing a nest for ghost crab predation as abovementioned, this result was excluded from the total percentages of predation to nests 2008-2009 season. Ghost crabs are natural predators at Ningaloo and research is required to determine the dynamics of ghost crab predation and nesting turtle populations at Ningaloo over space and time.

8.4 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. The hot temperatures that occur during the summer months along the Ningaloo coast mean that stranded turtles can quickly become dehydrated and overheat leading to death within a few hours following sunrise.

During the 2008-2009 season, 38 stranded female turtles were rescued and an additional 27 turtles were found deceased on the shoreline (of which 16 were adult female green turtles) (Table 7Table 8). Collectively the NTP has rescued 175 stranded turtles from 2002-2009 (Figure 13).

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.

9.0 CONCLUSION

The NTP was partially successful in meeting the objectives of the program in the 2008-2009 season:

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

Building on data from previous years a number of trends have been identified in turtle nesting activity within the Ningaloo region:

- Green and Hawksbill turtles have shown an upward trend in nesting activity since monitoring began. However, no observable trend has been identified for Loggerhead turtles.
- Nesting success is higher for Hawksbill and Loggerhead species compared to the Green turtle. The reason for lower Green turtle nesting success is unknown.
- In general, peak nesting activity occurs from early January to late January for each of the three species.

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

- 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 within the Bundera division, then followed by the Coral Bay division.
- Gnaraloo Bay is also considered significant loggerhead rookery; quantitative data was collected by through the Gnaraloo Bay Marine Turtle Survivorship Project and will be provided to the NTP for comparison.

9.3 Objective 3: Establish the level of predation on nests

- Data collected on nest disturbance by fox's assists DEC to target fox control in areas of high nest disturbance, thereby, decreasing the number of turtle nests damaged by foxes. Disturbance to nests has been less than 5 % of the total number of nests since 2004-2005.
- Fox presence has been steadily increasing in the region since 2005.
- Predation of turtle eggs by ghost crabs (natural predator), requires further investigation to establish if it is likely to be having a negative effect on hatchling production.

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

- This objective has been addressed through the development of the Jurabi Turtle Centre Program. Funding support is provided by Woodside Energy Ltd and Mitsui Ltd (2009 to 2011) through the Community Partnerships Program to assist DEC in the development of a sustainable guided interaction experience using TAFE accredited turtle tour guides.

9.5 Additional NTP Achievements 2002 - 2009

- Production of the NTP monitoring field guide and monitoring training videos. These resources were widely distributed to a range of community turtle projects around the world.
- The NTP continues to support marine turtle monitoring programs throughout Western Australia.
- Provided locations of rookeries to improve OSRA data (Oil Spill Contingency Atlas) and supported potential oil spill response planning activities.
- Provided data to implement restrictions of beach access for 4WD vehicles, in consuktation with the community.

- Data collected provides details on nest abundance and distribution that assists government agencies in planning for the future including tourism development,
- Data collected provided confirmation that existing carparks accessible to foreshore areas within the Jurabi Coastal Park were significantly encroaching on turtle nesting habitat. As a result in 2009 Jacobsz access car park was re-located to behind the fore dune area.
- The rescue of 175 stranded female turtles within the Ningaloo region (2002-2009).

The program will continue to collect data on nesting female turtles within the Ningaloo region in the coming years, providing long-term trend data to assist managers to identify turtle population recovery goals and to monitor the stability of local populations in the area.

10.0 GENERAL PROGRAM RECOMMENDATIONS

Recommendations for the 2008-09 NTP season include aspects of monitoring, research, and issues pertaining to the program and are outlined below.

10.1 Volunteer Coordination

Volunteer Participation

- Consider a fee structure associated with participation in the program by external volunteers. This would provide a cost recovery for volunteer accommodation, food, transport and general administrative expenses. This would alleviate issues associated with limited funding opportunities for the NTP.
- 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 2009-2010 NTP season.
- Due to the decrease in survey effort in future monitoring seasons, allow for a reduction in the number of volunteers required to participate in the program. Twelve volunteers per group were sufficient to run the NW Cape division and the remote camp at Bungelup (Cape Range division) in the 2008-09 season. If the same monitoring activities are to take place in upcoming seasons the same number of volunteers per group should be adequate.
- Expand capacity of local trainers and assessors prior to the arrival of the external volunteers. This will greatly reduce the work load of the coordinator and the other key trainers.

Field Data Collection

- Ensure volunteer accuracy in track and nest identification by carrying out concurrent cross-checks of nesting beaches and comparisons of data sheets. Ensure volunteers fill in data sheets accurately. Crosscheck data sheets on a daily basis and hold regular meetings with the volunteers regarding data recording issues. Update the Data Recording: common mistakes register located on the DEC server.
- Clarify understanding of monitoring techniques and data collection with all trainers and volunteers to 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 camp to expand knowledge base of loggerhead track identification.
- Train volunteers on how to use clipboard sheets and laminates prior to field training. A brief introduction on this information could be conducted during the GPS and radio training session..
- Provide local volunteers with radio and GPS training as for external volunteers.
- 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 enquiry list in the NTP email account. 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 operations.
- Continue to rotate team leaders through the Bungelup remote camp.

Coral Bay Operations

- Re-consider the benefits of monitoring Coral Bay subsections in achieving the NTP goals.

- Employ a part-time Volunteer Coordinator to oversee monitoring and volunteer management in Coral Bay.
- Continue to provide adequate training for Coral Bay volunteers. For example hold a weekend training camp at Bungelup - this year's camp was very successful and proved a great team building exercise.
- In addition, all new volunteers should attend at least one training session in Exmouth and a morning of familiarisation monitoring in Coral Bay with a local trainer. This ensures that the volunteers are committed to participating on the program.

Data Management

- Redesign the NTP data sheets to include separate columns for predator tracks: one for tracks/signs pertaining to possible causes of predation or nest damage (surrounding disturbed nests), and one for potential predator tracks seen within a 5m radius of all nests. This will eliminate some of the confusion in the database and create more concise data in relation to predation issues for the analysis stage.
- Consider including damage by other turtles and tide damage as additional options in the column for causes of nest disturbance.
- 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. Make clear, consistent instructions for data entry e.g. protocol for mistakes
- Continue to cross-check data using a Microsoft Excel spreadsheet to data entered in the database.

Volunteer Education, Information and Communication

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

10.2 Field Monitoring

- Continue to monitor turtle activity along the NW Cape, Cape Range and Coral Bay divisions to indicate long-term trends. Opportunistic monitoring should continue within the Bundera division where possible.
- Base survey effort on the findings of Andrea Whiting (2008), Consolidation of the NTP.
- Include sampling in Carbaddaman and Boat Harbour, & validating nesting success by night time observations etc.

10.3 Predation Control

- Continue with the current DEC fox baiting program within the four divisions - NW Cape, Cape Range, Bundera and Coral Bay to maintain the current level of fox predation on nests within the Ningaloo region.
- Ensure fox control within the Bungelup section is adequate to reduce predation levels to less than 5% of observed nests.

- Determine nest predation levels during mid February to mid March for comparison with previous annual data collection.
- Further investigate the impacts of ghost predation on nesting success within the Ningaloo region.

10.4 Turtles Rescues

- Continue to conduct opportunistic turtle rescues (when required)
- Consider listing turtle stranding rescues as a program objective.
- Prioritise areas with significant numbers of turtle strandings and deaths recorded within previous seasons - Brookes to Graveyards, Jacobs South to Wobiri, 5 Mile to Trisel and Burrows to Jurabi Point sub-sections located in the NW Cape division.
- Incorporate rescue monitoring points into DEC operational works program

10.5 NTP Progress

- By reducing the survey effort of the program we would see a significant decrease in financial resource requirements for the duration of the program.
- Compile a report over-viewing NTP achievements, monitoring changes, and research conducted by students and other researchers that have been achieved over the past 8 years and future research goals.
- Review and update the NTP goals and objectives to reflect the progression and changes to the program which have occurred since monitoring began in 2002.

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12.0 APPENDIX

12.1 NW Cape Division

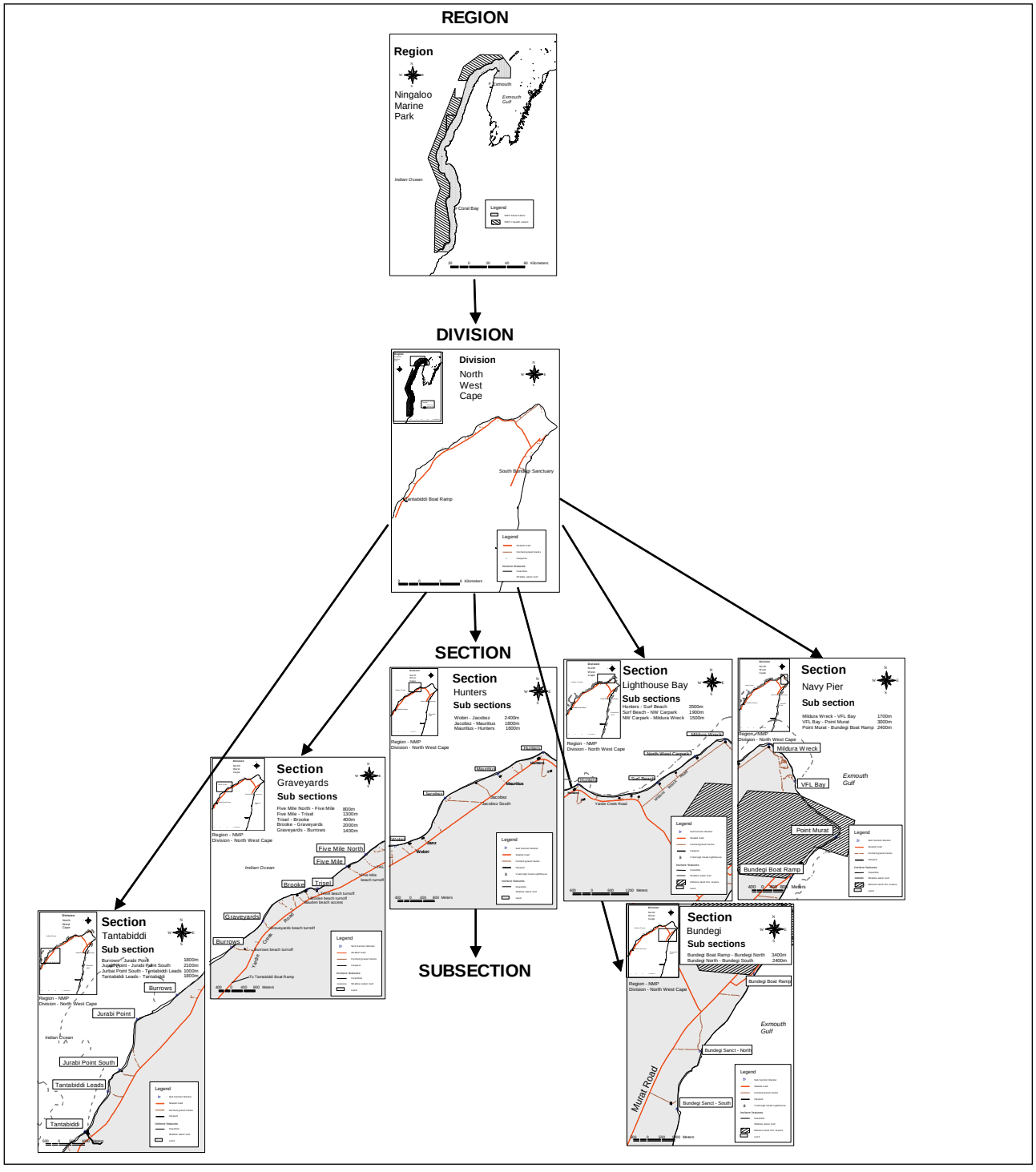

Figure 33: Hierarchical representation of the NW Cape Division.

Table 15: Location and distance of each subsection monitored during the 2008-09 season in the North West Cape division

Subsection	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

12.2 Cape Range Division

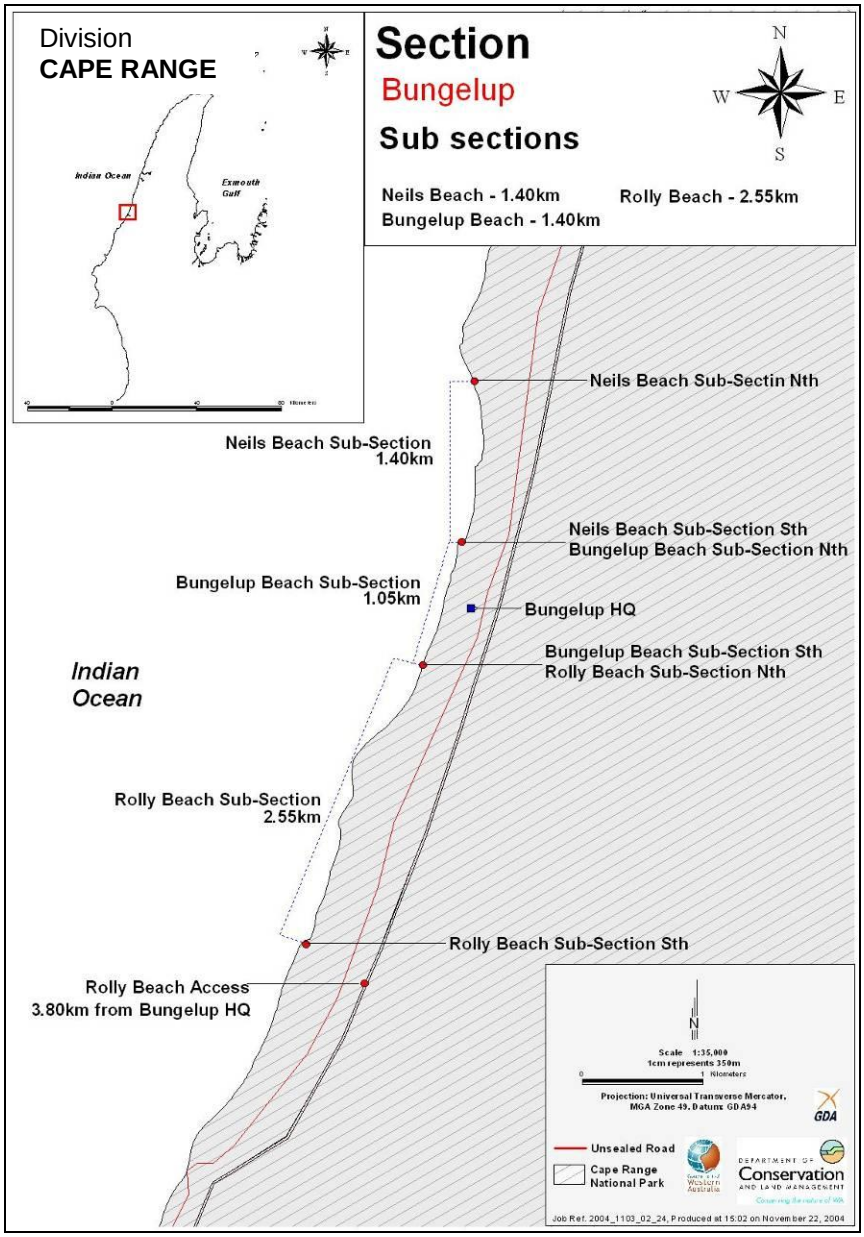

Figure 34: Location of the Cape Range division and the associated subsections.

Table 16: Location and distance of each subsection monitored during the 2008-09 season in the Cape Range division.

Subsection	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

12.3 Coral Bay Division

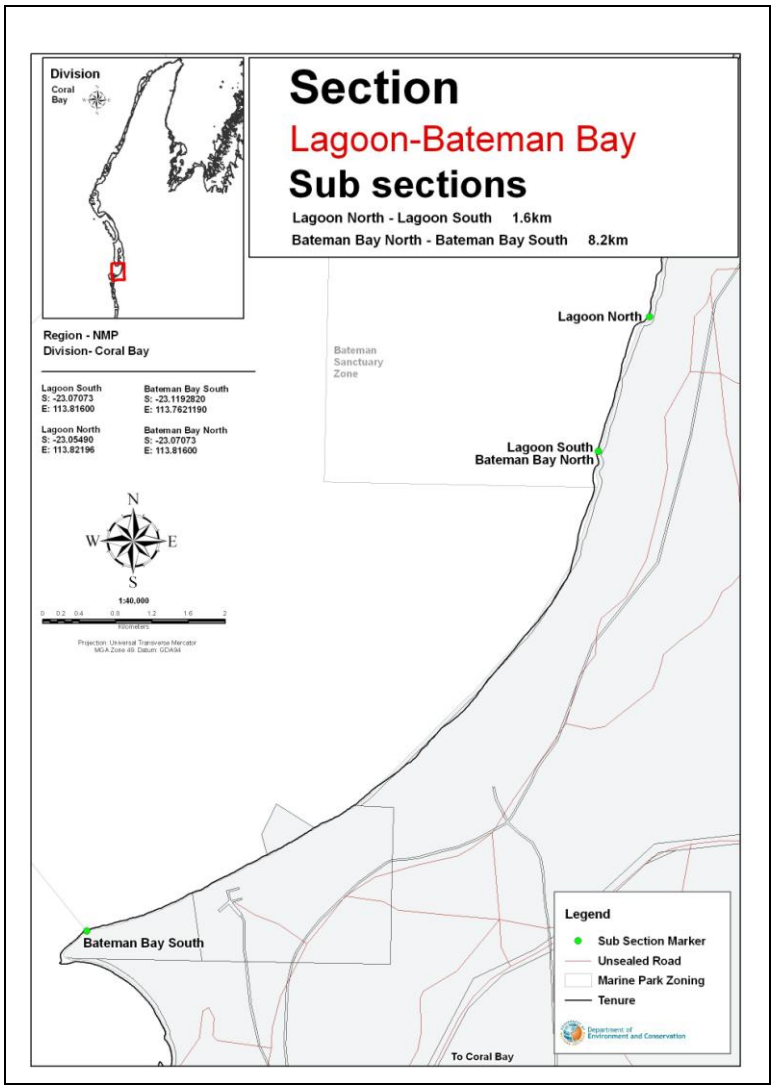

Figure 35: Location of the Coral Bay division and the associated sections and subsections: (Lagoon section), Lagoon South- Lagoon North; Batemans South – Batemans North subsection (Batemans section).

Table 17: Location and distance of each subsection monitored during the 2008-09 season in the Coral Bay division.

Subsection	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

12.4 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: _____

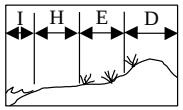

TABLE A: FALSE CRAWLS / NON-NESTING EMERGENCES TALLY

	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?
Comments:								

12.5 Details of tagged turtles re-sighted in 2008-2009

Table 18: Details of tagged turtles re-sighted in 2008-2009.

West Australian Turtle Research - Nesting Turtles Tagged Turtle Resightings 2008-2009							
Species	**Sex**	**Date and location 2008-2009**	**Tag left**	**Tag right**	**Tagging Details**	**Previous sightings**	**Turtle Activity**
Green	F	7 Dec 08 Brookes to Graveyards	NIL	WA13717	13-14 December 1991- Wobiri Beach	Twice in 1991/1992 Season	Returning to the sea
Green	F	16 Dec 2008 Brookes to Graveyards	NIL	WA28410	8 January 1996- NW Cape	First time in 13 years	Stranded in inter-tidal- but was rescued
Green	F	19 Dec 2008 Jurabi Car Park	NIL	WA15877	26/27 December 1991-Wobiri Beach	19-21 December 1996 5 Mile Beach & Jan 1997 at Baudin Access	Dead-behind dunes
Green	F	21 Dec 2008 Five Mile- Trisel	-	WA28405	8 January 1996 - Trial Access	First Sighting in 13 years	Body pitting
Green	F	8 Jan 2009 5 Mile - Trisel	NIL	WA?13455	12 November 1991- Wobiri Access	5 x 1991/1992 but not again for 17 years	Returning to the sea
Green	F	14 Jan 2009 Brookes to Graveyards	NIL	WA27982	17 December 1995- Wobiri Access	First time in 13 years	Stranded in inter-tidal- but was rescued
Green	F	14 Jan 2009 Brookes to Graveyards	NIL	WA15736	14 January 1991- Baudin Access	2x 1991/1992, but not again for 17 years	Stranded in inter-tidal- but was rescued
Green	F	14 Jan 2009 5 Mile-5 Mile North	NIL	WA19100	26 December 1992- Jansz Access	First sighting in 16 years	Returning to the sea
Green	F	14 Jan 2009 5 Mile -5 Mile North	NIL	WA 9902	29 November 1988- Trisel Access	First sighting in 20 years	Covering nest
Green	F	22 Jan 2009 Hunters	WA43162	WA43161	30 December 1999- Hunters Access	First sighting in 9 years	Stranded in inter-tidal- but was rescued
Green	F	4 Feb 2009 Brookes to Graveyards	NIL	WA28410	8 January 1996- Trisel Access	2nd sighting for 2008/09	Stranded in inter-tidal- but was rescued
Green	F	7 Feb 2009 5 Mile-Trisel	NIL	WA15832	10 December 1999- Trial Access	2 additional sightings in 1999, but not again for 8 years	Stranded in inter-tidal- but was rescued
Green	F	20 Jan 2009 5 Mile-5 Mile North	WA43109		29 December 1999- 5 Mile Beach	Not since tagging	Tag found on the beach

12.6 NTP Divisions, Sections and Sub-sections that have been monitored 2002-2009

Table 19: NTP Divisions, Sections and Sub-sections that have been monitored 2002-2009

Division	Section	Subsection
North West Cape	Bundegi	Bundegi North - Bundegi Boat Ramp
		Bundegi South - Bundegi North
	Navy Pier	Bundegi Boat Ramp - Bundegi Jetty
		Bundegi Jetty - Point Murat
		Point Murat - VLF Bay
		VLF Bay - Mildura Wreck
	Lighthouse Bay	Mildura Wreck - North West Car park
		North West Car park - Surf Beach
		Surf beach - Hunters
	Hunters	Hunters - Mauritius
		Mauritius - Jacobz South
		Jacobz South - Wobiri
	Graveyards	Five Mile North - Five Mile Car park
		Trisel - Five Mile Car park
		Trisel - Brooke
		Brooke - Graveyards
		Graveyards - Burrows
	Tantabiddi	Burrows - Jurabi Point
		Jurabi Point - Jurabi Point South
		Jurabi Point South - Tantabiddi Leads
		Tantabiddi Leads - Tantabiddi
Cape Range	Turquoise Bay	Turquoise Bay
	Bloodwood	Reef Retreat North
		Reef Retreat South
		Kurrajong
		Pilgramunna
	Bungarra	Osprey
		Bungarra North
		Bungarra South
Bundera	Bungelup	Neils Beach
		Bungelup Beach
		Rolly Beach
	Yardie Creek	Yardie Creek North - Bungelup
		Yardie Creek North - Yardie Creek South
	Boat Harbour	One K
		Shell Beach
		Alli Beach
		Boat Harbour
	Carbaddaman	Doddys
		Sandy Point
		Carbaddaman North
		Carbaddaman South
	Winderabandi	Winderabandi
	Point Billy	Point Billy
	Norwegian Bay	Norwegian Bay
	Janes Bay	Janes Bay
	Whaleback Beach	Whaleback Beach
Coral Bay	Lagoon	Beach One
		Beach Two
		Beach Three
	Batemans Bay	Batemans Bay
Coral Bay	Turtle Beach	Turtle Beach
Waroora Station	Waroora Homestead	Elles Camp
		Maggies Beach
Gnaraloo Bay	Red Bluff	Red Bluff

12.7 Errors found in the Ningaloo Turtle Program Database

Table 20: Errors in NTP database for survey effort

Date	*12.7.1.1.1.1.1.1 Division*	**Section**	**SubSection**	**Comment**
8-12-2008	NWC	Graveyards	FiveMileNorth-FiveMileCarpark	Duplicate Entry
8-12-2008	NWC	Graveyards	Trisel - Five Mile Carpark	Missing Entry?? (Should be added)
15-12-2008	NWC	Lighthouse Bay	MilduraWreck-NorthWestCarpark	Duplicate Entry
20-12-2008	NWC	Graveyards	Brooke-Graveyards	Duplicate Entry
20-12-2008	NWC	Graveyards	Graveyards-Burrows	Missing Entry?? (Should be added)
13-1-2009	NWC	Tandabiddi	Burrows- Jurabi Point	Triplicate Entry
17-1-2009	NWC	Graveyards	FiveMileNorth-FiveMileCarpark	Duplicate Entry
17-1-2009	NWC	Graveyards	Trisel - Five Mile Carpark	Missing Entry?? (Should be added)
24-1-2009	NWC	Tandabiddi	Burrows- Jurabi Point	Duplicate Entry
18-12-2008	CapeRange	Bungelup	Bungelup Beach	Duplicate Entry
18-12-2008	CapeRange	Bungelup	Rolly Beach	Missing Entry?? (Should be added)
26-1-2009	CapeRange	Bungelup	Bungelup Beach	Duplicate Entry
26-1-2009	CapeRange	Bungelup	Rolly Beach	Missing Entry?? (Should be added)
21-1-2009	Coral Bay	Batemans Bay		Blank Entry for SubSection. I think this should be “Batemans Bay”

Table 21: Errors in NTP database for all turtle nesting and "false crawls"

Date	Division	Section	SubSection	Comment
8-12-2008	NWC	Graveyards	FiveMileNorth-FiveMileCarpark	Duplicate Entries. There are 2 area_svyd_id's for the one location (14761 and 14762). I think one of these should be "Trisel - Five Mile Carpark"
20-12-2008	NWC	Graveyards	Brooke-Graveyards	Duplicate Entries. There are 2 area_svyd_id's for the one location (14881 and 14882). I think one of these should be "Graveyards-Burrows"
13-1-2009	NWC	Tandabiddi	Burrows- Jurabi Point	Duplicate Entries. There are 2 area_svyd_id's for the one location (15091 and 15092). This may be mislabelled?? Perhaps 15091 is for "Graveyards-Burrows" as data is missing for that day???
13-1-2009	NWC	Graveyards	Graveyards-Burrows	Missing data – see comment above
17-1-2009	NWC	Graveyards	FiveMileNorth-FiveMileCarpark	Duplicate Entries. There are 2 area_svyd_id's for the one location (15144 and 15145). I think one of these should be "Trisel - Five Mile Carpark"
24-1-2009	NWC	Lighthouse Bay	MilduraWreck-NorthWestCarpark	No data – don't know if this was not entered or not collected (not in survey effort either)
18-12-2008	CapeRange	Bungelup	Rolly Beach	Duplicate Entries. There are 2 area_svyd_id's for the one location (15322 and 15323). I think one of these should be "Rolly Beach"
26-1-2009	CapeRange	Bungelup	Bungelup Beach	No data - don't know if this was not entered or not collected (not in survey effort either)
21-1-2009	Coral Bay	Batemans Bay		Blank Entry for SubSection. I think this should be "Batemans Bay"