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TABLE OF CONTENTS

GLOSSARY..... iv

LIST OF ABBREVIATIONS vi

1.0 SUMMARY..... 1

2.0 INTRODUCTION..... 2

3.0 METHODS..... 4

4.0 MONITORING ZONES.....5

5.0. RESULTS 6

 5.1 SURVEY EFFORT.....6

 5.2 TURTLE ACTIVITY.....9

 5.3 NESTING SUCCESS.....19

 5.4 NEST DAMAGE..... 23

 5.5 TURTLE RESCUES.....27

 5.6 TURTLE MORTALITIES..... 28

 5.7 WEATHER EVENTS 2016-17 28

 5.8 TAGGED TURTLE RE-SIGHTINGS 2016-1729

 5.9 ADDITIONAL MONITORING SITE (SOUTH MANDU).....30

6.0 ACKNOWLEDGEMENTS..... 31

7.0 REFERENCES 32

8.0 APPENDICES 33

 APPENDIX 1: ZONING OF THE NW CAPE DIVISION 33

 APPENDIX 2: ZONING OF THE CAPE RANGE DIVISION..... 35

 APPENDIX 3: ZONING OF THE CORAL BAY DIVISION..... 37

 APPENDIX 4: CURRENT NTP DATA SHEET 39

 APPENDIX 5: TAGGED TURTLE RE-SIGHTINGS DATASHEET..... 40

 APPENDIX 6: MARINE TURTLE STRANDING AND MORTALITY DATASHEET 41

 APPENDIX 7: LIGHTHOUSE BAY SECTION - LOCATION OF NEW NESTS (NTP 2016-17) MAP 1 & 2..... 42

 APPENDIX 8: HUNTERS SECTION - LOCATION OF NEW NESTS (NTP 2016-17) MAP 1 & 2..... 44

 APPENDIX 9: GRAVEYARDS SECTION - LOCATION OF NEW NESTS (NTP 2016-17) MAP 1 & 2..... 46

 APPENDIX 10: TANTABIDDI SECTION - LOCATION OF NEW NESTS (NTP 2016-17) MAP 1..... 48

 APPENDIX 11: BUNGELUP SECTION - LOCATION OF NEW NESTS (NTP 2016-17) MAP 1 & 2..... 49

LIST OF TABLES

TABLE 1: SURVEY EFFORT AND TURTLE ACTIVITY 2002-17 ENTIRE SEASON (ALL DATA AND SUBSECTIONS)..... 7

TABLE 2: THE TOTAL NUMBER OF ACTIVITIES (SUSPECTED NESTS AND FALSE CRAWLS) RECORDED FOR EACH SPECIES WITHIN THE NORTH WEST DIVISION, NTP 2016-17 ENTIRE SEASON 9

TABLE 3: THE TOTAL NUMBER OF ACTIVITIES (SUSPECTED NESTS AND FALSE CRAWLS) RECORDED FOR EACH SPECIES WITHIN THE CAPE RANGE DIVISION, NTP 2016-17 ENTIRE SEASON 10

TABLE 4: TOTAL NUMBER OF DAMAGED NESTS (NEW AND OLD) AND CAUSE PER SEASON NTP 2002-2017 25

TABLE 5: TAGGED TURTLE SIGHTING DETAILS, NTP 2016-17.....29

LIST OF FIGURES

FIGURE 1: COMPARISON OF NESTING ACTIVITY (SUSPECTED NESTS AND FALSE CRAWLS) RECORDED IN EACH NW CAPE SECTION, NTP 2016-17 FOR ENTIRE SEASON.....9

FIGURE 2: PERCENTAGE COMPARISON OF NESTS BY SPECIES RECORDED WITHIN THE NORTH WEST CAPE DIVISION, 2016-17 ENTIRE SEASON.....10

FIGURE 3: COMPARISON OF NESTING ACTIVITY (SUSPECTED NESTS AND FALSE CRAWLS) RECORDED WITHIN EACH BUNGELUP SUBSECTION (CAPE RANGE DIVISION), NTP 2016-17.....11

FIGURE 4: PERCENTAGE COMPARISON OF NESTS BY SPECIES WITHIN THE CAPE RANGE DIVISION, 2016-17.....11

FIGURE 5: SEASONAL GREEN, LOGGERHEAD AND HAWKSBILL TURTLE ACTIVITY (NESTS AND FALSE CRAWLS) STANDARDISED BY SURVEY EFFORT DURING THE INTENSIVE PEAK MONITORING PERIOD.....12

FIGURE 6: SEASONAL GREEN, LOGGERHEAD AND HAWKSBILL NESTS STANDARDISED BY SURVEY EFFORT DURING THE INTENSIVE PEAK MONITORING PERIOD.....13

FIGURE 7: SEASONAL GREEN TURTLE ACTIVITY (NESTS AND FALSE CRAWLS) STANDARDISED BY SURVEY EFFORT DURING THE INTENSIVE PEAK MONITORING PERIOD.....14

FIGURE 8: SEASONAL GREEN TURTLE NESTS STANDARDISED BY SURVEY EFFORT DURING THE INTENSIVE PEAK MONITORING PERIOD.....15

FIGURE 9: SEASONAL HAWKSBILL ACTIVITY (FALSE CRAWLS AND NESTS) STANDARDISED BY SURVEY EFFORT DURING THE INTENSIVE PEAK MONITORING PERIOD.....16

FIGURE 10: SEASONAL HAWKSBILL NESTS STANDARDISED BY SURVEY EFFORT DURING THE INTENSIVE PEAK MONITORING PERIOD.....17

FIGURE 11: SEASONAL LOGGERHEAD ACTIVITY (FALSE CRAWLS AND NESTS) STANDARDISED BY SURVEY EFFORT DURING THE INTENSIVE PEAK MONITORING PERIOD.....18

FIGURE 12: SEASONAL LOGGERHEAD NESTS STANDARDISED BY SURVEY EFFORT DURING THE INTENSIVE PEAK MONITORING PERIOD.....19

FIGURE 13: GREEN TURTLE NESTING SUCCESS 2002-2017 (%) STANDARDISED BY SURVEY EFFORT DURING INTENSIVE PEAK MONITORING PERIOD.....21

FIGURE 14: HAWKSBILL TURTLE NESTING SUCCESS (%) 2002-17 STANDARDISED BY SURVEY EFFORT DURING THE INTENSIVE PEAK MONITORING PERIOD.....22

FIGURE 15: LOGGERHEAD TURTLE NESTING SUCCESS 2002-17 (%) STANDARDISED BY SURVEY EFFORT DURING INTENSIVE PEAK MONITORING PERIOD.....23

FIGURE 16: FOX AND DOG PREDATION AS A PERCENTAGE OF TOTAL NESTS PER SEASON, NTP 2002-17.....26

FIGURE 17: THE NUMBER OF TURTLES RESCUED IN EACH NTP SEASON, 2002-17.....27

FIGURE 18: THE NUMBER OF TURTLES MORTALITIES RECORDED PER SEASON FROM 2007 – 2017.....28

FIGURE 19: MAP OF SOUTH MANDU MONITORING TRANSECT.....30

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.
New nest	A suspected nest laid during the night before or the morning of monitoring, which has therefore not been previously recorded.
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 2016-17 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 nine volunteers contributed a total of 2857 hours to the Ningaloo Turtle Program in 2016-17. Since commencement of the program, volunteers have contributed a total of 61 125 hours. These figures demonstrate the effort and value of the volunteers over the life span of the program.

A total of 2626 suspected nests and 5730 false crawls were recorded in the Ningaloo Region over the entire 2016-17 season. Overall, activity levels were on average and nesting levels slightly above average in comparison to data from other seasons. Volunteers recorded 1856 green turtle nests and 4243 green false crawls, which equates to a nesting success rate of 30.5% for this species. Green turtle activity was below average in comparison to that recorded in previous seasons. Loggerhead turtles had a nesting success rate of 33% with 696 nests and 1395 false crawls being recorded, equating to the highest level of loggerhead activity recorded in the program to date. Hawksbill turtle records accounted for 67 nests and 89 false crawls which resulted in the highest nesting success rate of 43%. Activity data for this species in 2016-17 was lower than average in comparison to other seasons.

Nest disturbance was observed towards 12 nests, which is 0.46% of the total recorded nests. This was attributed to natural causes, being tidal inundation and turtles accidentally excavating other turtle's nests. No nest disturbance by invasive predators was recorded.

During 2016-17 eight stranded turtles were rescued, adding to a total of 249 rescued since 2002. Two turtle mortalities and 14 tagged turtles were recorded during the 2016-17 season. This is the most tag re-sightings and the least mortalities that have been recorded in the program to date.

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.

Woodside Energy Ltd is the main sponsor of the program and has been providing significant contributions to the program's operational costs since 2012. This has included the funding toward volunteer costs, website maintenance, community activities, equipment and educational materials.

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

In 2008 the NTP was consolidated after 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. Additionally, weekend monitoring during the pre and post peak nesting periods captures early and late fluctuations in the nesting activity. This period and configuration was identified to be suitable through an analysis of data from previous seasons.

Trend analysis is undertaken every three years, most recently in 2016. 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. The most recent trend analysis is available online at http://www.ningalooturtles.org.au/media_reports.html.

The goals and objectives listed below have been formulated through a community-based committee 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 technology. 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 Section 5.0 of the NTP Annual Report 2012-13 (Coote et al 2013), or the NTP Turtle Monitoring Field Guide Edition 7 (McKinna et al 2015), 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 egg laying is not actually witnessed. 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 but has the same meaning.
- The proportion of damage recorded may not be conclusively accurate, since nests are only checked for signs of predation on the morning after they were laid. Any subsequent damage is recorded only on an incidental basis during track monitoring. Therefore there is a possibility that some predation and disturbance to old nests goes undetected, resulting in an underestimate of predation.

In recognition of this, additional research 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 (Markovina and Valentine 2015). Only 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. This project has not yet been repeated since. It is recommended that more research is conducted in the future to aid in concluding whether current NTP monitoring techniques provide a true level of turtle nest predation.

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 the 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 there 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 there during monthly fox baiting operations, but for the purpose of this report this data has not been included.

5. RESULTS

5.1 Survey Effort

In 2016-17 monitoring was conducted in the NW Cape Division (35-48 days) and Cape Range Division (26-28 days), depending on the weather conditions and availability of volunteers for each of the subsections.

Forty nine volunteers contributed a total of 2857 hours to the Ningaloo Turtle Program in 2016-17, not including a significant amount of additional time contributed by Parks and Wildlife staff. Since commencement of the program a total of 61125 volunteer hours have been contributed to the program. This time was primarily accrued during beach monitoring, but also through data entry, training, additional research projects and general tasks toward the running of the program.

From the 12th December 2016 – 8th January 2017 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 5th & 6th and 19th & 20th November, and the 3rd & 4th December in 2016. The post monitoring weekends occurred on the 29th January (28th cancelled due to potential cyclone) and the 11^h & 12th and 25th & 26th February in 2017. 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 2002-17 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	2015/16	2016/17	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	31/10/15	27/10/16	
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Division	Section	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	2/03/14	1/03/15	7/03/16	26/02/17	
North	Graveyards	165	375	374	368	341	336	234	160	153	144	162	172	185	193	174	3362
West	Hunters	248	263	271	271	256	252	173	117	114	109	111	117	120	123	111	2545
Cape	Lighthouse Bay	127	137	215	260	222	251	147	83	93	97	106	113	113	119	106	2083
	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	N/A	N/A	86
	Tantabiddi	115	3	N/A	85	86	84	58	38	37	36	41	38	43	41	39	705
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	N/A	N/A	4
	Bungelup	1	49	152	114	120	140	124	72	87	91	78	114	91	85	82	1318
	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	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	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	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	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	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	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	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	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	N/A	N/A	271
Total survey effort		940	1265	1738	1278	1199	1161	804	470	484	477	496	554	552	561	512	512
Number subsections monitored		22	29	28	20	19	19	18	14	14	14	14	14	14	14	14	14
																	14

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	2015/16	2016/17	TOTAL
Green nests	1539	1552	788	4695	4349	5254	6297	571	2732	6594	585	2276	628	759	1856	38619
Green false crawls	5404	3086	2533	9948	14395	13156	12608	1451	6507	22865	1769	4960	1465	1357	4243	101504
Green activity	6943	4638	3321	14643	18744	18410	18905	2022	9239	29459	2354	7236	2093	2116	6099	140123
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%	35.9%	30.4%	27.6%
Hawksbill nests	48	81	100	108	157	156	336	202	189	65	125	69	91	75	67	1802
Hawksbill false crawls	49	60	139	71	153	145	207	202	132	84	192	51	108	65	89	1658
Hawksbill activity	97	141	239	179	310	301	543	404	321	149	317	120	199	140	156	3460
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%	53.6%	42.9%	52.1%
Loggerhead nests	288	387	777	1068	540	795	580	288	405	382	304	430	436	519	696	7199
Loggerhead false crawls	429	359	1040	925	477	954	486	471	388	715	466	595	580	583	1395	8468
Loggerhead activity	717	746	1817	1993	1017	1749	1066	759	793	1097	770	1025	1016	1102	2091	15667
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%	47.1%	33.3%	46.0%
Unidentified nests	29	123	59	42	33	61	38	8	18	7	7	20	19	4	7	468
Unidentified false crawls	44	20	82	45	19	29	12	8	9	4	12	17	14	3	3	318
Unidentified activity	73	143	141	87	52	90	50	16	27	11	19	37	33	7	10	786
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%	57.1%	70.0%	59.5%
Total all species nests	1904	2180	1724	5913	5279	6266	7252	1069	3343	7049	1023	2795	1174	1357	2626	48328
Total all species false crawls	5925	3536	3794	10989	15044	14284	13314	1451	7038	23668	2439	5623	2167	2008	5730	111280
Total activity	7829	5716	5518	16902	20323	20550	20566	2520	10381	30717	3462	8418	3341	3365	8356	159608

5.2 Turtle Activity

5.2.1 2016 – 2017 Season

North West Cape Division

A total of 2130 suspected nests and 4624 false crawls were recorded within the NW Cape Division during 2016-17 (Table 2). Green turtles showed the greatest nesting activity in the NW Cape Division (both nests and false crawls) being responsible for 89.7 % of total activity recorded, followed by loggerhead turtles (8.3%), then hawksbills (1.9%) and unidentified species (0.1%).

Table 2: The total number of activities (suspected nests and false crawls) recorded for each species within the North West Division, NTP 2016-17 entire season

North West Cape Division	Turtle Species					Total
	Green	Hawksbill	Loggerhead	Flatback	Unidentified	
New nests	1845	55	224	0	6	2130
False crawls	4216	71	335	0	2	4624
Total activity	6061	126	559	0	8	6754

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.

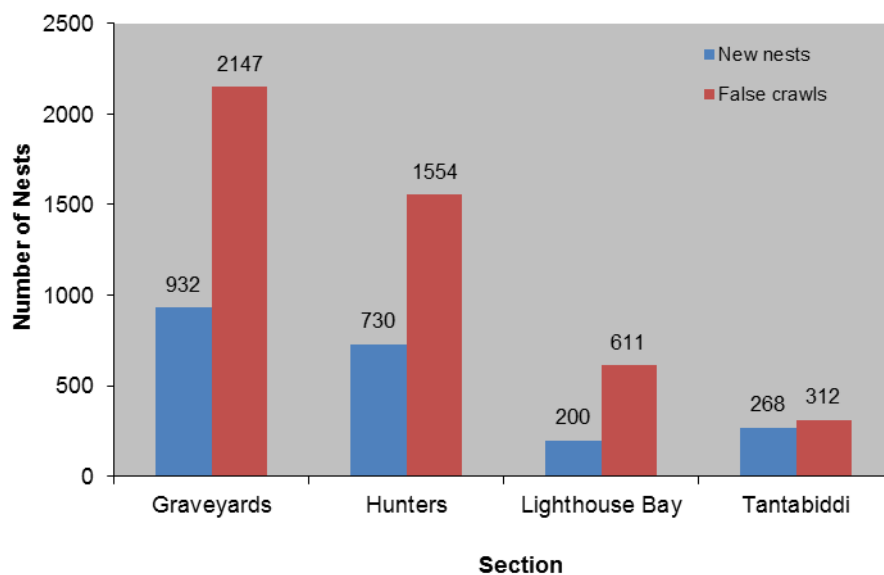


Figure 1: Comparison of nesting activity (suspected nests and false crawls) recorded in each NW Cape Section, NTP 2016-17 for entire season.

Figure 2 shows that green turtles were responsible for the highest proportion of nesting activity recorded within the North West Cape Division, which is in line with findings from all previous seasons.

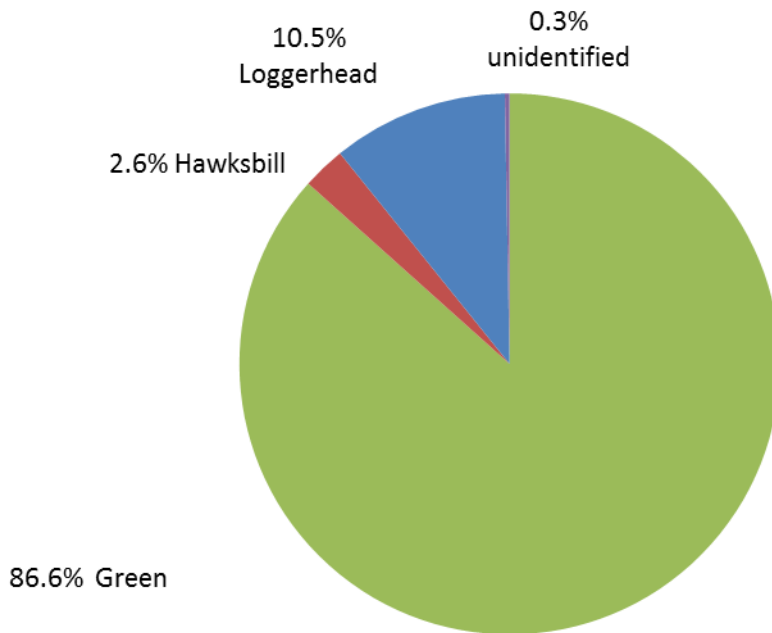


Figure 2: Percentage comparison of nests by species recorded within the North West Cape Division, 2016-17 entire season

Cape Range Division

A total of 496 suspected nests and 1106 false crawls were recorded in the Bungelup Section (Cape Range Division) during the 2016-17 NTP season (Table 3). Loggerhead Turtles showed the greatest nesting activity in the Bungelup Section (both suspected nests and false crawls) with 95.6%, followed by green (2.4%), hawksbill (1.9%) and unidentified turtle species (0.1%). 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 2016-17 entire season

Cape Range Division	Turtle Species				Total
	Green	Hawksbill	Loggerhead	Unidentified	
New nests	11	12	472	1	496
False crawls	27	18	1060	1	1106
Total activity	38	30	1532	2	1602

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

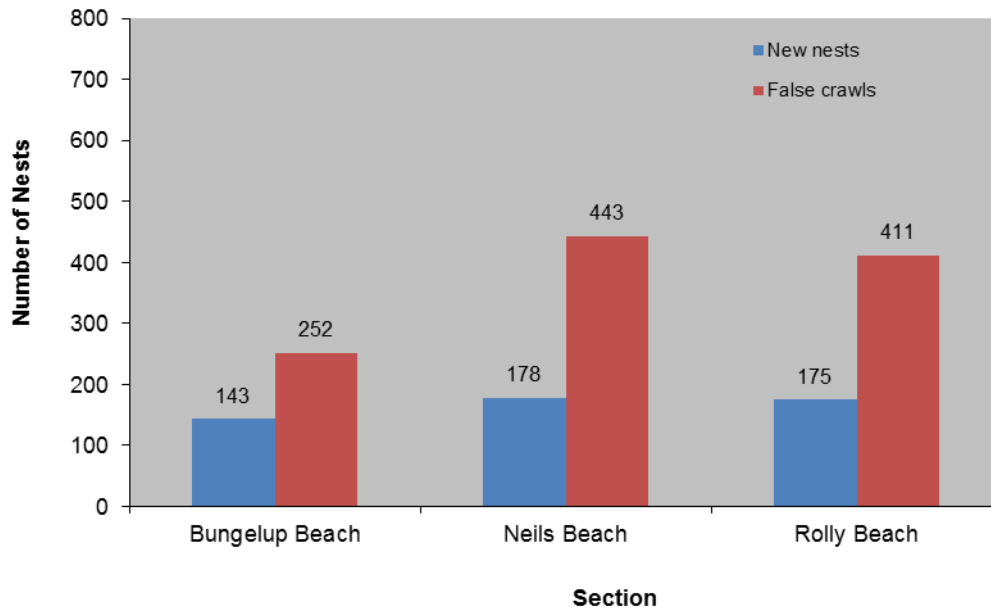


Figure 3: Comparison of nesting activity (suspected nests and false crawls) recorded within each Bungelup subsection (Cape Range Division), NTP 2016-17.

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.

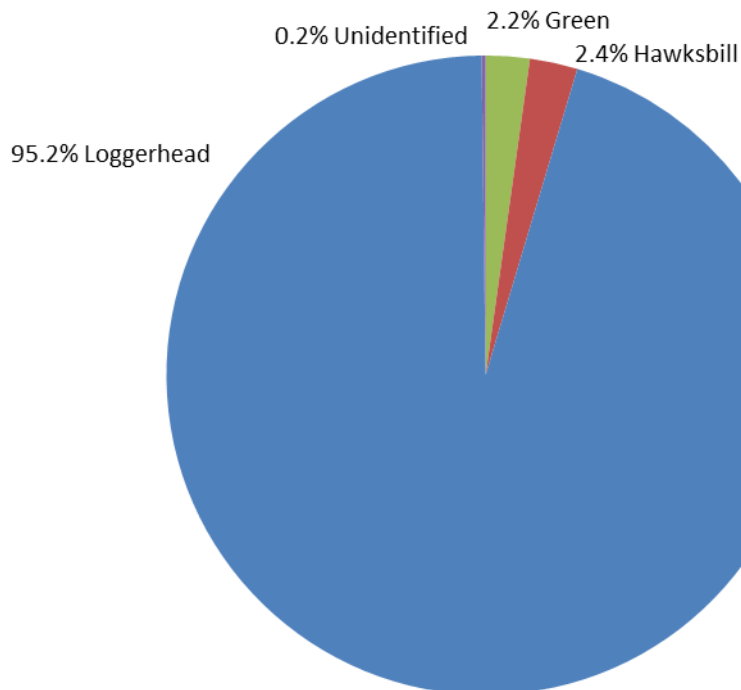


Figure 4: Percentage comparison of nests by species within the Cape Range Division, 2016-17.

5.2.2 History of Turtle Activity (2002-2017)

NTP has recorded 50 954 suspected nests and 117 010 false crawls (total activity: 167 964) in total (full season data and all subsections included) since commencement of the program in 2002 (Table 1). Green turtles are by far the most abundant species with a total of 146 222 nests and false crawls recorded, followed by loggerhead turtles (17 758 activities) and hawksbill turtles (3616 activities). A total of 796 activities have been recorded as being from unidentified species (Table 1).

During 2002 – 2017, within the standardised intensive peak monitoring period, the NTP has recorded a total of 28 459 nests and 68 962 false crawls (total activity: 97 421). In comparisons between seasonal total activity levels, the 2016-17 season (standardized figure) activity level was ranked 7th out of 15 (Figure 5), and the total standardized nesting level was ranked equal 6th out of 15 (Figure 6). Within the intensive monitoring period green turtle activities are recorded the most often, with 83 009 activities (nests and false crawls) recorded during the intensive monitoring between 2002 and 2017. This is followed by loggerhead turtles with 11 964 activities and then hawksbills with 2128 activities. A total of 317 turtle activities have been recorded as unidentified species.

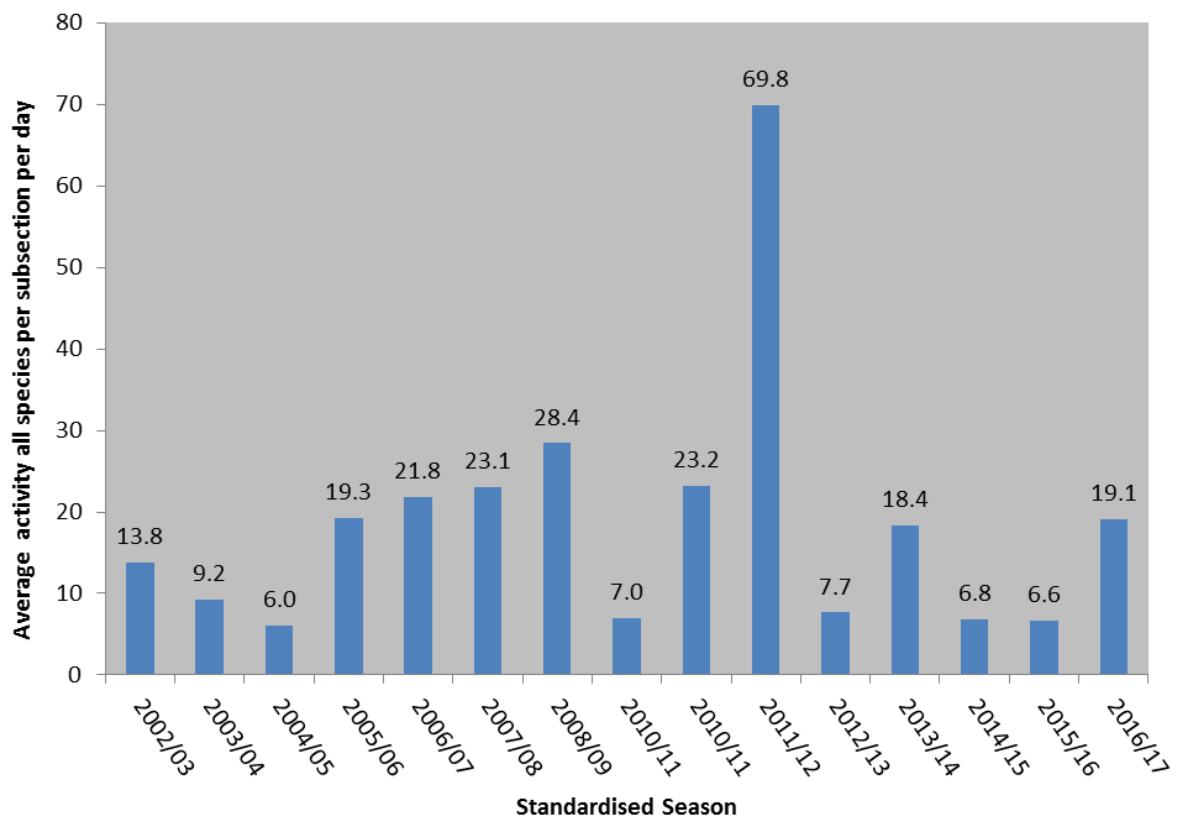


Figure 5: Seasonal green, loggerhead and hawksbill turtle activity (nests and false crawls) standardised by survey effort during the intensive peak monitoring period.

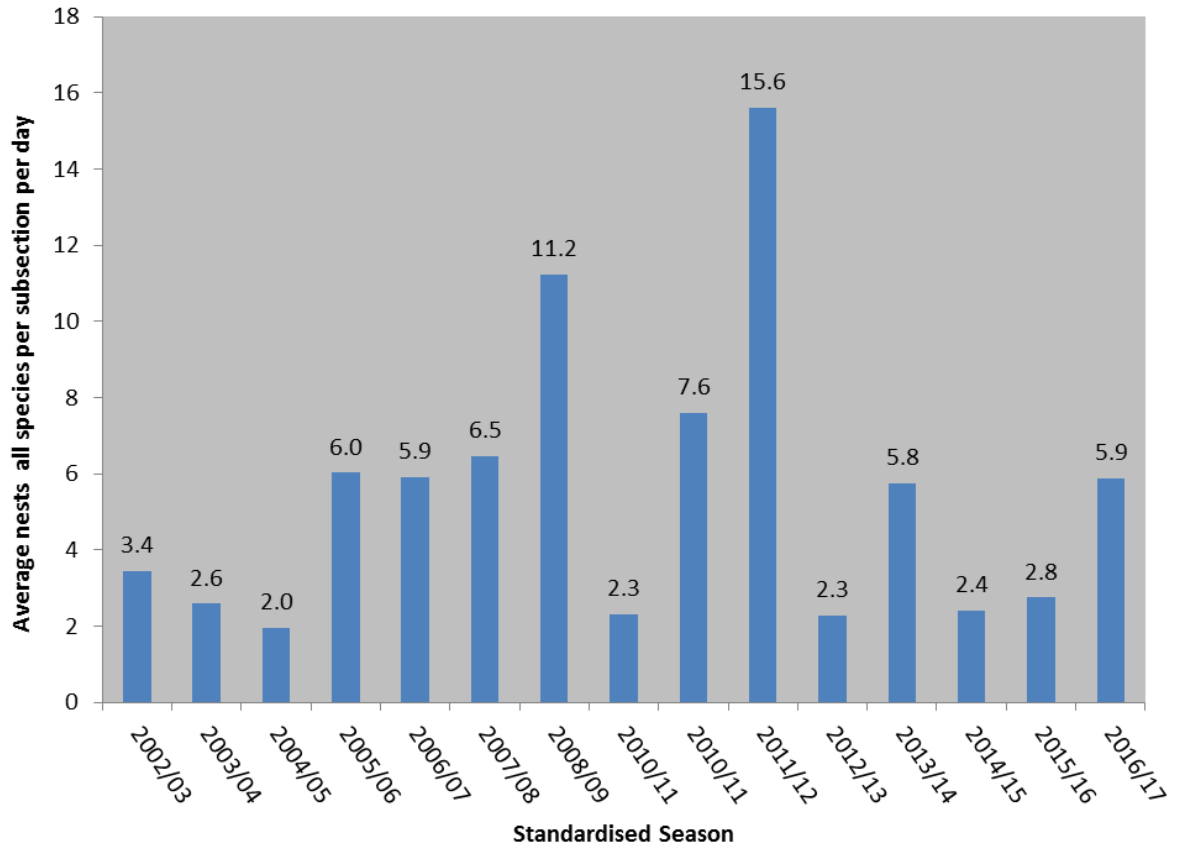


Figure 6: Seasonal green, loggerhead and hawksbill nests standardised by survey effort during the intensive peak monitoring period.

Green Turtles

When comparing standardised seasons, the level of green turtle activity recorded during 2016-17 was slightly below average (Figure 7), as were nesting levels (Figure 8).

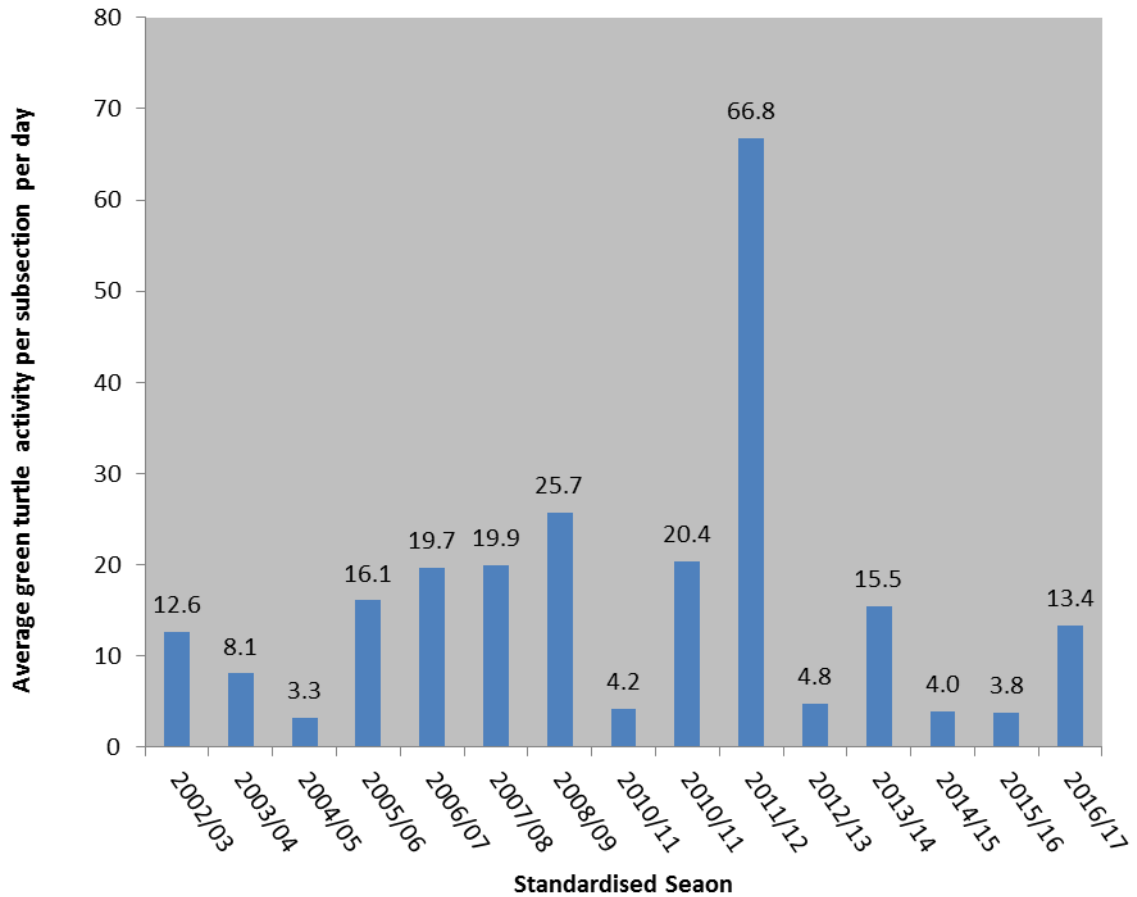


Figure 7: Seasonal green turtle activity (nests and false crawls) standardised by survey effort during the intensive peak monitoring period.

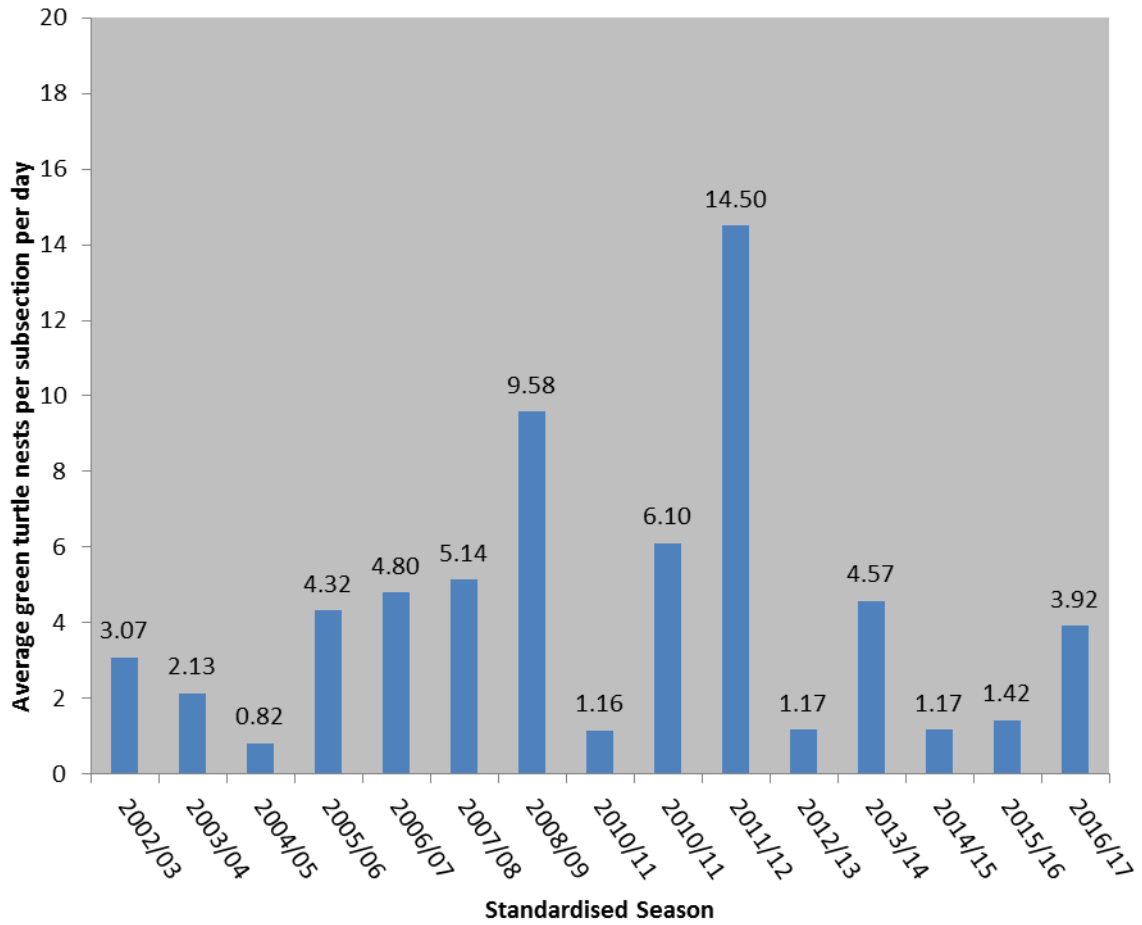


Figure 8: Seasonal green turtle nests standardised by survey effort during the intensive peak monitoring period.

Hawksbill Turtles

The standardised levels of hawksbill turtle activity and nesting recorded during the 2016-17 season were slightly below average in comparison to the data from other seasons (Figure 9 and Figure 10 respectively).

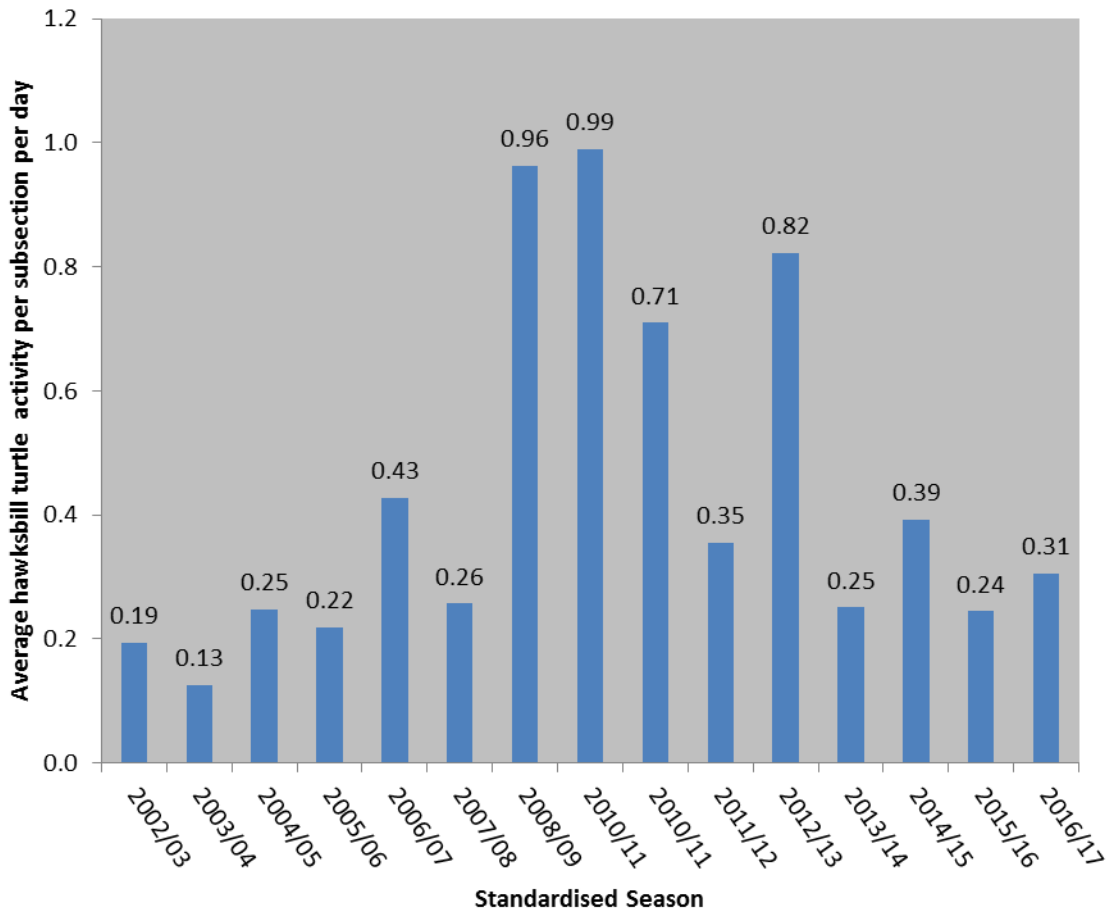


Figure 9: Seasonal hawksbill activity (false crawls and nests) standardised by survey effort during the intensive peak monitoring period.

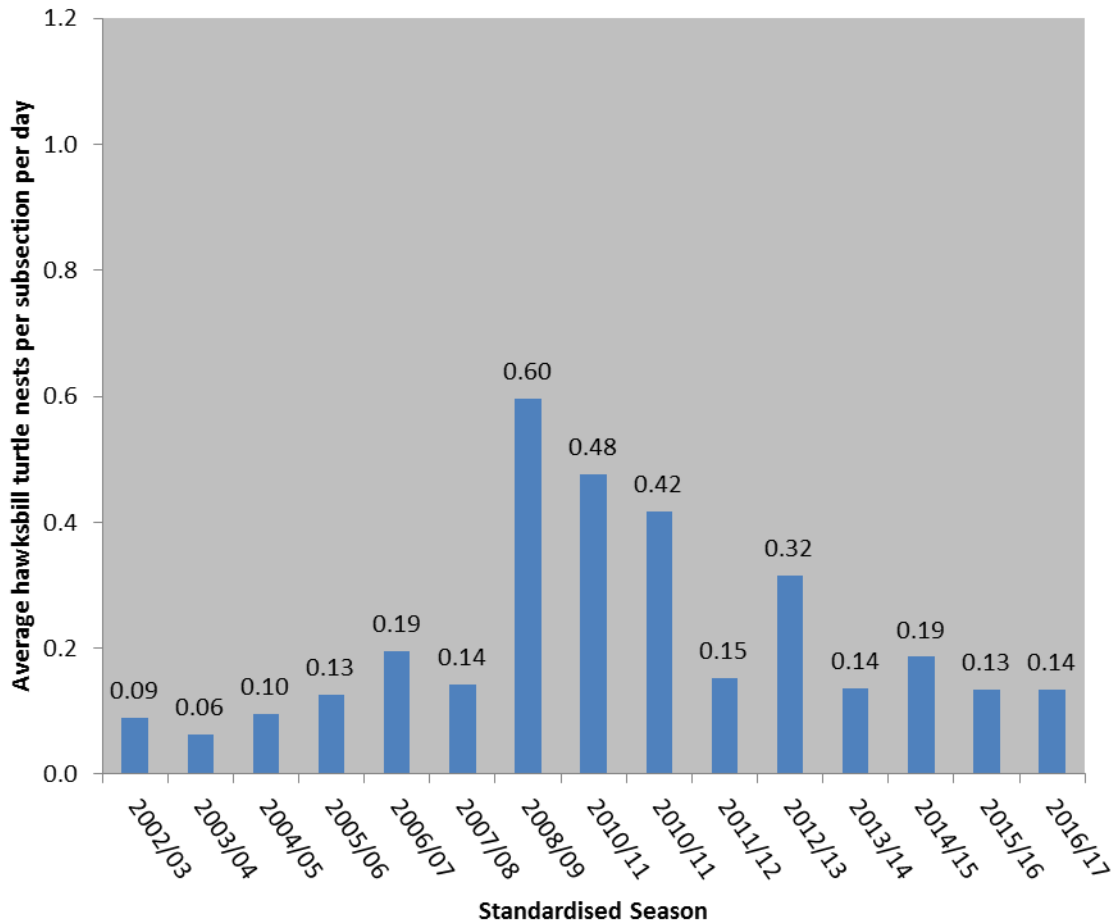


Figure 10: Seasonal hawksbill nests standardised by survey effort during the intensive peak monitoring period.

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 was 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). These techniques have remained the same since the 2014-15 season. A trend analysis conducted in 2016 demonstrated that this change in track identification caused no significant effect on annual recorded levels of hawksbill and loggerhead activity, most likely due to the similarity in the two techniques.

Loggerhead Turtles

The standardised levels of loggerhead turtle activity and nesting recorded during the 2016-17 season were the highest in comparison to the same data recorded from all other seasons (Figure 11 and Figure 12 respectively). Calculations also showed that the standardised loggerhead activity levels were the highest ever recorded (approximately double the level of any other

seasons) for both the North West Cape division and the Cape Range division when the data for the two divisions was analysed separately.

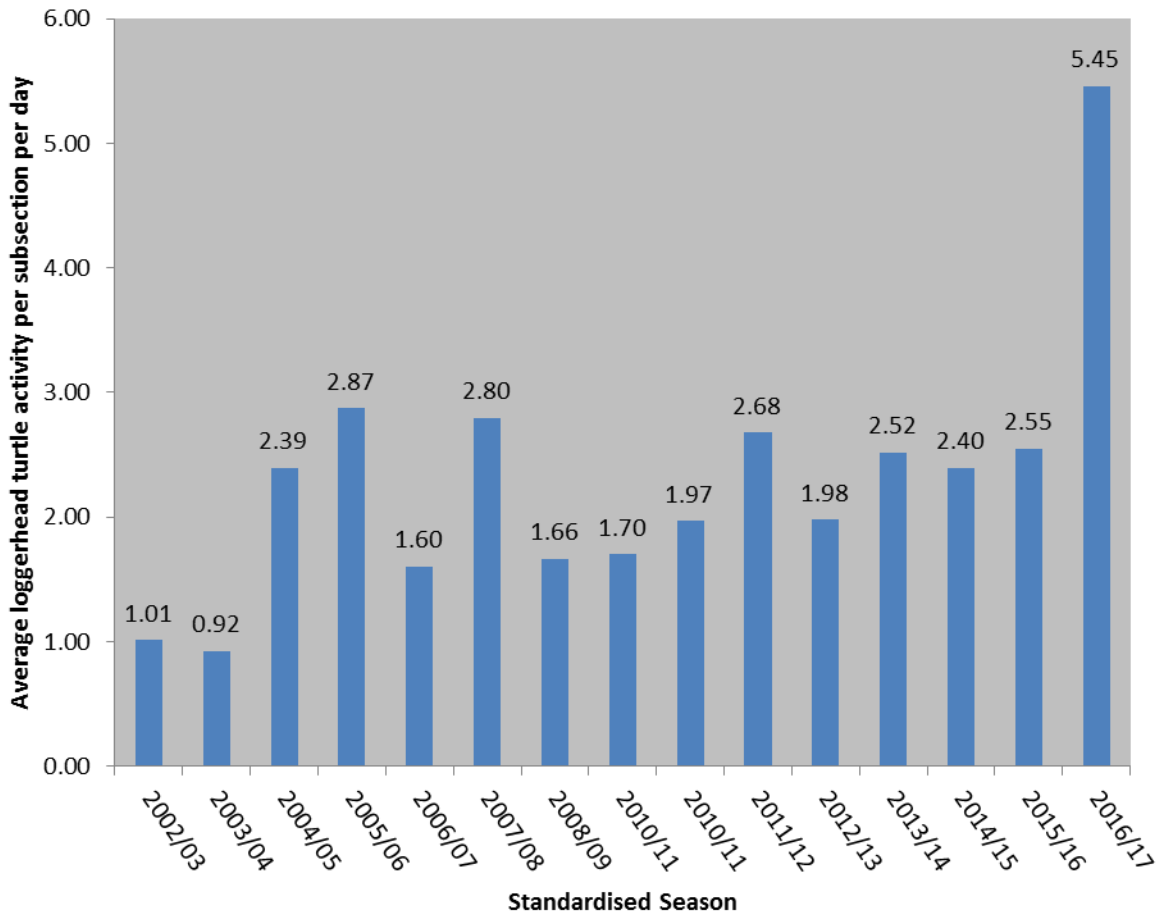


Figure 11: Seasonal loggerhead activity (false crawls and nests) standardised by survey effort during the intensive peak monitoring period.

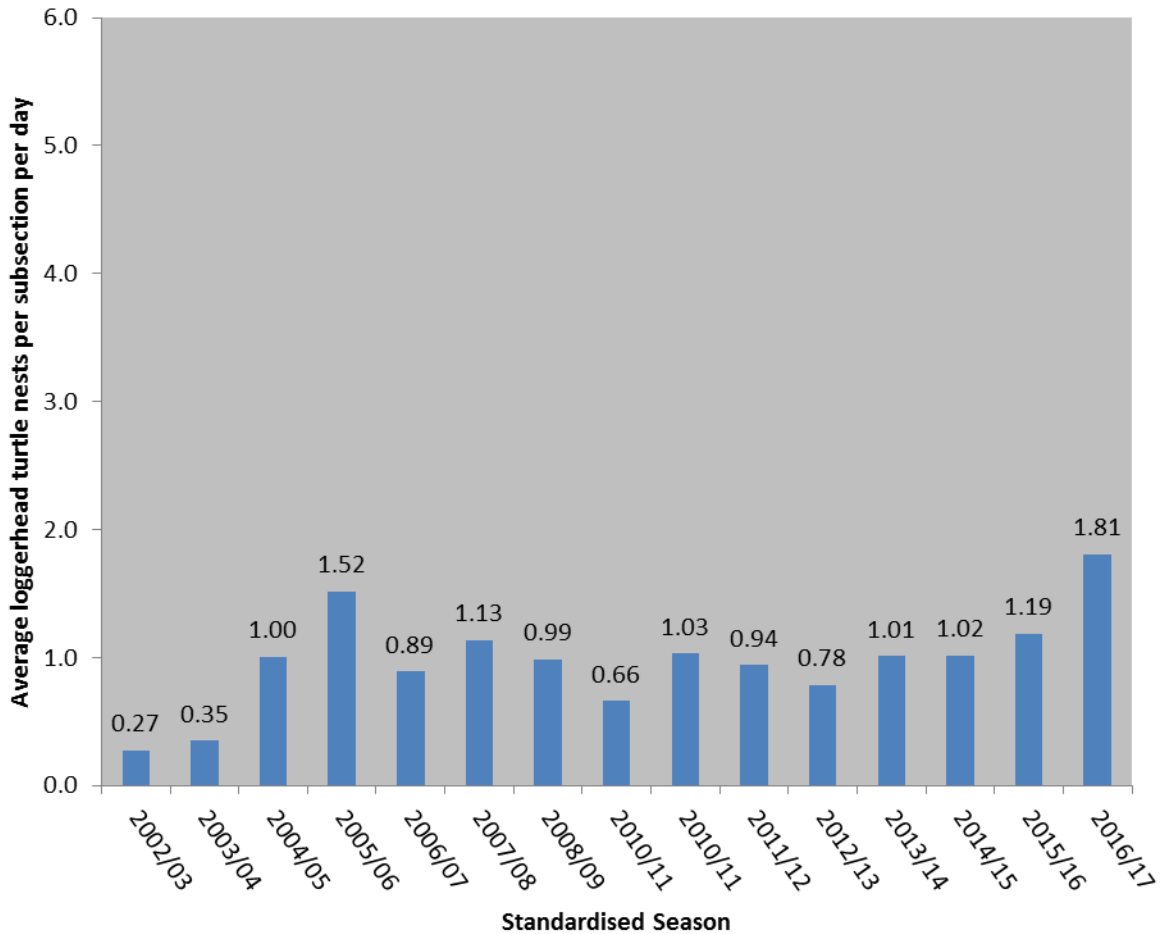


Figure 12: Seasonal loggerhead nests standardised by survey effort during the intensive peak monitoring period.

5.3 Nesting Success

5.3.1 2016-17

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 the actual egg-laying is not observed.

Study into nightly observations of at least 30 nesting turtles has been previously recommended to indicate the level of error associated with identifying a viable nest using NTP methodology (Whiting, 2010). In the 2014-15 season a nest predation study was undertaken during which twenty nests were monitored until hatching. The egg chamber could not be located for one of the nests, but the others were positively identified as nests after incubation was complete. In addition, trainer collaboration and refresher exercises are undertaken each season which have all resulted in positive identification of nests and false crawls by trainers. It is recommended for

more research to be conducted to continue to learn, refine techniques and aid in the assessment of nest identification accuracy.

When the entire season's data is compared per species, NTP recorded a total of 1856 green turtle nests and 4243 false crawls during the 2016-17 season, which equates to a 30.4% nesting success. Hawksbill and loggerhead turtles had the greatest nesting success rates of 42.9% and 33.3% respectively, with NTP recording 67 nests and 89 false crawls for hawksbills and 696 nests and 1395 false crawls for loggerheads (Table 1).

5.3.2 Nesting Success History (2002-17)

In the latest trend analysis (including data up to 2015-16 season) it was identified that no significant linear trends existed for the nesting success of green, loggerhead or hawksbill turtles, however a correlation was identified indicating that the nesting success of the three species fluctuates in synchrony (Whiting 2016).

Green Turtles

Green turtle nesting success rates recorded since the start of the NTP have generally remained 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 starting at 21.7%. (Figure 13) Nesting success in 2016-17 was above average at 29.3%.

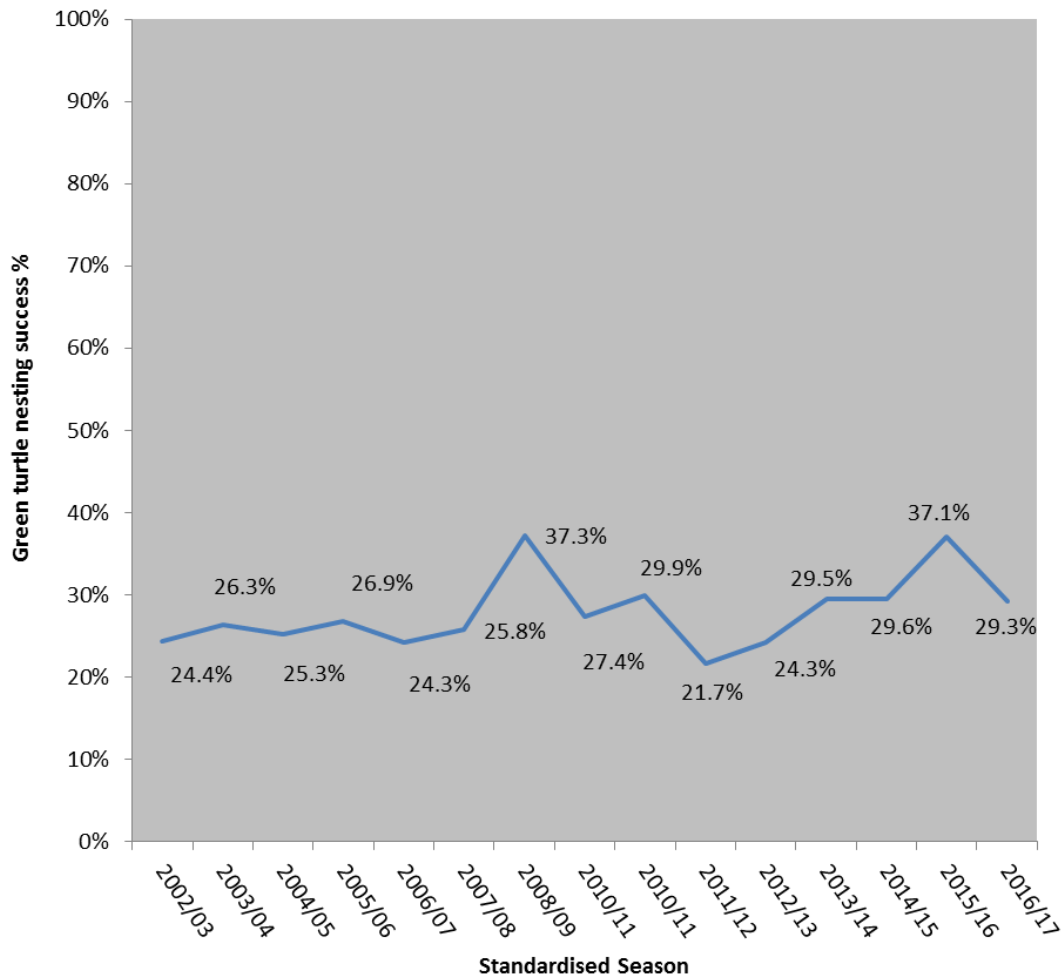


Figure 13: Green turtle nesting success 2002-2017 (%) standardised by survey effort during intensive peak monitoring period.

Hawksbill Turtles

Nesting success rates of hawksbill turtles has varied between 38.4 - 61.9% throughout the past fourteen nesting seasons (Figure 14). The 2016-17 season success rate (44.2%) was below the average and mid-range figures.

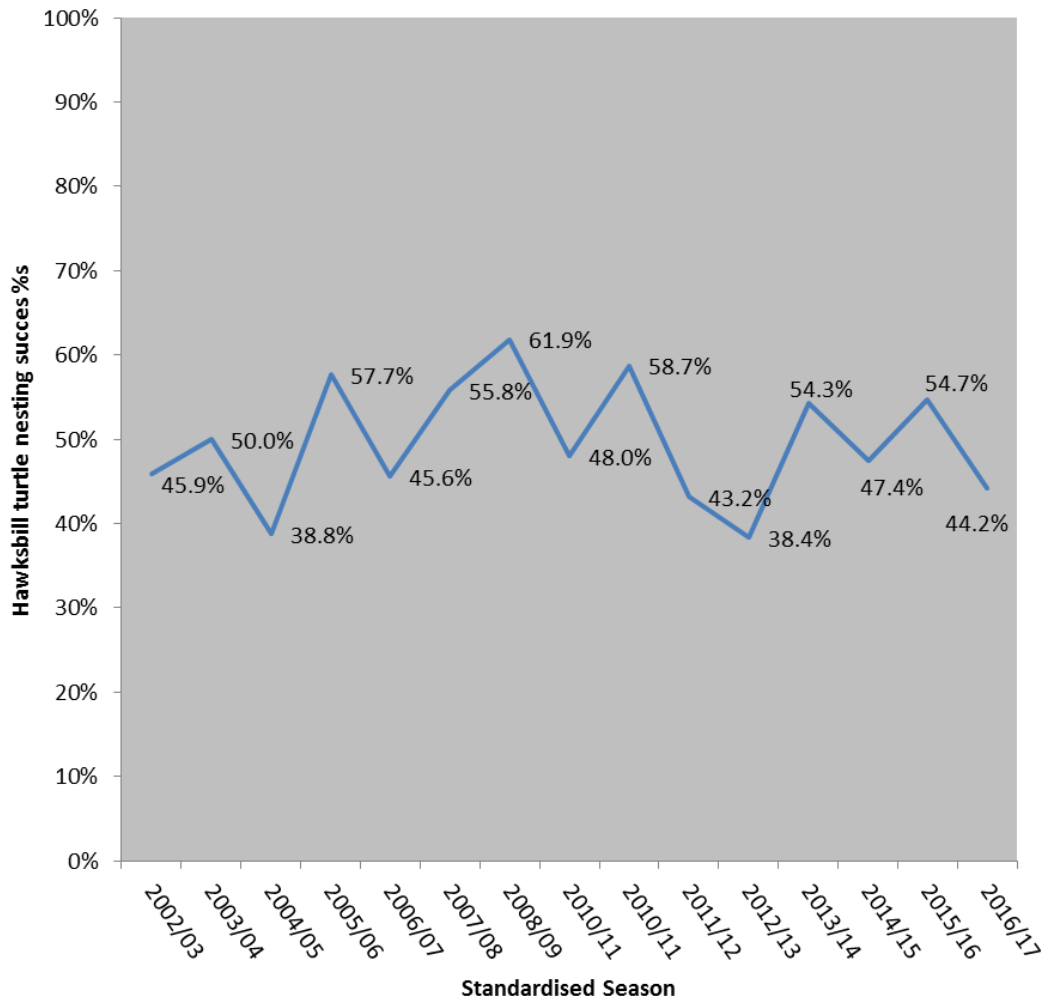


Figure 14: Hawksbill turtle nesting success (%) 2002-17 standardised by survey effort during the intensive peak monitoring period.

Loggerhead Turtles

The loggerhead turtle nesting success rate has varied from 26.9 – 59.5% since 2002 (Figure 15). The success rate observed in the 2016-17 season was the second lowest recorded since the program commenced (33.1%). This has coincided along with the highest level of loggerhead turtle activity ever recorded in the program. Similar findings were observed in the 2011-12 season for green turtles whereby the highest level of seasonal activity recorded also yielded the poorest nesting success rate.

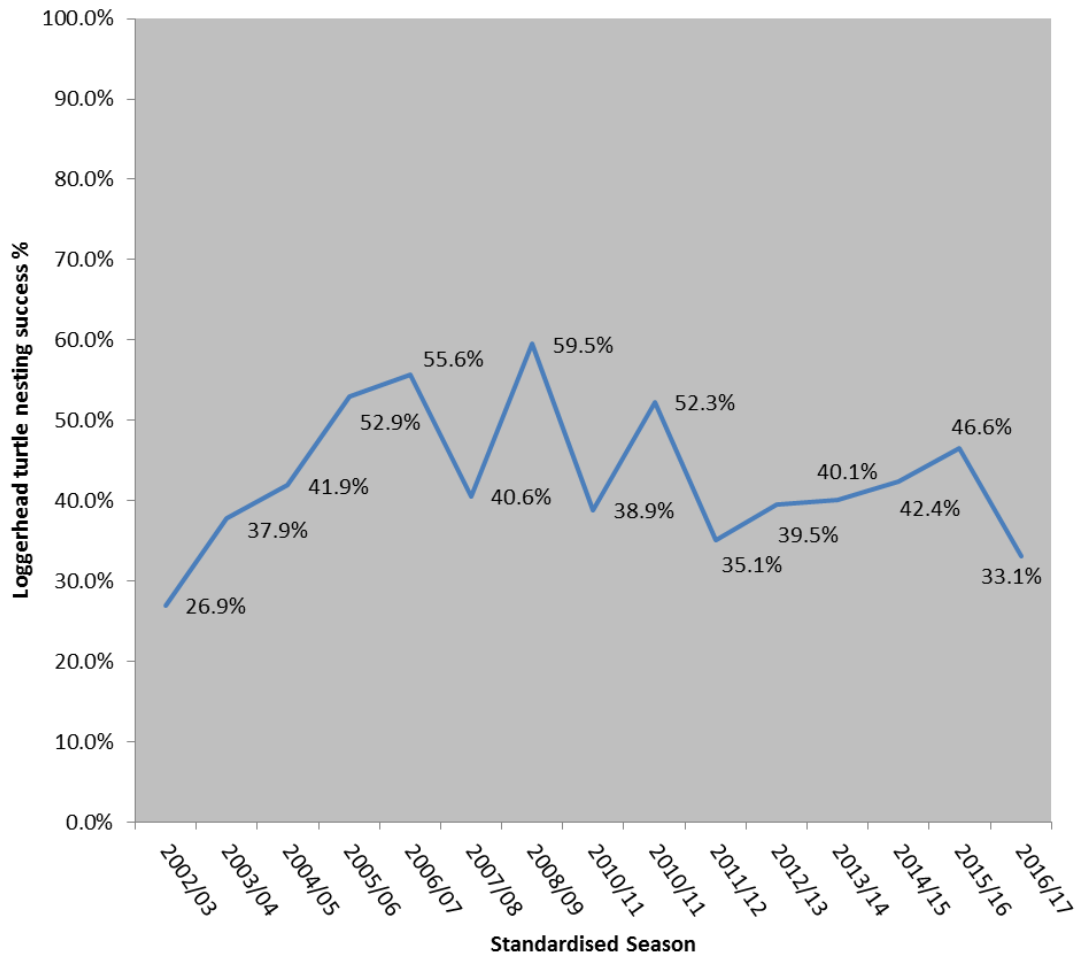


Figure 15: Loggerhead turtle nesting success 2002-17 (%) standardised by survey effort during intensive peak monitoring period

5.4 Nest Damage

5.4.1 2016-17

Eight new nests and eight old nests were recorded to have been damaged in the 2016-17 full season, equating to 0.61% of total recorded nests. One of the old nests and four of the new nests were recorded in the Cape Range Division and the remainder of damaged nests were located within the North West Cape Division. Half of the damage was attributed to tidal inundation, and the other half as accidental damage by another nesting turtle (see Table 4 below). 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 (Markovina and Valentine 2015). 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. This study has not yet since been repeated. 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 (2002-17)

Since monitoring began in 2002, a total of 894 nests (new and old) have been recorded as damaged within the Ningaloo Region (Table 4). This equates to 1.7% of total nests recorded within the Ningaloo Region 2002-2017 (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 2002-2017. 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	0	NA	NA	7	42	NA	66
2012-2013	0	0	1	1	0	0	NA	0	1	NA	3
2013-2014	7	1	1	N/A	3	3	NA	0	26	NA	41
2014-2015	0	0	0	N/A	0	0	NA	6	2	NA	8
2015-2016	2	1	0	N/A	0	1	NA	3	6	NA	13
2016-2017	2	0	0	0	0	0	0	7	7	0	16
Total	174	30	305	156	18	29	9	49	121	3	894

5.4.3 Predation of nests by foxes and dogs

Since 2002, 37.5% of total nest damage has been caused by foxes and dogs. However since 2010, yearly figures of fox and dog predation have generally remained below 8% of the total predation.

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. Fox and dog predation figures recorded by the NTP have not exceeded 5% of the total number of recorded nests since the program commenced (Figure 16).

Since monitoring began, the highest recorded level of fox and dog predation was 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.

A nest predation study undertaken in the 2014-15 season recorded (via remote camera) one unconfirmed fox predation event of a hatchling but no actual nest predation by foxes or dogs was observed (Markovina and Valentine 2015). This supports the findings observed through the standard NTP data collection. No fox or dog predation was recorded during the 2016-17 season. Parks and Wildlife have anecdotally observed a reduction in fox numbers in recent years through remote camera monitoring, invasive predator track monitoring, and trapping. It is believed this is attributed to the effectiveness of Parks and Wildlife's rigorous invasive predator control program.

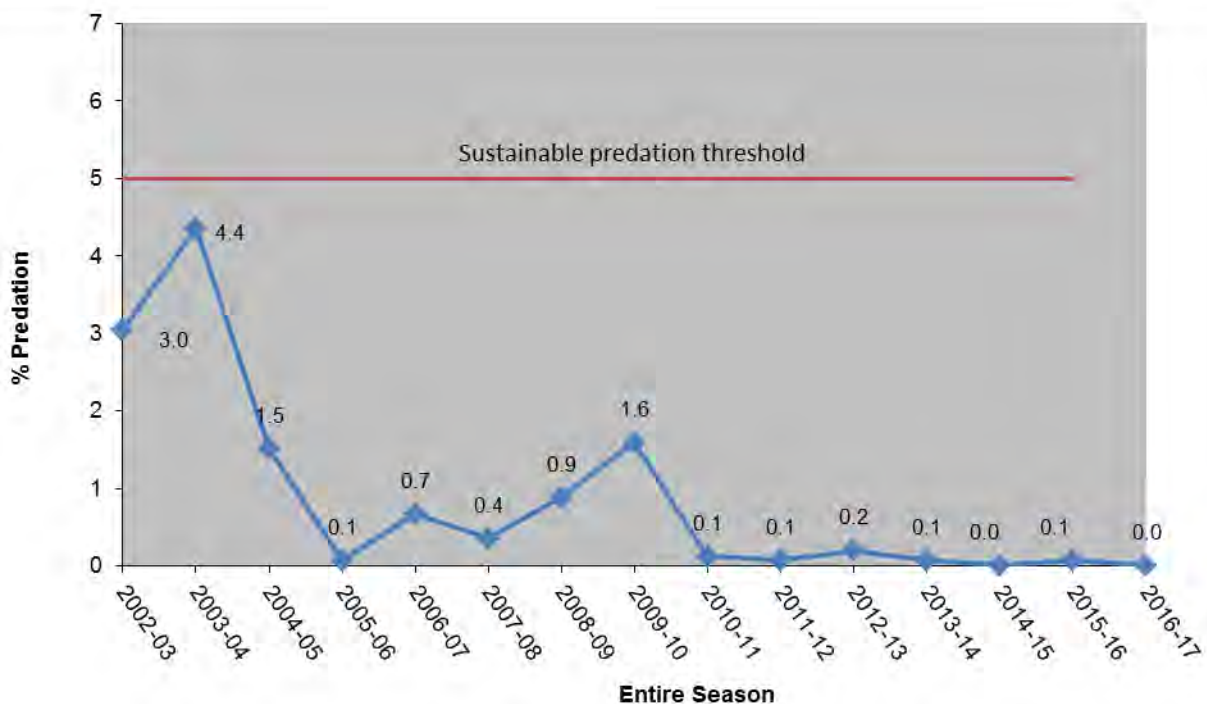


Figure 16: Fox and dog predation as a percentage of total nests recorded per season, NTP 2002-17. Note: data from 2009-10 season onwards includes NW Cape and Cape Range Divisions only, other seasons include an additional two divisions.

During cat trapping activities in the North West Cape Division in 2016, the remains of turtle hatchlings were found within the gut contents of a captured cat upon dissection. It was

previously thought that hatchling predation by cats could occur however prior to this finding it had never been confirmed.

The Ningaloo Turtle Program volunteers have been recording data on cat print presence since the 2013-14 season. Cat presence has been consistently higher in the North West Cape division than the Cape Range division. Annual total cat presence has appeared to oscillate over the past four seasons.

5.5 Turtle Rescues

There were eight turtle rescues carried out during the 2016-17 NTP season. NTP volunteers have rescued a total of 250 stranded marine turtles from 2002-2017. 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 turtle activity levels are thought to be correlated with higher turtle rescue numbers).

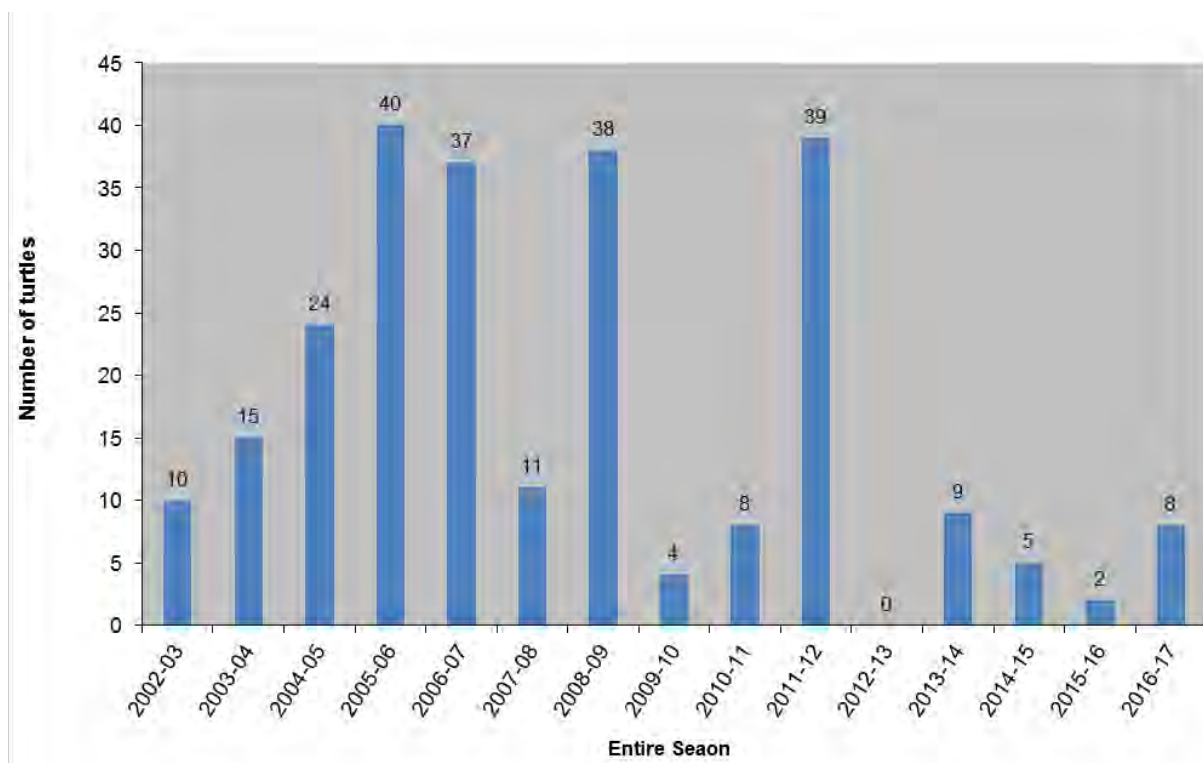


Figure 17: The number of turtles rescued in each NTP season, 2002-17. Note: from 2009-10 season onwards data includes NW Cape and Cape Range Divisions only, other seasons include an additional two divisions.

5.6 Turtle Mortalities

Two turtle mortalities were recorded by NTP volunteers during the 2016-17 season. An additional six mortalities were recorded at Janes Bay but this is outside of the monitoring area. 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. The 2016-17 season saw the lowest number of mortalities within the NTP monitoring areas.

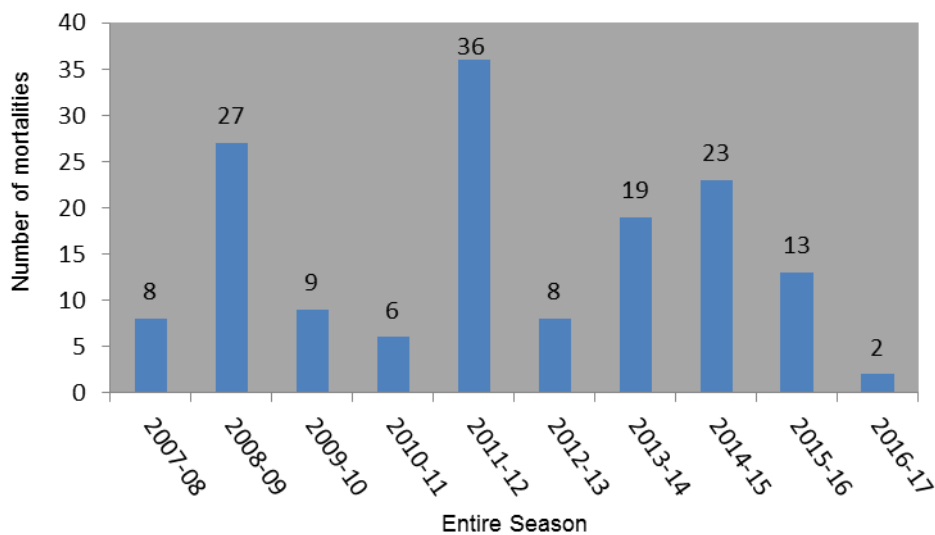


Figure 18: The number of turtles mortalities recorded per season from 2007 - 2017 (2002-06 data not available).

5.7 Weather Events 2016-17

The Ningaloo Turtle Program monitoring beaches are susceptible to seasonal weather events, such as cyclones, storm surge and flooding. These can have significant effects on turtle nests and available nesting habitat. Nesting beach profiles are constantly changing due to weather events and coastal processes that occur between nesting seasons.

In 2016-17 monitoring was cancelled on the 28th February due to the threat of a cyclone coming through the area. The tropical low did not form into a cyclone and monitoring was resumed on the 29th February.

5.8 Tagged Turtle Re-sightings 2016-17

Fourteen tagged turtles were sighted during the 2016-17 season by NTP volunteers and an additional one by CSIRO staff. This is the highest number of tagged turtle sightings that have been recorded since the NTP commenced. Details are provided in Table 5 below.

Table 5: Tagged turtle sighting details, NTP 2016-17 season

Species	Gender	Year tagged	Location tagged	Number of sightings since tagged	Comments
Green	Female	1992	Trisel	7	Sighted twice in 2016-17 season
Green	Female	1988	Jacobz	4	
Green	Female	1989	Trisel	16	
Green	Female	1989	Trisel	8	
Loggerhead	Female	1997	Trisel	2	
Green	Female	1989	Bauden	6	
Green	Female	1993	Trisel	5	
Green	Female	2000	Jacobz	2	
Green	Female	1997	Jacobz	2	
Green	Female	1989	Barrow Island	2	First time sighted away from Barrow Island
Green	Female	1995	Trisel	2	
Green	Female	1992	Five Mile	1	
Green	Female	1992	Turquoise Bay	1	
Green	Female	1993	Jacobz	1	

5.9 Additional Monitoring Site (South Mandu)

During the 2016-17 season Parks and Wildlife staff trained three staff members from the Sal Salis Eco Retreat at South Mandu, within Cape Range National Park, as per current NTP methodology. This occurred in conjunction with the formation of a new monitoring subsection at South Mandu (Figure 19) to gain an understanding of turtle activity at this site. The subsection was monitored twelve times between the 21/12/2016 and the 2/3/2017, during which seven green turtle nests, ten loggerhead nests and one hawksbill nest were recorded. Additionally, six green and five loggerhead false crawls were recorded.

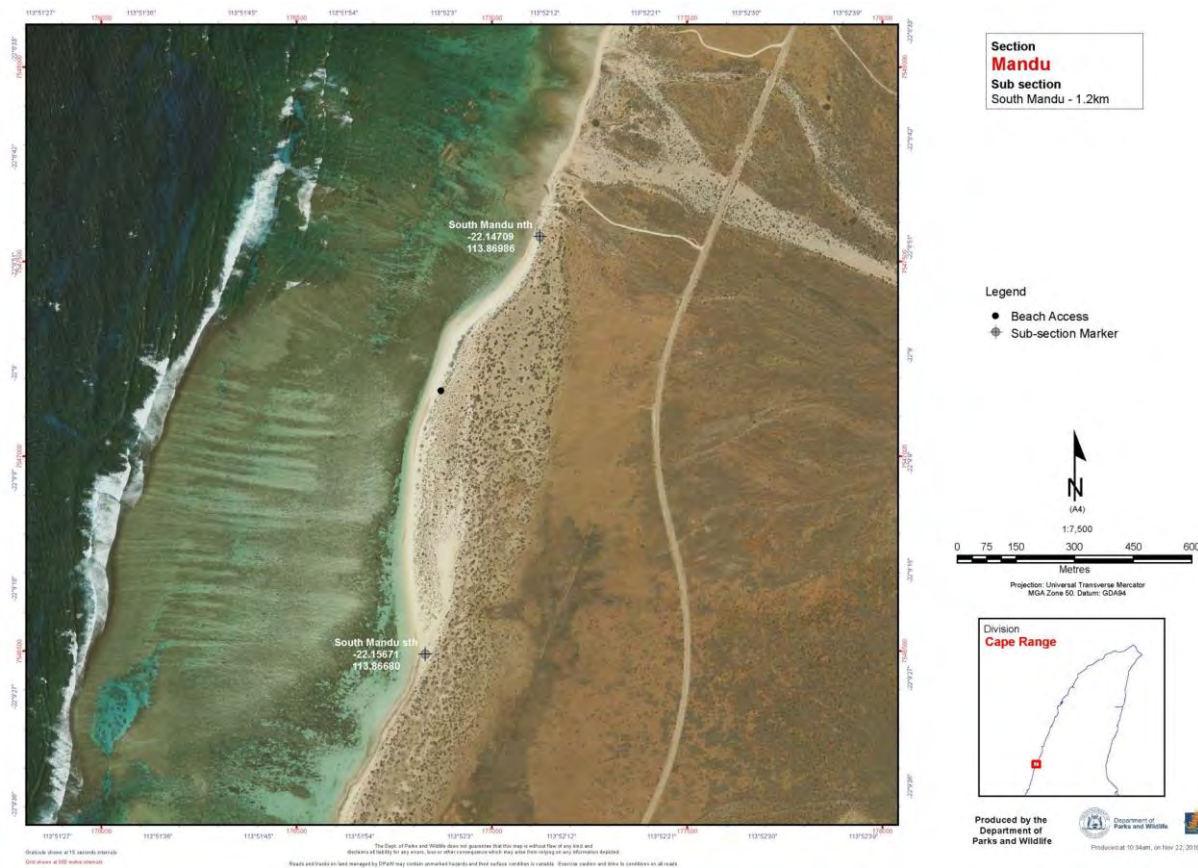


Figure 19: Map of South Mandu monitoring transect

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.

Thank you also to the local NTP volunteers from the Exmouth community, the external volunteers recruited from national and international areas, and the team leader and media intern volunteers. 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.

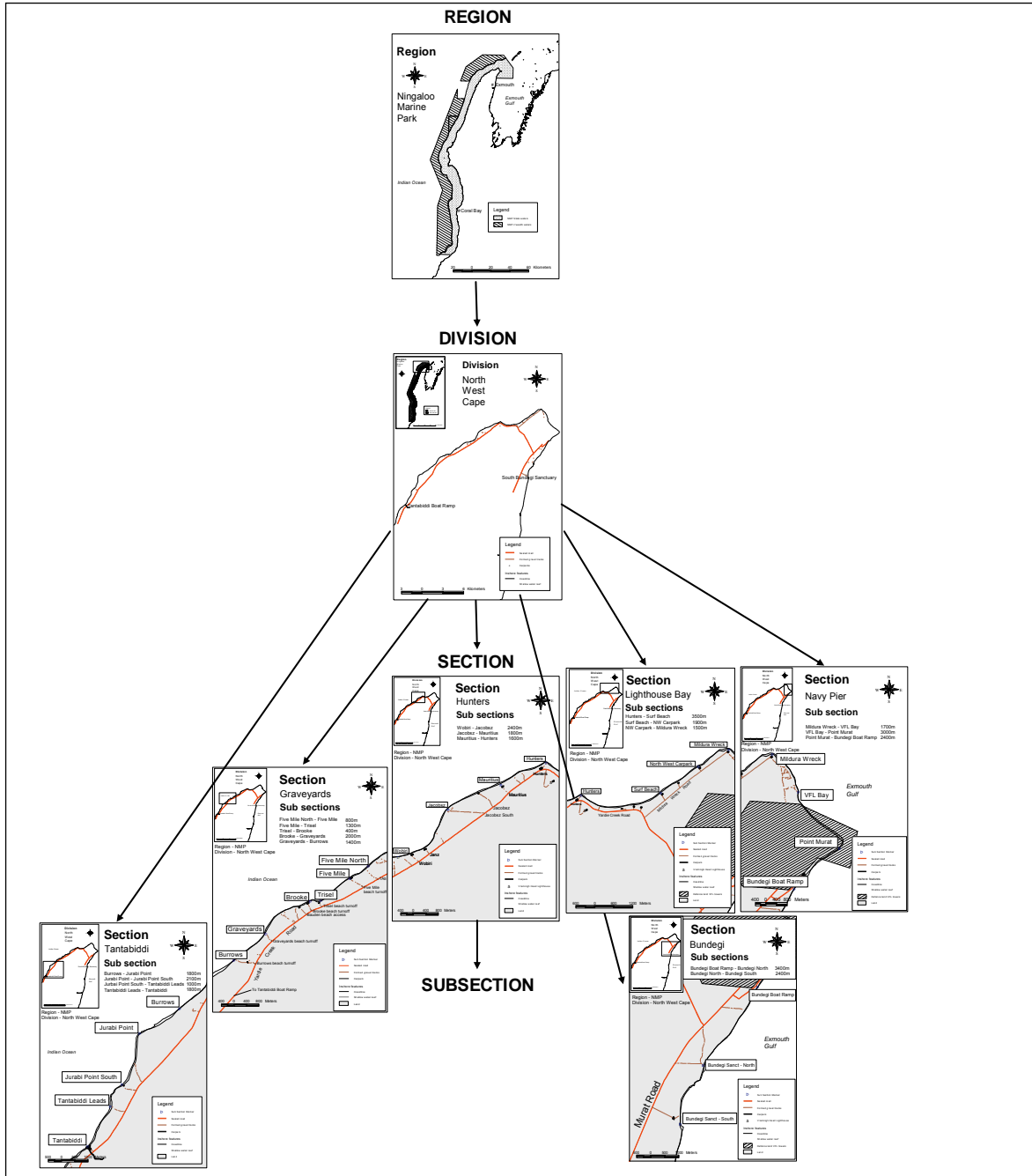
Gnulli Working Group – The program is conducted on the traditional lands of the Jinigudira, Thalanji and Baiyungu people. We recognise their traditional custodial role and continued support for turtle conservation.

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8.0 Appendix

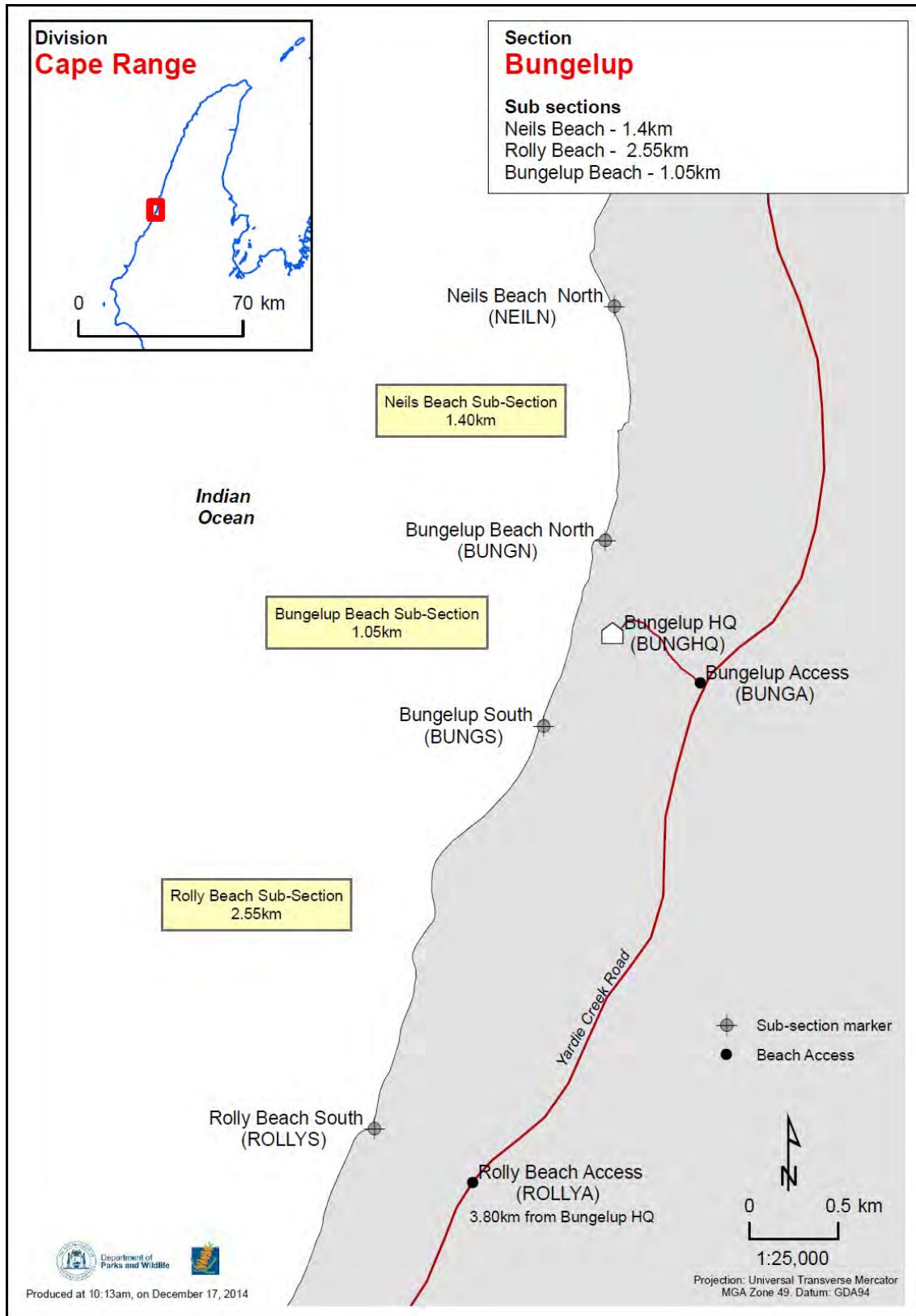
Appendix 1: Zoning of the NW Cape Division.



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.

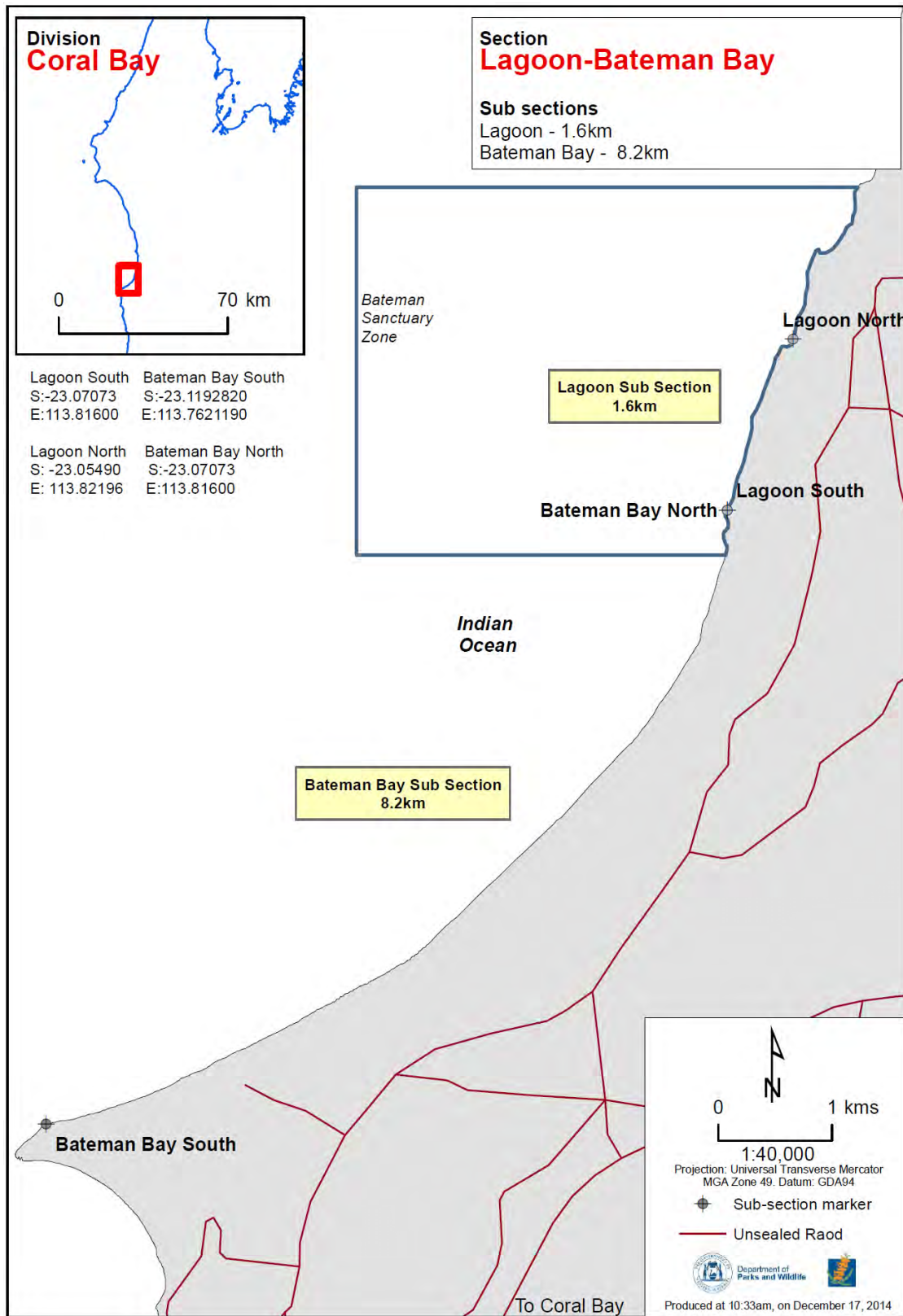


Location and distance of each subsection within Cape Range Division.

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: Zoning of the 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 4: Current NTP Data Sheet



NINGALOO TURTLE PROGRAM MONITORING DATASHEET Daily Report

Page.....of.....

Date		Recorder	
Start subsection		Finish subsection	
Start time		Finish time	
Equipment Details		Radio No	
GPS No		Camera No	

TABLE A: FALSE CRAWLS TALLY			
Green	Loggerhead	Hawksbill	Unknown
Total			

Prints in subsection?	
Fox	Y / N
Dog	Y / N
Cat	Y / N

TABLE B: NESTS

New (N) / Old* (O) Nest?	Species Type G/L/H/U	GPS Position (in decimal degrees) (Datum WGS84)		Nest Position I/H/E/D	Is Nest Damaged? Y/ N	Damage Cause? A/D/F/G/H/Ti	Photo Frame No.	Any Other Observations? (e.g. Diggings, Egg shells, Hatchlings, Turtle)
		latitude (S)	longitude (E)					



Comments:

Cause of Damage Key: A= Another turtle, D= Dog, F= Fox, G= Goanna, H= Human, Ti= Tide

* Only record old nest data if it has been disturbed.

~Please complete and return even if no nests are recorded!

Appendix 5: Tagged Turtle Re-sightings Datasheet

West Australian Turtle Research - Nesting Turtles TAGGED TURTLE RESIGHTINGS Locality: _____ Date: _____ Observer: _____	 Department of Parks and Wildlife	
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Tag Left	Tag Right	Time	Turtle Activity	Nest Location	Egg Count	Turtle Species

Tag position: Please record tag number for both left and right flippers and include all letters and numbers on the tag. If single tagged, put 'nil' in the column as needed.

- | | |
|-----------------------------|-------------------------------|
| Turtle Activity Key: | |
| A: Resting at waters edge | F: Excavating egg chamber |
| B: Leaving water | G: Laying eggs |
| C: Climbing beach slope | H: Covering eggs (filling in) |
| D: Moving over bare sand | I: Returning to water |

- | |
|---------------------------|
| Nest Location Key: |
| A: Above high tide mark |
| B: At high tide mark |
| C: Below high tide mark |
| D: Edge of vegetation |

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:

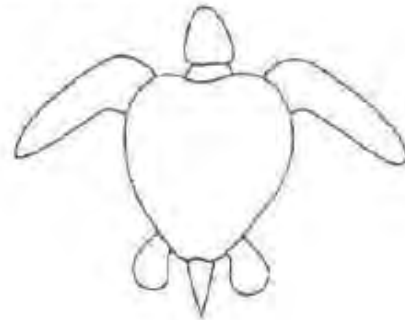
- | | |
|--|--|
| <input type="checkbox"/> Live but subsequently died | <input type="checkbox"/> Carcass poor (advanced decomposition) |
| <input type="checkbox"/> Carcass in good condition (fresh/edible) | <input type="checkbox"/> Mummified carcass (skin holding bones) |
| <input type="checkbox"/> Carcass 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 2016-17) Map 1 & 2



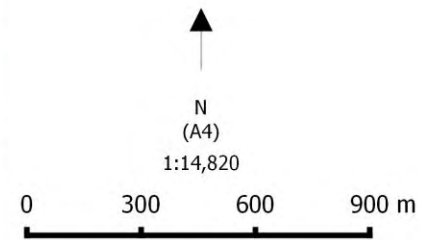
**Ningaloo Turtle Program
2016-2017 (new nests)**

LIGHTHOUSE BAY SECTION

Map 1 of 2

Legend

- Subsection locations
- Turtle nests 2017**
- Green
- Hawksbill
- Loggerhead
- Unidentified



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



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**Ningaloo Turtle Program
2016-2017 (new nests)**

LIGHTHOUSE BAY SECTION

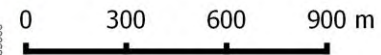
Map 2 of 2

Legend

- Subsection locations
- Turtle nests 2017**
- Green
- Hawksbill
- Loggerhead
- Unidentified



1:17,315



Projection: Universal Transverse Mercator
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Appendix 8: Hunters Section - Location of New Nests (NTP 2016-17) Map 1 & 2



**Ningaloo Turtle Program
2016-2017 (new nests)**

HUNTERS SECTION

Map 1 of 2

Legend

- Subsection locations
- Turtle nests 2017**
- Green
- Hawksbill
- Loggerhead
- Unidentified



N
(A4)

1:17,635



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

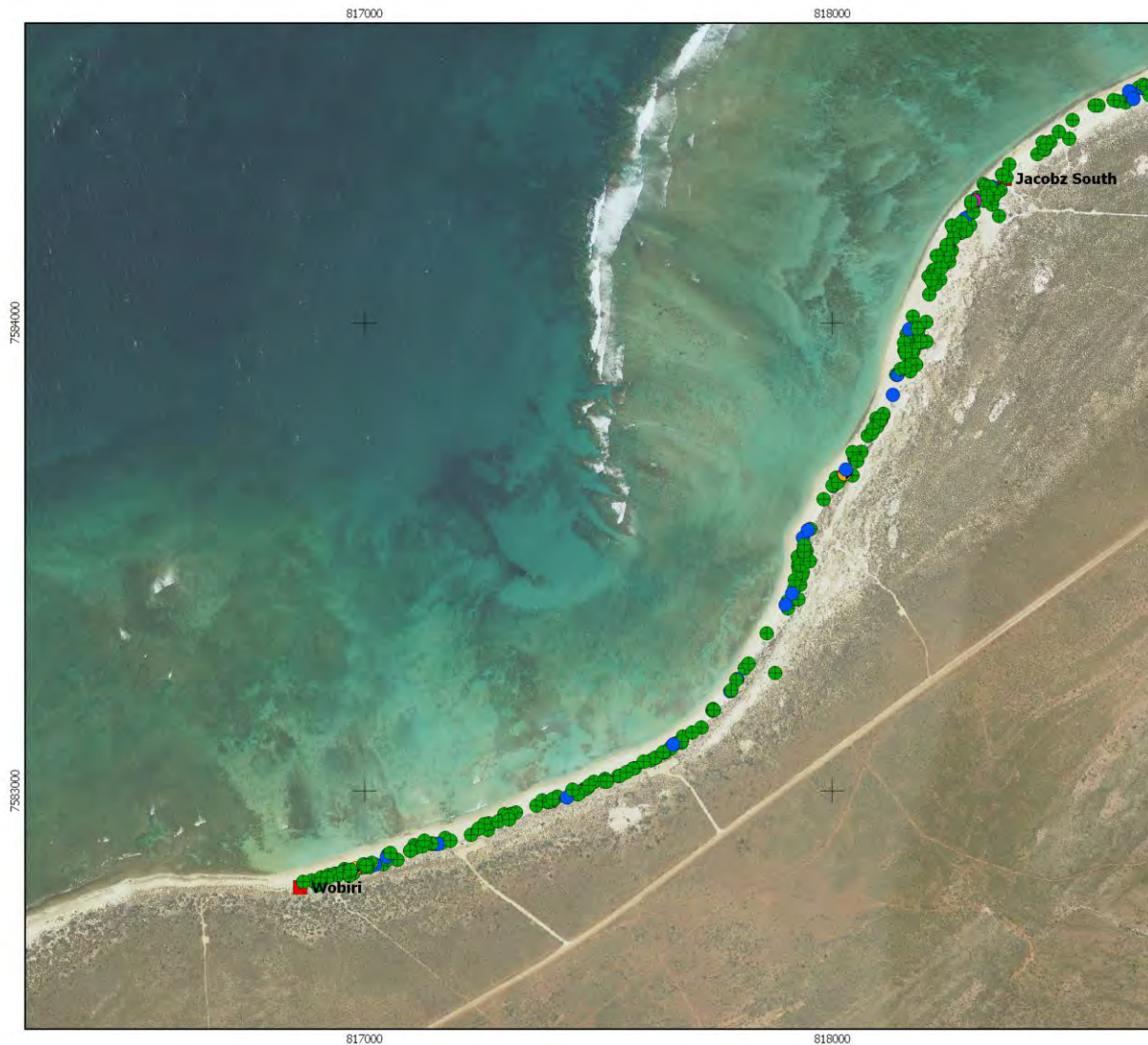


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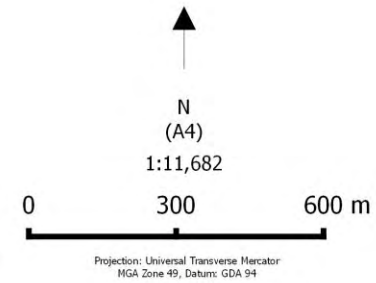
**Ningaloo Turtle Program
2016-2017 (new nests)**

HUNTERS SECTION

Map 2 of 2

Legend

- Subsection locations
- Turtle nests 2017**
- Green
- Hawksbill
- Loggerhead
- Unidentified



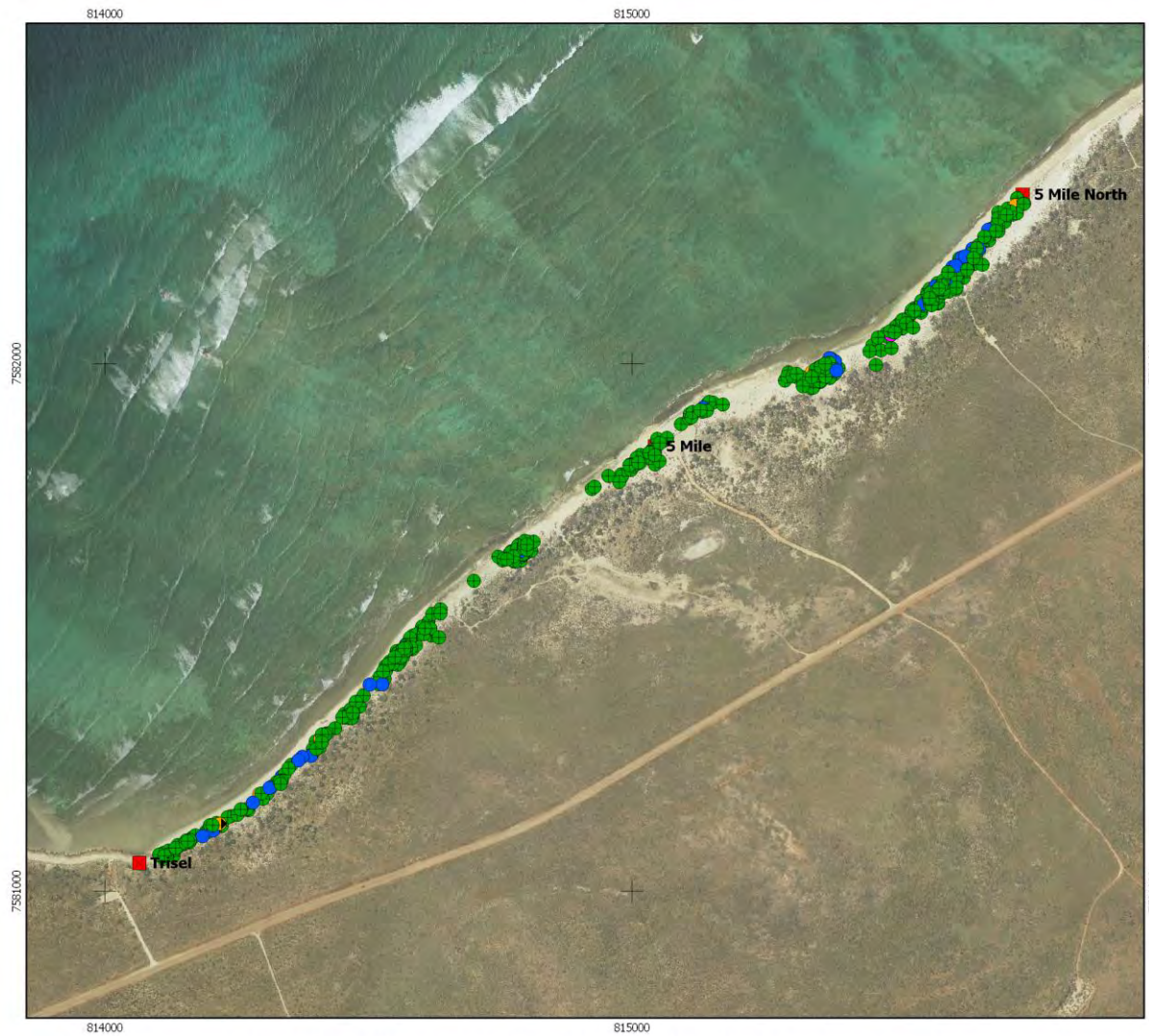
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Appendix 9: Graveyards Section - Location of New Nests (NTP 2016-17) Map 1 & 2



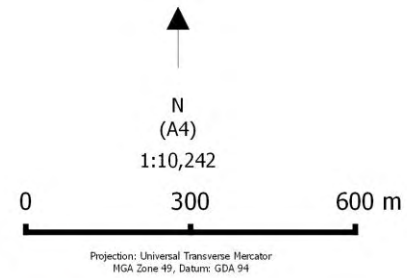
**Ningaloo Turtle Program
2016-2017 (new nests)**

GRAVEYARDS SECTION

Map 1 of 2

Legend

- Subsection locations
- Turtle nests 2017**
- Green
- Hawksbill
- Loggerhead
- Unidentified



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**Ningaloo Turtle Program
2016-2017 (new nests)**

GRAVEYARDS SECTION

Map 2 of 2

Legend

- Subsection locations
- Turtle nests 2017**
- Green
- Hawksbill
- Loggerhead
- Unidentified



(A4)

1:13,910



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



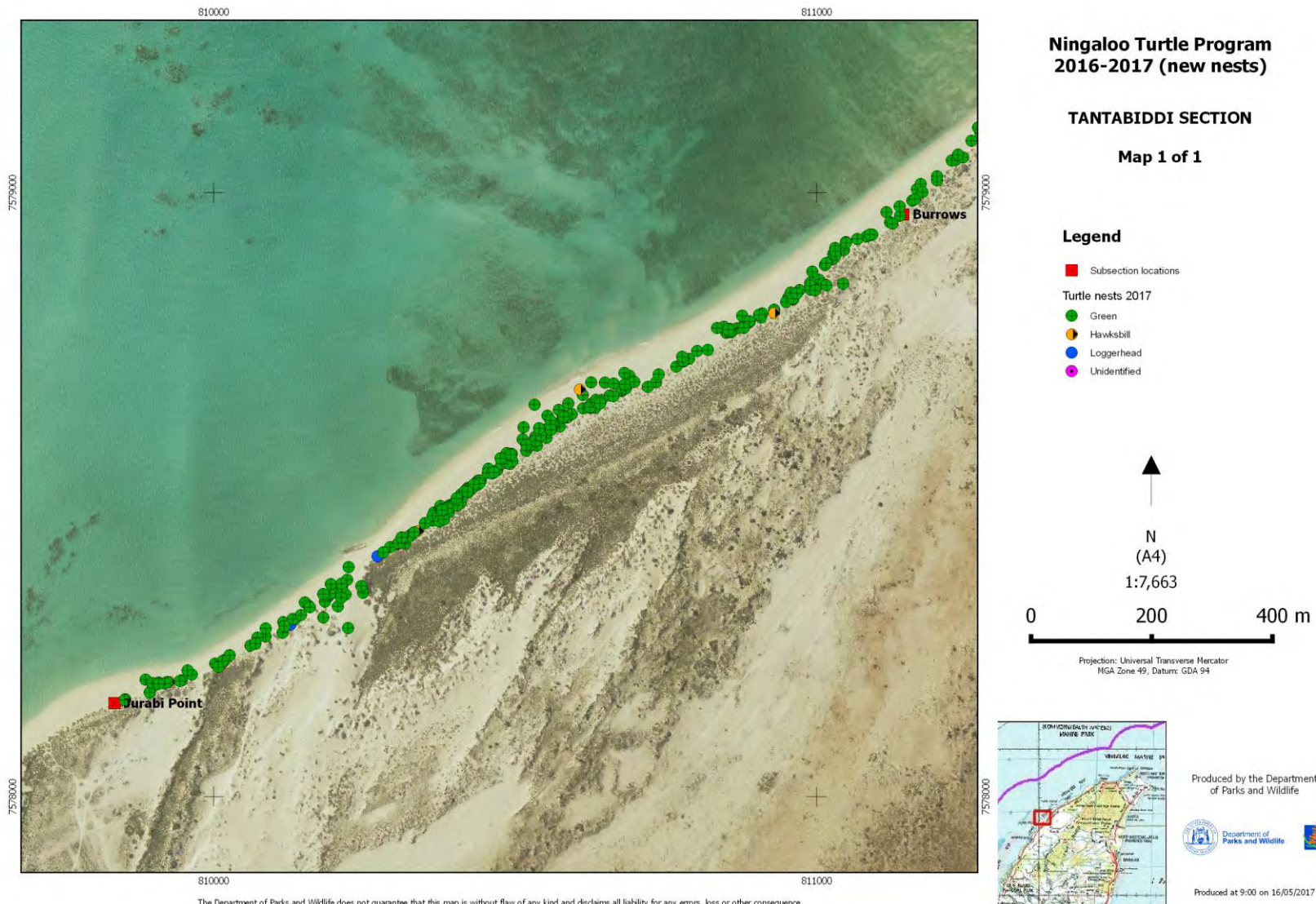
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of Parks and Wildlife



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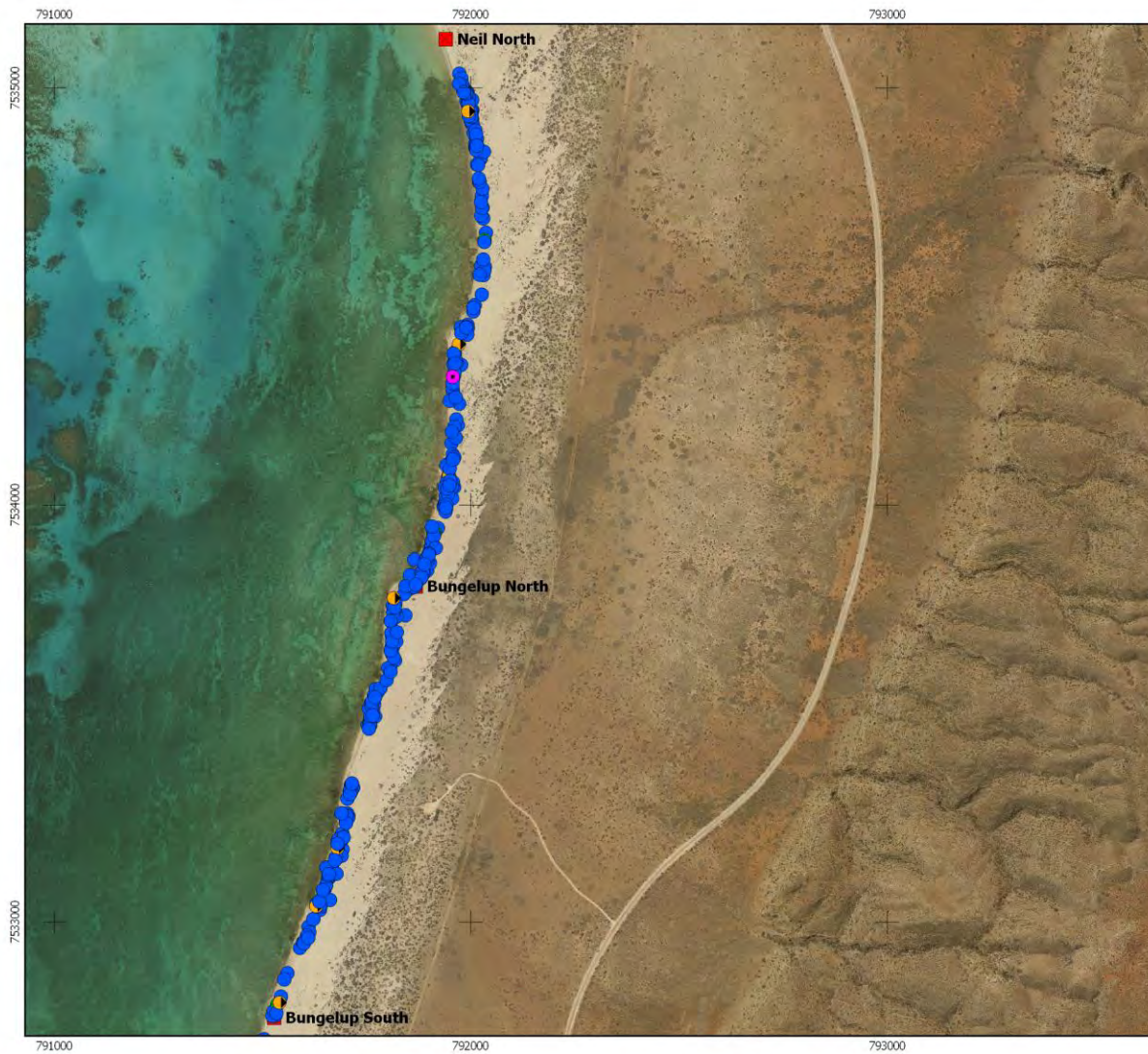
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Appendix 10: Tantabiddi Section - Location of New Nests (NTP 2016-17) Map 1



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Appendix 11: Bungelup Section - Location of New Nests (NTP 2016-17) Map 1 & 2



**Ningaloo Turtle Program
2016-2017 (new nests)**

BUNGELUP SECTION

Map 1 of 2

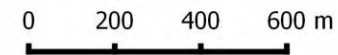
Legend

- Subsection locations
- Turtle nests 2017**
- Green
- Hawksbill
- Loggerhead
- Unidentified



N
(A4)

1:13,178



Projection: Universal Transverse Mercator
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**Ningaloo Turtle Program
2016-2017 (new nests)**

BUNGELUP SECTION

Map 2 of 2

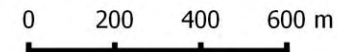
Legend

- Subsection locations
- Turtle nests 2017**
- Green
- Hawksbill
- Loggerhead
- Unidentified



N
(A4)

1:13,178



Projection: Universal Transverse Mercator
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