

Ningaloo **TURTLE** PROGRAM



CITATION

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TABLE OF CONTENTS

GLOSSARY..... iv

LIST OF ABBREVIATIONSVi

1.0 SUMMARY..... 1

2.0 INTRODUCTION..... 2

3.0 METHODS..... 3

4.0 MONITORING ZONES.....4

5.0. RESULTS 5

 5.1 SURVEY EFFORT..... 5

 5.2 TURTLE ACTIVITY..... 8

 5.3 NESTING SUCCESS.....18

 5.4 NEST DAMAGE..... 21

 5.5 TURTLE RESCUES.....24

 5.6 TURTLE MORTALITIES..... 26

 5.7 WEATHER EVENTS 2014-15..... 26

 5.8 TAGGED TURTLE RE-SIGHTINGS 2014-15.....26

6.0 ACKNOWLEDGEMENTS 27

7.0 REFERENCES 28

8.0 APPENDICES 29

 APPENDIX 1: ZONING OF THE NW CAPE DIVISION 29

 APPENDIX 2: ZONING OF THE CAPE RANGE DIVISION..... 31

 APPENDIX 3: CORAL BAY DIVISION..... 33

 APPENDIX 4: CURRENT NTP DATA SHEET..... 35

 APPENDIX 5: TAGGED TURTLE RE-SIGHTINGS DATASHEET..... 36

 APPENDIX 6: MARINE TURTLE STRANDING AND MORTALITY DATASHEET..... 37

 APPENDIX 7: LIGHTHOUSE BAY SECTION - LOCATION OF NEW NESTS (NTP 2014-15) MAP 1 & 2..... 38

 APPENDIX 8: HUNTERS SECTION - LOCATION OF NEW NESTS (NTP 2014-15) MAP 1 & 2..... 40

 APPENDIX 9: GRAVEYARDS SECTION - LOCATION OF NEW NESTS (NTP 2014-15) MAP 1 & 2..... 42

 APPENDIX 10: TANTABIDDI SECTION - LOCATION OF NEW NESTS (NTP 2014-15) MAP 1..... 44

 APPENDIX 11: BUNGELUP SECTION - LOCATION OF NEW NESTS (NTP 2014-15) MAP 1 & 2..... 45

LIST OF TABLES

TABLE 1: SURVEY EFFORT AND TURTLE ACTIVITY 2002-15 ENTIRE SEASON (ALL DATA AND SUBSECTIONS)..... 6

TABLE 2: THE TOTAL NUMBER OF ACTIVITIES (SUSPECTED NESTS AND FALSE CRAWLS) RECORDED FOR EACH SPECIES WITHIN THE NORTH WEST DIVISION, NTP 2014-15 ENTIRE SEASON 8

TABLE 3: THE TOTAL NUMBER OF ACTIVITIES (SUSPECTED NESTS AND FALSE CRAWLS) RECORDED FOR EACH SPECIES WITHIN THE CAPE RANGE DIVISION, NTP 2014-15 ENTIRE SEASON 9

TABLE 4: TOTAL NUMBER OF DAMAGED NESTS (NEW AND OLD) AND CAUSE PER SEASON NTP 2002-2015 23

LIST OF FIGURES

FIGURE 1: COMPARISON OF NESTING ACTIVITY (SUSPECTED NESTS AND FALSE CRAWLS) RECORDED IN EACH NW CAPE SECTION, NTP 2014-15 FOR ENTIRE SEASON.....	8
FIGURE 2: PERCENTAGE COMPARISON OF NESTS BY SPECIES RECORDED WITHIN THE NORTH WEST CAPE DIVISION, 2014-15 ENTIRE SEASON.....	9
FIGURE 3: COMPARISON OF NESTING ACTIVITY (SUSPECTED NESTS AND FALSE CRAWLS) RECORDED WITHIN EACH BUNGELUP SUBSECTION (CAPE RANGE DIVISION), NTP 2014-15.....	10
FIGURE 4: PERCENTAGE COMPARISON OF NESTS BY SPECIES WITHIN THE CAPE RANGE DIVISION, 2014-15.....	10
FIGURE 5: SEASONAL GREEN, LOGGERHEAD AND HAWKSBILL TURTLE ACTIVITY (NESTS AND FALSE CRAWLS) STANDARDISED BY SURVEY EFFORT DURING THE INTENSIVE PEAK MONITORING PERIOD.....	11
FIGURE 6: SEASONAL GREEN, LOGGERHEAD AND HAWKSBILL NESTS STANDARDISED BY SURVEY EFFORT DURING THE INTENSIVE PEAK MONITORING PERIOD.....	12
FIGURE 7: SEASONAL GREEN TURTLE ACTIVITY (NESTS AND FALSE CRAWLS) STANDARDISED BY SURVEY EFFORT DURING THE INTENSIVE PEAK MONITORING PERIOD.....	13
FIGURE 8: SEASONAL GREEN TURTLE NESTS STANDARDISED BY SURVEY EFFORT DURING THE INTENSIVE PEAK MONITORING PERIOD.....	14
FIGURE 9: SEASONAL HAWKSBILL ACTIVITY (FALSE CRAWLS AND NESTS) STANDARDISED BY SURVEY EFFORT DURING THE INTENSIVE PEAK MONITORING PERIOD.....	15
FIGURE 10: SEASONAL HAWKSBILL NESTS STANDARDISED BY SURVEY EFFORT DURING THE INTENSIVE PEAK MONITORING PERIOD.....	16
FIGURE 11: SEASONAL LOGGERHEAD ACTIVITY (FALSE CRAWLS AND NESTS) STANDARDISED BY SURVEY EFFORT DURING THE INTENSIVE PEAK MONITORING PERIOD.....	17
FIGURE 12: SEASONAL LOGGERHEAD NESTS STANDARDISED BY SURVEY EFFORT DURING THE INTENSIVE PEAK MONITORING PERIOD.....	18
FIGURE 13: GREEN TURTLE NESTING SUCCESS 2002-2015 (%) STANDARDISED BY SURVEY EFFORT DURING INTENSIVE PEAK MONITORING PERIOD.....	19
FIGURE 14: HAWKSBILL TURTLE NESTING SUCCESS (%) 2002-15 STANDARDISED BY SURVEY EFFORT DURING THE INTENSIVE PEAK MONITORING PERIOD.....	20
FIGURE 15: LOGGERHEAD TURTLE NESTING SUCCESS 2002-15 (%) STANDARDISED BY SURVEY EFFORT DURING INTENSIVE PEAK MONITORING PERIOD.....	21
FIGURE 16: FOX AND DOG PREDATION AS A PERCENTAGE OF TOTAL NESTS PER SEASON, NTP 2002-15.....	24
FIGURE 17: THE NUMBER OF TURTLES RESCUED IN EACH NTP SEASON, 2002-15.....	25
FIGURE 18: THE NUMBER OF TURTLES MORTALITIES RECORDED PER SEASON FROM 2007 – 2015.....	26

GLOSSARY

Body pit	A depression dug in the sand by a turtle during a nesting attempt.
Carapace	The shell covering the dorsal surface of the turtle.
Costal scales	Large scales lining both sides of the carapace, below the centre row of scales.
Combined tracks	Tracks left from both false crawls and nests.
Egg chamber	A deep cylindrical hole which a turtle digs into a primary body pit with her back flippers only. The eggs are deposited here.
Emerging track	Track of a turtle emerging from the ocean onto land.
Entire season	All NTP database season dates and subsections except 1080 baiting data. This included the intensive peak period monitoring and the pre and post peak period monitoring period data.
Escarpment	The edge of a ridge which indicates a filled-in primary body pit.
False crawl	An abandoned nesting attempt not resulting in eggs being laid.
GPS unit	Global Positioning System unit: an electronic navigational device which obtains a position on the earth using satellite signals.
Hatchling	A newly hatched young turtle.
Pre and post peak period	Monitoring of the weekends either side of the intensive peak monitoring period.
Intensive peak monitoring period	Four-week period centred roughly around the 31 st of December, during which monitoring takes places every day.
Nest	A new suspected nesting attempt which we expect has resulted in eggs being deposited.
Nest damage	The nest has been dug up, eggs or fresh empty egg shells are around the nest or eggs are exposed.
Nesting success	The number of suspected nests laid as a percentage of total turtle activities.
Old nest	A suspected nest laid during the current season (but not laid during the previous night) which has been predated on.
Plastron	The underside of a turtle.
Prefrontal scales	Situated on the head of a turtle, anterior to the frontal bone.

Pre-ocular scales	Situated on the head of a turtle, anterior from the eyes.
Primary body pit	A depression dug in the sand by a turtle during a nesting attempt with the aim of laying eggs into it. The egg chamber is located here in a successful nest but a primary body pit can also be left exposed from a false crawl.
Returning track	Track of a turtle returning from the land to the ocean.
Rookery	A significant breeding area for a large number of animals.
Secondary body pit	A depression dug lastly during a successful nesting attempt to cover the primary body pit and egg chamber with sand.
Standardised season	Period which only includes the intensive peak monitoring period so as to make data comparisons possible between seasons which would otherwise have different monitoring timeframes.
Survey effort	Factors in the total number of times monitoring was conducted and the total number of subsections monitored over a specified period of time.
Suspected nest	'Nests' suspected of containing eggs as a result of assessment using standard monitoring techniques. Eggs were not witnessed being deposited into an egg chamber within the structure, hence the 'nests' are referred to as "suspected nests".
Tracks	In the form of false crawls or the tracks left behind during nesting.
Track abundance	The number of recorded turtle tracks (includes false crawl tracks and nest tracks). This term is interchangeable with the level of turtle activity.
Turtle activity	Includes both turtle nests and false crawls.
Turtle tracker	A volunteer competent in identifying turtle species and observing activity during monitoring.
Zoning	Hierarchical spatial classification system of divisions, sections & subsections.

LIST OF ABBREVIATIONS

CCG	Cape Conservation Group Inc.
EPBC Act	Environmental Protection and Biodiversity Conservation Act 1999
JTC	Jurabi Turtle Centre
NMP	Ningaloo Marine Park
NTP	Ningaloo Turtle Program
NW Cape	North West Cape
Parks and Wildlife	Department of Parks and Wildlife

1.0 SUMMARY

The Ningaloo Turtle Program was established in 2002 as a collaborative effort between the Cape Conservation Group Inc., World Wildlife Fund Australia and the Department of Parks and Wildlife (Parks and Wildlife), Exmouth District. During the 2014-15 season, NTP sponsors Woodside Energy Ltd. made a significant contribution to the program and BHP Billiton contributed to the supply of a vehicle for the program's use during the peak monitoring period. The primary aim of the program is to predict long-term trends in marine turtle populations along the Ningaloo coast.

Fourty seven volunteers contributed a total of 3470 hours to the Ningaloo Turtle Program in 2014-15. Since commencement of the program, a total of 55331 volunteer hours have been contributed to the program. These figures demonstrate the effort of the volunteers over the life span of the program.

A total of 1174 suspected nests and 2167 false crawls were recorded in the Ningaloo Region over the entire 2014-15 season. Volunteers recorded 628 green turtle nests and 1465 green false crawls, which equates to a nesting success rate of 30% for this species. Loggerhead turtles had a nesting success rate of 42.9% with 436 nests and 580 false crawls being recorded, equating to an average level of activity when compared to other seasons for this species. Hawksbill turtle records accounted for 91 nests and 108 false crawls which resulted in the highest nesting success rate of 45.7%. Activity data for this species in 2014-15 was lower than average in comparison to other seasons.

Nest disturbance was observed towards 8 nests. This was attributed to natural causes, with two nests being damaged by turtles accidentally excavating another turtle's nest and the rest damaged by the tide/storm surge. This amounted to 0.68% of the total nests recorded for the season.

Typical NTP monitoring techniques may underestimate levels of fox and dog predation on turtle nests seeing as predation and nest damage is recorded for all new nests but only opportunistically for old nests. Therefore any subsequent damage and predation on nests (from the second night after they are laid onwards) may go unnoticed as the nests are not specifically checked every day throughout incubation. Therefore further research on predation was undertaken during the 2014 - 15 season during which a selection of 20 nests were monitored daily throughout incubation until hatching using both remote cameras and in-field monitoring. One unconfirmed incidence of fox predation of a hatchling was noted, resulting in predation levels no greater than 5%, which is in line with current NTP results. Repetition of this project in the future may allow more accurate comparisons and aid in concluding whether current NTP monitoring techniques provide an accurate level of turtle nest predation.

During 2014-15 four stranded turtles were recorded. The total number of turtles rescued since 2002 has been 239 turtles. Thirteen turtle mortalities were recorded during the 2014-15 season.

2.0 INTRODUCTION

The Ningaloo Turtle Program (NTP) was established in 2002, as a collaborative initiative between the Department of Parks and Wildlife (Parks and Wildlife) - Exmouth District, Cape Conservation Group Inc. (CCG), Murdoch University and the World Wildlife Fund - Australia (WWF). The mission statement of the program is to predict long-term trends in marine turtle populations along the Ningaloo coast. This is accomplished through the collection of turtle nesting information such as nesting abundance and disturbance data. This data assists Parks and Wildlife in the reduction of disturbance levels to nesting turtles and therefore improves the conservation of the species breeding in the area.

Volunteers are essential to the maintenance of the program. Based in Exmouth, Western Australia, the NTP provides an opportunity for local community, interstate and international volunteers to take part in turtle conservation. Participating volunteers gain practical experience with turtle monitoring, turtle rescues and other related activities.

In 2008 it was determined that trends in marine turtle populations within the study area could be detected with a reasonable level of error when survey effort was reduced. Survey effort would need to include both the pre-peak, intensive and post-peak monitoring periods in order to establish these trends in abundance (Whiting, 2008).

A typical NTP monitoring season now includes a peak nesting period of intensive monitoring, which constitutes four weeks of daily effort. This period was identified by analysing previous seasons data. Additionally, weekend monitoring during the pre and post peak nesting periods captures early and late fluctuations in the nesting activity.

Trend analysis is undertaken every three years, most recently in 2013. A generalised additive model is applied to the data to predict nesting abundance throughout the seasons. Linear regression models are used to calculate annual nesting abundance and trends in track and nest counts.

Woodside Energy Ltd has provided a significant contribution to the programs operational costs since 2012 and is the main sponsor of the program. This has included the funding of volunteer food and accommodation, website maintenance, community activities, equipment and educational materials costs.

BHP Billiton has also generously contributed to the sponsorship of the program since 2010 and has funded the hire of a mini-bus, which is used to transport the volunteers to and from the monitoring beaches during the program.

The goals and objectives listed below have been formulated through a community-based community and are updated as required.

NTP Overarching Goals

- Collect data at key nesting beaches as representative sites for local turtle populations.
- Monitor turtle activity levels within the Ningaloo region and assess nesting trends through time.
- Build a culture of awareness and stewardship for marine turtle conservation

NTP Primary Objectives

- Estimate the abundance and distribution of turtle nests on key sections of beach over specified time intervals for each species that nests within the area.
- Identify the relative significance of specific nesting beaches to each species.
- Identify any temporal changes relating to nesting season and spatial changes in nesting distribution amongst species.
- Quantify predation and disturbance levels through NTP methodology and external supporting research.
- Support external research initiatives relating to the goals of the program.
- Encourage community and wider involvement, through continuous education and the recruitment of volunteers, in order to build interest, skills and knowledge to assist with turtle conservation.

3.0 Methods

Data is collected by observing fresh tracks to determine turtle species and identify suspected nests. Volunteers use standard procedures to determine if the turtle activity has resulted in a successful nest or a false crawl. Nest positions are recorded using GPS's. Signs of predation at nests are also recorded, along with tagged turtle sightings, the presence of feral animals, turtle mortalities, and rescues.

For more detailed information on current NTP monitoring methodologies please see NTP Annual Report 2012-13 (Section 5.0) or the Turtle Monitoring Field Guide, both of which are available at www.ningalooturtles.org.au

Points worth noting in regards to the NTP methodology:

- Throughout the report the term nest is used, but during monitoring the eggs aren't actually witnessed being laid. Therefore error can be expected as turtles can sometimes create the appearance of nests without depositing any eggs into them (Whiting pers.com. 2012). Due to this, the term 'suspected nest' is used interchangeably with 'nest' throughout the report.

- The proportion of damage recorded is not conclusively accurate, since only new nests are checked for signs of predation after the first evening of the incubation term. Old nests are recorded on an incidental basis, during the monitoring of the new nests. Therefore there is a possibility that some predation and disturbance to old nests goes undetected, resulting in an underestimate of predation.

As a result, additional research on nest predation was undertaken during the 2014 - 15 season during which a selection of 20 nests were monitored daily throughout incubation until hatching using both remote cameras and in-field monitoring. One unconfirmed incidence of fox predation of a hatchling was noted, resulting in predation levels no greater than 5%, which is in line with current NTP results. Repetition of this project in the future may allow more accurate comparisons and aid in concluding whether current NTP monitoring techniques provide an accurate level of turtle nest predation. The full report (Green Turtle Nest Predation Report: North West Cape; Ningaloo Turtle Program 2014-15) is available online at www.ningalooturtles.org.au.

4.0. MONITORING ZONES

Important nesting beaches were identified through past aerial and ground surveys. For the purpose of the program, the Ningaloo Region is divided into four divisions. These are further divided into sections and subsections. Subsections were determined by natural barriers that separate beaches and car parks. Subsection length is an important consideration and restricted to an average length of 2-3kms so that they are practical to survey on foot. A subsection is defined with a GPS location and NTP totem markers are located at the start and finish point of each one.

North West Cape Division

The North West Cape (NW Cape) Division includes Lighthouse Bay, Hunters, Graveyards and Tantabiddi sections, which are further divided into subsections (see Appendix 1 for further division information).

Cape Range Division

The Cape Range Division encompasses one Bungelup Section, which is divided into three subsections (see Appendix 11 for further division information).

Bundera/Ningaloo Division

The Bundera/Ningaloo Division includes six sections. These sections are classified into subsections. This division has not been monitored by NTP since the 2007-08 season. However, Parks and Wildlife staff have conducted opportunistic monitoring within this division during monthly fox baiting operations. Since then this data has been omitted from the results contained within this report.

Coral Bay Division

The Coral Bay Division is divided into two sections: Batemans Bay and The Lagoon. These sections are classified into one or more subsections. This division has not been monitored by NTP since the 2008-09 season. Parks and Wildlife staff have conducted opportunistic monitoring within this division during monthly fox baiting operations, but for the purpose of this report these data have not been included.

5. RESULTS

5.1 Survey Effort

In 2014-15 monitoring was conducted in the NW Cape Division (37-49 days) and Cape Range Division (29-31 days), depending on the weather conditions and availability of volunteers for each of the subsections.

Fourty seven volunteers contributed a total of 3470 hours to the Ningaloo Turtle Program in 2014-15. Since commencement of the program a total of 55331 volunteer hours have been contributed to the program. This time was primarily accrued during beach monitoring, but also included data entry, training, a nest predation project and general tasks toward the running of the program.

From the 15th December 2014 – 11th January 2015 intensive peak period monitoring was conducted seven days a week at both the NW Cape Division and Cape Range Division. Outside of the intensive peak period monitoring, pre and post peak weekend monitoring was undertaken on the 8th & 9th and 22rd & 23th November, and the 6th & 7th December in 2014. The post monitoring weekends occurred on the 31st January & 1st February, 14th & 15th February and the 28th February & 1st March in 2015. These weekend monitoring sessions were conducted only within the NW Cape Division.

Parks and Wildlife field staff conducted opportunistic turtle monitoring during monthly fox baiting operations in the Bundera/Ningaloo and Coral Bay Divisions, but for the purpose of this report this data has been omitted from the results.

Survey effort figures incorporate both the number of days and the number of subsections monitored within that day. Some figures throughout this report are adjusted by survey effort in order to make fair comparisons between seasons (i.e. because the number of days for which monitoring occurred, and the number of subsections monitored each day may vary between seasons).

Table 1: Survey effort and turtle activity 2002-15 entire season (all data and subsections)

Season		2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	TOTAL
Survey Dates for entire season		18/11/02-	11/11/03-	3/11/04-	21/11/05-	1/12/06-	1/12/07-	7/12/08-	7/11/09 -	6/11/10-	12/11/11	10/11/12-	28/10/13	3/11/14 -	
		16/04/03	30/03/04	18/03/05	28/02/06	28/02/07	28/02/08	1/03/09	27/03/10	27/03/11	11/03/12	10/03/13	- 2/3/14	1/3/15	
Division	Section														
North West Cape	Graveyards	165	375	374	368	341	336	234	160	153	144	162	172	185	3169
	Hunters	248	263	271	271	256	252	173	117	114	109	111	117	120	2422
	Lighthouse Bay	127	137	215	260	222	251	147	83	93	97	106	113	113	1964
	Navy Pier	N/A	86	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	86
	Tantabiddi	115	3	N/A	85	86	84	58	38	37	36	41	38	43	664
Cape Range	Bloodwood	N/A	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4
	Bungelup	1	49	152	114	120	140	124	72	87	91	78	114	91	1233
	Turquoise Bay	N/A	16	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	16
	Boat Harbour	N/A	N/A	203	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	203
Bundera/ Ningaloo	Carbaddaman	7	N/A	204	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	211
	Janes Bay	13	24	12	29	22	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	104
	Norwegian Bay	2	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3
	Whaleback Beach	N/A	7	8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	15
Coral Bay	Batemans Bay	103	100	117	51	76	47	34	N/A	N/A	N/A	N/A	N/A	N/A	528
	Lagoon	103	100	116	51	76	47	34	N/A	N/A	N/A	N/A	N/A	N/A	527
	Turtle Beach	56	100	66	49	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A	271
Total survey effort		940	1265	1738	1278	1199	1161	804	470	484	477	496	554	552	11418
Number subsections monitored		22	29	28	20	19	19	18	14	14	14	14	14	14	239

Season	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	TOTAL
Green nests	1539	1552	788	4695	4349	5254	6297	571	2732	6594	585	2276	628	37860
Green false crawls	5404	3086	2533	9948	14395	13156	12608	1451	6507	22865	1769	4960	1465	100147
Green activity	6943	4638	3321	14643	18744	18410	18905	2022	9239	29459	2354	7236	2093	138007
Green nesting success %	22.2%	33.5%	23.7%	32.1%	23.2%	28.5%	33.3%	28.2%	29.6%	22.4%	24.9%	31.5%	30.0%	27.4%
Hawksbill nests	48	81	100	108	157	156	336	202	189	65	125	69	91	1727
Hawksbill false crawls	49	60	139	71	153	145	207	202	132	84	192	51	108	1593
Hawksbill activity	97	141	239	179	310	301	543	404	321	149	317	120	199	3320
Hawksbill nest success %	49.5%	57.4%	41.8%	60.3%	50.6%	51.8%	61.9%	50.0%	58.9%	43.6%	39.4%	57.5%	45.7%	52.0%
Loggerhead nests	288	387	777	1068	540	795	580	288	405	382	304	430	436	6680
Loggerhead false crawls	429	359	1040	925	477	954	486	471	388	715	466	595	580	7885
Loggerhead activity	717	746	1817	1993	1017	1749	1066	759	793	1097	770	1025	1016	14565
Loggerhead nesting success	40.2%	51.9%	42.8%	53.6%	53.1%	45.5%	54.4%	37.9%	51.1%	34.8%	39.5%	42.0%	42.9%	45.9%
Unidentified nests	29	123	59	42	33	61	38	8	18	7	7	20	19	464
Unidentified false crawls	44	20	82	45	19	29	12	8	9	4	12	17	14	315
Unidentified activity	73	143	141	87	52	90	50	16	27	11	19	37	33	779
Unidentified nesting success	39.7%	86.0%	41.8%	48.3%	63.5%	67.8%	76.0%	50.0%	66.7%	63.6%	36.8%	54.1%	57.6%	59.6%
Total all species nests	1904	2180	1724	5913	5279	6266	7252	1069	3343	7049	1023	2795	1174	46971
Total all species false crawls	5925	3536	3794	10989	15044	14284	13314	1451	7038	23668	2439	5623	2167	109272
Total activity	7829	5716	5518	16902	20323	20550	20566	2520	10381	30717	3462	8418	3341	156243

5.2 Turtle Activity

5.2.1 2014 – 2015 Season

North West Cape Division

A total of 1174 suspected nests and 2167 false crawls were recorded within the NW Cape Division during 2014-15 (Table 2). Green turtles showed the greatest nesting activity in the NW Cape Division (both nests and false crawls) being responsible for 82.9 % of total activity recorded, followed by loggerhead turtles (11.1%), then hawksbills (5.2%) and unidentified species (0.8%). No flatback turtle activity was recorded.

Table 2: The total number of activities (suspected nests and false crawls) recorded for each species within the North West Division, NTP 2014-15 entire season

North West Cape Division	Turtle Species					Total
	Green	Hawksbill	Loggerhead	Flatback	Unidentified	
New nests	622	60	128	0	14	824
False crawls	1451	71	150	0	5	1677
Total activity	2073	131	278	0	19	2501

Figure 1 shows the distribution of nests and false crawls amongst the four NW Cape sections. For individual nest locations see maps in Appendix 7, 8, 9 and 10.

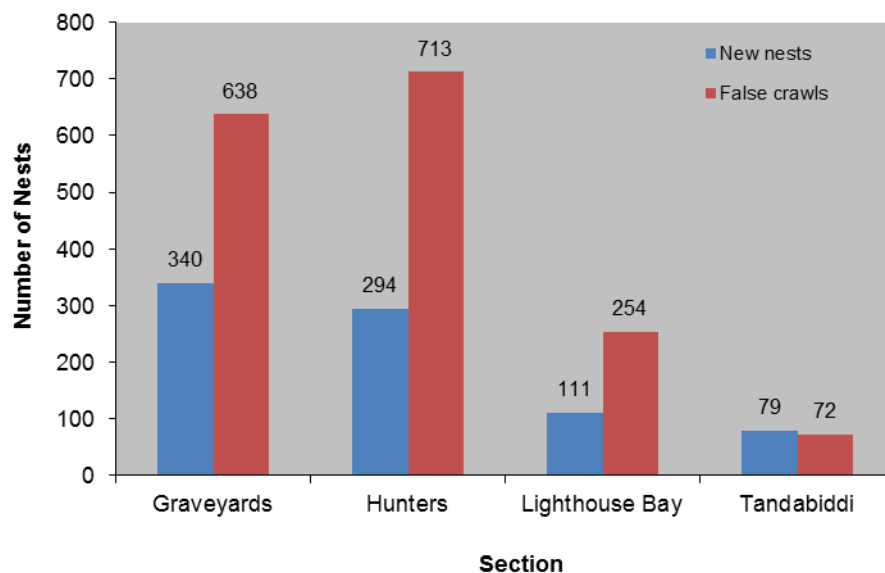


Figure 1: Comparison of nesting activity (suspected nests and false crawls) recorded in each NW Cape Section, NTP 2014-15 for entire season.

Figure 2 shows that green turtles were responsible for the highest proportion of nesting activity recorded within the North West Cape Division. No nesting activity was recorded for flatback turtles.

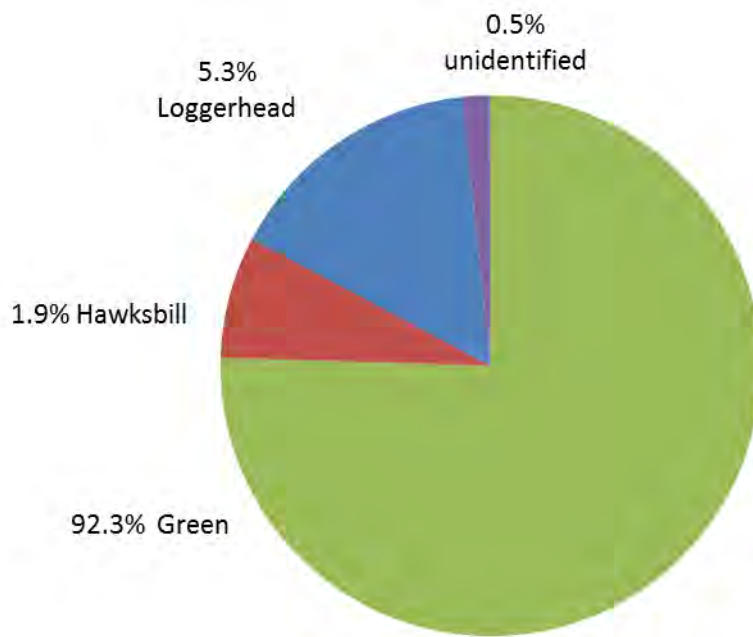


Figure 2: Percentage comparison of nests by species recorded within the North West Cape Division, 2014-15 entire season

Cape Range Division

A total of 350 suspected nests and 490 false crawls were recorded in the Bungelup Section (Cape Range Division) during the 2014-15 NTP season (Table 3). Loggerhead Turtles showed the greatest nesting activity in the Bungelup Section (both suspected nests and false crawls) with (87.8%), followed by hawksbill (8.1%), green (2.4%) and unidentified turtle species (1.7%). No flatback turtle activity was recorded.

Table 3: The total number of activities (suspected nests and false crawls) recorded for each species within the Cape Range Division, NTP 2014-15 entire season

Cape Range Division	Turtle Species				Total
	Green	Hawksbill	Loggerhead	Unidentified	
New nests	6	31	308	5	350
False crawls	14	37	430	9	490
Total activity	20	68	738	14	840

Figure 3 shows the distribution of nests and false crawls amongst the Cape Range subsections. For individual nest locations see Appendix 11.

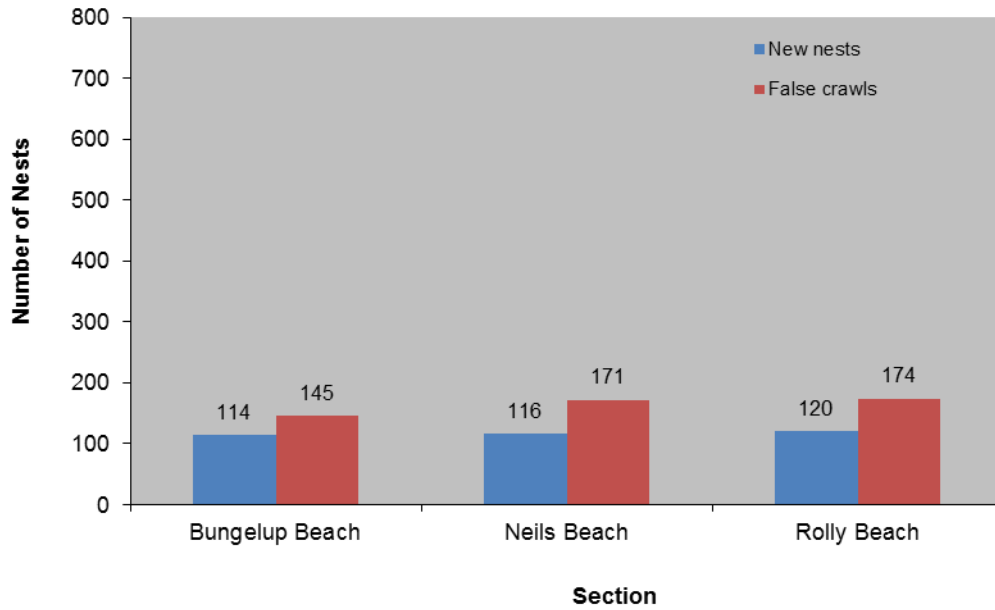


Figure 3: Comparison of nesting activity (suspected nests and false crawls) recorded within each Bungelup subsection (Cape Range Division), NTP 2014-15.

Figure 4 shows loggerhead turtles accounted for the highest proportion of nests recorded within the Cape Range Division, followed by hawksbill and then green turtles. A small proportion of nests could not be identified to a species.

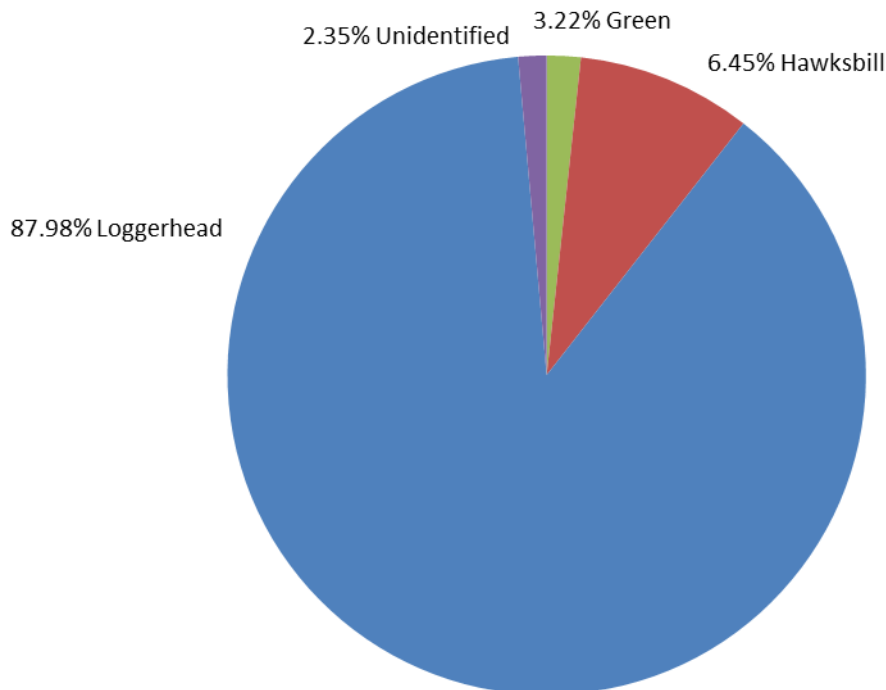


Figure 4: Percentage comparison of nests by species within the Cape Range Division, 2014-15.

5.2.2 History of Turtle Activity (2002-2015)

NTP has recorded 46971 suspected nests and 109 272 false crawls (total activity: 156 243) over-all season dates and subsections since commencement of the program in 2002 (Table 1). Green turtles are by far the most abundant species with a total of 138 007 nests and false crawls recorded, followed by loggerhead turtles (14 565 activities) and hawksbill turtles (3320 activities). A total of 779 activities have been recorded as being from unidentified species (Table 1).

During 2002 – 2015, within the standardised intensive peak monitoring period, the NTP has recorded a total of 25 214 nests and 62 538 false crawls (total activity: 87 752). When comparing the activity recorded over the past twelve years, the 2014-15 season figure for total turtle activity was comparatively the second lowest recorded since 2002 (Figure 5), and total nesting levels were also below average (Figure 6). Green turtles are by far the most abundant species with a total of 76 572 activities (nests and false crawls) recorded within the intensive monitoring periods (2002 – 2015), followed by loggerhead turtles (8954 activities) and hawksbill turtles (1920 activities). A total of 303 turtle activities have been recorded as unidentified species.

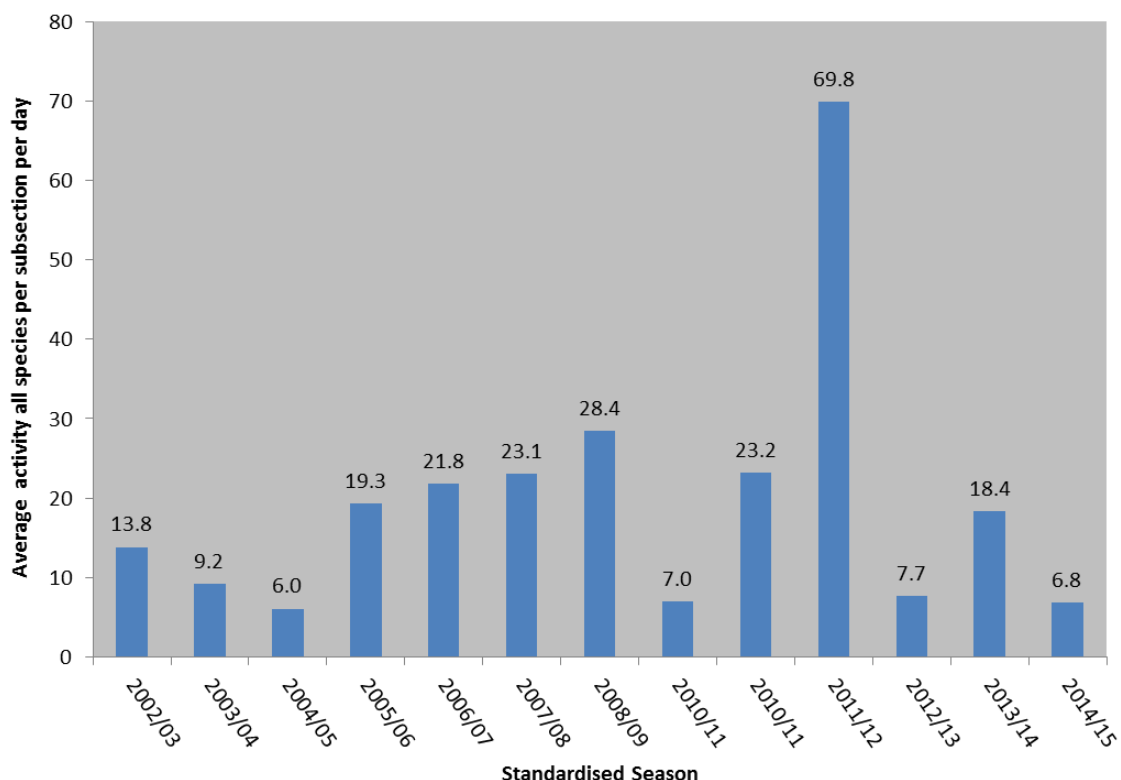


Figure 5: Seasonal green, loggerhead and hawksbill turtle activity (nests and false crawls) standardised by survey effort during the intensive peak monitoring period.

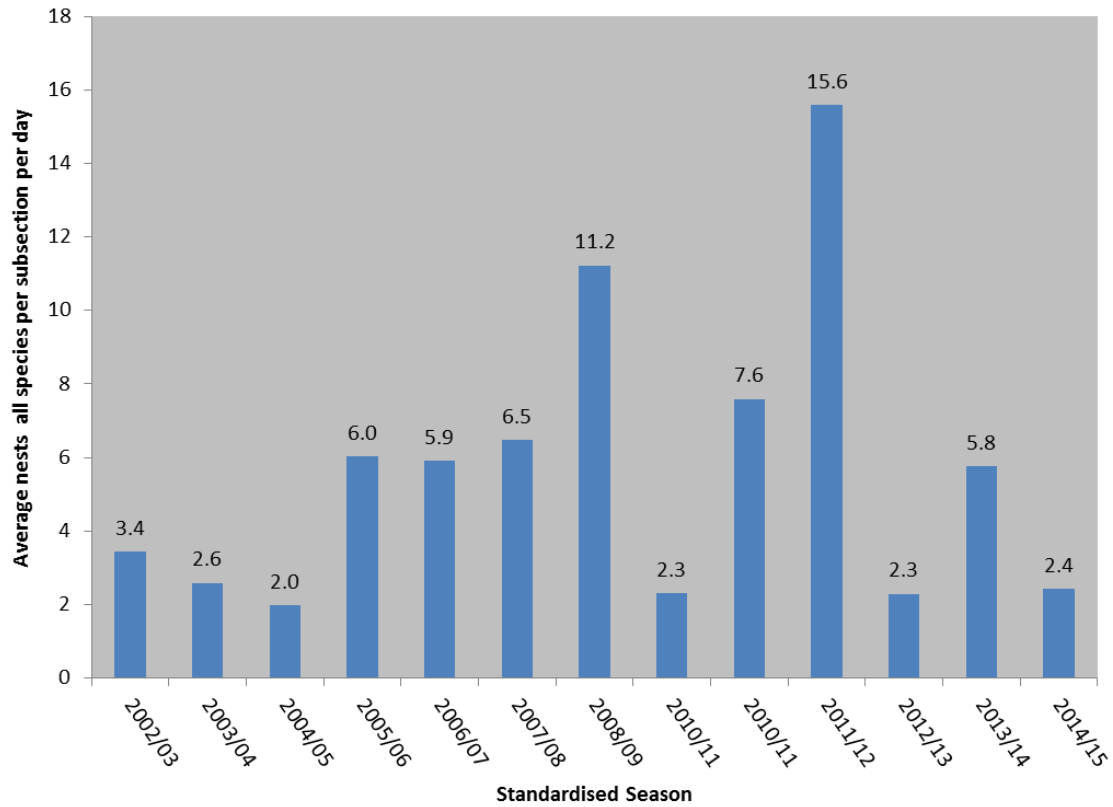


Figure 6: Seasonal green, loggerhead and hawksbill nests standardised by survey effort during the intensive peak monitoring period.

Green Turtles

When comparing standardised seasons, the level of green turtle activity recorded during 2014-15 was below average (Figure 7), as were nesting levels (Figure).

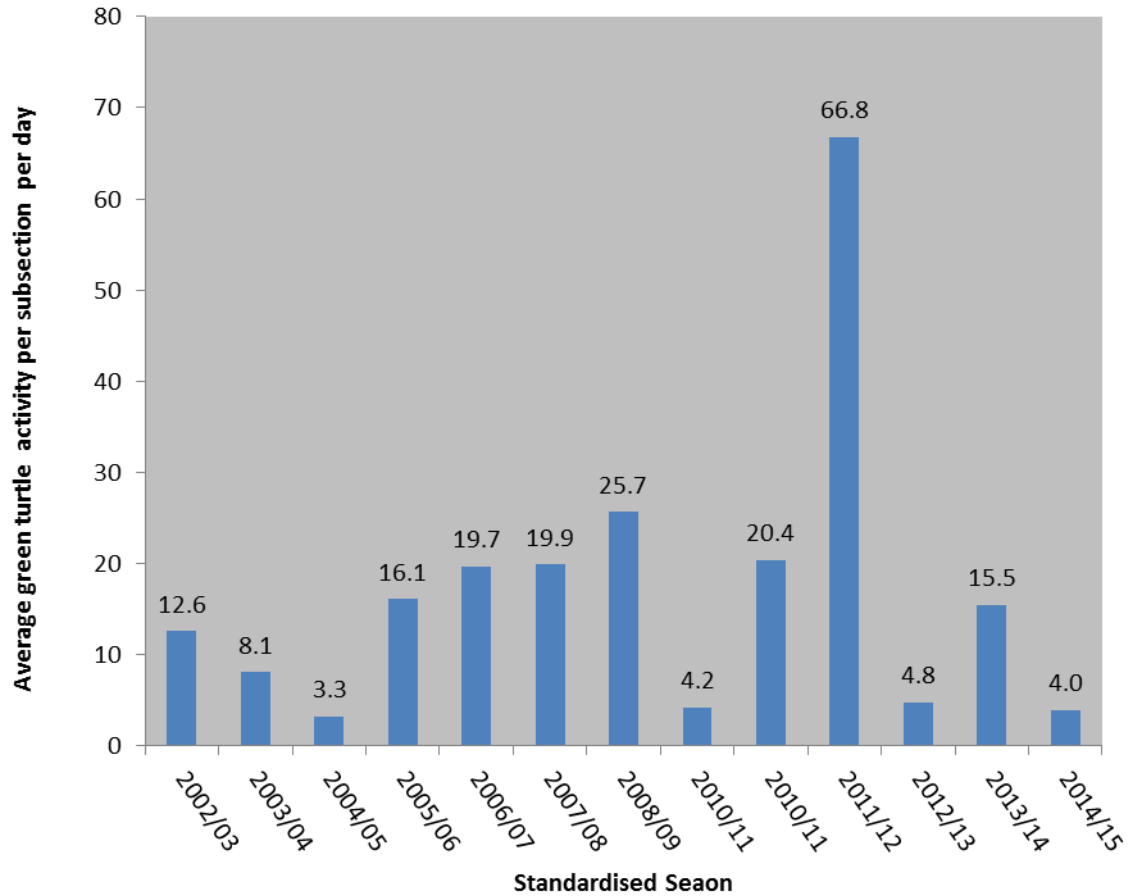


Figure 7: Seasonal green turtle activity (nests and false crawls) standardised by survey effort during the intensive peak monitoring period.

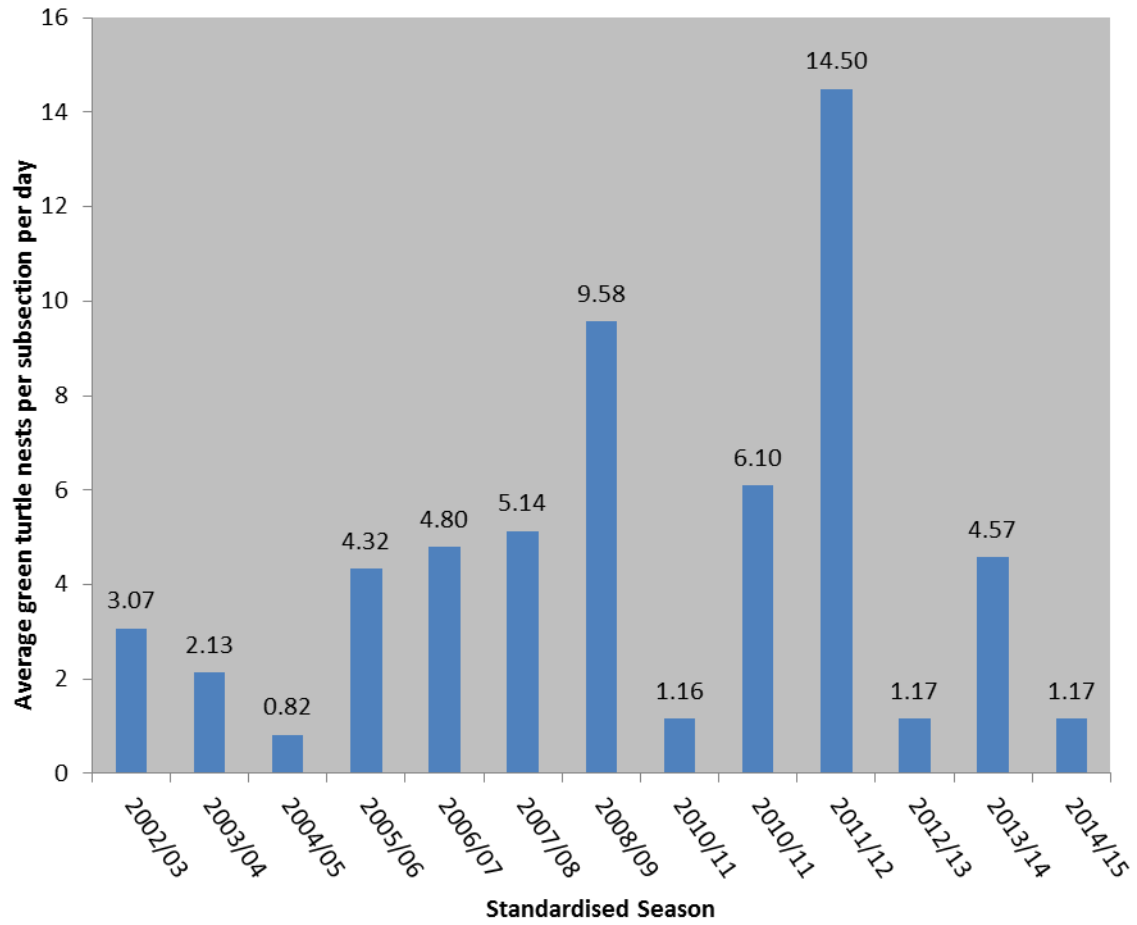


Figure 8: Seasonal green turtle nests standardised by survey effort during the intensive peak monitoring period.

Hawksbill Turtles

Since the commencement of NTP, the level of hawksbill turtle total activity and nesting has varied between seasons but both were sitting on average in 2014-15 in comparison to all seasons data (Figure 9 and Figure 10 respectively).

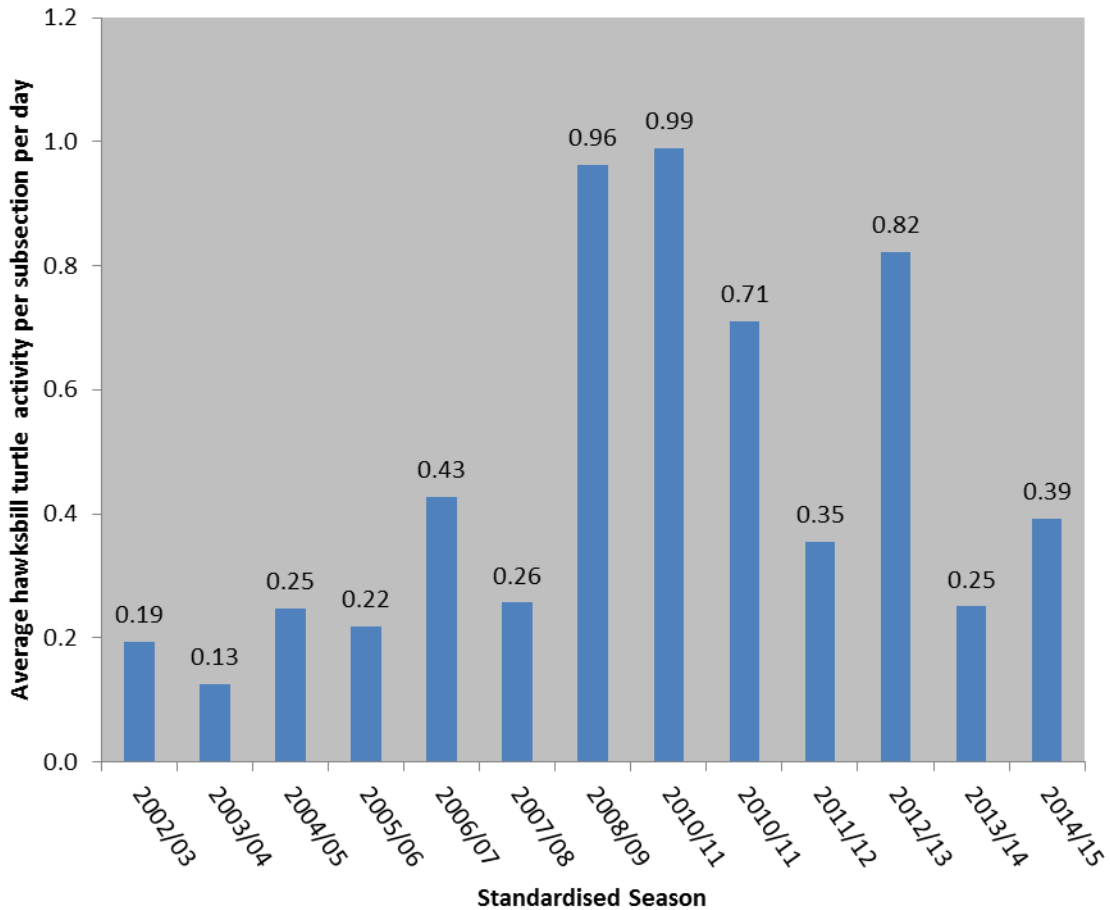


Figure 9: Seasonal hawksbill activity (false crawls and nests) standardised by survey effort during the intensive peak monitoring period.

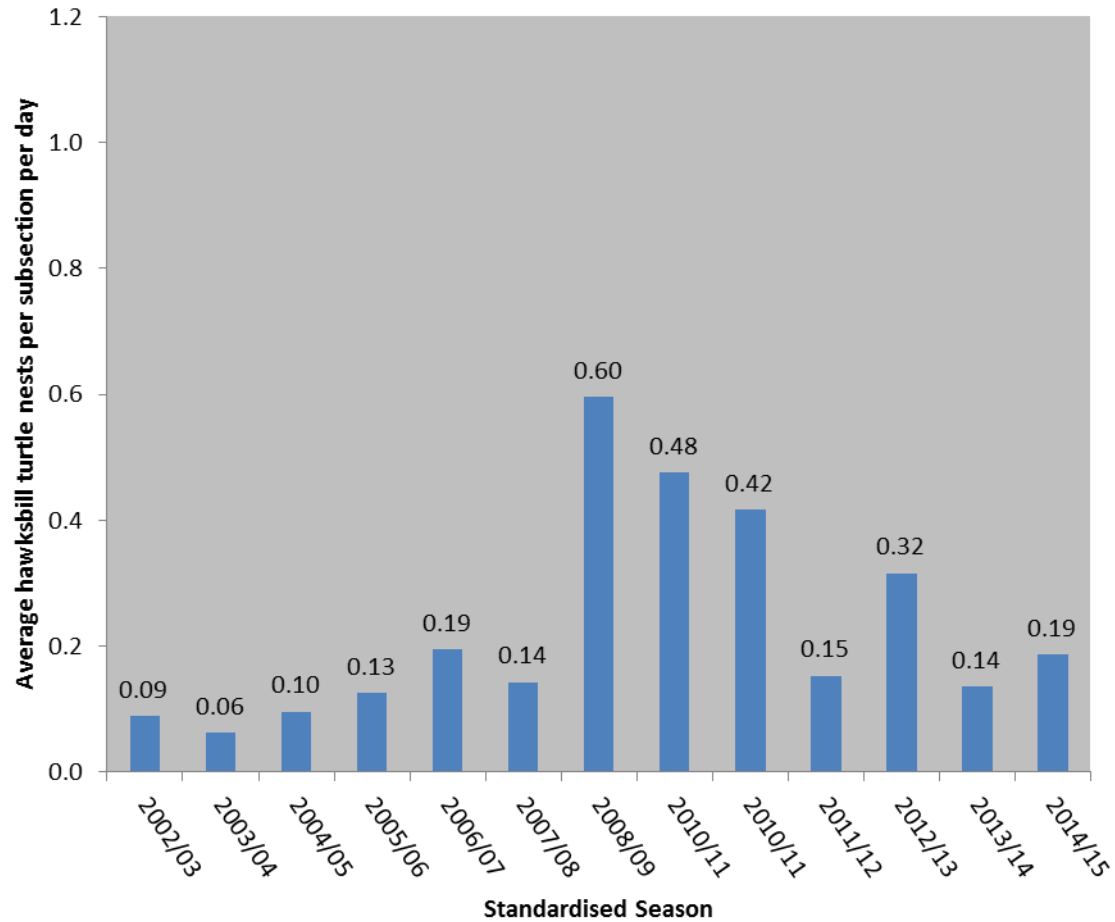


Figure 10: Seasonal hawksbill nests standardised by survey effort during the intensive peak monitoring period.

In the 2014-15 season the methodology of distinguishing hawksbill and loggerhead tracks was slightly altered due to the difficulty that relatively inexperienced volunteers were having in distinguishing the two similar track types. In the past, the width of the track and the presence/absence of tail drag marks were used as indicative features, however there were no defined rules. The new rule introduced in 2014 is that if the track is alternate with a continuous or broken tail drag mark it is classified as a hawksbill track. Any other alternate tracks are classified as loggerhead tracks (unless they are flatback tracks which can be alternate too but look quite different). The impact of this change on annual levels of hawksbill and loggerhead activity are expected to be minimal due to the similarity in the two techniques, however it is worth noting for the purposes of this report.

Loggerhead Turtles

Since the commencement of NTP, the level of activity and nesting recorded for loggerhead turtles has varied. Total activity and nesting levels recorded for the 2014-15 season were above average (Figure 11 and Figure 12).

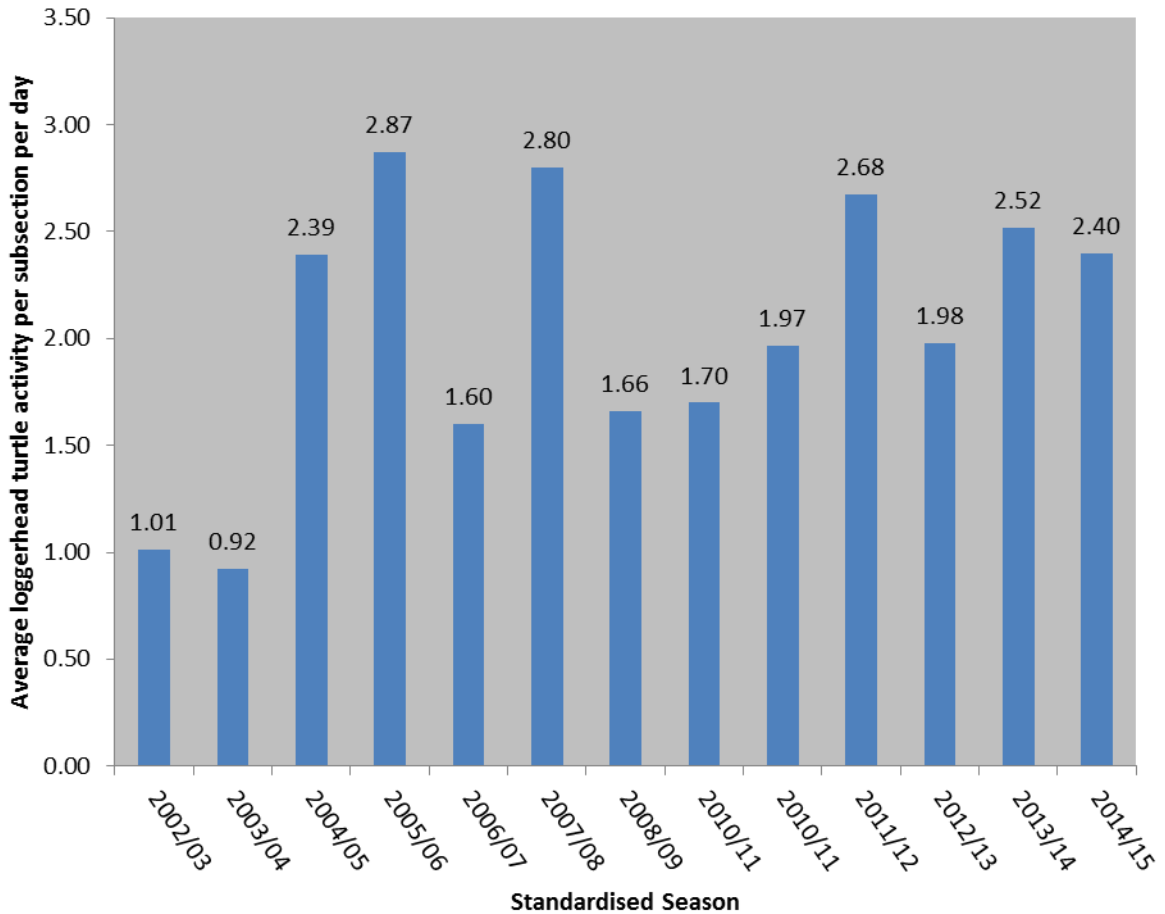


Figure 11: Seasonal loggerhead activity (false crawls and nests) standardised by survey effort during the intensive peak monitoring period.

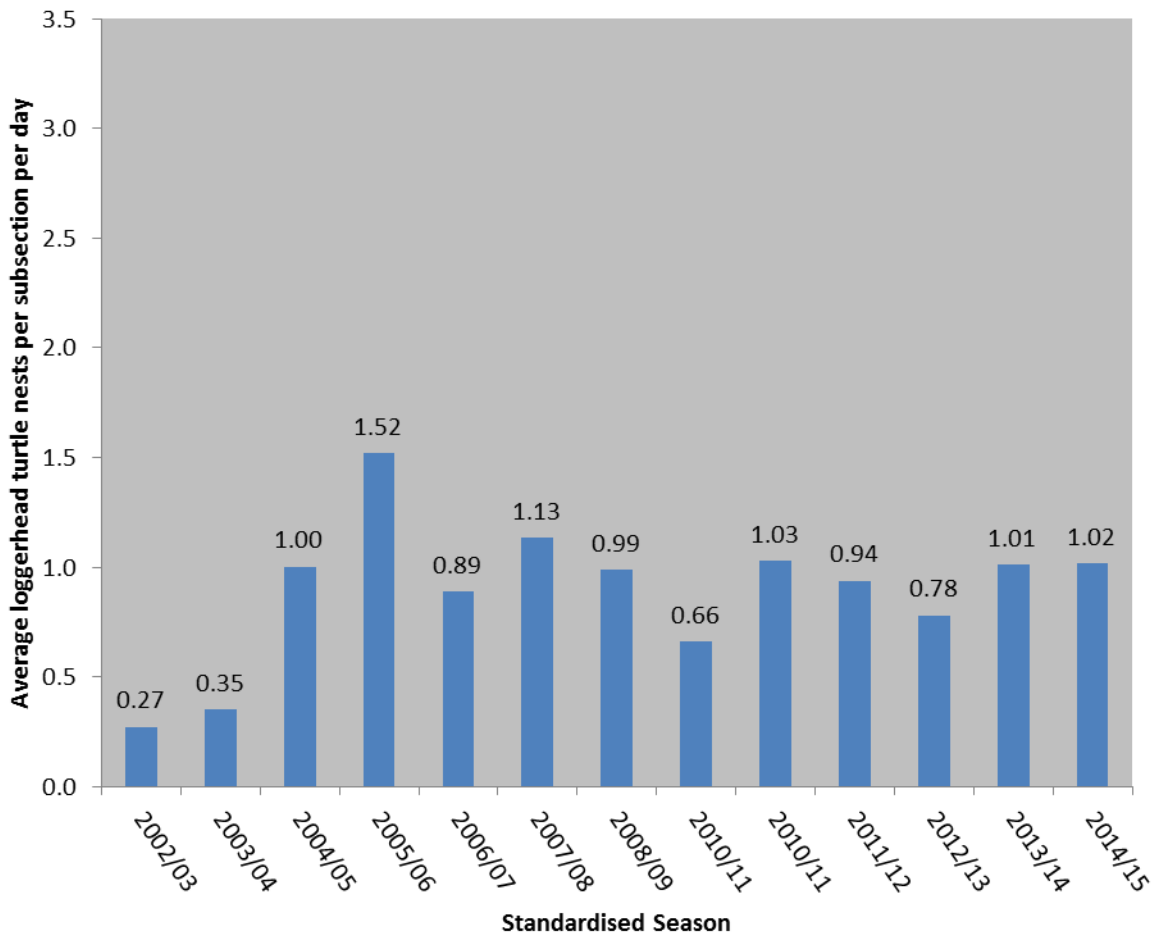


Figure 12: Seasonal loggerhead nests standardised by survey effort during the intensive peak monitoring period.

5.3 Nesting Success

5.3.1 2014-15

For the purposes of this report, nesting success is defined as the number of suspected nests laid as a percentage of total turtle activities. It should be noted that nesting success has been calculated using visual assessment of the nest after the turtle has left the beach. The nests are identified and recorded as nests if they meet the visual characteristics which define nests, however eggs have not been observed deposited into the nest. Therefore it has been recommended that night time observations of at least 30 nesting turtles be undertaken to check whether eggs are deposited or not and thus give an indication of the level of error associated with identifying a viable nest (Whiting, 2010). In the 2014-15 season a nest predation study was undertaken. Twenty nests were chosen and monitored until hatching. There was one nest for which the egg chamber could not be located. A trainer collaboration exercise was also undertaken which resulted in positive identification of nests and false crawls. Continuation of these exercises will aid in the assessment of nest identification accuracy.

When the entire season's data is compared per species, NTP recorded a total of 628 green turtle nests and 1465 false crawls during 2014-15 season, which equates to 30.0% nesting success. Hawksbill and loggerhead turtles had the greatest nesting success rates of 45.7% and 42.9% respectively, with NTP recording 91 nests and 108 false crawls for hawksbills and 436 nests and 580 false crawls for loggerheads (Table 1).

5.3.2 Nesting Success History (2002-15)

Green Turtles

Green turtle nesting success rates have varied over the years but generally remain lower than those of loggerhead and hawksbill turtles. A maximum green turtle nesting success rate of 37.34% occurred in 2008-09, but in other seasons figures have remained in a range between 21.7% – 29.9% (Figure 13). The success rate recorded for the 2014-15 season was above the average and mid range figures.

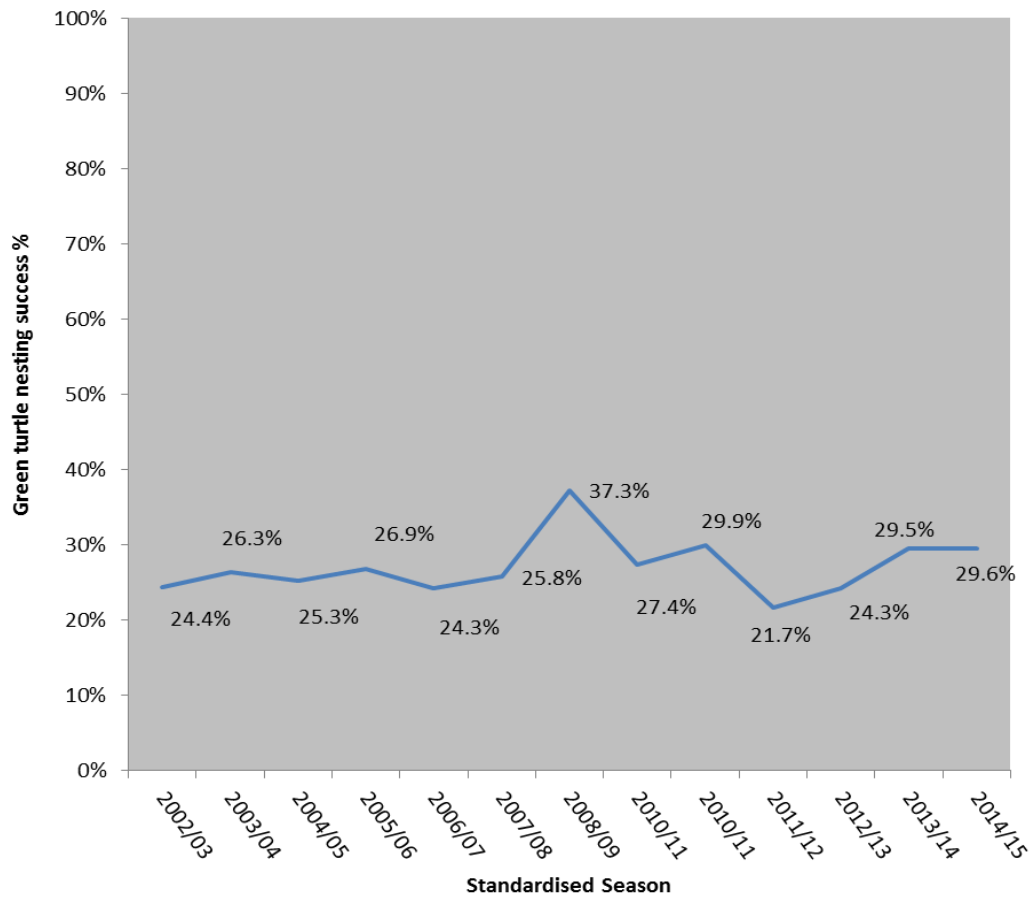


Figure 13: Green turtle nesting success 2002-2015 (%) standardised by survey effort during intensive peak monitoring period.

Hawksbill Turtles

Nesting success rates of hawksbill turtles has varied between 38.4-61.9% throughout the past thirteen nesting seasons (Figure 14). The 2014-15 season success rate was slightly below the average and mid-range figures.

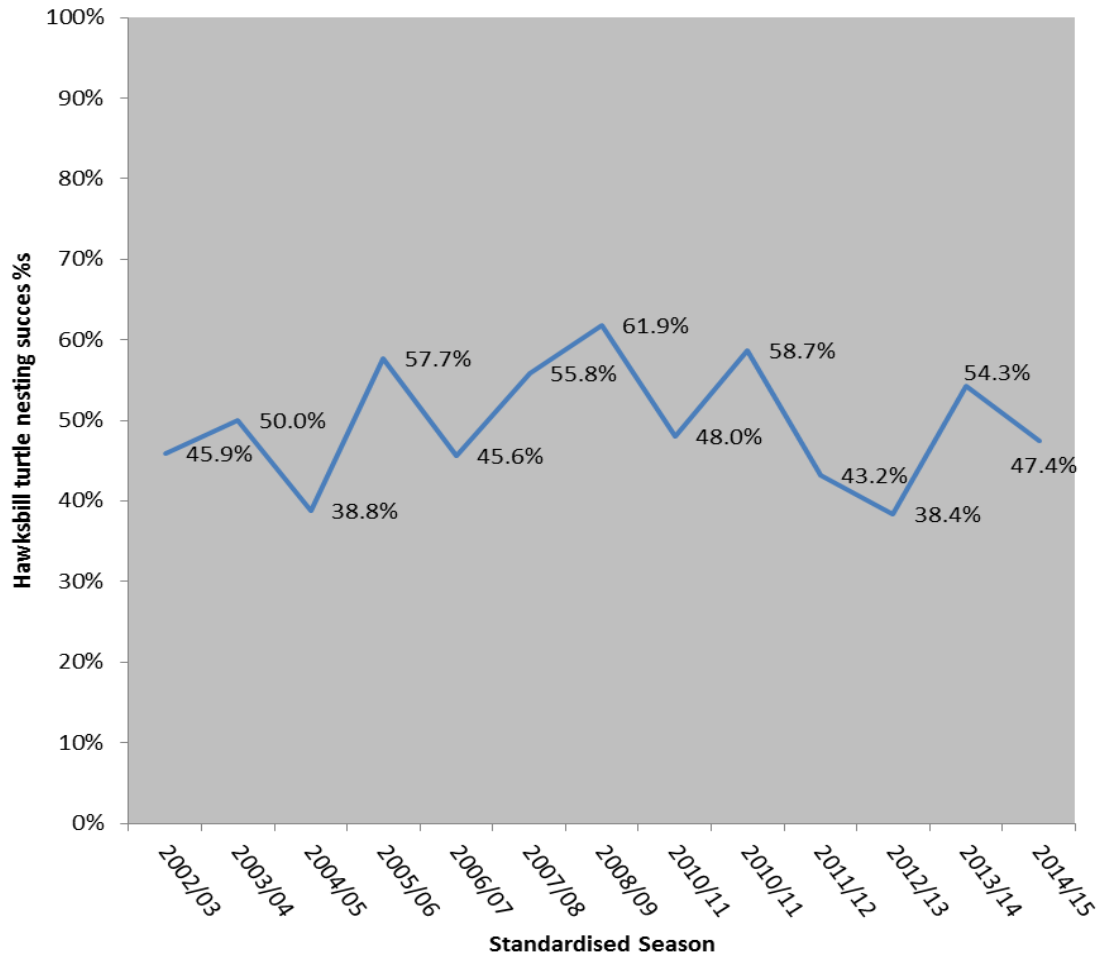


Figure 14: Hawksbill turtle nesting success (%) 2002-15 standardised by survey effort during the intensive peak monitoring period.

Loggerhead Turtles

The loggerhead turtles nesting success rate has varied from 26.9 – 59.5% since 2002 (Figure 15). The success rate observed in the 2014-15 season was slightly below the average and mid-range figures.

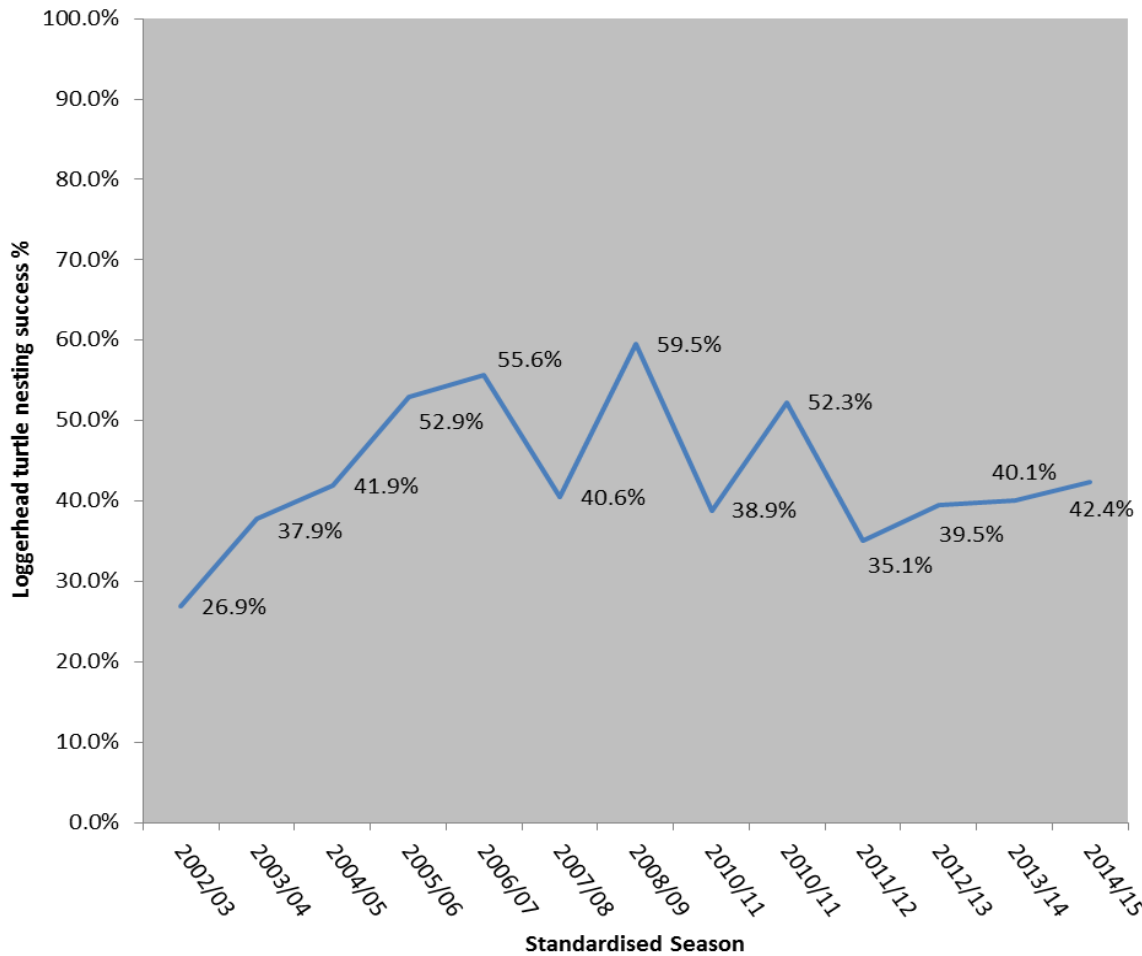


Figure 15: Loggerhead turtle nesting success 2002-15 (%) standardised by survey effort during intensive peak monitoring period

5.4 Nest Damage

5.4.1 2014-15

Four new nests and four old nests were recorded as damaged in the 2014-15 full season. One of these was recorded in the Cape Range Division and the remainder in the North West Cape Division. Two nests were accidentally disturbed by other nesting turtles and six were damaged by the tide. Refer to Appendix 1 and Appendix 2 for maps of sections.

Note: The accuracy of nest damage records mentioned above is not confirmed seeing as only new nests (i.e. first day of incubation period) are specifically checked for signs of damage whereas damage to old nests (i.e. day two of the incubation period until hatching) is only recorded on an incidental basis if it is encountered whilst monitoring new nests. Therefore it is possible that incidences of damaged nests go undetected. In light of this, a turtle nest predation study was undertaken during the 2014-15 season to assess the effectiveness of current NTP predation monitoring techniques. Nest predation was recorded as 3.4% of the sample size of 29 nests (attributed to intra-nest predation by

ghost crabs) and an additional four cases of nest disturbance (dune encroachment, tide and another turtle digging up a nest) were noted. The results are similar to those collected in the NTP but further studies are required for more conclusive comparisons. For more detailed results on the project please see 'Green Turtle Nest Predation Report: North West Cape Division; Ningaloo Turtle Program 2014-15' available at www.ningalooturtles.org.au.

5.4.2 Nest Damage History (2002-15)

Since monitoring began in 2002, a total of 865 nests (new and old) have been recorded as damaged within the Ningaloo Region (Table 4). This equates to 1.8% of total nests recorded within the Ningaloo Region 2002-2015 (please note that survey effort within the Region varies for each NTP season; see Table 1 for detailed survey effort data).

Table 4: Total number of damaged nests (new and old) and cause per season NTP 2002-2015. NA indicates data no longer collected on this category.

Season	Cause of Nest (new and old) Damage										Total
	Unknown	Dog	Fox	Ghost Crab	Goanna	Human	Seagull	Tide	Another Turtle	Vehicle	
2002-2003	14	0	58	14	3	9	2	2	3	0	105
2003-2004	53	0	95	4	2	11	2	4	2	0	173
2004-2005	10	0	26	2	1	1	0	2	1	2	45
2005-2006	0	0	4	12	0	0	2	2	4	1	25
2006-2007	5	5	30	22	1	0	0	1	13	0	77
2007-2008	9	9	13	96	4	2	3	9	13	0	158
2008-2009	31	7	57	1	0	0	0	0	1	0	97
2009-2010	15	2	15	2	4	1	0	0	0	0	39
2010-2011	14	2	2	3	0	1	0	6	0	0	28
2011-2012	12	2	3	NA	NA	NA	NA	7	42	NA	66
2012-2013	0	0	1	1	0	0	0	0	1	0	3
2013-2014	7	1	1	0	3	3	0	0	26	0	41
2014-2015	0	0	0	0	0	0	0	6	2	0	8
Total	170	29	305	156	18	28	9	39	108	3	865

5.4.3 Predation of nests by foxes and dogs

Since 2002, damage by foxes and dogs has accounted for 38.6% of the total damaged nests recorded. Nest predation by foxes and dogs has remained below 5% for all recorded nests. When the NTP was commenced, discussions were held on the possible sustainable level of fox/dog predation to turtle nests, with the consideration of advice provided by C. Limpus (pers. com.). It was concluded that a desirable maximum threshold of 5% would be adequate to monitor a measure of the success of fox baiting regimes. However, this threshold is not indicative of the acceptable total level of predation, as the cumulative effects of mortality of hatchlings, juvenile and adult turtles would need to be considered in order to assess a truly sustainable level of predation for the whole turtle population.

The highest record of fox and dog predation since monitoring began is 4.4% of total nests in 2003-04 and was primarily within the Five Mile subsection. As this subsection is a significant green turtle rookery, fox control measures were introduced by the Department of Environment and Conservation in 2004-05 (Halkyard, 2008). As a result of this initiative, fox and dog predation has declined significantly in subsequent seasons and has maintained a low level (less than 2%) due to continued fox baiting at key rookeries.

It should be noted that an additional suspected case of a fox preying a hatchling was observed on camera during the green turtle nest predation study. This was not confirmed and is not in line with NTP methodologies (as feral predation incidences are primarily focused on predation of eggs seeing as it is more feasible to see the signs of diggings, predator prints and eggshells than it is to capture hatchling predation using the “morning-after” monitoring technique). However if this was incorporated the overall fox and dog predation rate would still be under the 5% sustainable predation threshold.

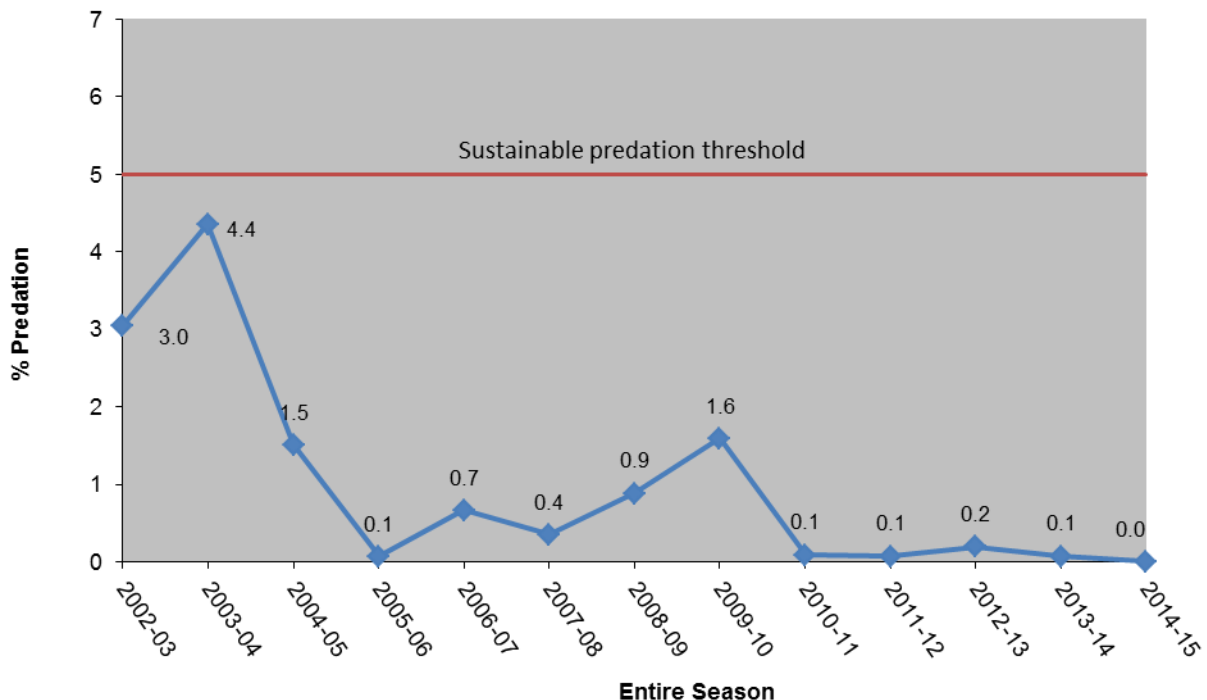


Figure 16: Fox and dog predation as a percentage of total nests per season, NTP 2002-15. Note: data from 2009-10 season onwards includes NW Cape and Cape Range Divisions only, other seasons include an additional two divisions.

5.5 Turtle Rescues

There were five turtle rescues carried out during the 2014-15 NTP season. NTP volunteers have rescued a total of 240 stranded marine turtles from 2002-2015. The number of turtles rescued has fluctuated over the seasons (Figure 17), which is often influenced by the level of turtle activity for the season (i.e. higher activity levels mean more turtles present on the beaches, which can also result in more turtle rescues being required).

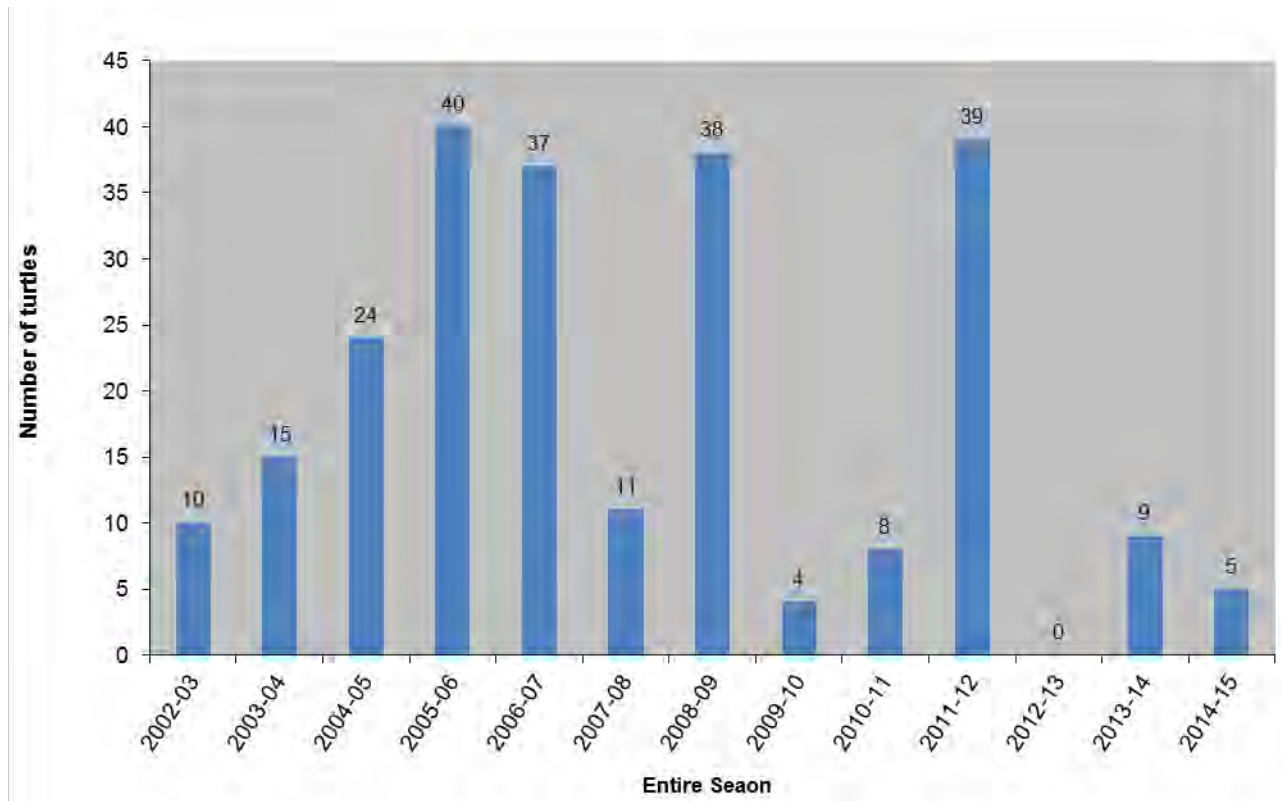


Figure 17: The number of turtles rescued in each NTP season, 2002-15. Note: from 2009-10 season onwards data includes NW Cape and Cape Range Divisions only, other seasons include an additional two divisions.

5.6 Turtle Mortalities

Twenty three turtle mortalities were recorded during the 2014-15 season. Detailed mortality reports can be obtained from the Department of Parks and Wildlife Exmouth District.

Turtle mortalities have only been recorded as part of NTP since 2007-08. This number has fluctuated greatly over the seasons, with the highest number of deceased turtles recorded in 2011-12, which coincides with the highest level of turtle activity recorded since the commencement of the program.

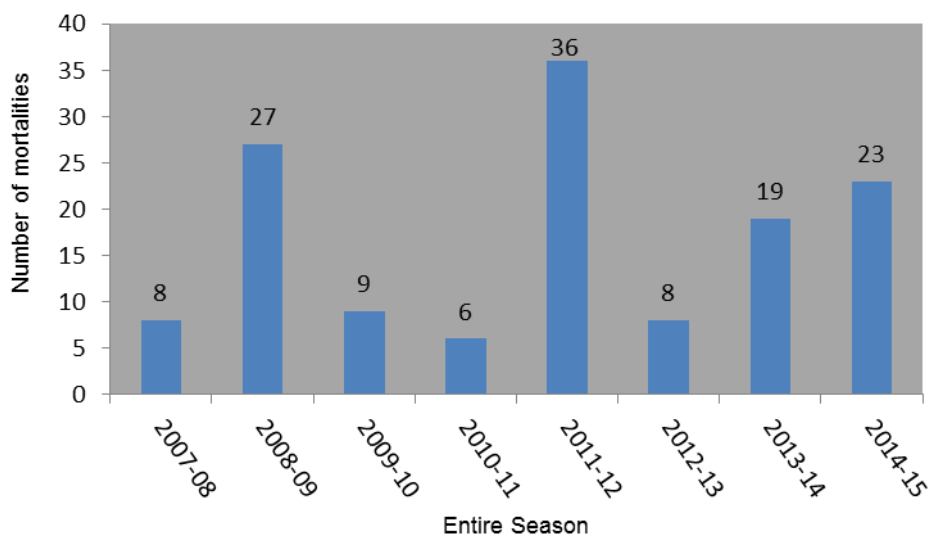


Figure 18: The number of turtles mortalities recorded per season from 2007 - 2015 (2002-06 data not available).

5.7 Weather Events 2014-15

The Ningaloo Turtle Program monitoring beaches are susceptible to seasonal weather events, such as cyclones. These can have significant effects on turtle nests and available nesting habitat. On the 12th March 2015 Tropical Cyclone Olwyn impacted the Ningaloo coastline as a high Category 3 system. As this occurred towards the end of the hatching season, and outside of the turtle monitoring season, the effect on remaining turtle nests was not specifically assessed. It is possible however that unhatched nests may have been inundated due to a combination of high tides and significant storm surge during the event. Nesting beach profiles are constantly changing due to weather events and coastal processes that occur between nesting seasons.

5.8 Tagged Turtle Re-sightings 2014-15

Five tagged Turtles were recorded as being sighted in the 2014-15 season. These turtles do not have resighting records since they were last observed in the 1991-92, 1993-94, 1997-98 and 2002-03 nesting seasons. The latter of which was tagged at Barrow Island and is among three

turtles on record that were tagged on the island and then later sighted on the beaches within the North West Cape Division.

6.0 ACKNOWLEDGEMENTS

Thank you to Woodside Energy Ltd. for the significant funding contribution to the operational costs of the Ningaloo Turtle Program and to BHP Billiton for funding the minibus which is used to transport the volunteers.

Thanks also to the local NTP volunteers from the Exmouth community, the external volunteers recruited from national and international areas, and the team leader interns. The program would not be able to function without the significant contribution of time and effort that these volunteers contribute.

Cape Conservation Group Inc. and the Department of Parks and Wildlife for their initial collaborative partnership and their continued passion and support for the program.

Roland Mau, Susie Bedford and David Waayers, for the 2001-2002 NTP pilot program.

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.

7.0 REFERENCES

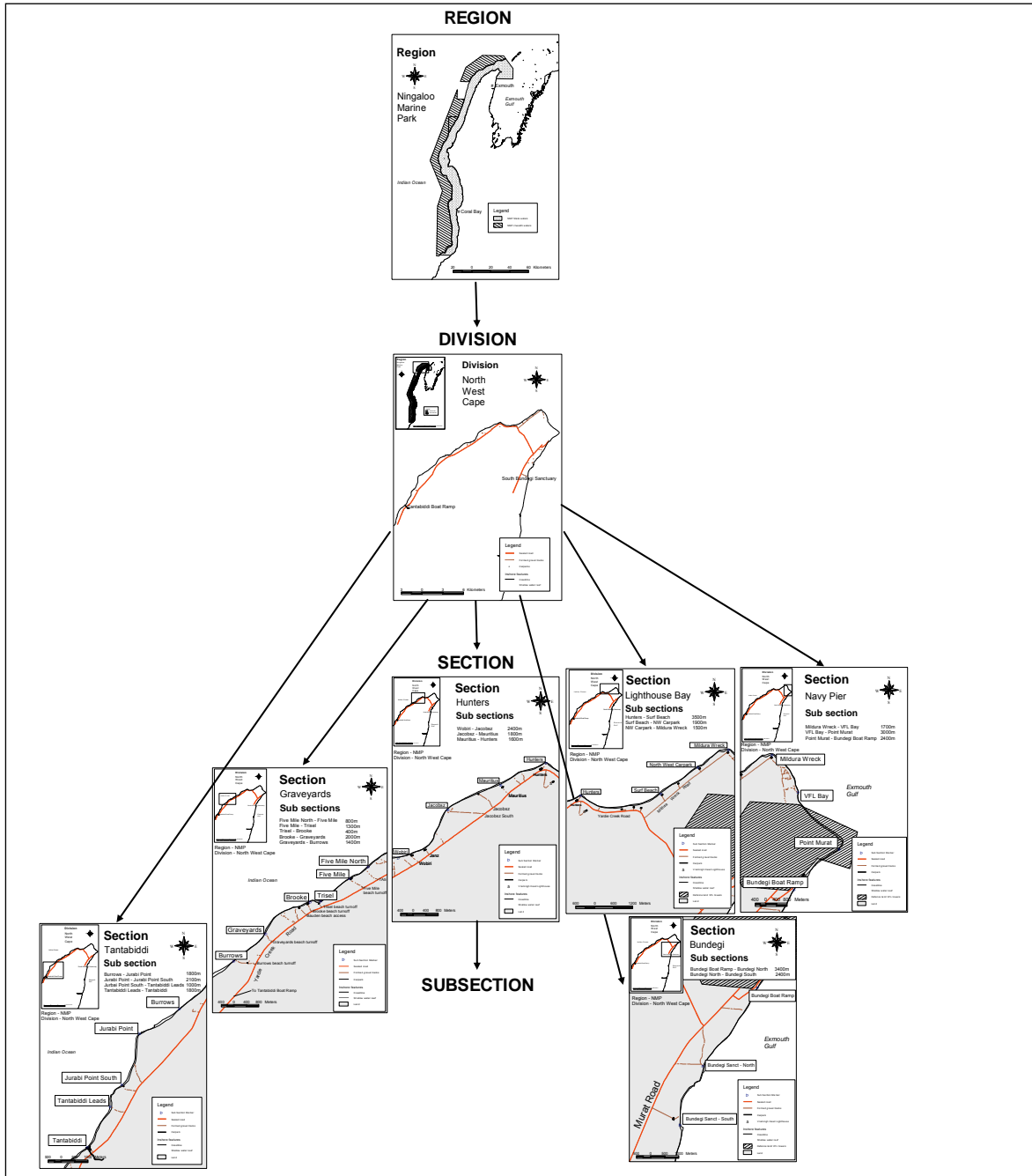
Halkyard, B. (2008). Progress Report: Fox Control for Turtle Conservation in Ningaloo Marine Park 2007-08 Nesting Season. Department of Environment and Conservation, Exmouth District, Western Australia. Unpublished report.

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8.0 Appendix

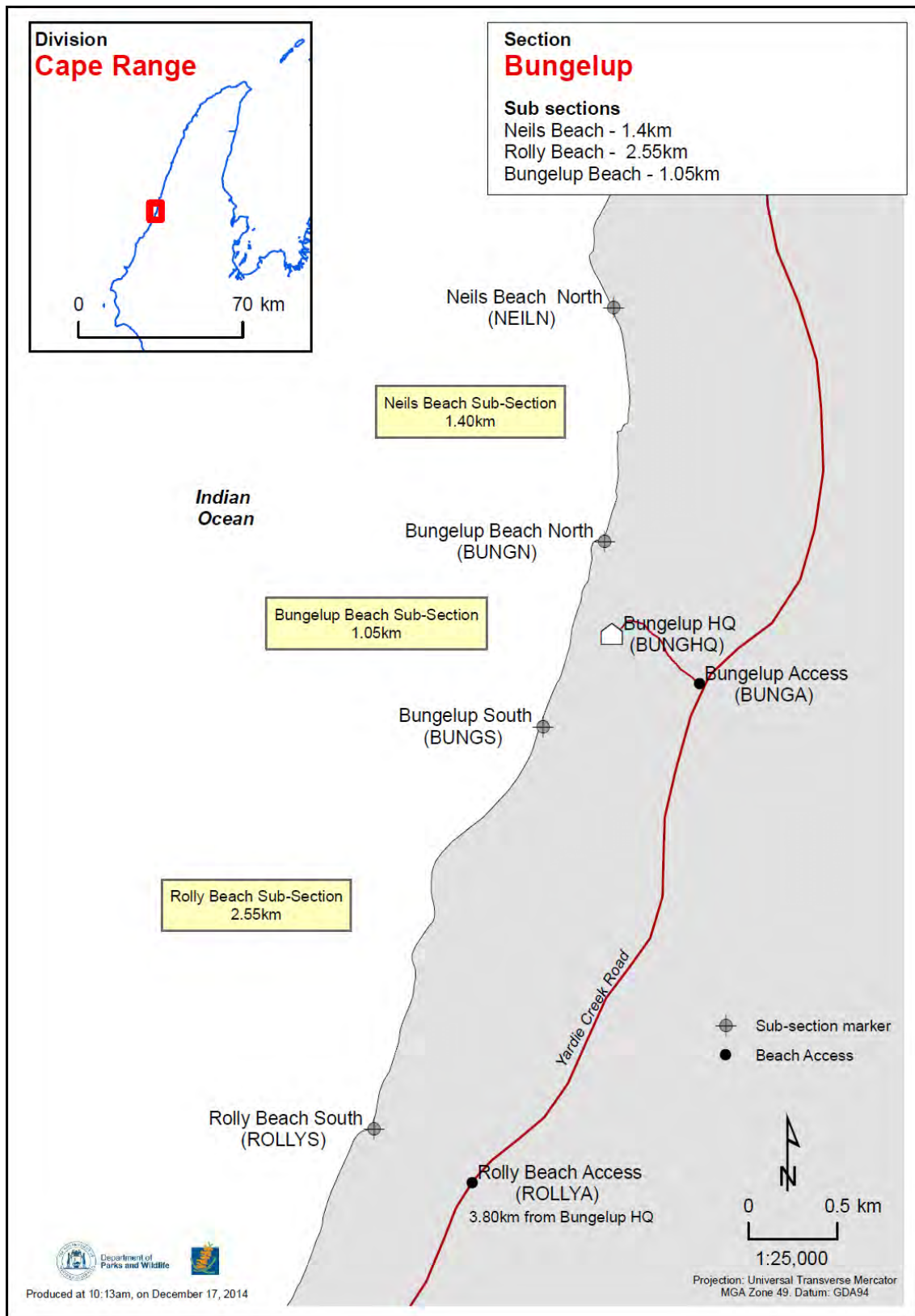
Appendix 1: Zoning of the NW Cape Division.



Location and distance of each subsection within NW 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

Appendix 2: Zoning of the Cape Range Division.

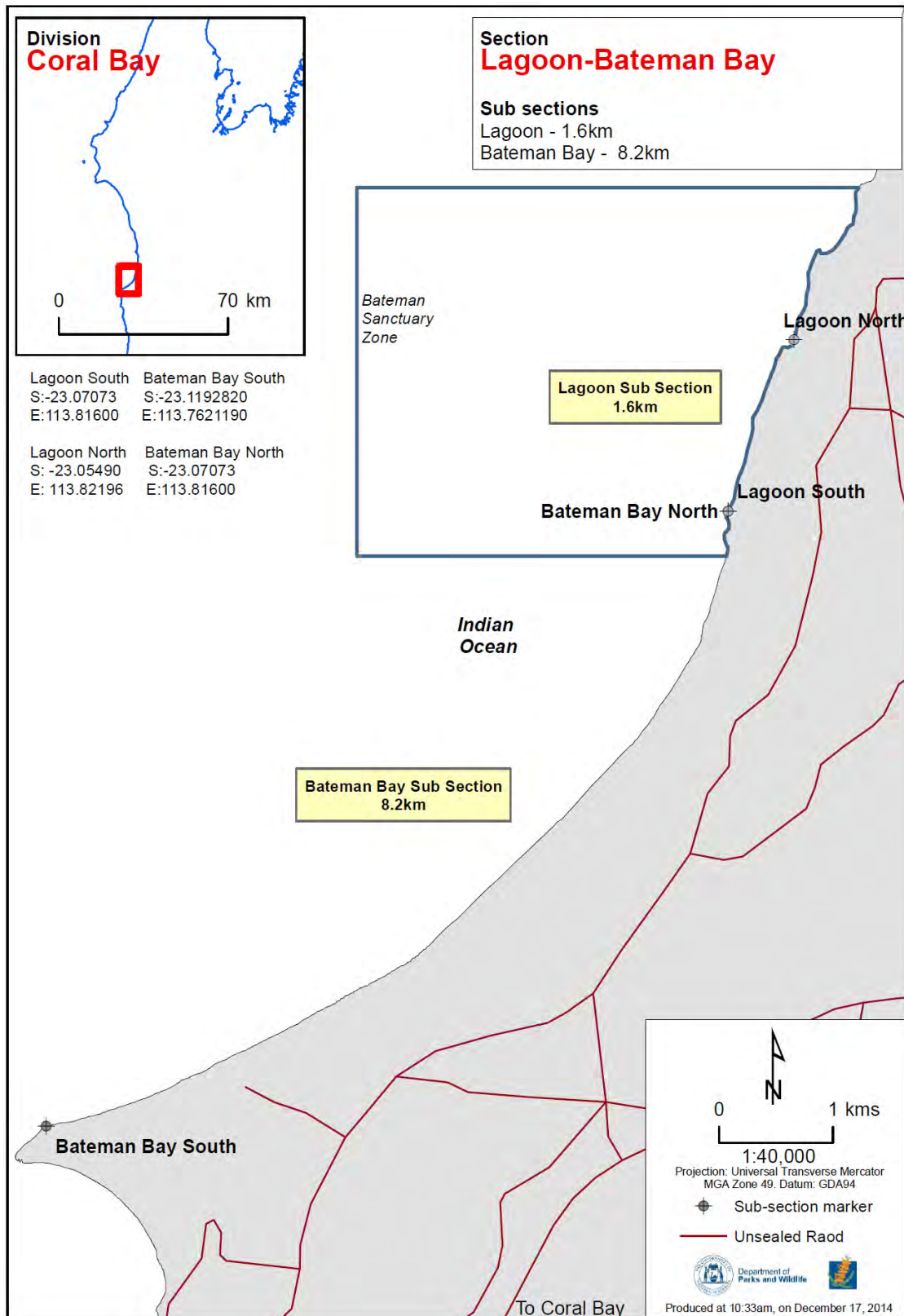


Location and distance of each subsection within Cape Range Division.

Subsection	Location of northern totem	Location of southern totem	Distance (m)
Neils Beach North - Bungelup Beach North	22.26489 S; 113.83277 E	22.27674 S; 113.83231 E	1400
Bungelup North - Bungelup Beach South	22.27674 S; 113.83231 E	22.28613 S; 113.8292 E	1400
Bungelup Beach South - Rolly Beach South	22.28613 S; 113.8292 E	22.30650 S; 113.82062 E	2550

Appendix 3: Coral Bay Division

Location of subsection within the Lagoon-Bateman Bay Section (Coral Bay Division), (Lagoon South - Lagoon North; Batemans South - Batemans North).



Location and distance of each subsection within 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

Appendix 6: Marine Turtle Stranding and Mortality Datasheet

MARINE TURTLE STRANDING AND MORTALITY DATASHEET – Pilbara Region

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

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

LOCATION: _____

Latitude: _____ ° S

Longitude: _____ ° E

STATUS: Alive Condition/Behaviour: _____

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

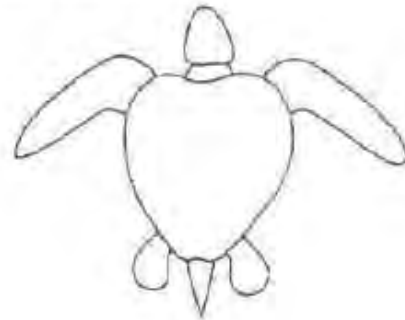
- | | |
|--|--|
| <input type="checkbox"/> Live but subsequently died | <input type="checkbox"/> Carcass poor (advanced decomposition) |
| <input type="checkbox"/> Carcass in good condition (fresh/edible) | <input type="checkbox"/> Mummified carcass (skin holding bones) |
| <input type="checkbox"/> Carcass fair (decomposed but organs intact) | <input type="checkbox"/> Disarticulated bones (no soft tissue remaining) |

SPECIES (see key overleaf):

- Green
 Loggerhead
 Flatback
 Hawksbill
 Olive Ridley
 Leatherback
 Unknown

DISTINGUISHING FEATURES: (please also indicate on diagram)

- Obvious damage/injuries
 Missing limbs
 Barnacles
 Algal growth on carapace
 Tagging scars



TAG NUMBERS: Left flipper _____

Right flipper _____

MEASUREMENTS:

Curved Carapace Length:	_____ mm	<input type="checkbox"/> Measured	<input type="checkbox"/> Estimated
Curved Carapace Width:	_____ mm	<input type="checkbox"/> Measured	<input type="checkbox"/> Estimated
Tail Length (from Carapace):	_____ mm	<input type="checkbox"/> Measured	<input type="checkbox"/> Estimated
Maximum Head Width:	_____ mm	<input type="checkbox"/> Measured	<input type="checkbox"/> Estimated

SEX: Male Female Unknown

MATURITY: Juvenile Adult Unknown

PHOTOGRAPHS* (see overleaf): _____

SECURITY/DISPOSAL/RELEASE of turtle: _____

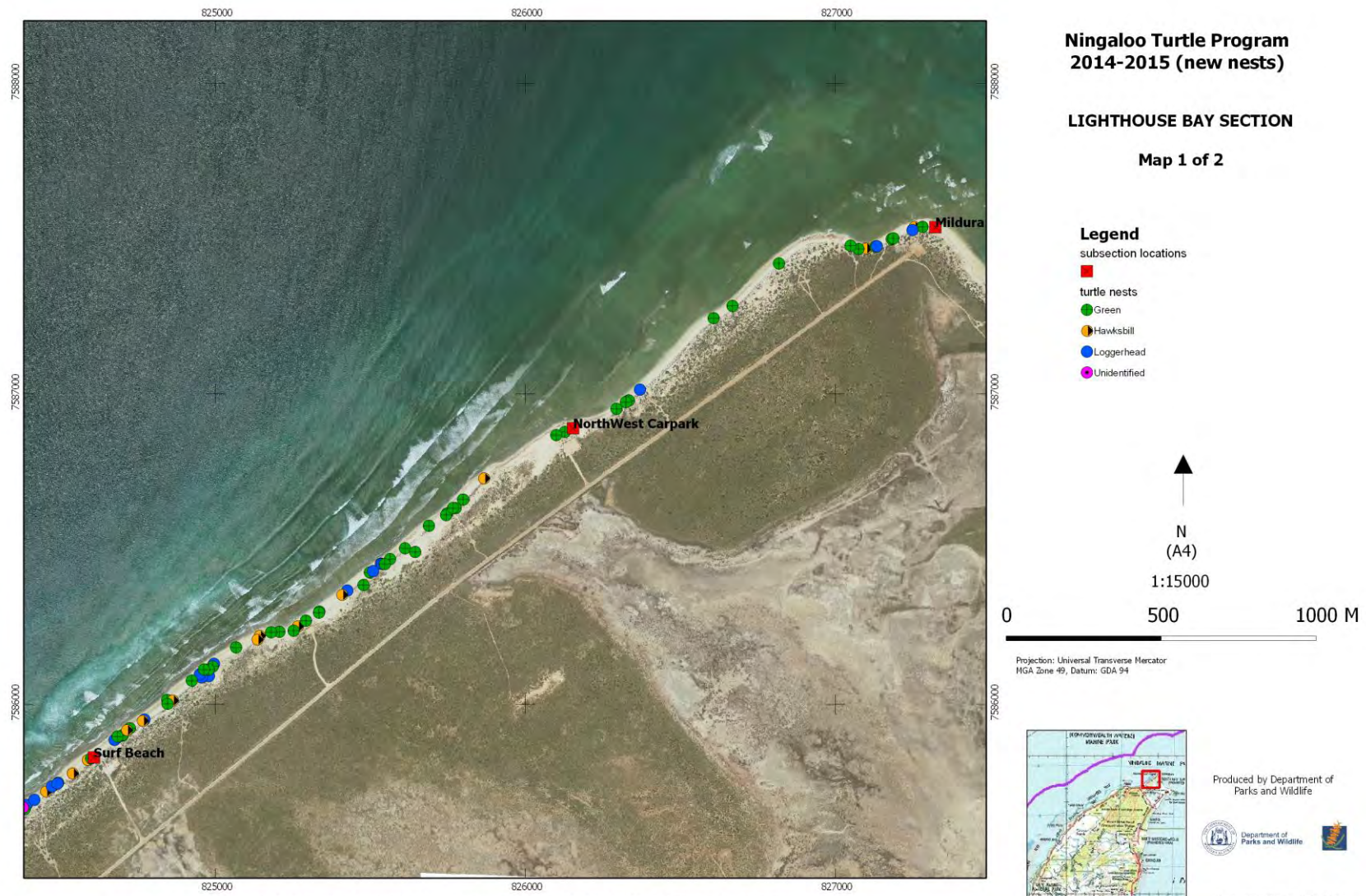
NOTES: _____

CONTACT DETAILS:

Name: _____ Phone number: _____

Address: _____ Email: _____

Appendix 7: Lighthouse Bay Section - Location of New Nests (NTP 2014-15) Map 1 & 2



The Department of parks and Wildlife does not guarantee that this map is without flaw of any kind and disclaims all liability for any errors, loss or other consequence which may arise from relying on any information depicted. Roads and tracks on land managed by Parks and Wildlife may contain unmarked hazards and their surface condition is variable. Exercise caution and drive to conditions on all roads.



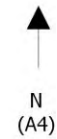
**Ningaloo Turtle Program
2014-2015 (new nests)**

LIGHTHOUSE BAY SECTION

Map 2 of 2

Legend

- subsection locations
- turtle nests
- Green
- Hawksbill
- Loggerhead
- Unidentified



1:16751

0 500 1000 M

Projection: Universal Transverse Mercator
MGA Zone 49, Datum: GDA 94



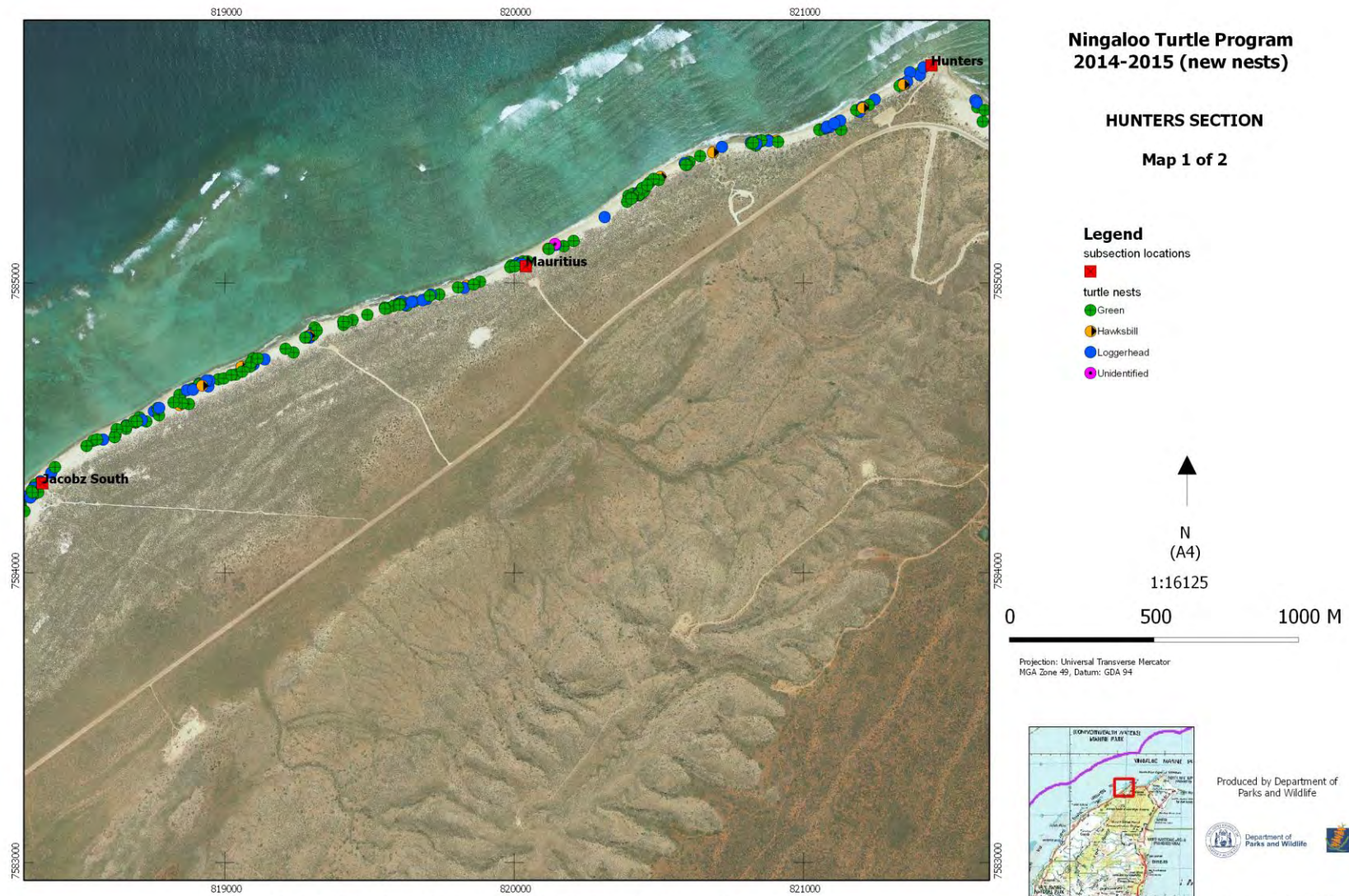
Produced by Department of
Parks and Wildlife



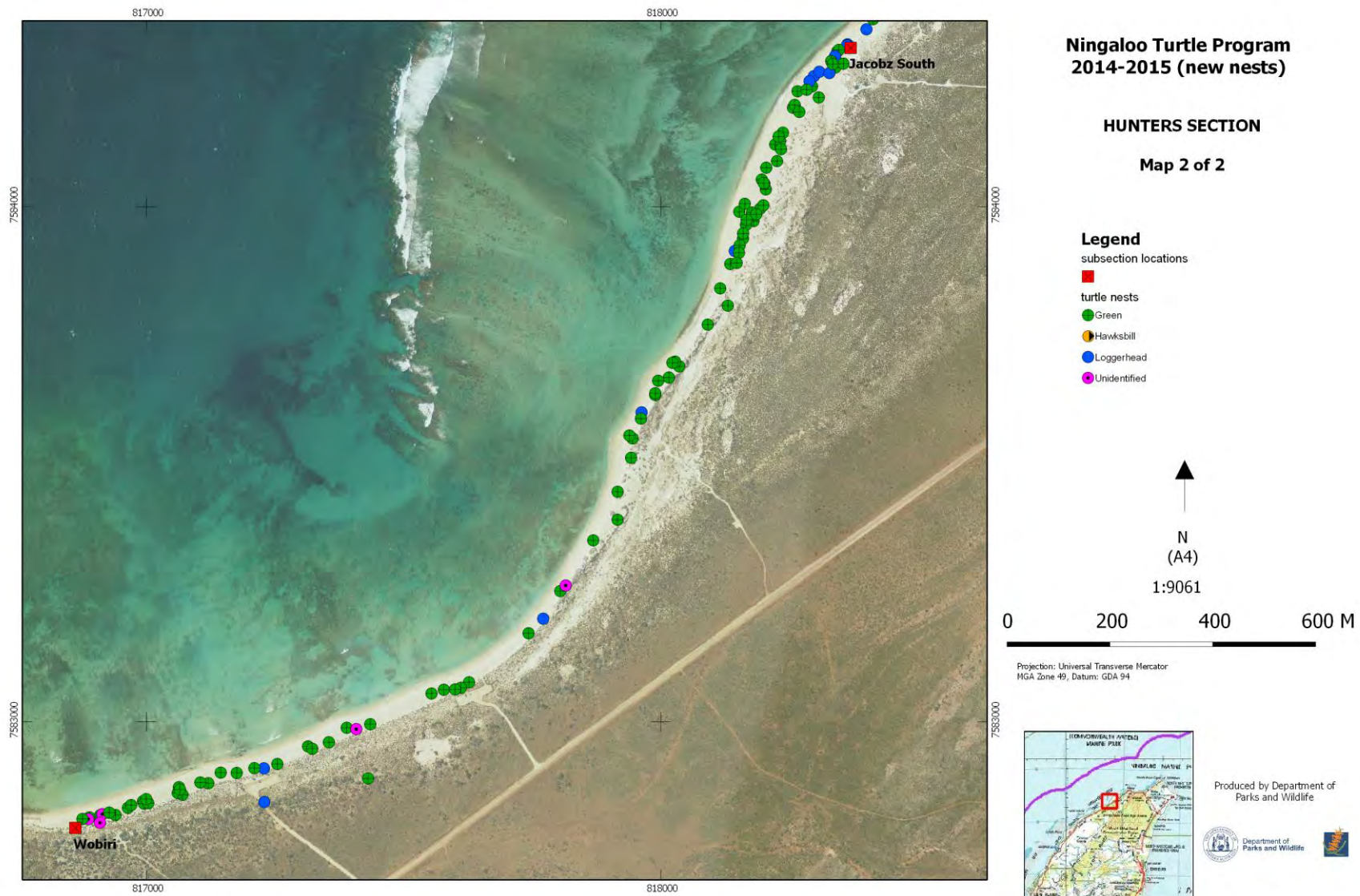
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Appendix 8: Hunters Section - Location of New Nests (NTP 2014-15) Map 1 & 2

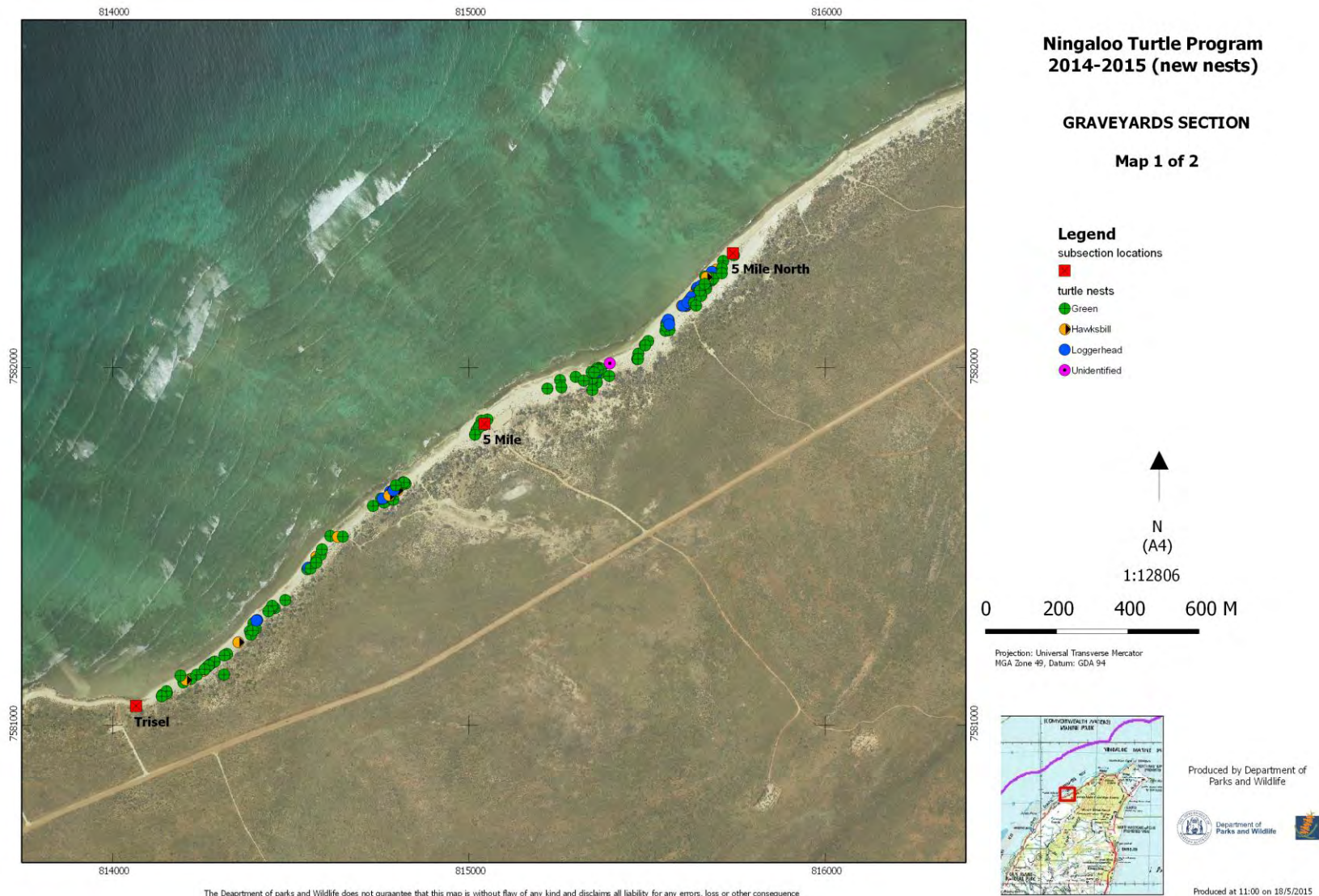


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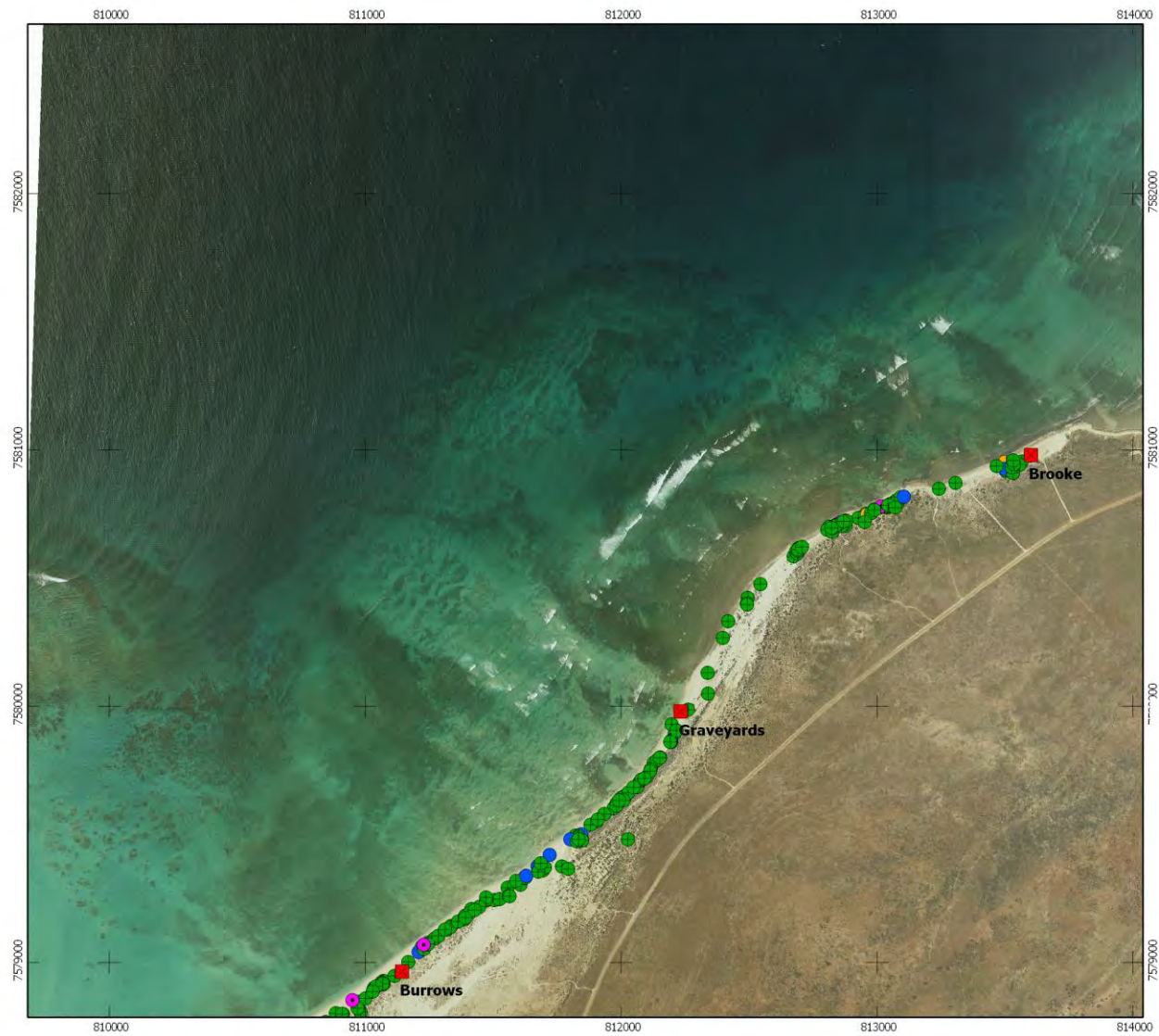


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Appendix 9: Graveyards Section - Location of New Nests (NTP 2014-15) Map 1 & 2



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**Ningaloo Turtle Program
2014-2015 (new nests)**

GRAVEYARDS SECTION

Map 2 of 2

Legend

- subsection locations
- turtle nests
 - Green
 - Hawkbill
 - Loggerhead
 - Unidentified



N
(A4)

1:21054



Projection: Universal Transverse Mercator
MGA Zone 49, Datum: GDA 94



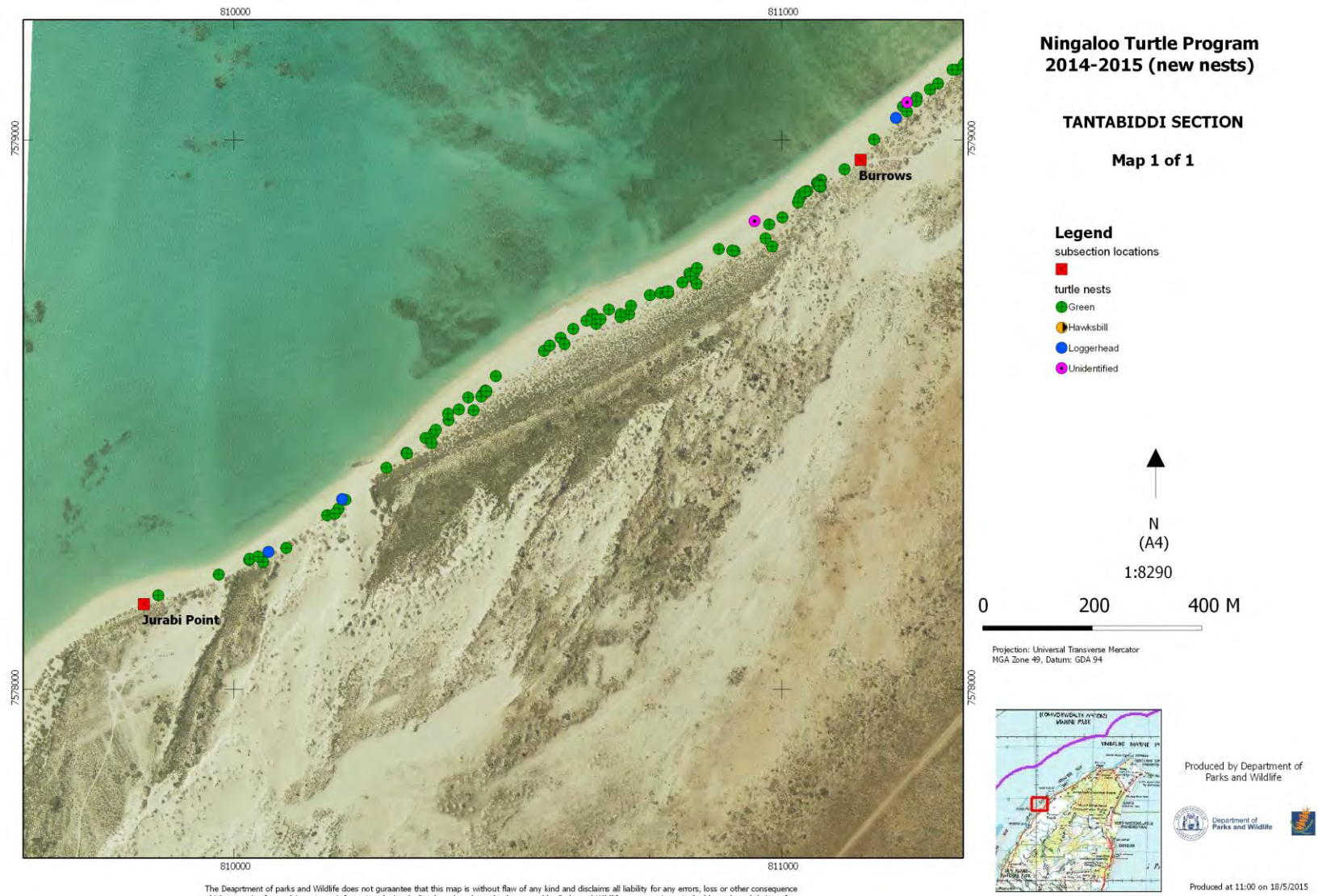
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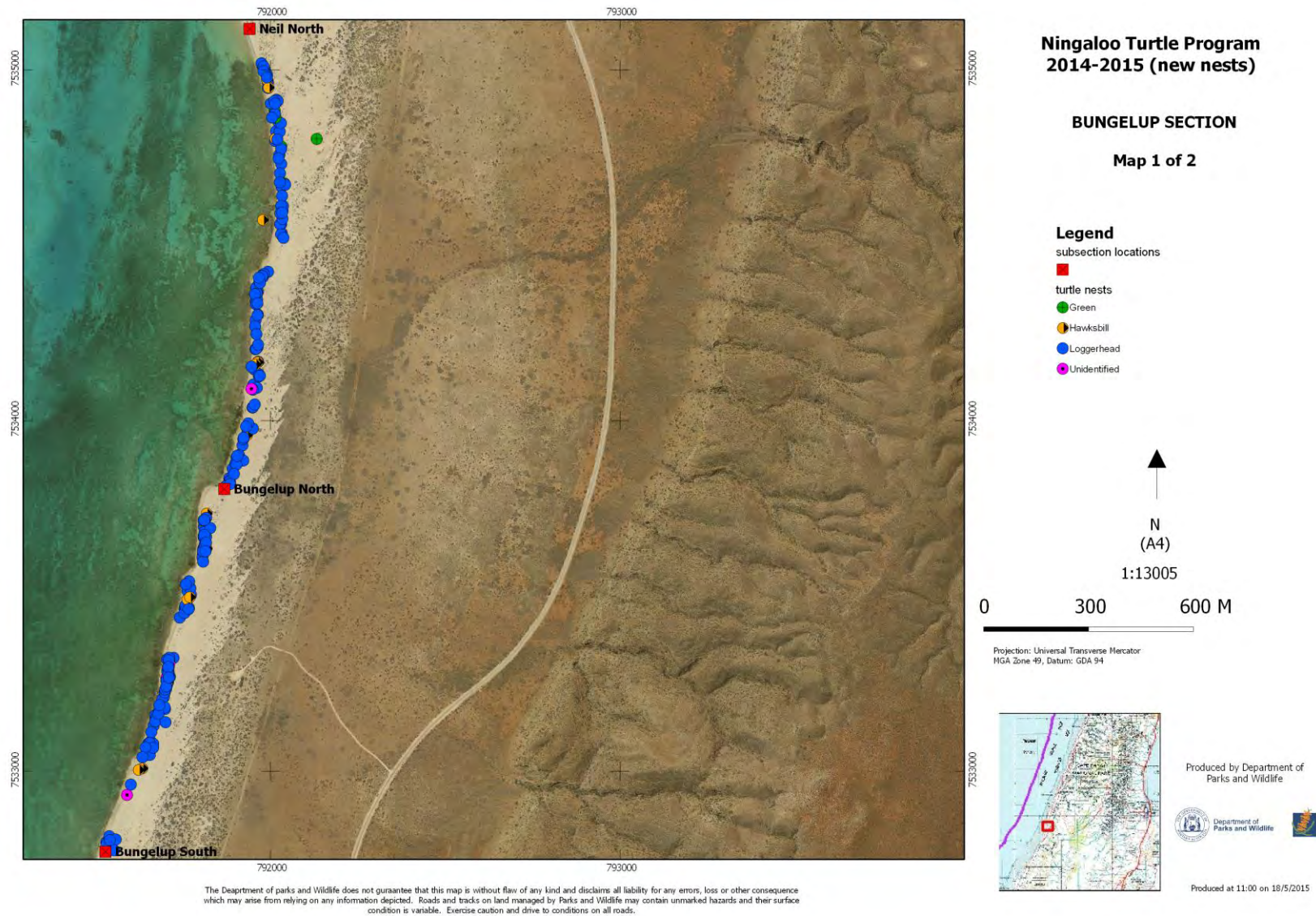
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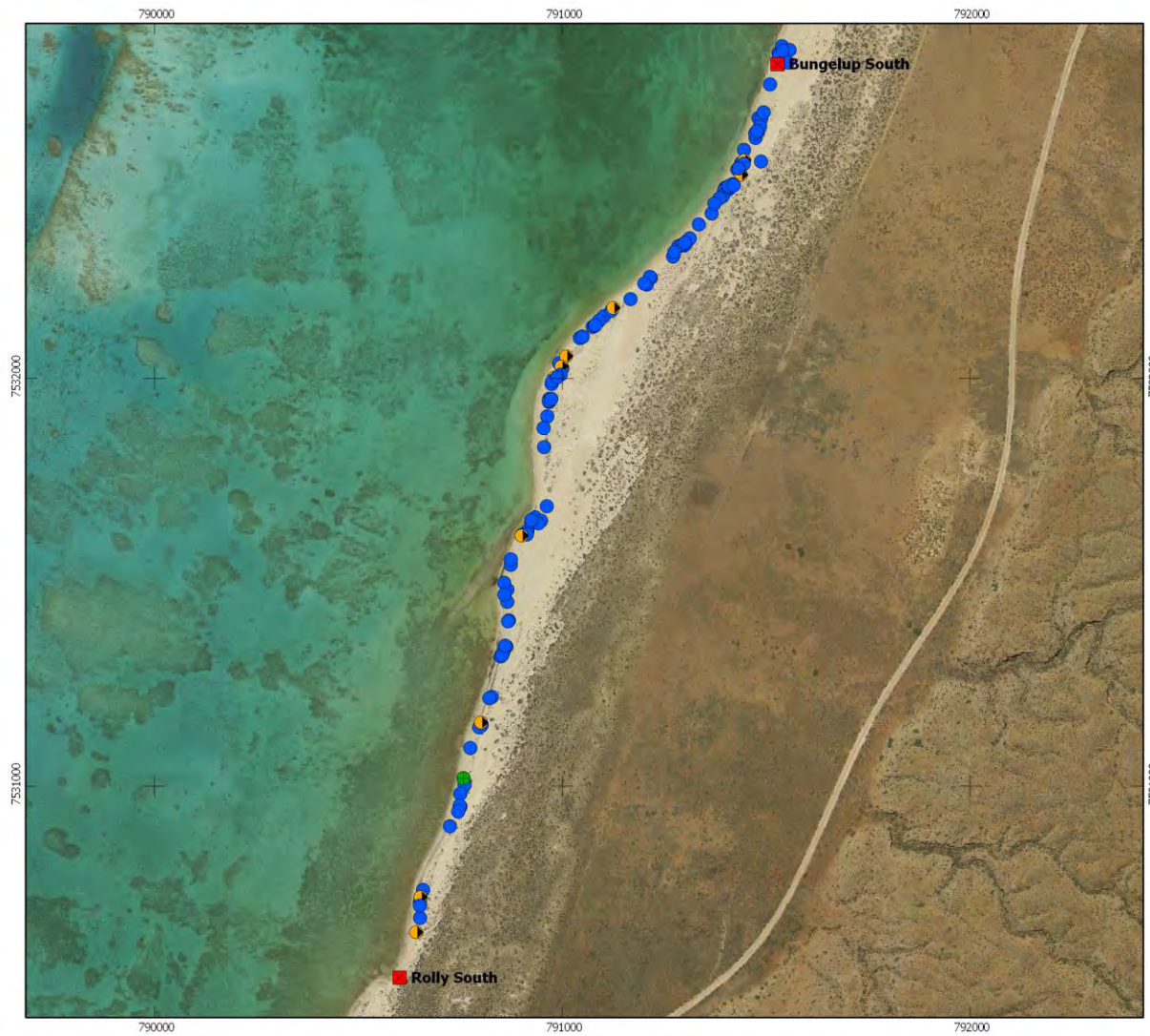
Appendix 10: Tantabiddi Section - Location of New Nests (NTP 2014-15) Map 1



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Appendix 11: Bungelup Section - Location of New Nests (NTP 2014-15) Map 1 & 2





**Ningaloo Turtle Program
2014-2015 (new nests)**

BUNGELUP SECTION

Map 2 of 2

Legend

- subsection locations
-
- turtle nests
- Green
- Hawksbill
- Loggerhead
- Unidentified



N
(A4)

1:13241



Projection: Universal Transverse Mercator
MGA Zone 49, Datum: GDA 94



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