



Ningaloo Turtle Program Annual Report 2020 -21



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GLOSSARY

Body pit	A depression dug in the sand by a turtle during a nesting attempt.
Egg chamber	A deep cylindrical hole which a turtle digs into the bottom of a primary body pit with her back flippers only. The eggs are deposited here.
Entire season	All NTP database season dates and subsections except 1080 baiting data. This includes the intensive peak period monitoring and the pre and post peak period monitoring data.
False crawl	An abandoned nesting attempt with no eggs being laid.
GPS unit	Global Positioning System unit: an electronic navigational device which obtains a position on the earth using satellite signals.
Pre and post peak	Monitoring on the weekends either side of the intensive peak monitoring period.
Intensive peak monitoring period	Four-week period centred around the 31 December, during which monitoring takes places every day. Note: peak period was identified by Andrea Whiting as the 7 January but due to having volunteers adequately trained before Christmas, the peak period has been brought forward one week every year.
Nest	A nesting attempt which we suspect 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 tracks counted.
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.
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.
Rookery	A significant breeding area for a large number of turtles.
Secondary body pit	The last depression dug 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	Total number of times each subsection was 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	The imprint left in the sand by a turtle emerging from and returning to the water.
Turtle activity	Includes both turtle nests and false crawls.
Unidentified species	A turtle activity that cannot be attributed to a green, loggerhead or hawksbill turtle is classed as belonging to an unidentified species. This may occur due to the track being too short in length, obscured by wind or another track, or a volunteer being unsure.
Zoning	Hierarchical spatial classification system of divisions, sections & subsections.

LIST OF ABBREVIATIONS

CCG	Cape Conservation Group Inc.
DBCA	Department of Biodiversity, Conservation and Attractions
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	Parks and Wildlife Service, Department of Biodiversity, Conservation and Attractions

SUMMARY

The Ningaloo Turtle Program (NTP) was established in 2002 as a collaboration between the Cape Conservation Group Inc., World Wildlife Fund Australia, Murdoch University and the predecessors of the Parks and Wildlife Service at the Department of Biodiversity, Conservation and Attractions, Exmouth District. During the 2020-21 season, NTP sponsors Woodside Energy Ltd made a significant contribution to the program. BHP provided sponsorship toward the hire of the 'turtle bus'. The primary aim of the NTP is support the conservation of marine turtles along the Ningaloo coast.

The monitoring design was the same as previous recent seasons; 4 weeks of daily monitoring during the predicted peak period of nesting at both the North West Cape and Cape Range divisions (referred to hereby as the standardised season) and 3 weekends pre-peak and 3 weekends post-peak at the North West Cape sections only.

The NTP was spatially expanded in 2018-19 to include monitoring of remote rookeries at Janes Bay and Whaleback Beach in the Ningaloo Marine Park adjacent to the former pastoral lease of Ningaloo Station (previously last monitored in 2007) and Gnarraloo Bay (previously monitored by the Gnarraloo Turtle Conservation Program). Monitoring continued at Janes Bay in 2020-21 with one four-day, one five-day and one seven-day survey done throughout the season. Gnarraloo Bay was not monitored in 2020-21.

Fifty two volunteers contributed 5034 hours to the Ningaloo Turtle Program in 2020-21. Since commencement of the program, volunteers have contributed over 77,200 hours. These hours demonstrate the effort and essential value of the volunteers over the life of the program.

5808 suspected nests and 25,130 false crawls were recorded in the Ningaloo Region over the full 2020-21 season. In the NW Cape division, 98.1% of activities were from green turtles. In the Cape Range division (Bungelup), 85.5% of activities were from loggerhead turtles. In the Ningaloo division (Janes Bay and Whaleback), 60.1% of activities were from green turtles and 36.8% were from loggerhead turtles.

Turtle activity has varied greatly among years since the start of monitoring in 2002. Relatively large variation has been particularly evident for green turtles, but relatively less so for loggerheads and hawksbills. There have been two clear peaks in activity since NTP began, one in 2011-12 and the other in 2020-21. The 2020-21 season had the highest activity per subsection per day since the program began (all species, subsections and dates included). It is of interest to note that both seasons coincided with La Nina weather patterns. There were more nests and false crawls by green and loggerhead turtles and fewer nests by hawksbill turtles in comparison to long-term averages. Nesting success was well below average for all three species.

In the standardised season (4 weeks of peak season monitoring in North West Cape and Cape Range divisions), volunteers recorded on average 70.3 green turtle activities per subsection per day (nests and false crawls), which is the highest on record for the NTP (long-term average

of 19.0 activities per day (range from 3.8 to 70.3 since 2002). Nesting success for green turtles of 16.9%, was the lowest on record and much lower than the long-term average of 26.9%.

Loggerhead turtles had an average of 3.86 activities per subsection per day which is higher than the long-term average of 2.49 activities and the second highest since the NTP began (range 0.92 to 5.45 since 2002). Nesting success rate was 32.9% (long-term average of 40.7%).

Hawksbill activity remained relatively small as expected, with 0.19 activities on average per subsection per day. The long-term average is 0.4 activities and the range since 2002 is 0.13 to 0.99). Nesting success (31.9%) was the lowest on record, with the long-term average of 49%.

Twenty four nests were considered to be disturbed, which was 0.41% of the total recorded nests. Fourteen were attributed to ghost crabs, four to a turtle excavating another turtle's nest, 1 to goanna predation and 1 to tide. Four disturbances were attributed to introduced predators (dog) or dingo.

During 2020-21, volunteers rescued 49 stranded turtles, contributing to at least 330 recorded rescues since 2002. Twenty seven mortalities and ten tagged turtles were also reported.

1. INTRODUCTION

The Ningaloo Turtle Program (NTP) was established in 2002, as a collaborative initiative between the predecessors of the Parks and Wildlife Service at the Department of Biodiversity, Conservation and Attractions 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 information such as nesting abundance, distribution and disturbance. This information informs management and conservation by Parks and Wildlife including reducing disturbance to nesting turtles, management of introduced predators and managing coastal access and visitation to support effective conservation of sea turtles on the Ningaloo Coast.

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

Woodside Energy Ltd has been the main external sponsor of the program, contributing to the program's operational costs since 2012. This has included funding contributing to volunteer costs, website maintenance, community activities, monitoring equipment and education.

In 2008 the monitoring design for NTP was consolidated from 60 days after it was determined that long-term trends in turtle populations could be detected with an acceptable level of confidence when survey effort was reduced (Whiting, 2008).

NTP seasons in the North West Cape division now consist of daily monitoring over the 28 days of the peak nesting period and three weekends of monitoring during each of the pre and post peak nesting periods. Sections in the Cape Range division are monitored daily over the 28 days of the peak nesting period.

To better understand turtle activity along the central Ningaloo Coast, remote rookeries at Janes Bay and Whaleback Beach (Bundera/Ningaloo division) were monitored during three periods (as recommended by Whiting, 2018) .by NTP volunteers and Parks and Wildlife staff throughout the season,

Trend analyses have been done every three years to understand longer-term changes in patterns of nesting at Ningaloo. The most recent trend analysis in 2016 is available online at http://www.ningalooturtles.org.au/media_reports.html.

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

NTP Overarching Goals

- Contribute to the understanding of turtle nesting and threats along the Ningaloo Coast to support informed evidence-based conservation and management
- Continue to develop a rigorous, peer-reviewed and reliable scientific monitoring programme supported by trained volunteers
- Build a culture of awareness and stewardship for marine turtle conservation.

NTP Primary Objectives

- Estimate the abundance, distribution and species of turtle nests on key sections of beach over specified time intervals
- Identify the relative significance of specific nesting beaches for each species
- Identify temporal changes in nesting season and spatial changes in nesting distribution for each species
- Identify long-term trends in nesting and populations
- Quantify predation and disturbance as part of NTP monitoring and through supporting external research
- Record observations of tagged turtles, strandings and mortalities
- Rescue stranded turtles when appropriate
- Support external research relevant to the goals of the program
- Encourage active community and wider involvement through education and the recruitment of volunteers in order to build interest, skills and knowledge to assist with turtle conservation
- Work with traditional owners to share knowledge and actively understand and manage turtles.

2. METHODS

Activities of turtles are recorded by observing fresh tracks from the previous night to determine species and identify suspected nests¹. Volunteers use standard procedures to determine if the activity has resulted in a successful nest or a false crawl. Nest positions are recorded using GPS. Signs of predation at nests are also recorded, along with sightings of tagged turtles, the presence of introduced animals, mortalities of turtles and rescues.

For more detailed information on the 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.

In the 2018-19 season, the NTP changed from recording data on paper data sheets and using a hand-held GPS to record locations to collecting data using the ODK Collect app, installed on Lenovo tablets (<https://getodk.org/>). This was part of a state-wide Departmental initiative to standardise and coordinate the collection of data among turtle monitoring programs throughout WA. The app has the benefit of eliminating human error in transcribing GPS coordinates from the GPS to the data sheet because the app enables the location to be automatically saved when recording a turtle activity. The data from the app were automatically uploaded via WIFI to a centralised database in Perth. This was the third NTP season using tablets. To support the reliable collection of data and use of the ODK app, staff and volunteers were provided with either new or refresher training in the use of the tablets prior to the season commencing.

2.1 Monitoring zones & dates

Important nesting beaches were identified through past aerial and ground surveys during the development of the program. For the purpose of the program, the Ningaloo Region is divided into four divisions. A fifth division was added in 2018-19 (Gnarraloo), but not monitored in 2020-21. Divisions are further divided into sections and subsections. Subsections are on average 2-3kms long so that they are practical to survey on foot (with the exception of Janes Bay). The starts and ends of subsections were determined by either natural barriers that separate beaches or positions of car parks to facilitate access by volunteers. Volunteers identify subsections with a GPS location and NTP totems located at the start and finish points.

¹ The term 'nest' is used in this report to indicate an activity that appeared to be a nest based on a consistent set of criteria. Nests however cannot be confirmed unless egg-laying is witnessed. Uncertainty can be expected as turtles can sometimes create the appearance of nests without depositing any eggs into them (Whiting pers. comm. 2012) or may deposit eggs without creating the appearance of a nest. Any uncertainty, however, was not considered to be a significant source of bias nor would likely affect the confidence in the interpretation of results.

North West Cape division

The North West Cape (NW Cape) division includes Lighthouse Bay, Hunters, Graveyards and Tantabiddi sections, which are further divided into 11 subsections (Appendix 2). In 2020-21, each subsection was monitored for 38 or 39 days depending on the availability of volunteers for each of the subsections. The NW Cape division was monitored daily during the intensive peak period from the 17 December 2020 to 13 January 2021 (with the exception of 1 Jan) and before the peak period on the weekends of the 7 & 8, 21 & 22 November and 5 & 6 December 2020 and after the peak period on the weekends of the 30 & 31 January and 13 & 14 and 27 & 28 February 2021.

Cape Range division

The Cape Range division includes the Bungelup section, which is divided into three subsections and South Mandu section (Appendix 3). South Mandu was not monitored in 2020-21. Each subsection of the Cape Range division was monitored for 26 or 27 days during the intensive peak period from the 17 December 2020 to 13 January 2021.

Bundera/Ningaloo division

The Bundera/Ningaloo division includes six sections each divided into subsections. The Janes Bay and Whaleback Beach sections (Appendix 4) were monitored in 2020-21 using the same sampling regime as in 2018-19 & 2019-20. They were monitored for 4 days pre-peak nesting period (25 – 28 November 2020), 7 days centred on the peak nesting period (5 – 11 January 2021) and 5 days post-peak nesting period (6 – 10 February 2021), as recommended by Whiting 2018. Parks and Wildlife staff also opportunistically monitor these subsections during monthly baiting operations for management of introduced predators including foxes and cats.

Coral Bay division

The Coral Bay division includes two sections: Batemans Bay and The Lagoon. These sections are divided into one or more subsections. This division has not been consistently monitored by NTP since the 2008-09 season. Parks and Wildlife staff opportunistically monitor these subsections during monthly baiting operations for management of introduced predators including foxes and cats, but for the purpose of this report these data have not been included.

Gnarraloo division

The Ningaloo Turtle Program was expanded in 2018-19 to include the minor loggerhead rookery in Gnarraloo Bay (Gnarraloo Bay section)². This was previously monitored extensively by the Gnarraloo Turtle Conservation Program from 2008-09 to 2017-18 (Hattingh *et al.* 2018). The NTP commenced monitoring in Gnarraloo Bay in 2018-19 using a sampling

² Gnarraloo Bay follows the traditional Baiyungu spelling of Ngarralu (double 'r'). Gnarraloo Station and the Gnarraloo Turtle Conservation Program use one 'r'.

regime recommended by Whiting (2018) based on assessment of available data from previous surveys at Gnarraloo Bay. Turtle nesting was not monitored in Gnarraloo Bay in 2020-21.

3.0 RESULTS

3.1 Volunteer engagement and coordination

Fifty two volunteers contributed 5034 hours to the Ningaloo Turtle Program in 2020-21, coordinated, managed, supervised and trained by Parks and Wildlife staff and supported by volunteers from the Cape Conservation Group. This is the most volunteer hours in a season since consolidation of the program in 2008 and is indicative of the busy nesting season with large numbers of turtle activities and therefore more time on the beaches. Since commencement of the program in 2002, 77,297 hours of time from volunteers have contributed to the program. Volunteer time was primarily monitoring, but also data uploading, training, education, school visits, turtle rescues, weekend coordination and assisting with external research.

3.2 Nesting Activity

3.2.1 NW Cape division

5315 suspected nests and 24,031 false crawls were recorded within the NW Cape division during the full 2020-21 season (Table 1). Green turtles were the most active species in the NW Cape division (both nests and false crawls) with 98.1% of total turtle activity recorded, followed by loggerheads (1.4%), hawksbills (0.3%), flatbacks (0.003%) and unidentified species (0.2%) (Figure 1).

Table 1: Total activities (suspected nests and false crawls) recorded for each species within the North West Cape division, NTP 2020-21 full season.

Activity	Turtle Species					Total
	Green	Hawksbill	Loggerhead	Flatback	Unidentified	
New nests	5128	26	138	0	23	5315
False crawls	23650	56	277	1	47	24031
Total activity	28778	82	415	1	70	29346

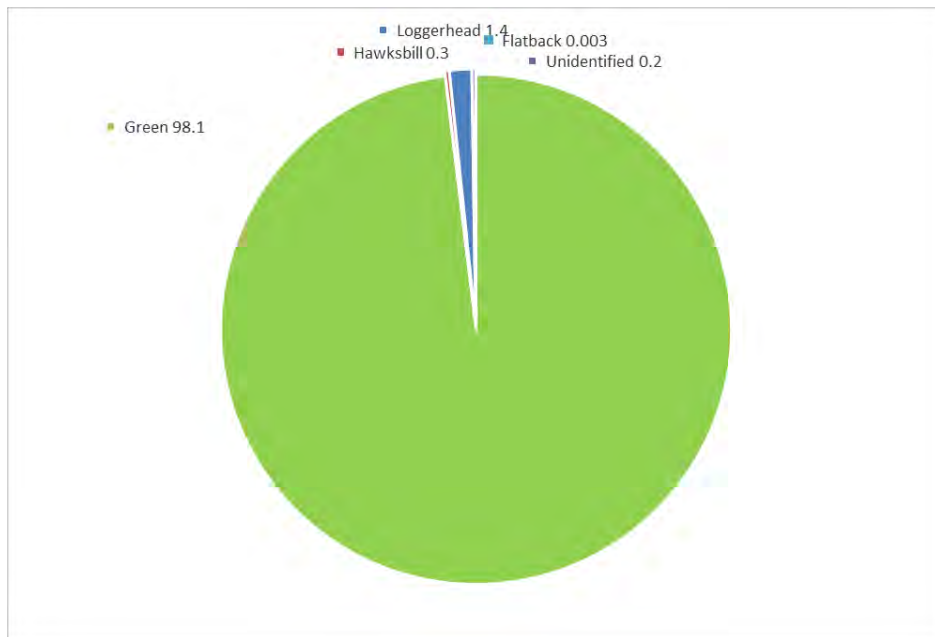


Figure 1: Percentage of activity by species within the North West Cape division, 2020-21 full season.

Numbers of nests and false crawls varied among the four NW Cape sections (Figure 2; section lengths and locations, see Appendix 2). The Graveyards section had the most activity and the Tantabiddi section had the least activity. Graveyards had the most nests and Lighthouse Bay had the fewest. For individual nest locations see maps in Appendix 6 – 9.

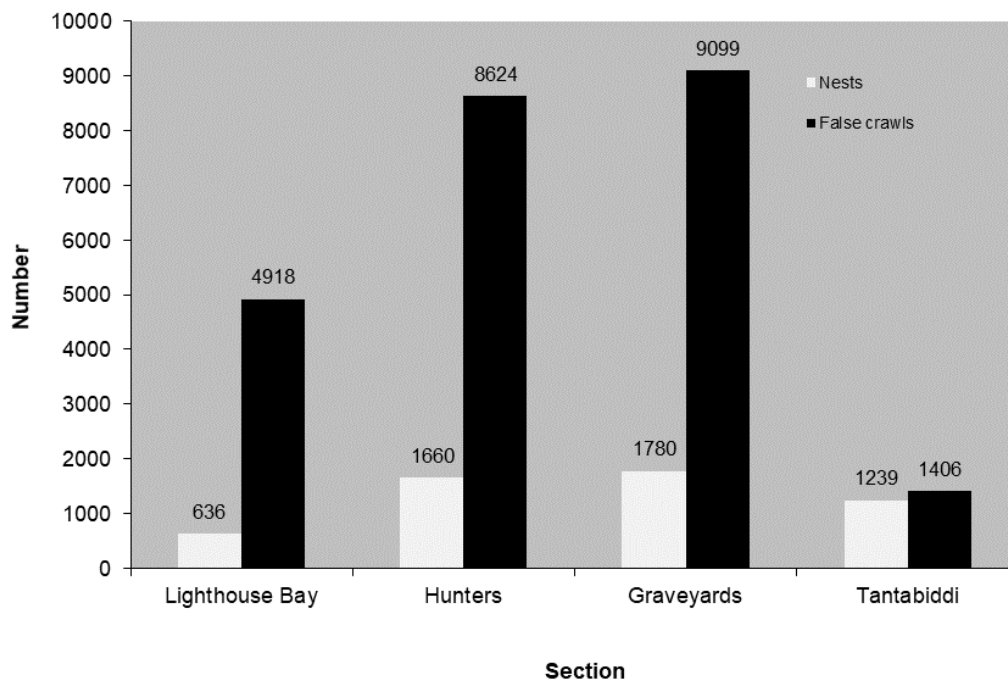


Figure 2: Nesting activity (nests and false crawls) for all species in each section of the North West Cape division, 2020-21 full season.

Density of nesting (nests per kilometre per day) was used to investigate the relative importance of each subsection of beach. Burrows to Jurabi Point had the densest nesting, followed by Five Mile to Five Mile North (Figure 3). Two of the northern subsections, Mildura Wreck to North West Cape, and Surf Beach to Hunters had the lowest density of nesting.

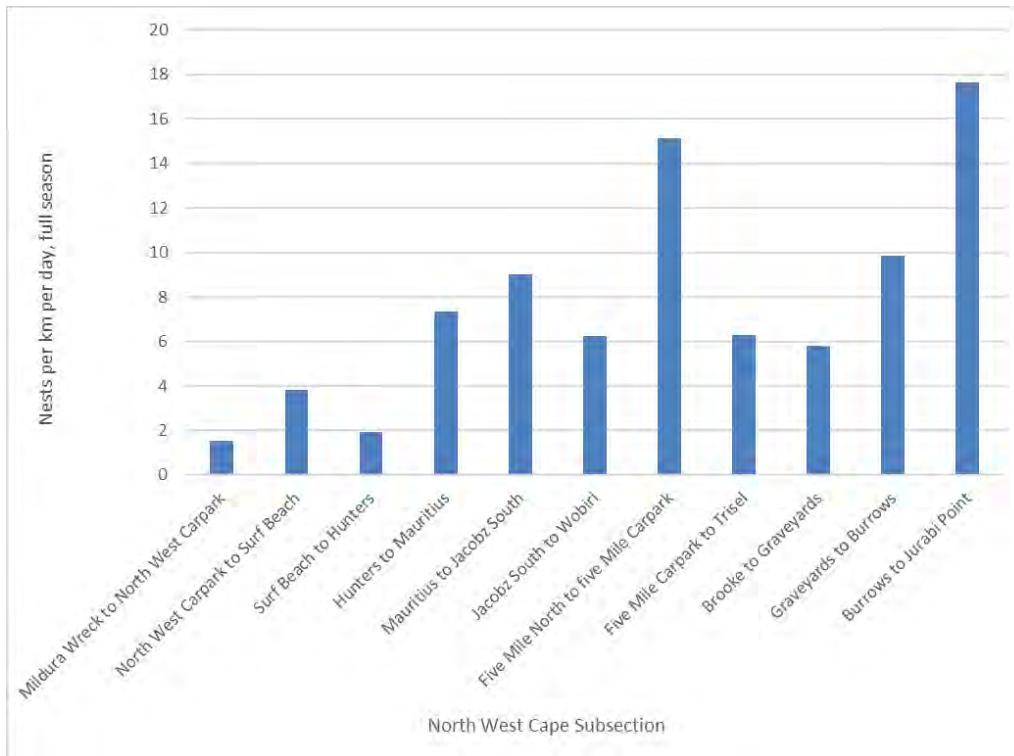


Figure 3: Density (nests per kilometre per day), for each subsection on the North West Cape, NTP 2020-21 full season.

Green turtles were the most abundant species throughout all sections on the North West Cape. The highest amounts of loggerhead and hawksbill activities on the North West Cape were both in the north, in the Lighthouse Bay section (Table 2).

Table 2: Percentage of nests for each species in each section of the North West Cape division, 2020-21 full season.

Percentage of nests per species in each section	Turtle species				
	Green	Hawksbill	Loggerhead	Unknown sp.	
Lighthouse Bay	90.1	1.7	7.5	0.6	100
Hunters	95.4	0.7	3.1	0.8	100
Graveyards	97.4	0.2	2.1	0.2	100
Tantabiddi	99.8	0.0	0.1	0.1	100

Numbers of nests for each species varied through time across the season on the NW Cape Division (Figure 4- green turtles, Figure 5- loggerhead turtles, Figure 6- hawksbill turtles). The peak seasons for each of green and loggerhead turtles appear to be during the period between

late December and early January. In contrast, a period of peak nesting for hawksbills was not able to be clearly identified, partly due to the very low numbers of hawksbill nests.

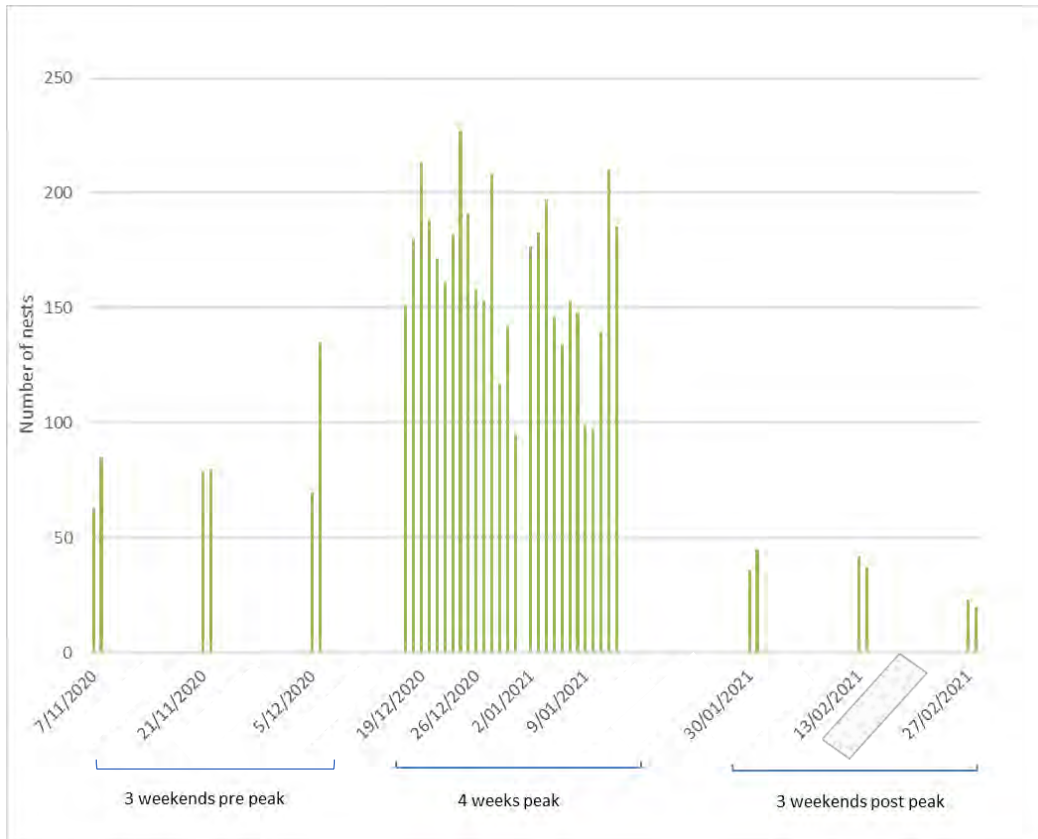


Figure 4: Number of green turtle nests recorded in the NW Cape Division per day in the 2020-21 season. Note, no monitoring occurred on 1 January.

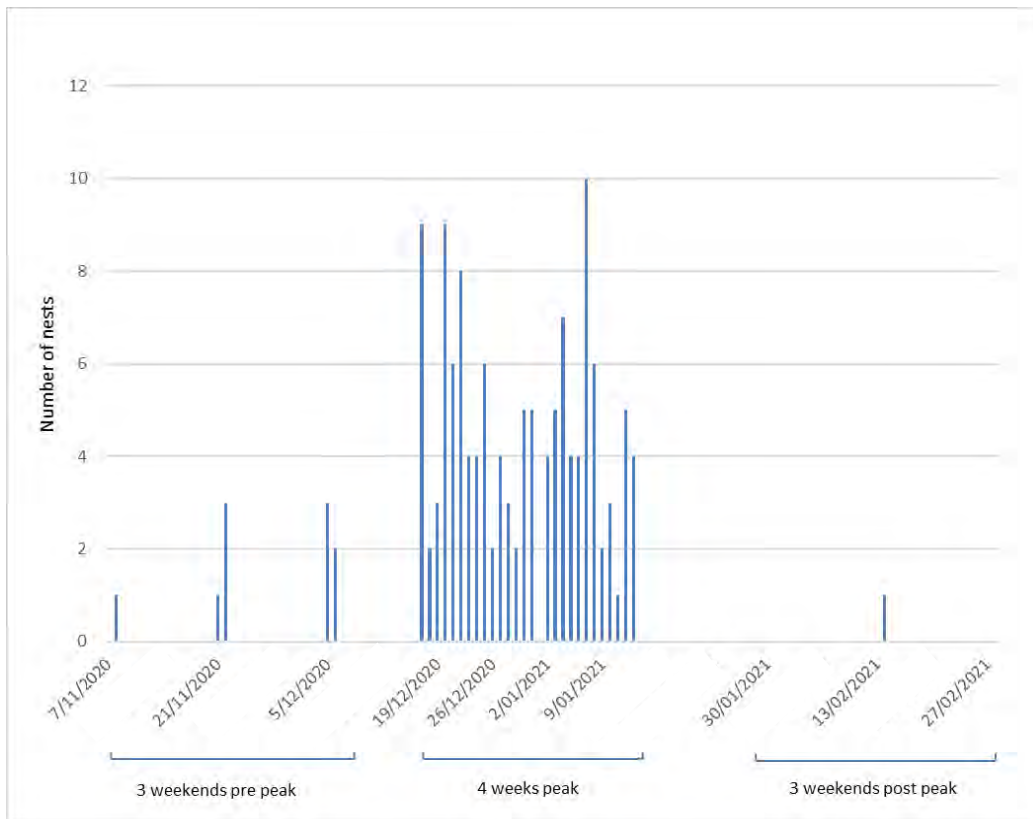


Figure 5: Number of loggerhead turtle nests recorded in the NW Cape Division per day in the 2020-21 season. Note, no monitoring occurred on 1 January.

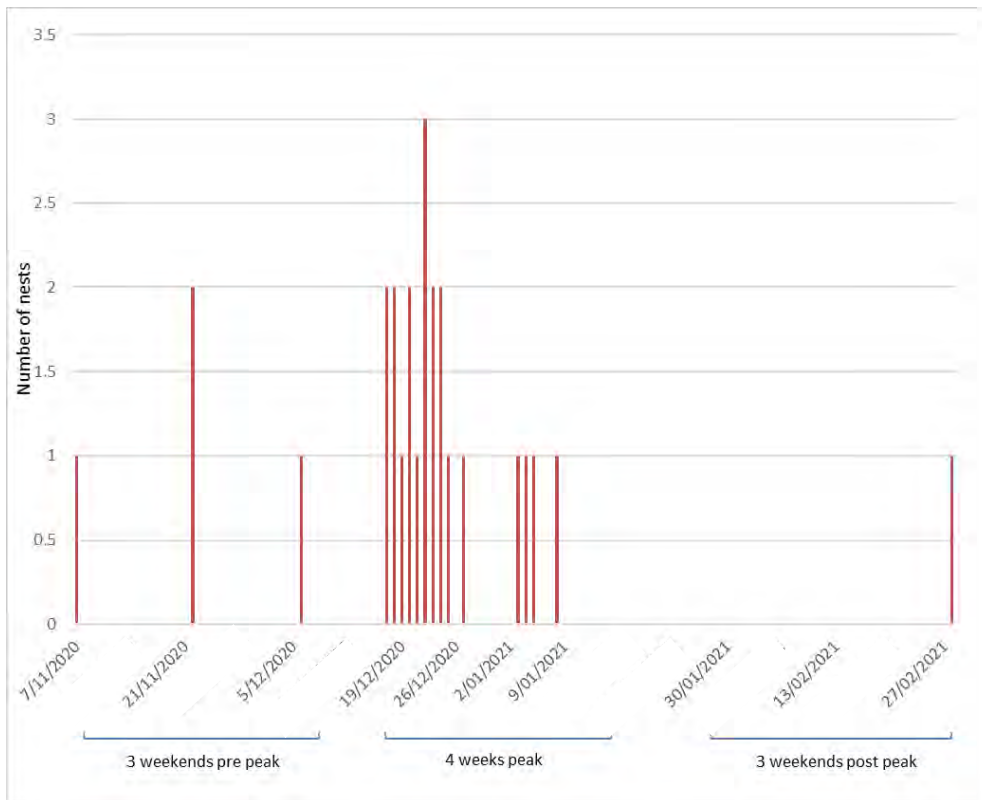


Figure 6: Number of hawksbill turtle nests recorded in the NW Cape Division per day in the 2020-21 season. Note, no monitoring occurred on 1 January.

3.2.2 Cape Range division (Bungelup)

393 suspected nests and 849 false crawls were recorded in the Bungelup section during the 2020-2021 NTP season (Table 3). Loggerhead turtles were the most common (85.5%), followed by green (13.5%), hawksbill (0.7%), and unidentified turtle species (0.2%) (Figure 7).

Table 3: Total activities (suspected nests and false crawls) recorded for each species within the Cape Range division, NTP 2020-21 full season.

Cape Range Division	Turtle Species					Total
	Green	Hawksbill	Loggerhead	Flatback	Unidentified	
New nests	41	2	348	0	2	393
False crawls	127	7	714	0	1	849
Total activity	168	9	1062	0	3	1242

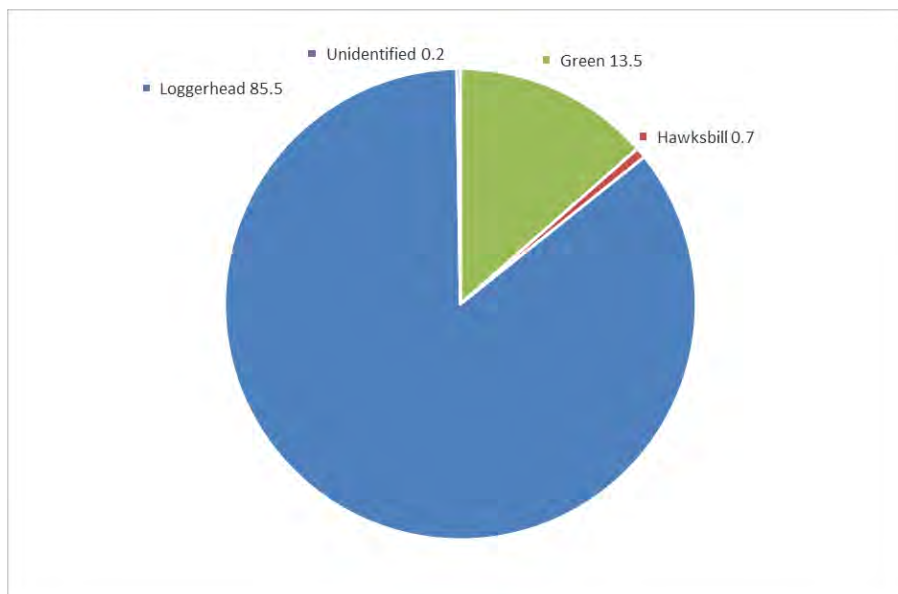


Figure 7: Percentage of turtle activity by species within the Bungelup section of the Cape Range division, 2020-21.

Activity varied across the three sections at Bungelup (Figure 8); for individual nest locations see maps in Appendix 10). The southernmost subsection (Rolly Beach) had the most activity.

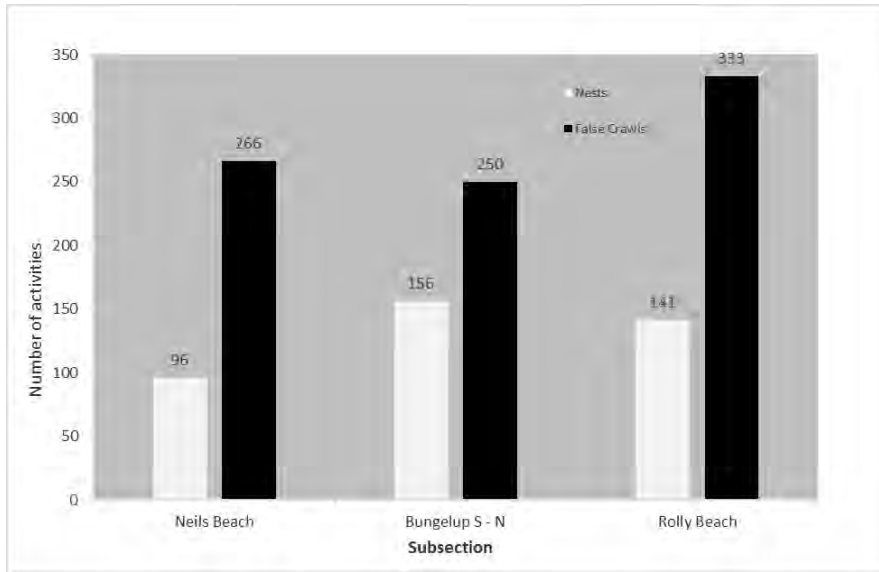


Figure 8: Numbers of suspected nests and false crawls within each Bungelup subsection (Cape Range division), 2020-21.

Density of nesting (nests per kilometre per day) provides the relative importance of each subsection of beach. The middle section of beach Bungalup South to North had the highest density of nesting (Figure 9).

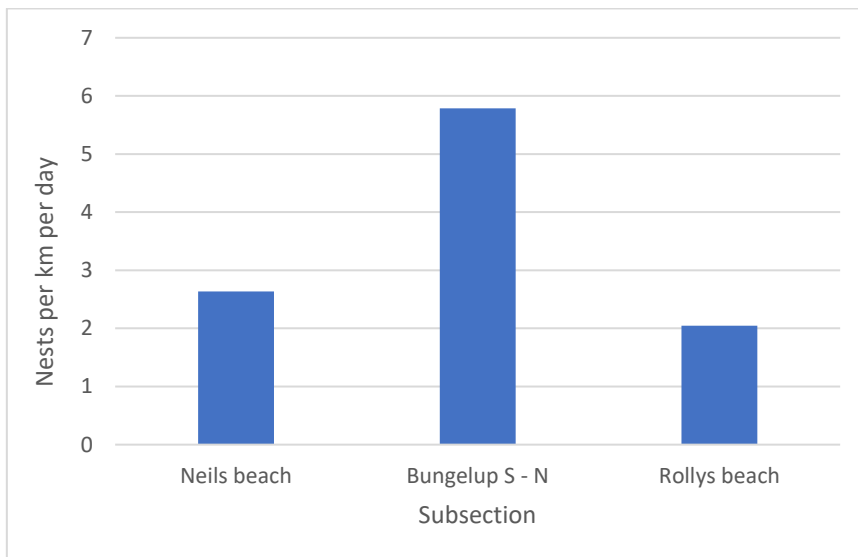


Figure 9: Nests per kilometre per day, for each subsection of Bungelup, Cape Range Division, NTP 2020-21.

Loggerhead turtles were the most abundant species throughout all three subsections at Bungelup (Table 4). The most green and hawksbill activities were in the middle subsection, Bungalup South to North.

Table 4: Percentage of nests for each species in each subsection of the Bungelup section, 2020-21 full season

% of nests in each subsection per species	Turtle species				
	Green	Hawksbill	Loggerhead	Unknown	
Neils Beach	7.3	0.0	92.7	0.0	100.00
Bungelup - South to North	12.8	1.3	85.9	0.0	100.00
Rollys Beach	9.9	0.0	88.7	1.4	100.00

Numbers of loggerhead nests varied through the season at Bungelup (Figure 10). There was a peak in nesting in late December, with a smaller peak in mid-January, which correlates with the inter-nesting interval of loggerhead turtles being approximately 14 days (Limpus, 2009).

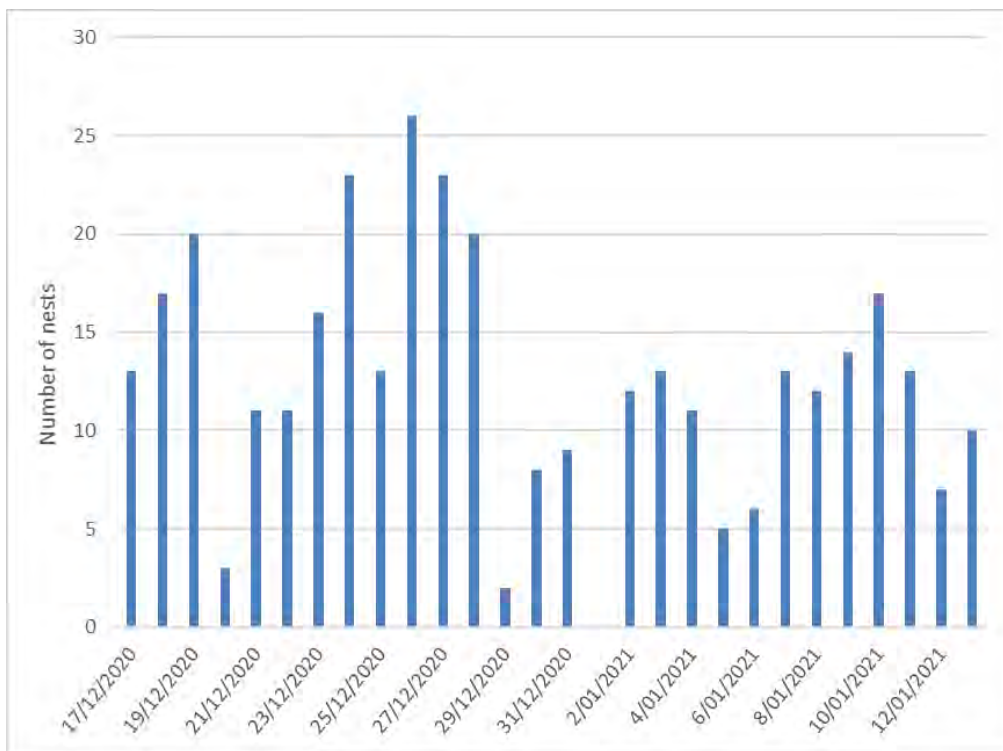


Figure 10: Number of loggerhead turtle nests recorded in the Cape Range Division (Bungelup) per day in the 2020-21 season. Note, no monitoring occurred on 1 January.

3.2.3 Ningaloo division (Janes Bay and Whaleback Beach)

100 suspected nests and 251 false crawls were recorded in the Janes Bay and Whaleback beach subsections in the 16 days of monitoring in 2020-21 (Table 5). 80.63% of turtle activity occurred in the northernmost subsection (JB1), with 7.41% in JB2, 7.12% in JB3 and 4.84% in Whaleback beach (JB4).

Green turtles were the most abundant (60.1% of activities) followed by loggerheads (36.8%), hawksbills (0.3%) and unidentified species (2.8%) (Figure 11). There were more loggerhead turtles nests than greens (Table 5). There was a concentration of green turtle activity in the northern area of Janes Bay while most of the loggerhead activity was observed in the southern areas. Whaleback beach had mostly loggerhead activity (Appendix 11).

Table 5: Total number of activities (suspected nests and false crawls) recorded for each species within the Ningaloo division, 2020-21.

Bundera / Ningaloo Division	Turtle Species				Total
	Green	Hawksbill	Loggerhead	Unidentified	
New nests	43	0	54	3	100
False crawls	168	1	75	7	251
Total activity	211	1	129	10	351

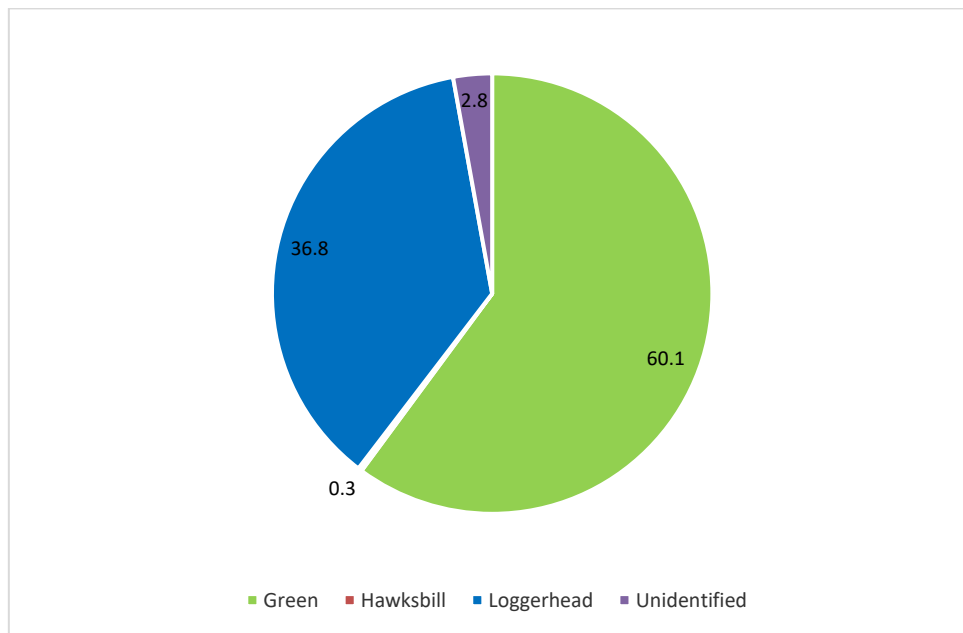


Figure 11: Percentage of activity by species within the Bundera/Ningaloo division in 2020-21.

3.3 Long-term patterns of nesting – NW Cape and Cape Range divisions

NTP has recorded 64,442 suspected nests and 164,254 false crawls since commencement of the program in 2002 (full season data and all subsections, Appendix 1). Green turtles have been consistently and by far the most abundant species with 87.63% of activities, followed by

loggerhead (10.12%), hawksbill (1.83%), unidentified species (0.41%) and flatback turtles (0.001%).

Estimates of activity for each season and subsection have been standardised using survey effort to compare activity among seasons. Survey effort is defined as the number of times each subsection was monitored. Not all subsections were monitored on the same days or for the same total number of days within or among seasons (Appendix 1).

From 2002-03 to 2020-21 including 19 seasons, within the intensive peak monitoring period (NW Cape and Cape Range divisions only), NTP has recorded 39,566 nests and 109,394 false crawls (total activity 148,960). There have been two clear peaks (2011-12 and 2020-21) in activity since the beginning of NTP where activity has been approximately 2.5 to 11 times greater than other seasons. (Figure 12). Activity during the 2020-21 season was the highest since the program began with an average of 74.5 activities per subsection per day. The long-term average is 22.0, noting it is highly variable each year (Figure 12). Number of nests was the second highest on record, with 13.3 nests per subsection per day (Figure 13).

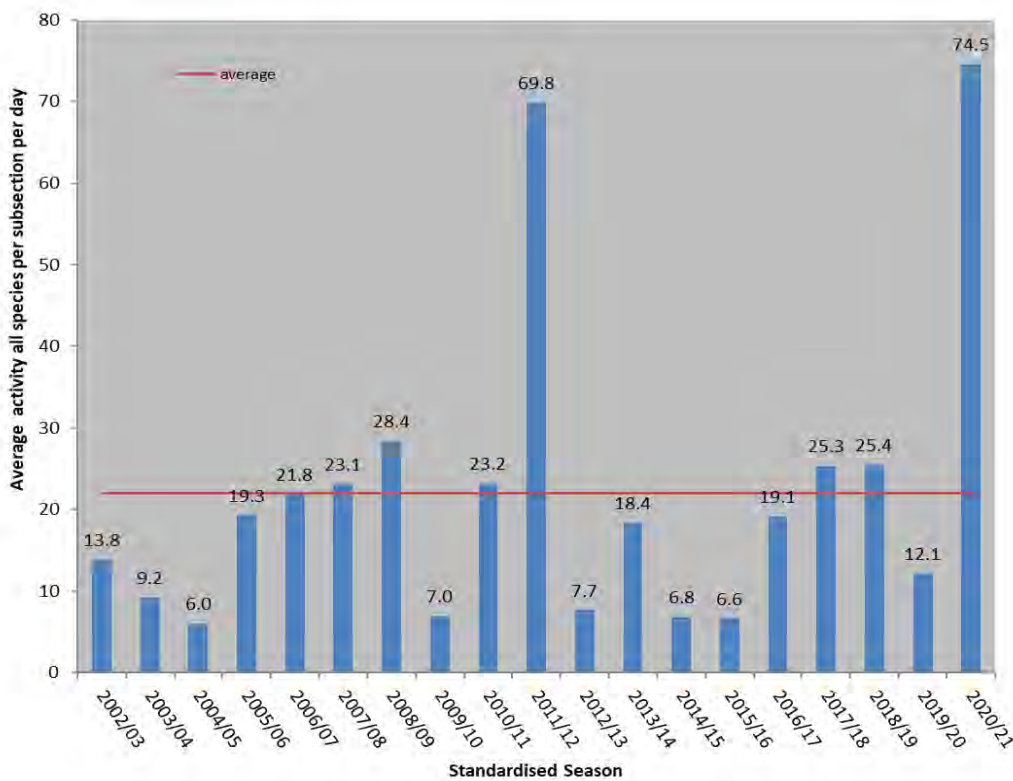


Figure 12: Turtle activity (nests and false crawls for all species) for each season standardised by survey effort during the intensive peak monitoring period (NW Cape and Cape Range divisions).

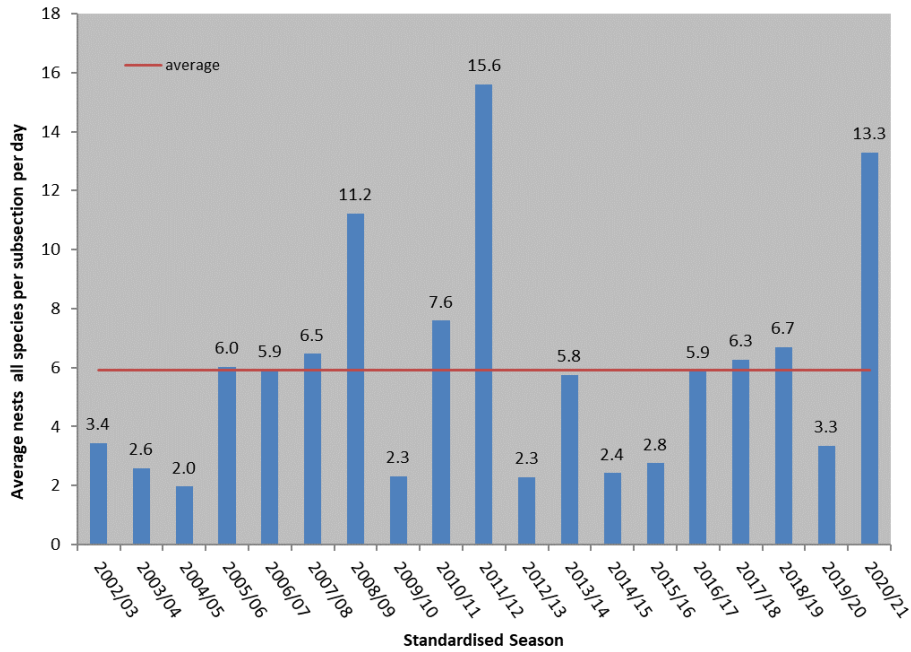


Figure 13: Nests (all species) for each season standardised by survey effort during the intensive peak monitoring period (NW Cape and Cape Range divisions).

Green turtles

Nesting activity by green turtles has varied largely among years. Green turtle activity in 2020-21 was the highest on record, with 70.3 activities per subsection per day (Figure 14). Number of nests was the second highest on record with 11.90 nests per subsection per day (Figure 15).

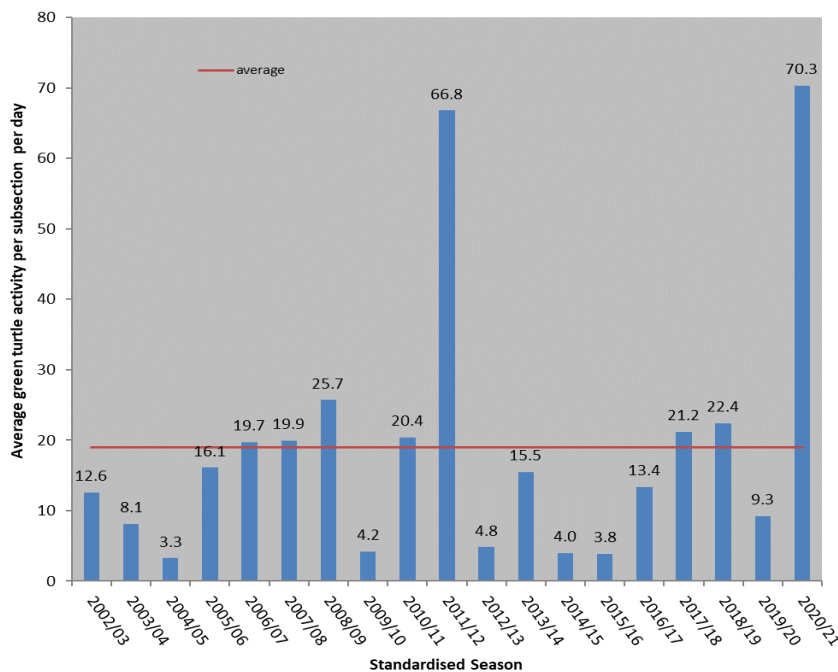


Figure 14: Green turtle activity (nests and false crawls) for each season standardised by survey effort during the intensive peak monitoring period (NW Cape and Cape Range divisions).

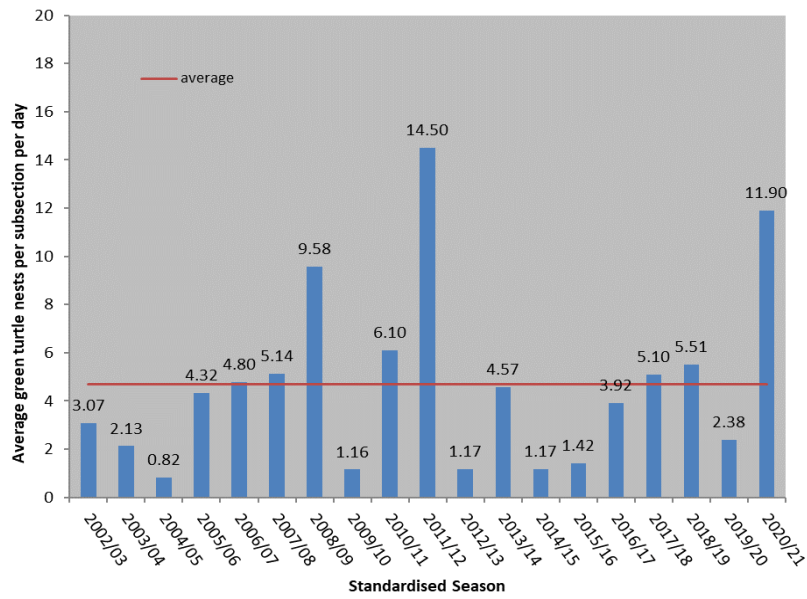


Figure 15: Green turtle nests for each season standardised by survey effort during the intensive peak monitoring period (NW Cape and Cape Range divisions).

Loggerhead turtles

The standardised level of loggerhead turtle activity during the 2020-21 season was above the long-term average and the second highest since the program began, with 3.86 activities per subsection per day (Figure 16). Standardised loggerhead nesting was above the long-term average and third highest (Figure 17).

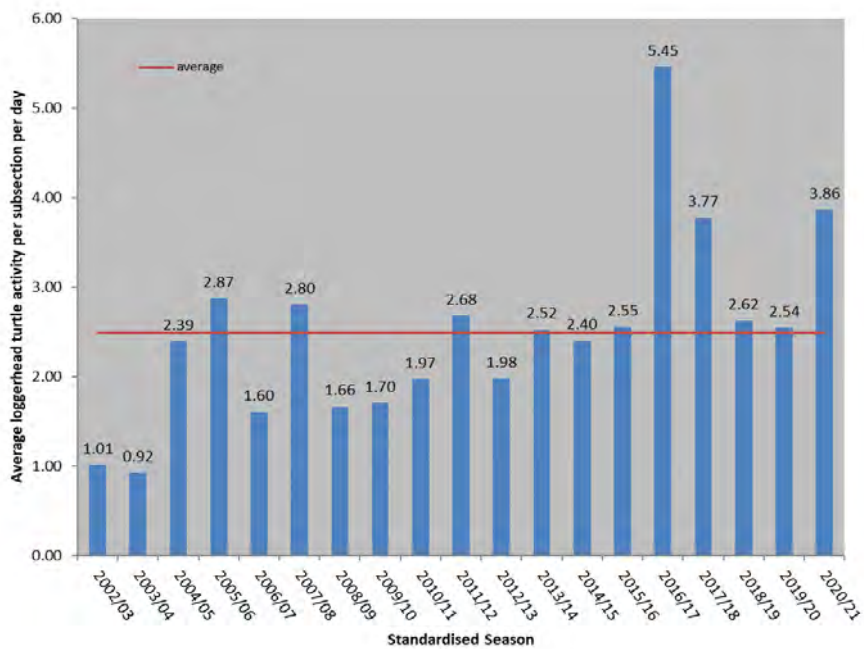


Figure 16: Loggerhead activity (false crawls and nests) for each season standardised by survey effort during the intensive peak monitoring period (NW Cape and Cape Range divisions).

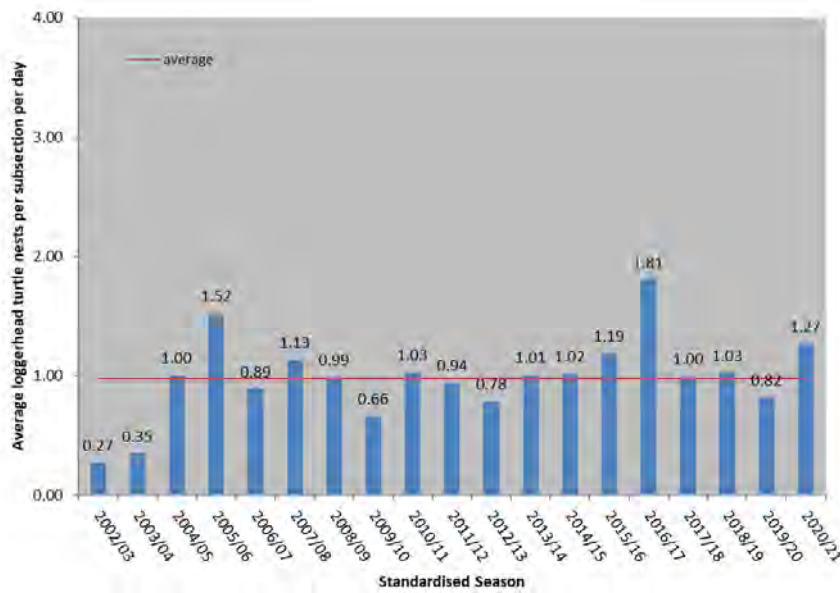


Figure 17: Loggerhead nests for each season standardised by survey effort during the intensive peak monitoring period (NW Cape and Cape Range divisions).

Hawksbill turtles

Hawksbill turtle activity remains relatively low on the North West Cape and Bungelup coastlines compared to activity by green and loggerhead turtles. The standardised level of hawksbill turtle activity during the 2020-21 season was below average in comparison to other seasons (Figure 18). Nesting was the equal lowest since the program began (Figure 19).

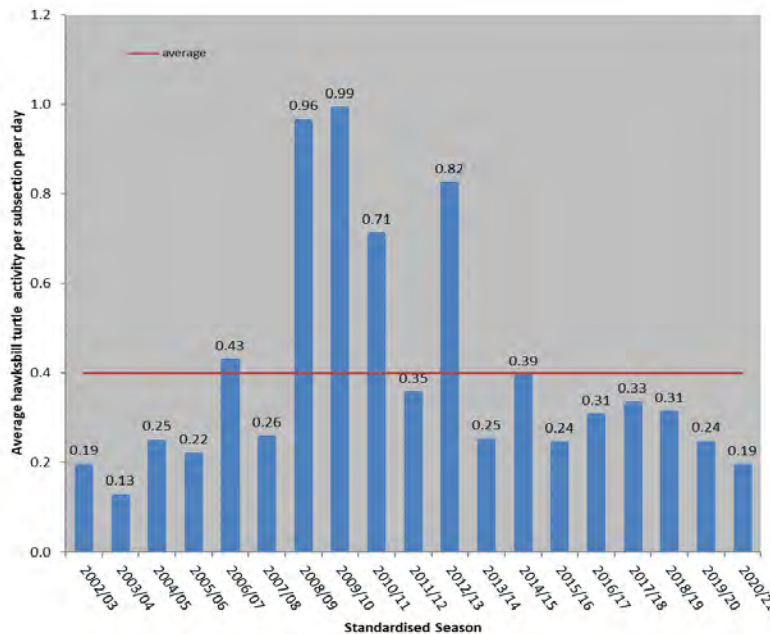


Figure 18: Hawksbill activity (false crawls and nests) for each season standardised by survey effort during the intensive peak monitoring period (NW Cape and Cape Range divisions).

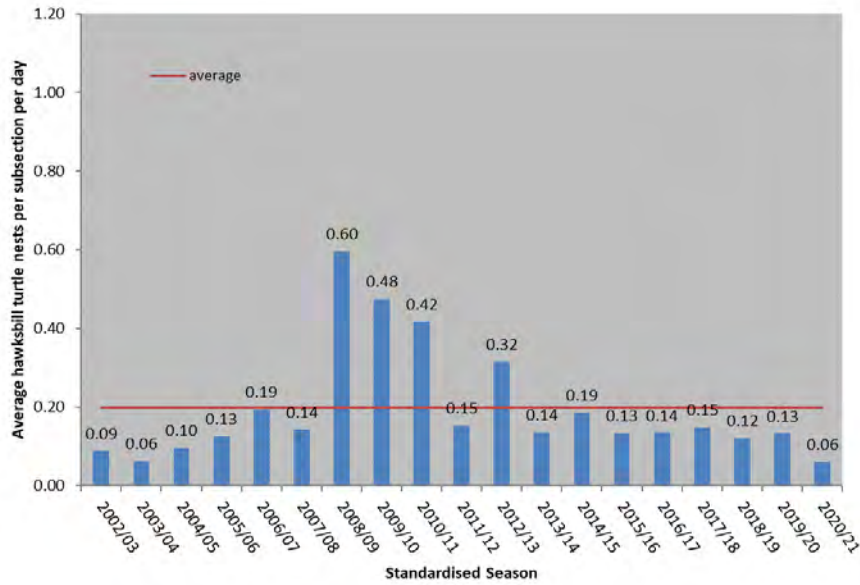


Figure 19: Hawksbill nests for each season standardised by survey effort during the intensive peak monitoring period (NW Cape and Cape Range divisions).

3.4 Nesting success

Nesting success is defined as the number of suspected nests laid as a percentage of total turtle activities.

3.4.1 NW Cape and Cape Range

Average nesting success for turtles has varied among years for all species (Figure 20, Figure 21 and Figure 22).

Patterns of nesting success of the three species in general have fluctuated in synchrony among seasons (Whiting 2016), as shown in long-term patterns of standardised seasons below. In general, when nesting success peaked for green turtles, it also peaked for loggerhead and hawksbill turtles. When nesting success declined for green turtles, it was also lower for loggerhead and hawksbill turtles. In the 2020-21 intensive peak season, nest success was well below average for all three species.

Green turtles

Nesting success for green turtles has generally been lower than for loggerhead and hawksbill turtles. Nesting success of 16.9% in the 2020-21 standardised season was the lowest since the program began compared to a maximum of 37.3% in the 2008-09 season with a long-term average of 26.9% (Figure 20). The previous lowest nesting success was in 2011-12 which was a clear peak in activity and nesting.

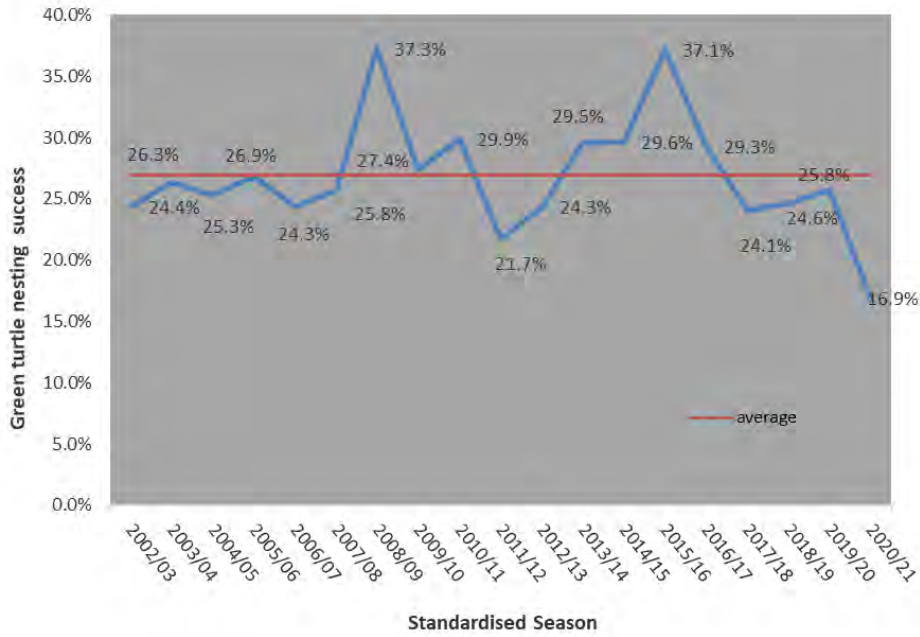


Figure 20: Nesting success (%) for green turtles averaged across the intensive peak monitoring periods each season.

Loggerhead turtles

Nesting success for loggerhead turtles has ranged from a maximum of 59.5% in 2008-09 to a minimum of 26.5% in 2017-18 (Figure 21). Nesting success of 32.9% in the 2020-21 standardised season was lower than average (40.7%).

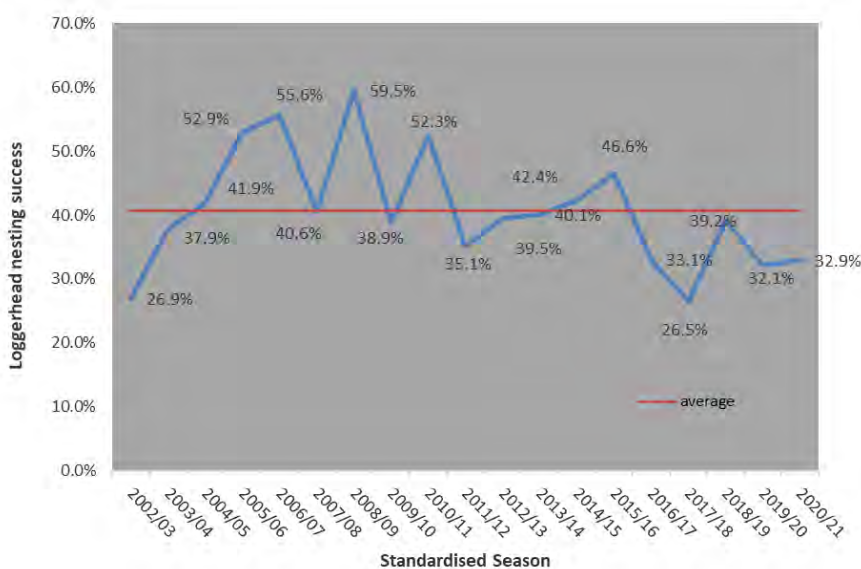


Figure 21: Nesting success (%) for loggerhead turtles during the intensive peak monitoring period each season.

Hawksbill turtles

Hawksbill turtles have generally had the highest nesting success of the three species. Nesting success of 31.9% in the 2020-21 standardised season was the lowest since the program began compared to a maximum of 61.9% in 2008-09 with a long-term average of 48.1% (Figure 22).

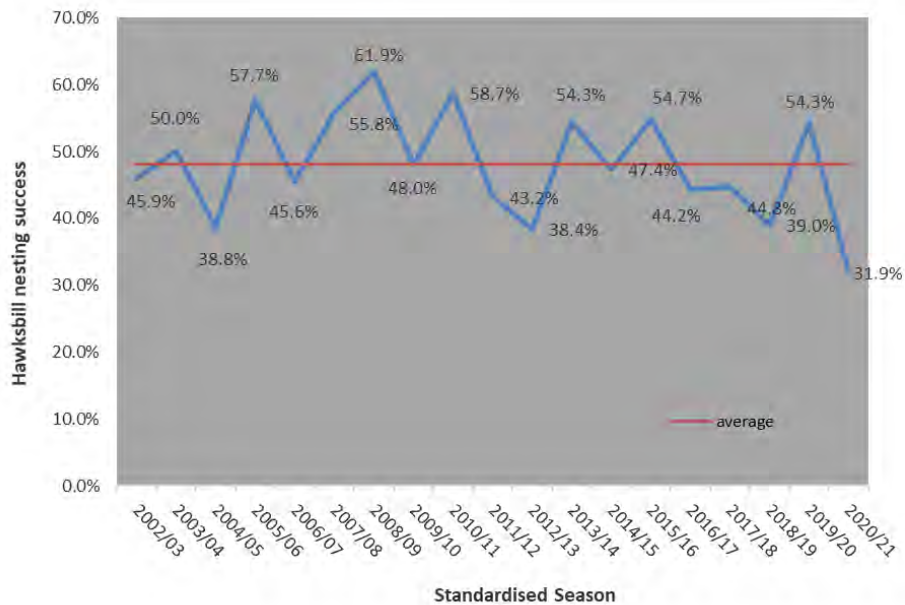


Figure 22: Nesting success (%) for hawksbill turtles during the intensive peak monitoring periods each season.

3.4.2 Ningaloo division (Janes Bay and Whaleback Beach)

Green turtles had a nesting success of 20.4%, which is similar to the lower nesting success at the NW Cape and Cape Range divisions for this season (16.9%). It should be noted that these estimates of nesting success are based on a relatively small sample size (Table 5) and should be interpreted with caution.

Loggerheads had a higher success rate in the Ningaloo division (41.9%) compared to the NW Cape and Cape Range divisions (32.9%) however this is very close to the long-term average of 40.7%.

The number of hawksbill turtle activities was too small in the Ningaloo division to estimate a meaningful nesting success (1 false crawl and no nests).

3.5 Nest damage and predation

Twenty four nests were recorded with damage in the 2020-21 full season in the NW Cape and Cape Range divisions (equating to 0.43% of total recorded nests)³. 23 of these nests were in the North West Cape division and 1 within the Cape Range division. Damage to fourteen nests was attributed to ghost crabs, 4 to turtles excavating other turtles' nests, 1 to a goanna, and 1 to the tide. Four nests were damaged by either a dingo or an introduced predator (possibly a dog other than a dingo)⁴.

In the Ningaloo division, one nest was recorded as being damaged and having signs of predation (cause unknown).

Parks and Wildlife have recorded a reduction in predation of nests by introduced predators in recent years coinciding with a rigorous introduced predator control program including aerial and ground baiting and trapping (Figure 23).

3.5.1 Presence of introduced species

Dogs and foxes are known to dig up turtle nests and eat the eggs. While feral cats can prey upon turtle hatchlings, they have not been observed nor are suspected to dig up nests (Lucy Clausen, 2019, *pers. comm*). NTP volunteers record the presence of prints and tracks from introduced species and dingos to help inform targeted management.

In 2020-21, volunteers recorded the tracks of dogs in all 11 subsections in NW Cape division, 2 of 3 subsections in the Cape Range division, and 1 of 4 subsections in the Ningaloo division and tracks of cats in 1 of the 11 subsections in NW Cape division, 2 of 3 subsections in the Cape Range division and 3 of 4 subsections in the Ningaloo division. No fox tracks were observed.

³ Only new nests (i.e., on first day of incubation period) are methodically checked for signs of disturbance. Damage to old nests (i.e., after the first day of the incubation period until hatching) is only recorded opportunistically if it is encountered whilst monitoring new nests. Therefore, it is likely that incidences of damaged nests go undetected.

⁴ The term 'dog' used throughout this report refers to wild dog, domestic dog or dingo as species cannot be differentiated from prints. A wild or domestic dog is considered an introduced species whereas a dingo is not.

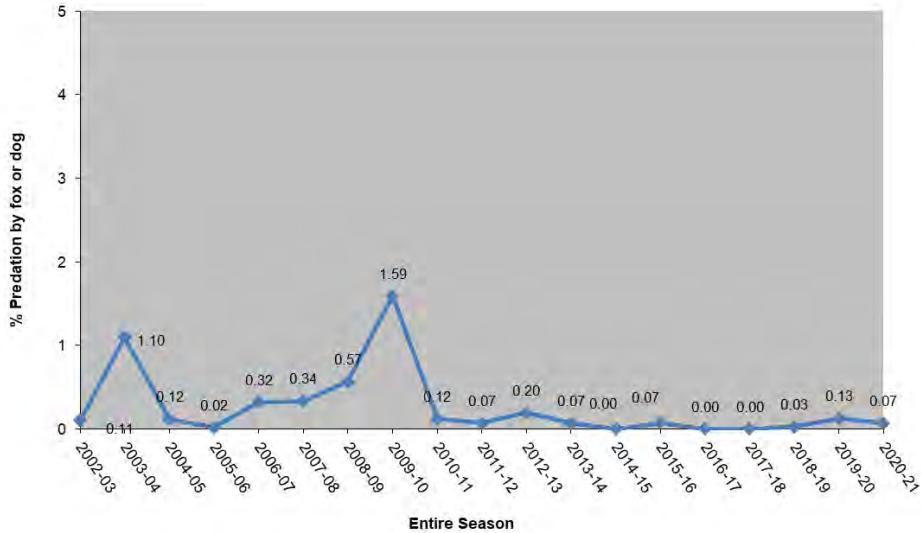


Figure 23: Percentage of new nests damaged by fox or dog per season, NW Cape and Cape Range divisions.

3.6 Other observations and data

3.6.1 Turtle mortalities

Turtle mortalities have been recorded as part of NTP since 2007-08 (Figure 24). Twenty two dead turtles were recorded by NTP volunteers during the 2020-21 season in the NW Cape and Cape Range divisions. A further 5 dead turtles were recorded in the Ningaloo division (Janes Bay and Whaleback Beach subsections).

Turtle mortalities have fluctuated greatly over the seasons, with the highest number recorded in 2011-12, which coincides with the high level of turtle activity. Mortalities recorded by Parks and Wildlife staff outside of the NTP season, or on beaches not monitored as part of NTP are not reported here.

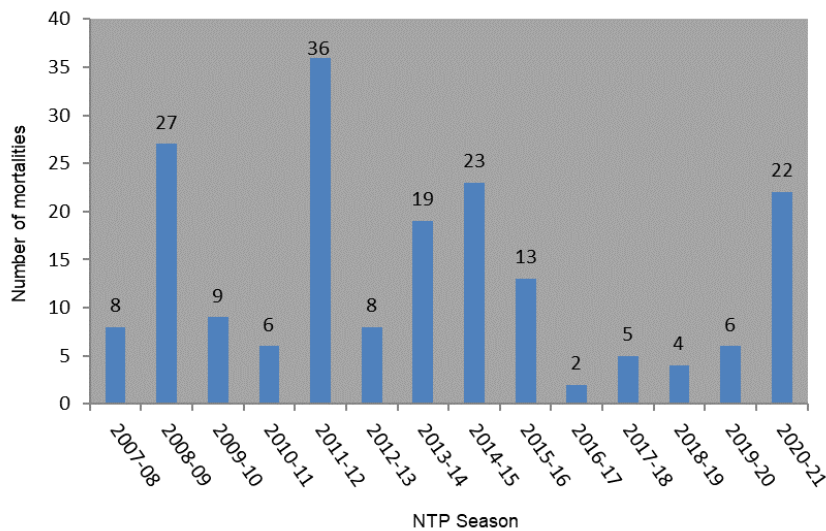


Figure 24: Turtle mortalities recorded during the NTP per season, from NW Cape and Cape Range divisions.

3.6.2 Rescues of stranded turtles

Forty nine turtles were rescued during the 2020-21 season by NTP volunteers and staff, all in the NW Cape division. Due to the high levels of activity observed throughout the season, the NTP trialled a dedicated daily ‘rescue squad’ for the two weeks immediately after the intensive peak monitoring period concluded. This involved teams of 2 local NTP volunteers visiting the beaches that typically had stranded turtles due to exposed rock shelves (Baudin, Trisel, Graveyards) early each morning to walk the sections and check for stranded turtles. They could rescue the turtles as appropriate or call Parks and Wildlife to assist if required. 19 of the 49 rescues were during this period.

At least 330 stranded marine turtles, mainly of nesting age, have been rescued since the program began in 2002-03. The number of turtles rescued has varied among seasons and rescues done outside of the NTP monitoring period are not reported here. For example, while patrolling remote beaches, Parks and Wildlife staff routinely “flip” stranded turtles that have been turned over by the waves on the shoreline.

Data collected by NTP over recent years have identified a regular location of turtle strandings at Trisel beach, which has resulted in turtle mortalities. In 2020-21 Parks and Wildlife trialled the use of water-filled road barriers to divert turtles away from an exposed rock shelf, see Appendix 12.

3.6.3 Re-sightings of flipper tagged turtles

Ten flipper-tagged turtles were re-sighted during the 2020-21 season by NTP volunteers (Table 6). Four of these were tagged in 1988, a resighting interval of 32 years.

Table 6: Re-sightings during NTP 2020-21 season of tagged turtles.

Tag	Species	Gender	Year tagged	Location tagged	CCL when tagged	Date resighted	Location resighted	CCL when resighted
WA9978 (left) WA9979 (right)	Green	F	29/11/1988	Trisel	900 mm	28/11/2020	Five mile	-
WA28587 (right)	Green	F	13/01/1996	Baudin	1015 mm	4/12/2020	Mauritius	-
WA21309 (right)	Green	F	11/01/1993	Trisel	935 mm	14/12/2020	Five mile	-
WA9789 (left)	Green	F	27/11/1988	Trisel	970 mm	18/12/2020	Trisel	990 mm
WA15968 (left)	Green	F	12/12/1991	Baudin	990 mm	18/12/2020	Trisel	-
WA7462 (left) WA7463 (right)	Green	F	19/11/1988	Trisel	920 mm	21/12/2020	Five mile	-
WA15799 (right)	Green	F	1/12/1991	Jacobsz	1005 mm	24/12/2020	Jacobsz Sth	-
WA7147 (left)	Green	F	28/11/1988	Trisel	990 mm	29/12/2020	Five mile	-
WA15664 (right)	Green	F	29/11/1991	Baudin	970 mm	10/01/2021	Brooke	-
WA16003 (left)	Green	F	27/11/1991	Baudin	1000 mm	18/01/2021	Baudin	-

3.6.4 Weather events

Beaches surveyed in the Ningaloo Turtle Program are susceptible to seasonal weather events such as cyclones, storm surges and flooding. These can significantly affect turtle nests and available nesting habitat and the program's ability to monitor. During the 2020-21 season there were no significant weather events and no disturbance to monitoring.

4.0 ACKNOWLEDGEMENTS

The NTP is conducted on the traditional lands of the Baiyungu, Thalanyji and Yinikurtura People. We recognise their traditional custodial role and continued support for turtle conservation. *Bujurrba nhuna majunjarri nyinggulubarndi* – looking after turtles in Nyinggulu.

Thank you to the local NTP volunteers from the Exmouth community, the external volunteers recruited nationally and internationally and the team leaders and media intern. The program would not be able to function without the significant contribution of time, effort, passion and enthusiasm that these volunteers contribute.

Thanks to the Cape Conservation Group Inc. for their partnership, passion and support for the program, and Roland Mau, Susie Bedford and David Waayers, for the development and implementation of the original 2001-2002 NTP pilot program.

Thank you to Woodside Energy Ltd for the ongoing funding contribution to the operational costs of the Ningaloo Turtle Program.

5.0 REFERENCES

- Coote C, Markovina K, Prophet M, Smallwood C, Whiting A (2013) Ningaloo Turtle Program Annual Report 2012-2013. Department of Environment and Conservation and the Ningaloo Turtle Program, Exmouth, Western Australia.
http://www.ningalooturtles.org.au/pdf_downloads/reports-publications/2012-13_NTP_Annual_Report.pdf.
- 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.
- Hattingh K, Bosshard S, Concannon T, DeSerisy T, Shipp H, and Soulsby M (2018) Gnaraloo Turtle Conservation Program. Gnaraloo Bay Rookery and Gnaraloo Cape Farquhar Rookery, Report 2008 - 2018. Gnaraloo Wilderness Foundation, Western Australia, www.gnaraloo.org
- Limpus C (2009) A biological review of Australian marine turtle species. 1. Loggerhead turtle, *Caretta caretta* (Linnaeus). The State of Queensland. Environmental Protection Agency 2008.
- Markovina K and Valentine C (2015) Predation on Green Turtle Nests: North West Cape. Ningaloo Turtle Program 2014-15. Ningaloo Turtle Program,
http://www.ningalooturtles.org.au/pdf_downloads/reports-publications/Green-Turtle-Nest-Predation-Report_2014-15.pdf
- McKinna S, Mau R, Bedford S, Reinhold L, Trinnie F, Carter R, McGrath K, Richards A, Ferrari, S, Samson C, Simpson T, Markovina K (2015) Turtle Monitoring Field Guide: Edition 7. Cape Conservation Group and Department of Parks and Wildlife.
<http://www.ningalooturtles.org.au/training.html>
- Whiting AU (2008) Consolidation of the Ningaloo Turtle Program: Development of a statistically robust and cost efficient survey design. Report to the Ningaloo Turtle Program.
- Whiting AU (2010) Sampling efficiency for monitoring nesting sea turtle populations. PhD Thesis, Charles Darwin University, Darwin NT.
- Whiting AU (2016) Estimating abundance and detecting trends for green, loggerhead and hawksbill turtles nesting within the Ningaloo region: 2013-14 to 2015-16 seasons. Report to the Ningaloo Turtle Program.
- Whiting AU (2018) Gnaraloo Bay & Cape Farquhar Turtle Monitoring – Advice on survey design for long-term monitoring. Unpublished report to DBCA.

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6.0 APPENDICES

Appendix 1: Survey effort and summaries of turtle activity

Survey effort* 2002/03 – 2020/21 entire season (all data and subsections)

Full 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	2017/18	2018/19	2019/20	2020/21	TOTAL	
Survey Dates for entire season		18/11/02-16/04/03	11/11/03-30/03/04	3/11/04-18/03/05	21/11/05-28/02/06	1/12/06-28/02/07	1/12/07-28/02/08	7/12/08-1/03/09	7/11/09 - 27/03/10	6/11/10-27/03/11	12/11/11-11/03/12	10/11/12-10/03/13	28/10/13 - 2/3/14	3/11/14 - 1/3/15	31/10/15 - 7/03/16	27/10/16 - 26/02/2017	11/11/17-2/03/18	10/11/18-24/02/2019	9/11/2019 - 23/02/2020	7/11/2020 - 28/02/2021		
Survey Effort																						
Division	Section																					
North West Cape	Graveyards	165	375	374	368	341	336	234	160	153	144	162	172	185	193	174	171	154	154	156	4171	
	Hunters	248	263	271	271	256	252	173	117	114	109	111	117	120	123	111	121	116	117	116	3126	
	Lighthouse Bay	127	137	215	260	222	251	147	83	93	97	106	113	113	119	106	100	115	115	117	2636	
	Navy Pier	-	86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	86
	Tantabiddi	115	3	-	85	86	84	58	38	37	36	41	38	43	41	39	41	39	39	39	39	902
Cape Range	Bloodwood	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
	Bungelup	1	49	152	114	120	140	124	72	87	91	78	114	91	85	82	81	81	80	79	1721	
	Turquoise Bay	-	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16
	Boat Harbour	-	-	203	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	203
Bundera/Ningaloo	Carbaddaman	7	-	204	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	211
	Janes Bay	13	24	12	29	22	4	-	-	-	-	-	-	-	-	-	-	-	51	51	48	254
	Norwegian Bay	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
	Whaleback Beach	-	7	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17	17	16	65
Coral Bay	Batemans Bay	103	100	117	51	76	47	34	-	-	-	-	-	-	-	-	-	-	-	-	-	528
	Lagoon	103	100	116	51	76	47	34	-	-	-	-	-	-	-	-	-	-	-	-	-	527
	Turtle Beach	56	100	66	49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	271
Gnaraloo	Gnaraloo Bay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17	17	-	-	34
Total survey effort		940	1265	1738	1278	1199	1161	804	470	484	477	498	554	552	561	512	514	590	590	571	14758	
Number subsections monitored		22	29	28	20	19	19	18	14	14	14	14	14	14	14	14	14	21	21	18	341	

* Survey effort is defined as the number of times each subsection was monitored. These are totalled for each section.

Turtle activity 2002/03 – 2020/21 entire season (all data and subsections)

Full 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	2017/18	2018/19	2019/20	2020/21	TOTAL or AVERAGE
Survey Dates for entire season	18/11/02-16/04/03	11/11/03-30/03/04	3/11/04-18/03/05	21/11/05-28/02/06	1/12/06-28/02/07	1/12/07-28/02/08	7/12/08-1/03/09	7/11/09 - 27/03/10	6/11/10-27/03/11	12/11/11 - 11/03/12	10/11/12-10/03/13	28/10/13 - 2/3/14	3/11/14 - 1/3/15	31/10/15 - 7/03/16	27/10/16 - 26/02/2017	11/11/17-2/03/18	10/11/18-24/02/2019	9/11/2019 - 23/02/2020	7/11/2020 - 28/02/2021	
Green nests	1539	1552	788	4695	4349	5254	6297	571	2732	6594	585	2276	628	759	1856	2518	2733	1184	5212	52122
Green false crawls	5404	3086	2533	9948	14395	13156	12608	1451	6507	22865	1769	4960	1465	1357	4243	7306	8082	3216	23945	148296
Green activity	6943	4638	3321	14643	18744	18410	18905	2022	9239	29459	2354	7236	2093	2116	6099	9824	10815	4400	29157	200418
Green activity adjusted by survey effort per day	7.39	3.67	1.91	11.46	15.63	15.86	23.51	4.30	19.09	61.76	4.73	13.06	3.79	3.77	11.91	19.11	18.33	7.46	51.06	15.67
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%	25.6%	25.3%	26.9%	17.9%	27.6%
Hawksbill nests	48	81	100	108	157	156	336	202	189	65	125	69	91	75	67	70	63	74	28	2104
Hawksbill false crawls	49	60	139	71	153	145	207	202	132	84	192	51	108	65	89	99	104	60	64	2074
Hawksbill activity	97	141	239	179	310	301	543	404	321	149	317	120	199	140	156	169	167	134	92	4178
Hawksbill activity adjusted by survey effort per day	0.10	0.11	0.14	0.14	0.26	0.26	0.68	0.86	0.66	0.31	0.64	0.22	0.36	0.25	0.30	0.33	0.28	0.23	0.16	0.33
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%	41.4%	37.7%	55.2%	30.4%	48.9%
Loggerhead nests	288	387	777	1068	540	795	580	288	405	382	304	430	436	519	696	392	481	379	540	9687
Loggerhead false crawls	429	359	1040	925	477	954	486	471	388	715	466	595	580	583	1395	1086	730	725	1065	13469
Loggerhead activity	717	746	1817	1993	1017	1749	1066	759	793	1097	770	1025	1016	1102	2091	1478	1211	1104	1605	23156
Loggerhead activity adjusted by survey effort per day	0.76	0.59	1.05	1.56	0.85	1.51	1.33	1.61	1.64	2.30	1.55	1.85	1.84	1.96	4.08	2.88	2.05	1.87	2.81	1.79
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%	26.5%	39.7%	34.3%	33.6%	42.3%
Unidentified nests	29	123	59	42	33	61	38	8	18	7	7	20	19	4	7	6	12	8	28	529
Unidentified false crawls	44	20	82	45	19	29	12	8	9	4	12	17	14	3	3	7	17	14	56	415
Unidentified activity	73	143	141	87	52	90	50	16	27	11	19	37	33	7	10	13	29	22	84	944
Total all species nests	1904	2143	1724	5913	5079	6266	7251	1069	3344	7048	1021	2795	1174	1357	2626	2986	3289	1645	5808	64442
Total new nests (all three species) adjusted by survey effort per day	2.03	1.69	0.99	4.63	4.40	5.40	9.02	2.27	6.91	14.78	2.05	5.05	2.13	2.42	5.13	5.81	5.57	2.79	10.17	4.91
Total all species false crawl	5926	3525	3794	10989	15044	14284	13313	2132	7036	23668	2439	5623	2167	2008	5730	8498	8933	4015	25130	164254
Total activity	7830	5668	5518	16902	20123	20550	20564	3201	10380	30716	3460	8418	3341	3365	8356	11484	12222	5660	30938	228696
Total turtle activity adjusted by survey effort	8.3	4.5	3.2	13.2	16.9	17.7	25.6	5.4	21.4	64.4	7.0	15.2	6.1	6.0	16.3	22.3	20.7	9.6	54.2	

Survey effort* 2002/03 – 2020/21 standardised season

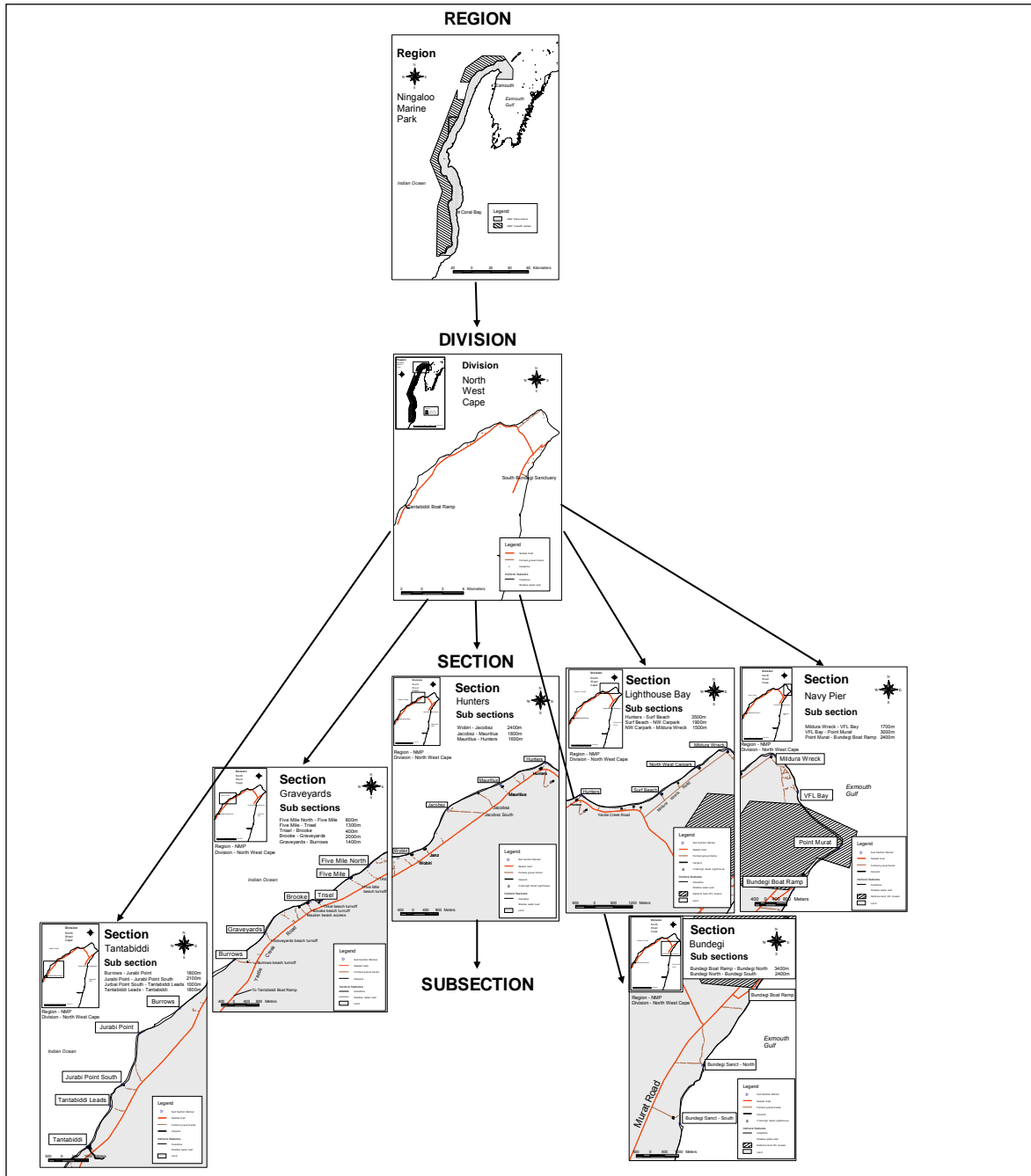
Standardised season		2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	TOTAL	
Survey Dates intensive peak period monitoring dates		16/12/02-12/01/03	15/12/03-11/01/04	20/12/04-16/01/05	19/12/05-15/01/06	18/12/06-14/01/07	17/12/07-13/01/08	15/12/08-11/01/09	14/12/09-10/01/10	20/12/10-16/01/11	19/12/11-15/01/12	17/12/12-11/01/13	16/12/13-12/01/14	15/12/14-11/1/15	14/12/15-10/1/16	12/12/16-8/1/17	18/12/17-14/01/18	17/12/18-13/01/19	16/12/19-12/01/20	17/12/20-13/01/21		
Survey Effort																						
Division	Section																					
North West Cape	Graveyards	57	100	112	107	100	100	96	70	108	112	104	108	112	112	107	108	108	107	107	1935	
	Hunters	72	78	84	81	75	75	72	50	81	84	78	81	84	84	78	81	81	81	81	80	1480
	Lighthouse Bay	53	34	56	77	75	75	72	39	77	84	78	81	84	83	78	80	81	81	81	81	1369
	Tantabiddi	9	-	-	27	25	25	24	17	27	28	26	27	28	28	28	27	27	27	27	27	427
Cape Range	Bungelup	0	11	71	66	69	60	60	30	79	84	75	78	84	82	79	80	81	80	79	1248	
Total survey effort*		191	223	323	358	344	335	324	206	372	392	361	375	392	389	370	376	378	376	374	6459	
Number subsections monitored		11	12	12	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14		

* Survey effort is defined as the number of times each subsection was monitored. These are totalled for each section.

Turtle activity 2002/03 – 2019/20 standardised season

Standardised 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	2017/18	2018/19	2019/20	2020/21	TOTAL or AVERAGE
Survey Dates intensive peak period monitoring dates	16/12/02-12/01/03	15/12/03-11/01/04	20/12/04-16/01/05	19/12/05-15/01/06	18/12/06-14/01/07	17/12/07-13/01/08	15/12/08-11/01/09	14/12/09-10/01/10	20/12/10-16/01/11	19/12/11-15/01/12	17/12/12-11/01/13	16/12/13-12/01/14	15/12/14-11/01/15	14/12/15-10/01/16	12/12/16-8/01/17	18/12/17-14/01/18	17/12/18-13/01/19	16/12/19-12/01/20	17/12/20-13/01/21	
Green new nests	587	475	266	1548	1650	1721	3103	239	2270	5683	422	1714	459	554	1449	1919	2082	896	4452	31489
Green new nests adjusted by survey effort per day	3.07	2.13	0.82	4.32	4.80	5.14	9.58	1.16	6.10	14.50	1.17	4.57	1.17	1.42	3.92	5.10	5.51	2.38	11.90	4.70
Green false crawls	1821	1328	785	4217	5138	4959	5226	634	5322	20501	1314	4098	1092	939	3495	6051	6397	2582	21843	97742
Green activity	2408	1803	1051	5765	6788	6680	8329	873	7592	26184	1736	5812	1551	1493	4944	7970	8479	3478	26295	129231
Green activity adjusted by survey effort per day	12.61	8.09	3.25	16.10	19.73	19.94	25.71	4.24	20.41	66.80	4.81	15.50	3.96	3.84	13.36	21.20	22.43	9.25	70.31	19.00
Green nesting success %	24.4%	26.3%	25.3%	26.9%	24.3%	25.8%	37.3%	27.4%	29.9%	21.7%	24.3%	29.5%	29.6%	37.1%	29.3%	24.1%	24.6%	25.8%	16.9%	26.9%
Hawksbill new nests	17	14	31	45	67	48	193	98	155	60	114	51	73	52	50	56	46	50	23	1243
Hawksbill new nests adjusted by survey effort per day	0.09	0.06	0.10	0.13	0.19	0.14	0.60	0.48	0.42	0.15	0.32	0.14	0.19	0.13	0.14	0.15	0.12	0.13	0.06	0.20
Hawksbill false crawls	20	14	49	33	80	38	119	106	109	79	183	43	81	43	63	69	72	42	49	1292
Hawksbill activity	37	28	80	78	147	86	312	204	264	139	297	94	154	95	113	125	118	92	72	2535
Hawksbill activity adjusted by survey effort per day	0.19	0.13	0.25	0.22	0.43	0.26	0.96	0.99	0.71	0.35	0.82	0.25	0.39	0.24	0.31	0.33	0.31	0.24	0.19	0.40
Hawksbill nesting success	45.9%	50.0%	38.8%	57.7%	45.6%	55.8%	61.9%	48.0%	58.7%	43.2%	38.4%	54.3%	47.4%	54.7%	44.2%	44.8%	39.0%	54.3%	31.9%	48.1%
Loggerhead new nests	52	78	324	544	306	380	320	136	383	368	282	379	398	462	668	375	388	307	475	6625
Loggerhead new nests adjusted by survey effort per day	0.27	0.35	1.00	1.52	0.89	1.13	0.99	0.66	1.03	0.94	0.78	1.01	1.02	1.19	1.81	1.00	1.03	0.82	1.27	0.98
Loggerhead false crawls	141	128	449	484	244	557	218	214	349	681	432	566	541	530	1350	1042	603	649	969	10147
Loggerhead activity	193	206	773	1028	550	937	538	350	732	1049	714	945	939	992	2018	1417	991	956	1444	16772
Loggerhead activity adjusted by survey effort per day	1.01	0.92	2.39	2.87	1.60	2.80	1.66	1.70	1.97	2.68	1.98	2.52	2.40	2.55	5.45	3.77	2.62	2.54	3.86	2.49
Loggerhead nesting success	26.9%	37.9%	41.9%	52.9%	55.6%	40.6%	59.5%	38.9%	52.3%	35.1%	39.5%	40.1%	42.4%	46.6%	33.1%	26.5%	39.2%	32.1%	32.9%	40.7%
Unidentified new nests	1	10	14	21	13	17	21	3	15	3	6	16	19	4	6	5	7	5	18	204
Unidentified new nests adjusted by survey effort per day	0.01	0.04	0.04	0.06	0.04	0.05	0.06	0.01	0.04	0.01	0.02	0.04	0.05	0.01	0.02	0.01	0.02	0.01	0.05	0.03
Unidentified false crawls	2	7	36	18	9	12	7	3	9	4	9	17	11	1	3	4	4	11	39	206
Unidentified activity	3	17	50	39	22	29	28	6	24	7	15	33	30	5	9	9	11	16	57	410
Unidentified activity adjusted by survey effort per day	0.02	0.08	0.15	0.11	0.06	0.09	0.09	0.03	0.06	0.02	0.04	0.09	0.08	0.01	0.02	0.02	0.03	0.04	0.15	0.06
Flatback new nests	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	1	0	5
Flatback false crawls	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	4	1	1	7
Flatback activity	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	6	2	1	12
Flatback activity adjusted by survey effort	0	0	0	0	0	0	0.00	0	0	0	0.01	0	0	0	0	0	0.02	0.01	0.00	0.001
Flatback nesting success	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	100.0%	n/a	n/a	n/a	n/a	n/a	33.3%	50.0%	0.0%	45.8
Total new nests (all species)	657	577	635	2158	2036	2166	3637	476	2823	6114	826	2160	949	1072	2173	2355	2525	1259	4968	39566
Total new nests (all species) adjusted by survey effort per day	3.44	2.59	1.97	6.03	5.92	6.47	11.23	2.31	7.59	15.60	2.29	5.76	2.42	2.76	5.87	6.26	6.67	3.35	13.30	5.90
Total false crawls (all species)	1984	1477	1319	4752	5471	5566	5571	957	5789	21265	1938	4724	1725	1513	4911	7166	7080	3285	22901	109394
Total activity	2641	2054	1954	6910	7507	7732	9208	1433	8612	27379	2764	6884	2674	2585	7084	9521	9599	4542	27869	148960
Total turtle activity adjusted by survey effort	13.8	9.2	6.0	19.3	21.8	23.1	28.4	7.0	23.2	69.8	7.7	18.4	6.8	6.6	19.1	25.3	25.4	12.1	74.5	22.00

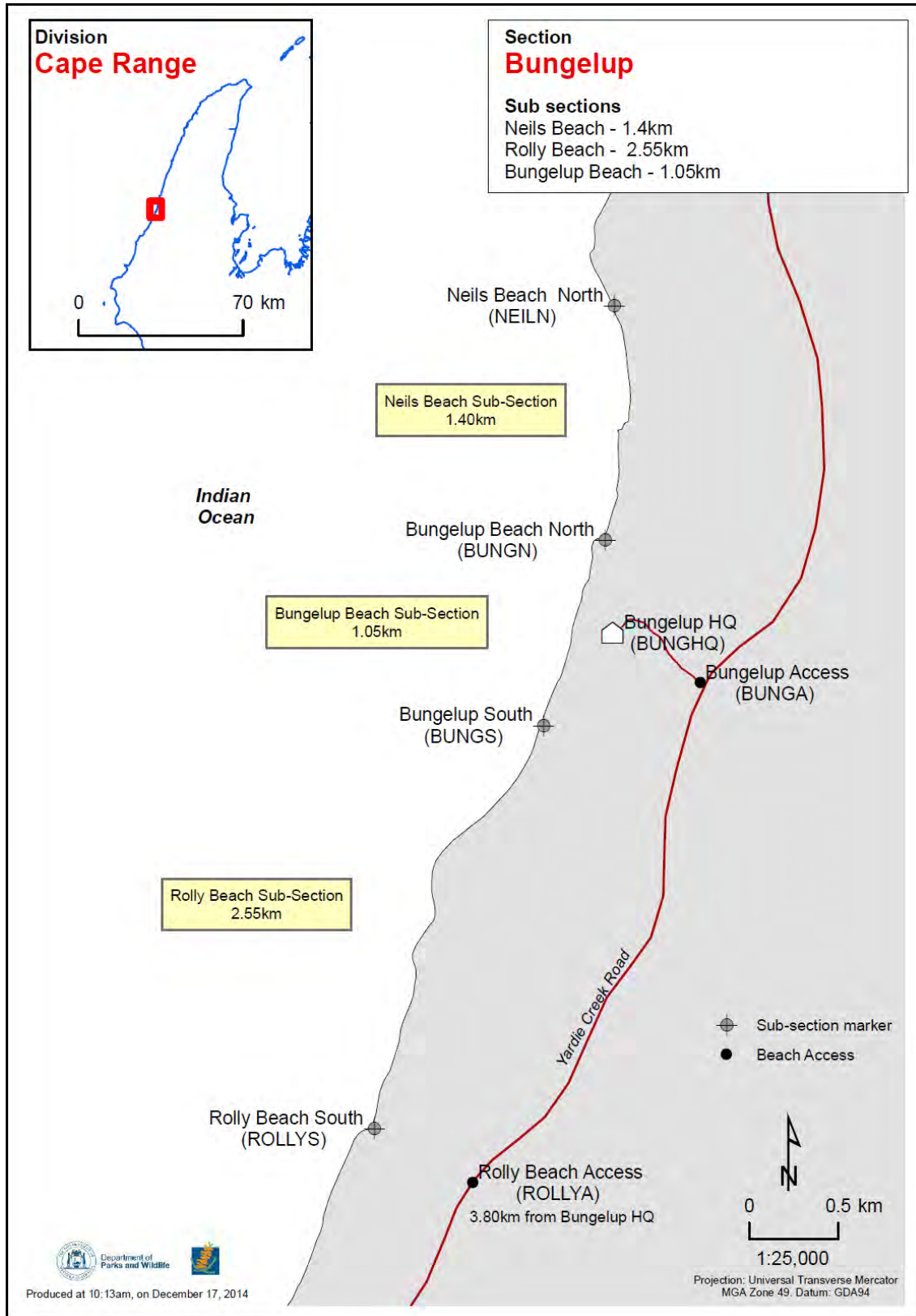
Appendix 2: Zoning and subsection details NW Cape division.



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

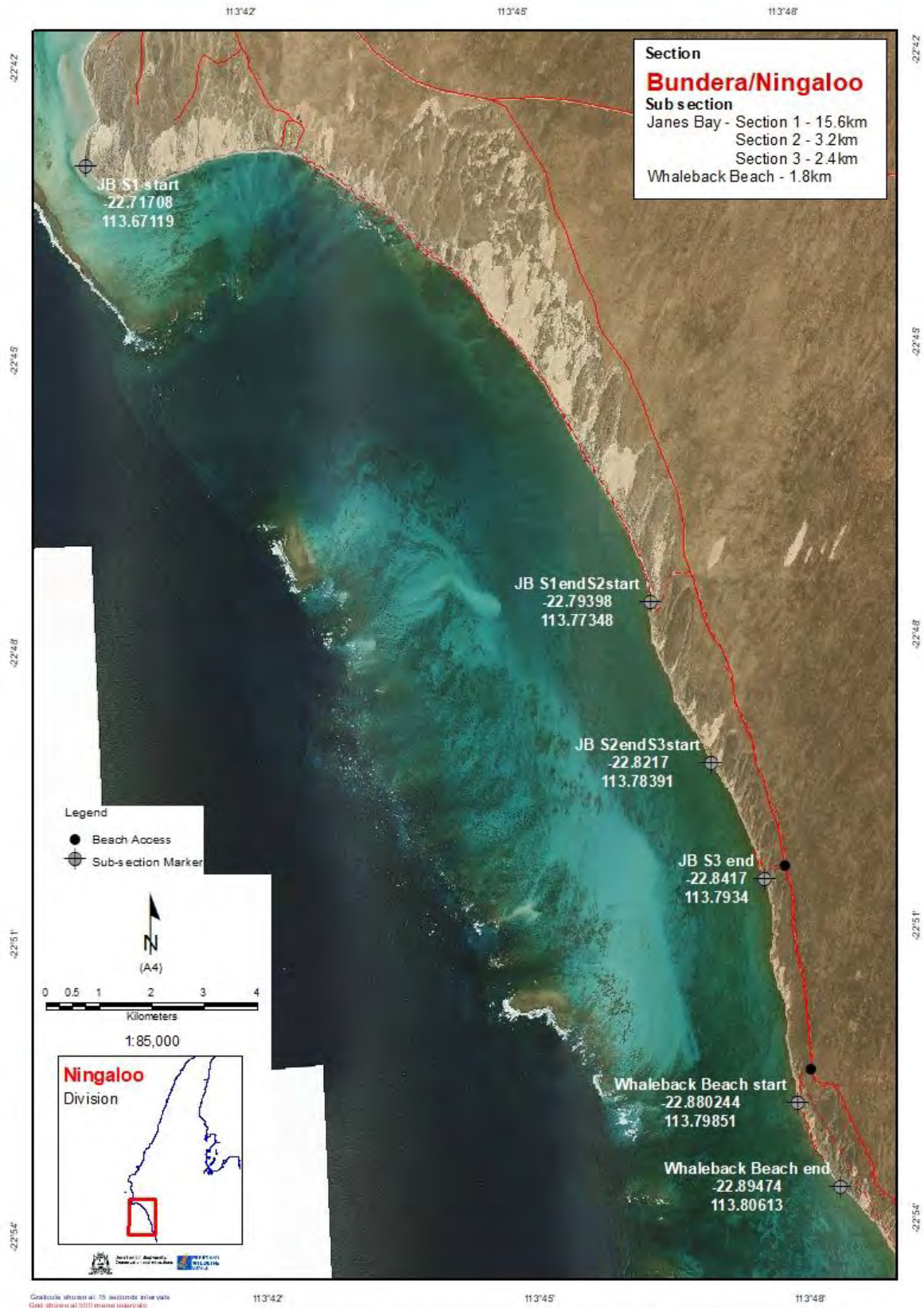
Appendix 3: Zoning and subsection details Cape Range division.



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	1050
Bungelup Beach South - Rolly Beach South	22.28613 S; 113.8292 E	22.30650 S; 113.82062 E	2550

Appendix 4: Zoning and subsection details Ningaloo division (Janes Bay and Whaleback sections)



Coordinates shown at 15 second intervals
 Grid shown at 300 metre intervals

113°42'

113°45'

113°48'

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Location and distance of each subsection within Janes Bay section.

Subsection	Location of northern totem	Location of southern totem	Distance (km)
Janes Bay subsection 1	22.71708 S; 113.67119 E	22.79398 S; 113.77348 E	15.6
Janes Bay subsection 2	22.79398 S; 113.77348 E	22.8217 S; 113.78391 E	3.2
Janes Bay subsection 3	22.8217 S; 113.78391 E	22.8417 S; 113.7934 E	2.4
Whaleback Beach	22.88024 S; 113.79851	22.89474 S; 113.80613 E	1.8

Appendix 5: Zoning and subsection details Gnarraloo division



Location and distance of each subsection within Gnarraloo division.

Subsection	Location of northern totem	Location of southern totem	Distance (km)
BP9 - BP8	23.72195 S; 113.5775 E	23.73631 S; 113.57448 E	3.2
BP8 - BP7	23.73631 S; 113.57448 E	23.75001 S; 113.56871 E	1.6
BP7 - GBN	23.75001 S; 113.56871 E	23.76708 S; 113.54584 E	1.8

Appendix 6: Lighthouse Bay section - New nests (NTP 2020-21) Map 1 & 2

Note: Locations of some nests in the figure may vary from actual locations due to occasional inaccuracies in the GPS. Inaccuracies are considered unlikely to affect illustrations of overall patterns of nesting across the section.



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**Ningaloo Turtle Program
2020-2021 (new nests)**

LIGHTHOUSE SECTION

Map 2 of 2

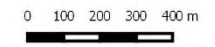
Legend

- Turtle Nests 2020 -2021
- Green
 - Hawksbill
 - Loggerhead
 - Unidentified
 - Flatback
- Turtle Monitoring Sections
- Access
 - Subsection location

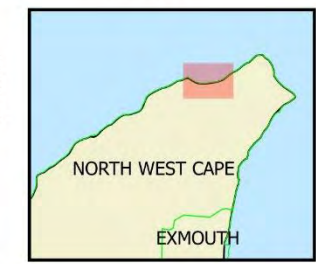


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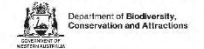
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Projection: MGA Zone 49
Datum: GDA94



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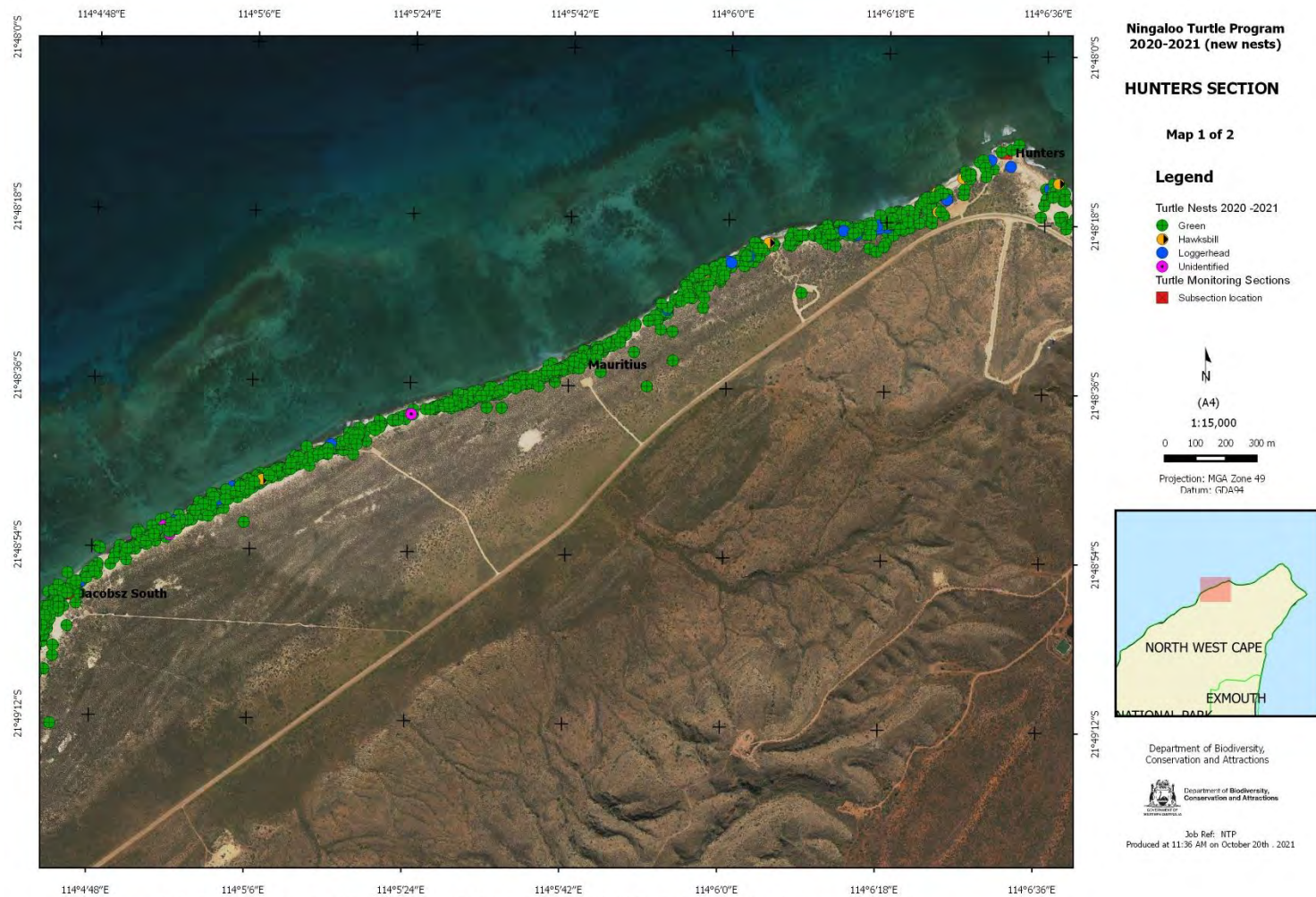
Job Ref: NTP
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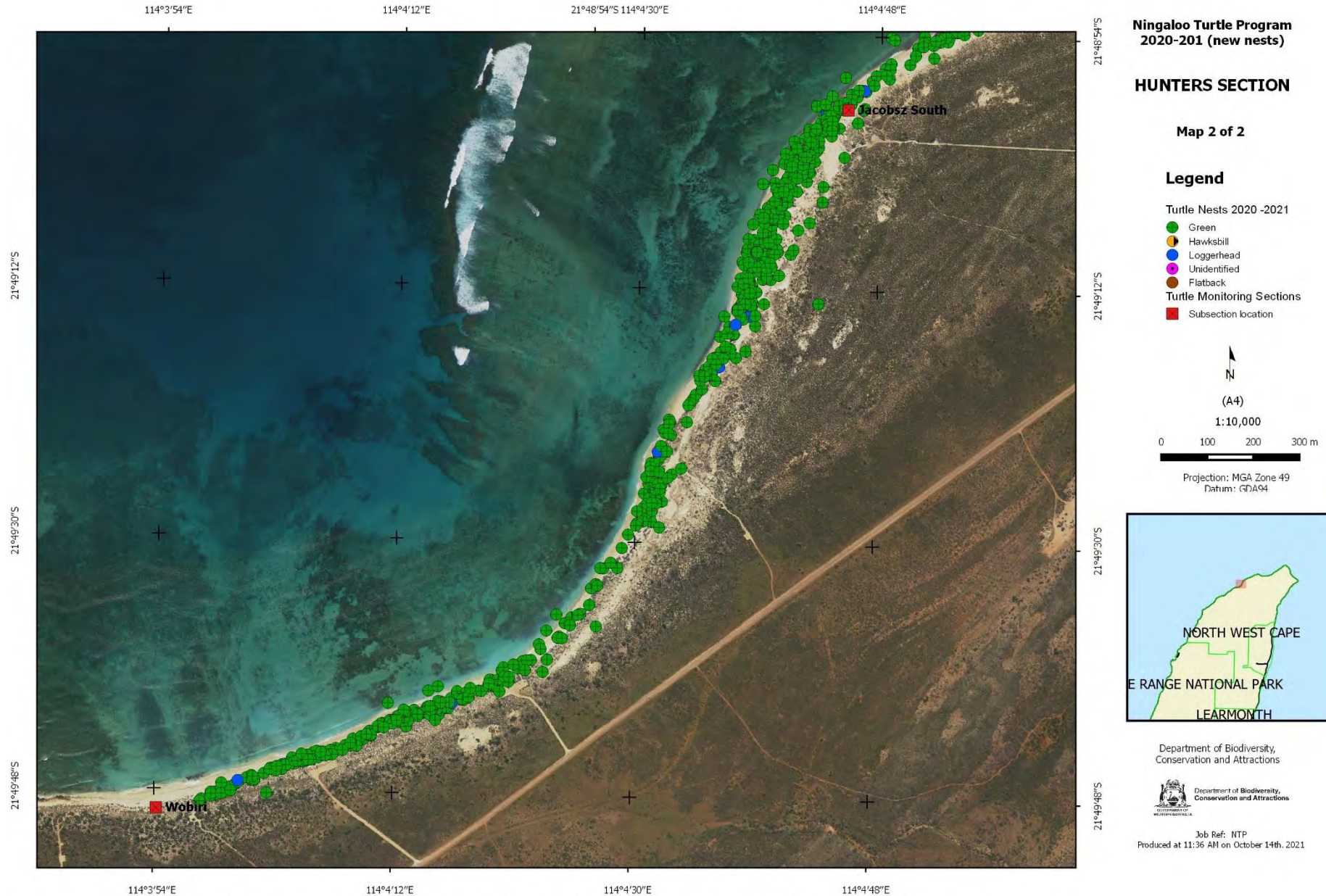
114°6'36"E 114°7'12"E 114°7'48"E 114°8'24"E

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Appendix 7: Hunters section - New nests (NTP 2020-21) Map 1 & 2

Note: Locations of some nests in the figure may vary from actual locations due to occasional inaccuracies in the GPS. Inaccuracies are considered unlikely to affect illustrations of overall patterns of nesting across the section.





**Ningaloo Turtle Program
2020-2021 (new nests)**

HUNTERS SECTION

Map 2 of 2

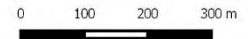
Legend

- Turtle Nests 2020 -2021**
- Green
 - Hawksbill
 - Loggerhead
 - Unidentified
 - Flatback
- Turtle Monitoring Sections**
- Subsection location



(A4)

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Projection: MGA Zone 49
Datum: GDA94



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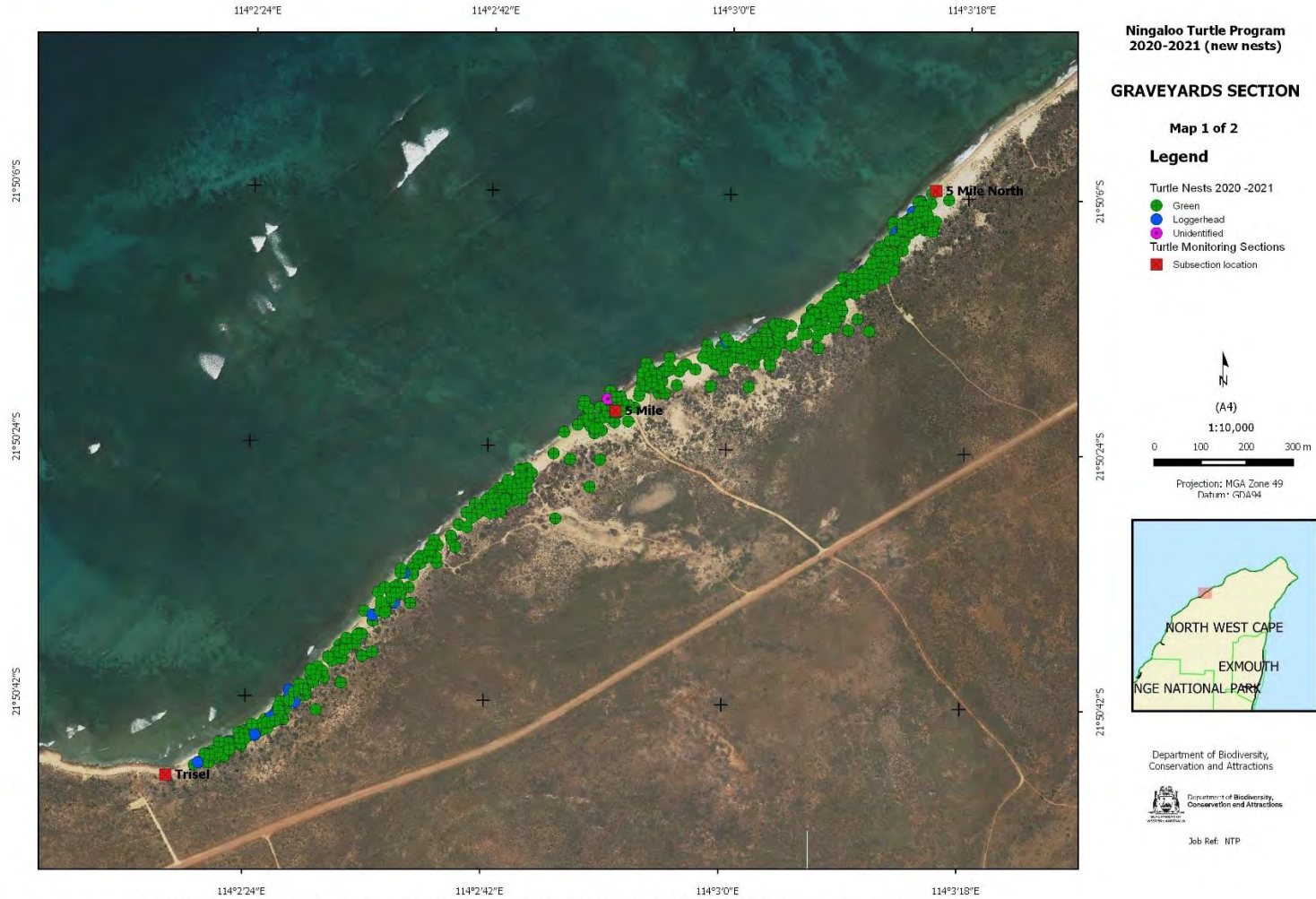


Job Ref: NTP
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Appendix 8: Graveyards section - New nests (NTP 2020-21) Map 1 & 2

Note: Locations of some nests in the figure may vary from actual locations due to occasional inaccuracies in the GPS. Inaccuracies are considered unlikely to affect illustrations of overall patterns of nesting across the section.



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**Ningaloo Turtle Program
2020-2021 (new nests)**

GRAVEYARDS SECTION

Map 2 of 2

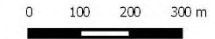
Legend

- Turtle Nests 2020 -2021
- Green
 - Hawksbill
 - Loggerhead
 - Unidentified
- Turtle Monitoring Sections
- Subsection location



(A4)

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Projection: MGA Zone 49
Datum: GDA94



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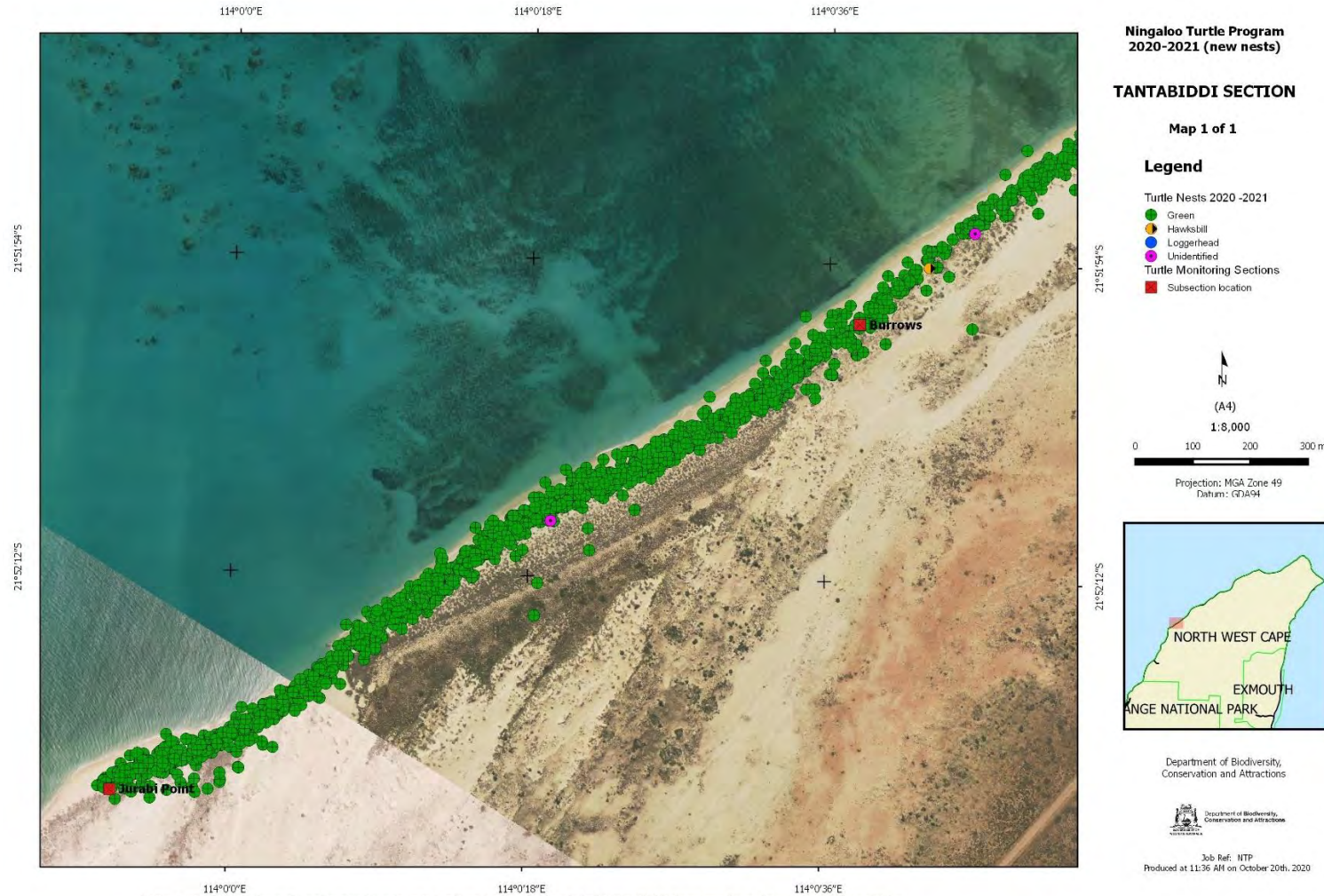


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Appendix 9: Tantabiddi section - New nests (NTP 2020-21) Map 1

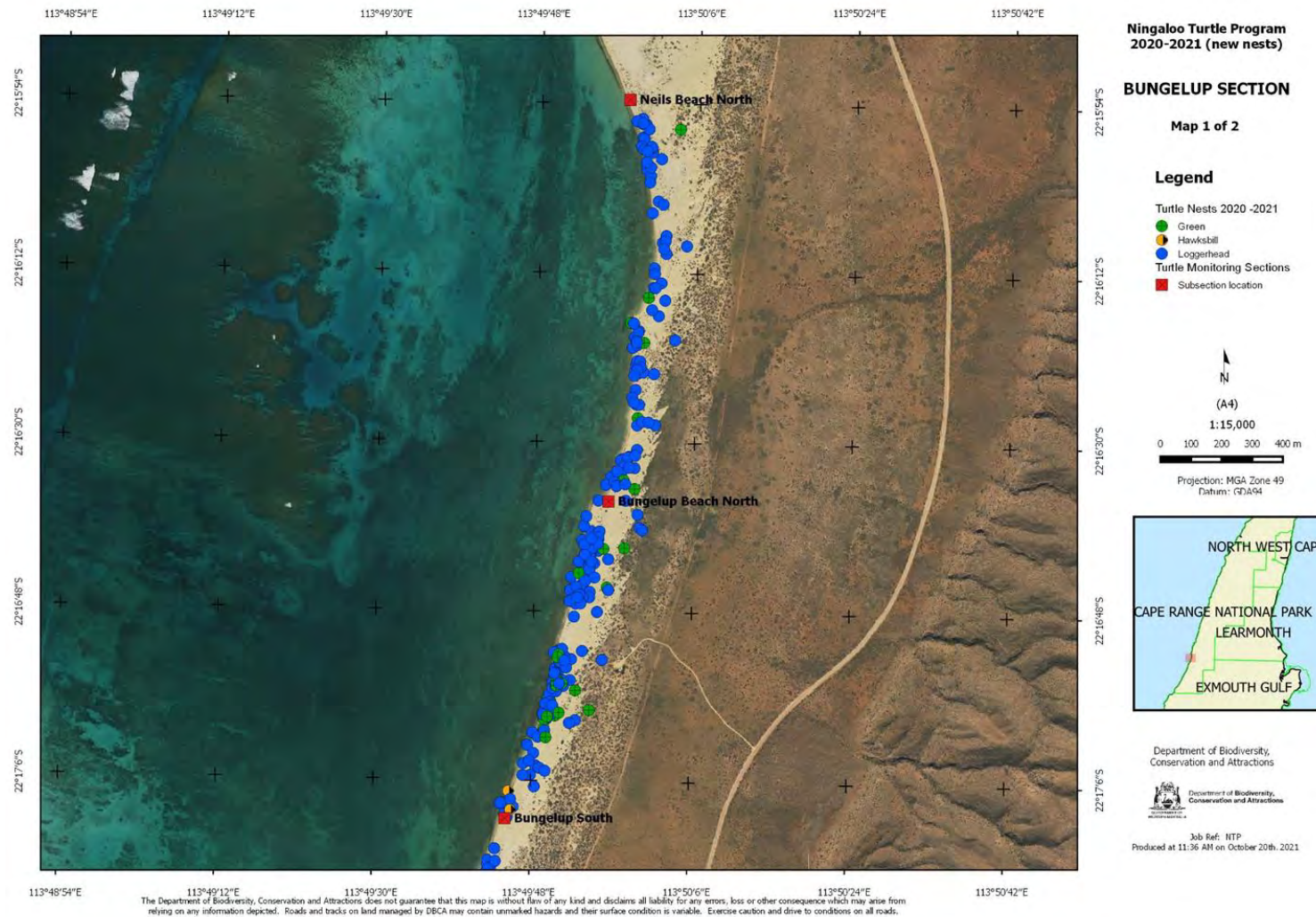
Note: Locations of some nests in the figure may vary from actual locations due to occasional inaccuracies in the GPS. Inaccuracies are considered unlikely to affect illustrations of overall patterns of nesting across the section.



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Appendix 10: Bungelup section - New nests (NTP 2020-21) Map 1 & 2

Note: Locations of some nests in the figure may vary from actual locations due to occasional inaccuracies in the GPS. Inaccuracies are considered unlikely to affect illustrations of overall patterns of nesting across the section.



**Ningaloo Turtle Program
2020-2021 (new nests)**

BUNGELUP SECTION

Map 2 of 2

Legend

Turtle Nests 2020 -2021

- Green
- Hawksbill
- Loggerhead
- Unidentified

Turtle Monitoring Sections

- Subsection location



(A4)

1:15,000

0 100 200 300 400 m



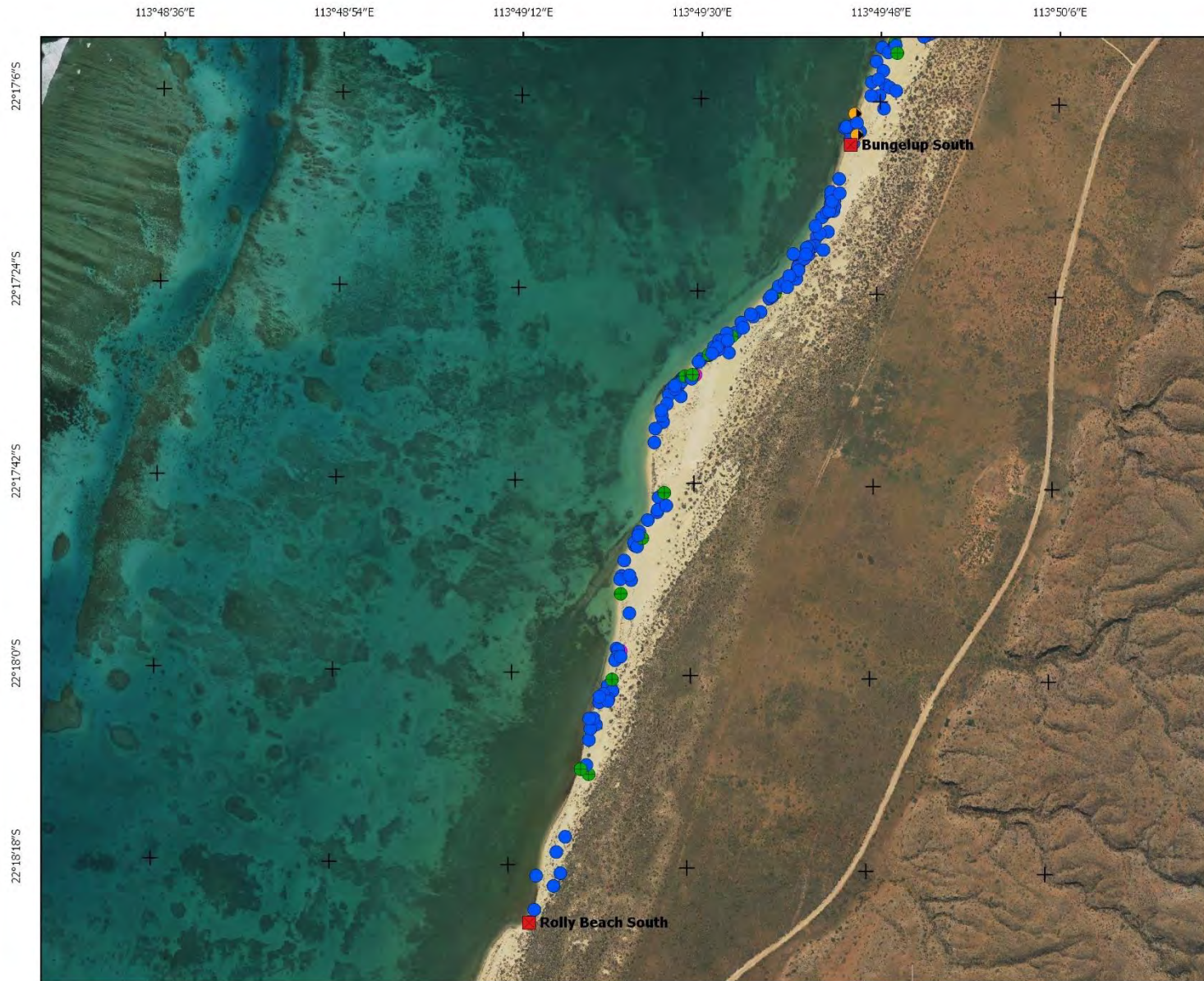
Projection: MGA Zone 49
Datum: GDA94



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Produced at 11:36 AM on October 20th, 2021

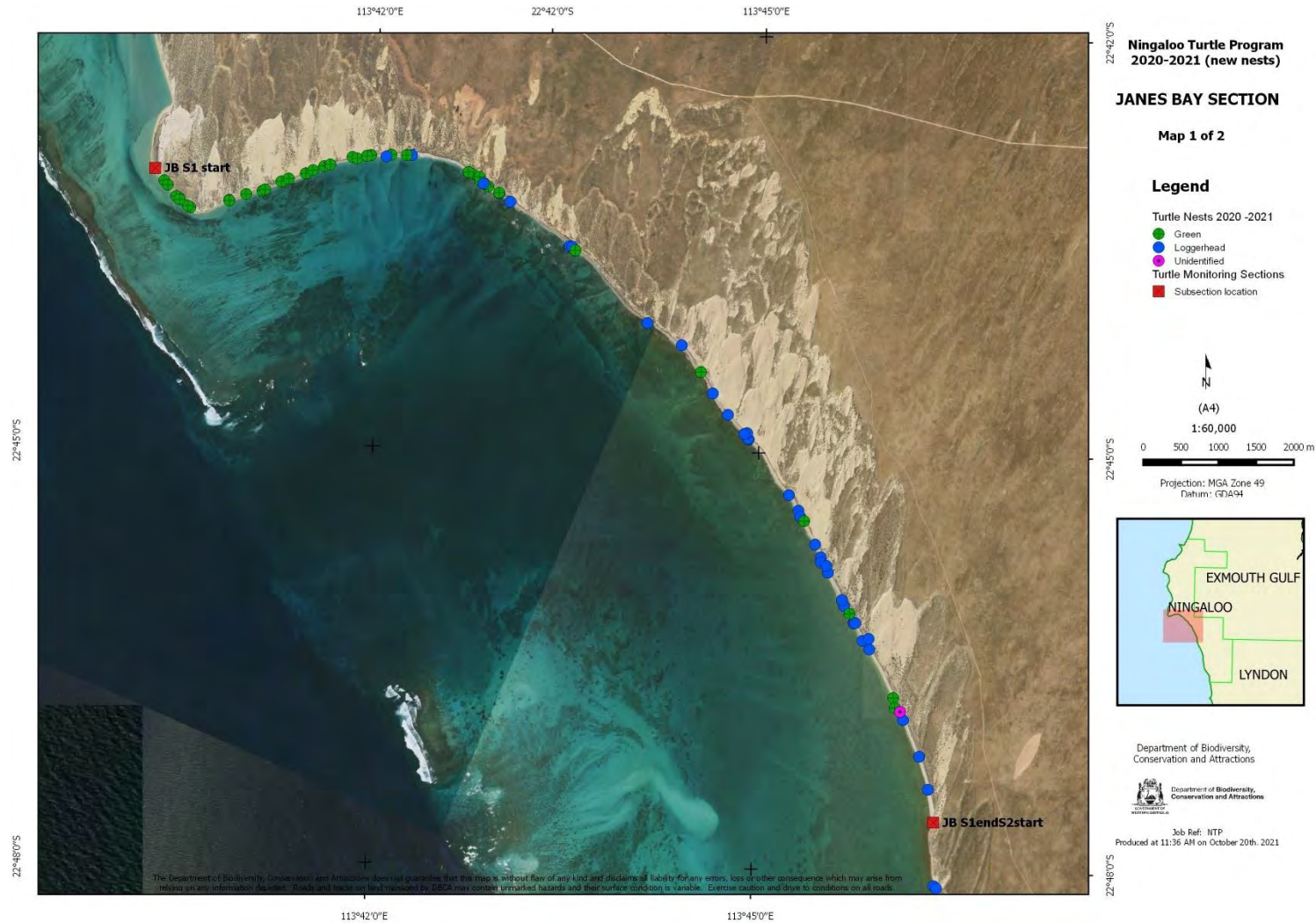


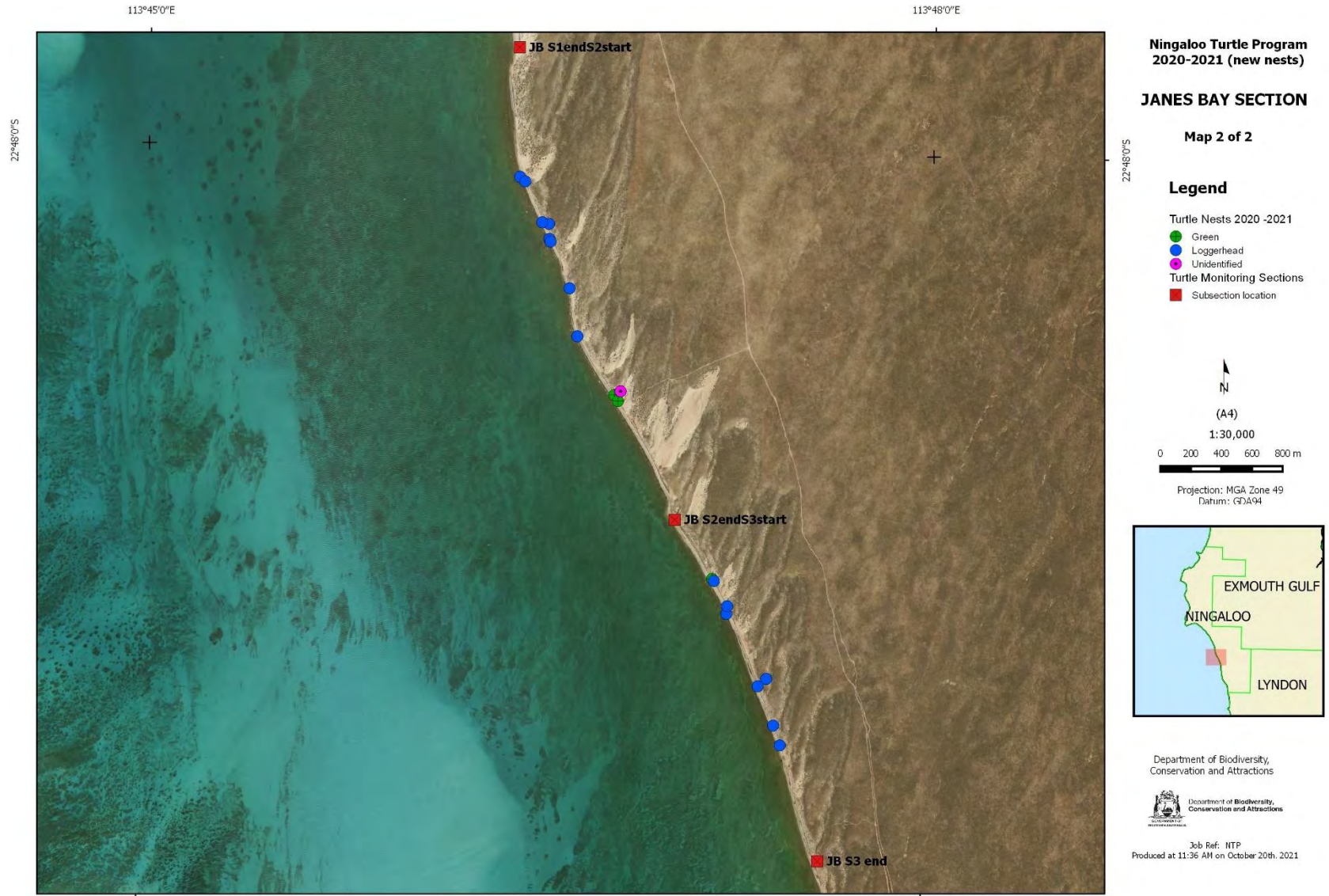
113°48'36"E 113°48'54"E 113°49'12"E 113°49'30"E 113°49'48"E 113°50'6"E

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Appendix 11: Janes Bay section – New nests (NTP 2020-21) Map 1 & 2 and Whaleback section Map 1

Note: Locations of some nests in the figure may vary from actual locations due to occasional inaccuracies in the GPS. Inaccuracies are considered unlikely to affect illustrations of overall patterns of nesting across the section.





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**Ningaloo Turtle Program
2020-2021 (new nests)**

WHALEBACK BEACH

Map 1 of 1

Legend

- Turtle Nests 2020 -2021
 - Loggerhead
 - Unidentified
- Turtle Monitoring Sections
 - Subsection location



(A4)

1:15,000

0 100 200 300 400 m

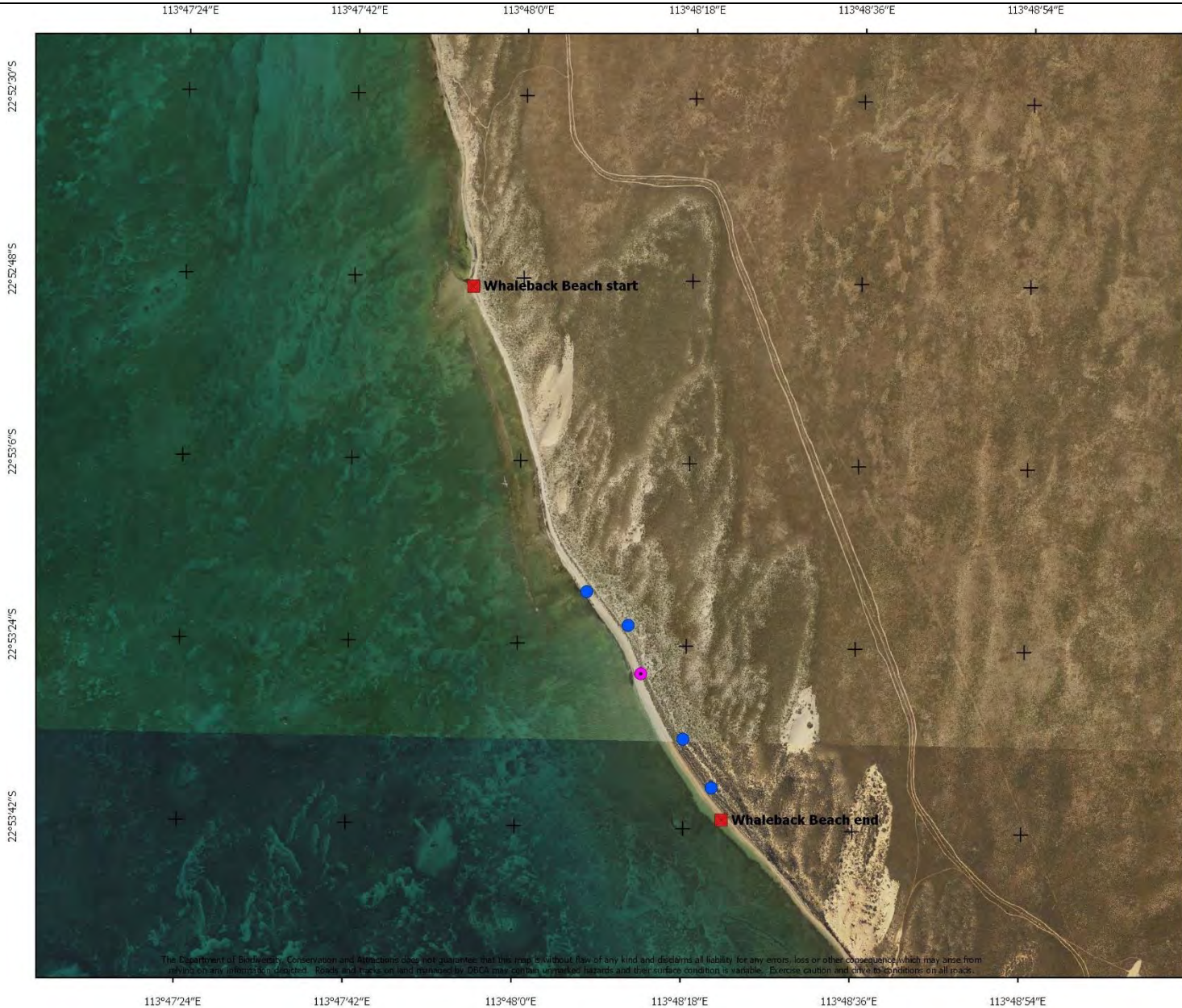
Projection: MGA Zone 49
Datum: GDA94



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Appendix 12: Trisel beach turtle barrier trial

Trisel beach includes a stretch of approximately 500m of coastline where the sandy beach has eroded to expose an underlying rocky shoreline. During the 2020/21 season the shoreline consisted of jagged rocks which at low tide formed a low cliff up to approximately 1.5 metres in height onto exposed sand below (Figure 1). In the previous 2 to 3 years there were many reports and first-hand observations by DBCA staff of nesting female turtles becoming stuck in the rocks when trying to return to the sea or falling from the rocks onto sand during low tides resulting in their deaths, presumably from breaking their necksⁱ.

Ongoing concern from the public and frequent reports and responses to strandings by NTP volunteers and DBCA staff prompted DBCA to investigate potential solutions to minimise the death or injury to nesting sea turtles caused by this rocky shoreline.

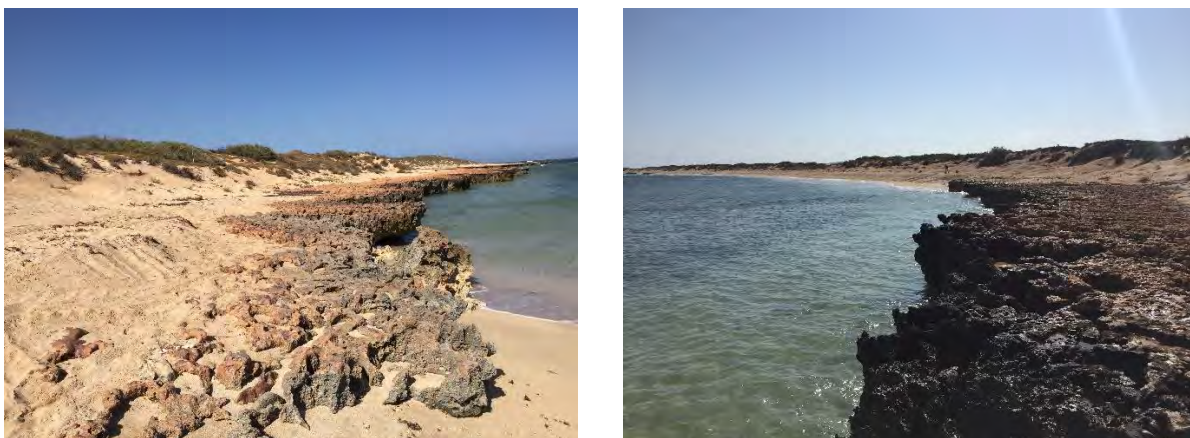


Figure 25: Trisel beach rock ledge, facing south (left) and facing north (right) at low tide.

DBCA sought advice from DBCA's turtle research scientists and the Queensland Parks and Wildlife Service's Raine Island Recovery Team who had been actively managing similar problems with green turtles on Raine Island. The Raine Island Recovery Team had been trialling and effectively using different types of barriers and fencing to manage risk to turtles on Raine Island. In these discussions, temporary water filled road barriers (Figure 2) were identified as a potentially effective method to prevent or reduce nesting turtles from entering the area of high risk adjacent to the low cliffs to reduce death and injury to turtles, while also allowing safe beach access to the public.

The barriers were arranged on the sandy beach near the northern edge of the cliffs above the high tide mark, then inland towards and across the dunes to the start of thicker vegetation which was considered a natural barrier that turtles would be unlikely to travel through or around (Figure 3). Two barriers were offset from the others to provide a point of access wide enough for visiting pedestrian traffic but narrow enough to restrict the movement of turtles to ensure they wouldn't be trapped by the barrier. Appropriate signage explaining the trial and pointing out pedestrian access were provided at access points and other platforms to inform visitors of the initiative. The site was monitored daily to assess the effectiveness of the barriers including whether: turtles had travelled beyond the barriers determined by the presence or absence of turtle tracks behind the barriers; the movement of turtles had been influenced by the presence of the barriers determined by turtle tracks leading to the barriers; turtles had tried to dig under barriers; whether barriers were stable

or were susceptible to tides, winds, etc; barriers had been interfered with by visitors; there were any unforeseen environmental or human activities associated with the barriers.



Figure 2: Temporary barriers in situ, with educational signage.



Figure 3: Location of barrier trial at Trisel beach.

Due to the pending threat of a tropical cyclone, the barriers were removed and the trial was ended earlier than planned. Barriers were in place for 10 days (21 – 31 Jan 2021). The barriers appeared to be effective at diverting turtles away from the rock ledge, due to the following:

- There was active nesting by green turtles on the beach directly north of the barriers during the trial (an example is shown in Figure 4).
- No turtles were observed trapped in rocks south of the barriers.
- No dead or injured turtles were reported.
- No tracks were observed on the cliff top south of the barriers.
- No adult or hatchling turtles were trapped by the barrier, while the barrier was in place.
- The barriers were not destabilised by tides or wind.
- No other unforeseen problems were identified.

It is worth noting that the 2020/21 Ningaloo Turtle Program recorded the highest amount of turtle nesting activity since the program started in 2002/03.

The results of this trial suggest the barriers can be an effective and cost-effective method for protecting a high-value demographic of the turtle populations (i.e. long-lived nesting females) when used strategically on beaches with effective communications and visitor-risk-management.



Figure 26: Turtle track approaching the barrier and diverting away, returning to the water in a safer location away from the cliff edge.

ⁱ Although no formal necropsies were done on dead turtles found in the Trisel area, many of the dead turtles, appeared to have broken or damaged necks (Peter Barnes, DBCA, pers. comm.).