



# Ningaloo Turtle Program Annual Report 2019 -20



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## GLOSSARY

<b>Body pit</b>	A depression dug in the sand by a turtle during a nesting attempt.
<b>Egg chamber</b>	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.
<b>Entire season</b>	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.
<b>False crawl</b>	An abandoned nesting attempt with no eggs being laid.
<b>GPS unit</b>	Global Positioning System unit: an electronic navigational device which obtains a position on the earth using satellite signals.
<b>Pre and post peak</b>	Monitoring on the weekends either side of the intensive peak monitoring period.
<b>Intensive peak monitoring period</b>	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.
<b>Nest</b>	A nesting attempt which we suspect has resulted in eggs being deposited.
<b>Nest damage</b>	The nest has been dug up, eggs or fresh empty egg shells are around the nest or eggs are exposed.
<b>Nesting success</b>	The number of suspected nests laid as a percentage of total turtle tracks counted.
<b>New nest</b>	A suspected nest laid during the night before or the morning of monitoring, which has therefore not been previously recorded.
<b>Old nest</b>	A suspected nest laid during the current season (but not laid during the previous night) which has been predated on.
<b>Primary body pit</b>	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.
<b>Rookery</b>	A significant breeding area for a large number of turtles.
<b>Secondary body pit</b>	The last depression dug during a successful nesting attempt to cover the primary body pit and egg chamber with sand.

<b>Standardised season</b>	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.
<b>Survey effort</b>	Total number of times each subsection was monitored over a specified period of time.
<b>Suspected nest</b>	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".
<b>Tracks</b>	The imprint left in the sand by a turtle emerging from and returning to the water.
<b>Turtle activity</b>	Includes both turtle nests and false crawls.
<b>Zoning</b>	Hierarchical spatial classification system of divisions, sections & subsections.

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## LIST OF ABBREVIATIONS

<b>CCG</b>	Cape Conservation Group Inc.
<b>DBCA</b>	Department of Biodiversity, Conservation and Attractions
<b>EPBC Act</b>	Environmental Protection and Biodiversity Conservation Act 1999
<b>JTC</b>	Jurabi Turtle Centre
<b>NMP</b>	Ningaloo Marine Park
<b>NTP</b>	Ningaloo Turtle Program
<b>NW Cape</b>	North West Cape
<b>Parks and Wildlife</b>	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 2019-20 season, NTP sponsors Woodside Energy Ltd made a significant contribution to the program. The primary aim of the NTP is to understand long-term trends in marine turtle populations and nesting 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 on Ningaloo Station (previously last monitored in 2007) and Gnarraloo Bay (previously monitored by the Gnarraloo Turtle Conservation Program). Monitoring continued at these locations in 2019-20 with three surveys done throughout the season.

Seventy two volunteers contributed 3352 hours to the Ningaloo Turtle Program in 2019-20. Since commencement of the program, volunteers have contributed 72,264 hours. These hours demonstrate the effort and value of the volunteers over the life of the program.

1645 suspected nests and 4015 false crawls were recorded in the Ningaloo Region over the full 2019-20 season. In the NW Cape division, 91.8% of activities were from green turtles. In the Cape Range division, 93.4% of activities were from loggerhead turtles. In the Ningaloo division, 79.6% of activities were from loggerhead turtles and 12.9% were from green turtles. 84.4% of activity in the Gnarraloo division was 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. In the 19/20 season there were fewer nests and false crawls by green and hawksbill turtles and fewer nests by loggerheads in comparison to long-term averages. Loggerhead total activities were slightly above average. Nesting success was above average for hawksbills, but lower for green and loggerhead turtles.

In the standardised season, volunteers recorded on average 9.3 green turtle activities per subsection per day (nests and false crawls), which is lower than the long-term average of 16.2 activities per day (range from 3.8 to 66.8 since 2002). Greens turtles had a nesting success rate of 25.8%, slightly lower than the long-term average of 27.4%.

Loggerhead turtles had an average of 2.5 activities per subsection per day which is similar to the long-term average of 2.4 activities (range 0.82 to 14.5 since 2002). Nesting success rate was 32.1% (long-term average of 41.2%).

Hawksbill activity remained relatively small as expected, with 0.2 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 (54.3%) was higher than the long-term average of 49%.

Eight nests were considered to be disturbed, which was 0.5% of the total recorded nests. Two were attributed to ghost crabs, two to a turtle excavating another turtle's nest and 2 to unknown causes. Two disturbances were attributed to introduced predators (dog) or dingo.

During 2019-20, volunteers rescued 5 stranded turtles, contributing to at least 281 recorded rescues since 2002. Six mortalities and four tagged turtles were also reported.

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## 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, 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 toward volunteer costs, website maintenance, community activities, monitoring equipment and education.

In 2008 the monitoring design for NTP was consolidated 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.

Remote rookeries at Janes Bay and Whaleback Beach (Bundera/Ningaloo division) and Gnarraloo Bay (Gnarraloo division) were monitored during three periods by NTP volunteers and Parks and Wildlife staff throughout the season, as recommended by Whiting, 2018.

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](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.

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## 2. METHODS

Activities of turtles are recorded by observing fresh tracks from the previous night to determine species and identify suspected nests<sup>1</sup>. 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](http://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 second NTP season using tablets and 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). 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.

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<sup>1</sup> 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.

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**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 2019-20, 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 16 December 2019 to 12 January 2020 (with the exception of 1 Jan) and also before the peak period on the weekends of the 9 & 10, 23 & 24 November and 7 & 8 December 2019 and again after the peak period on the weekends of the 25 & 26 January and 8 & 9 and 22 & 23 February 2020.

**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 2019-20. Each subsection of the Cape Range division was monitored for 26 or 27 days during the intensive peak period from the 16 December 2019 to 12 January 2020.

**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 2019-20 using the same sampling regime as 2018-19. They were monitored for 5 days pre-peak nesting period (18 – 22 November 2019), 7 days centred on the peak nesting period (5 – 11 January 2020) and 5 days post-peak nesting period (11 – 15 February 2020), 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)<sup>2</sup>. 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 regime recommended by Whiting (2018) based on assessment of available data from previous surveys at Gnarraloo Bay. Turtle nesting was monitored in Gnarraloo Bay between GBN and

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

beach point 9 (Appendix 5) for 5 days pre-peak period (15 - 19 November 2019), 7 days over the peak period (31 December 2019 - 6 January 2020) and 5 days post-peak period (4 - 8 February 2020).

### 3.0 RESULTS

#### 3.1 Volunteer engagement and coordination

Seventy two volunteers contributed 3352 hours to the Ningaloo Turtle Program in 2019-20, coordinated, managed, supervised and trained by Parks and Wildlife staff and supported by volunteers from the Cape Conservation Group. Since commencement of the program in 2002, 72,264 hours of time from volunteers have contributed to the program. This time was primarily monitoring, but also data uploading, training, education, school visits, turtle rescues, media and assisting with external research.

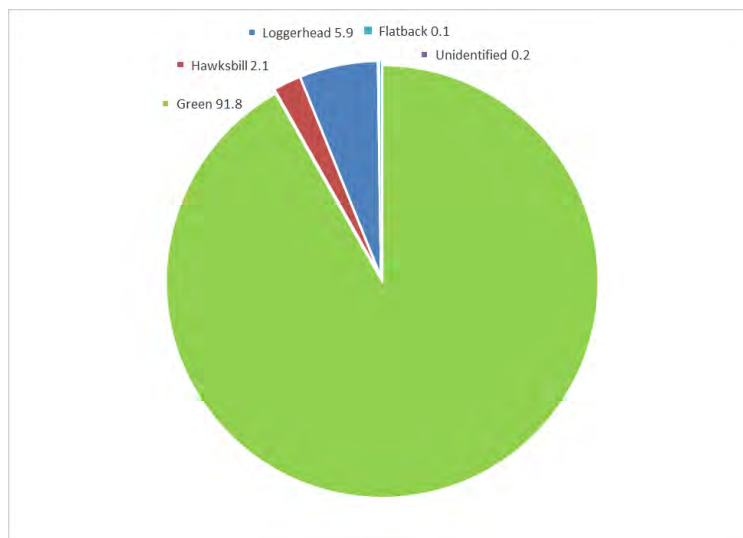
#### 3.2 Nesting Activity

##### 3.2.1 NW Cape division

1347 suspected nests and 3416 false crawls were recorded within the NW Cape division during the full 2019-20 season (Table 1). Green turtles were the most active species in the NW Cape division (both nests and false crawls) representing 91.8% of total turtle activity recorded, followed by loggerheads (5.9%), hawksbills (2.1%), flatbacks (0.1%) 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 2019-20 full season.

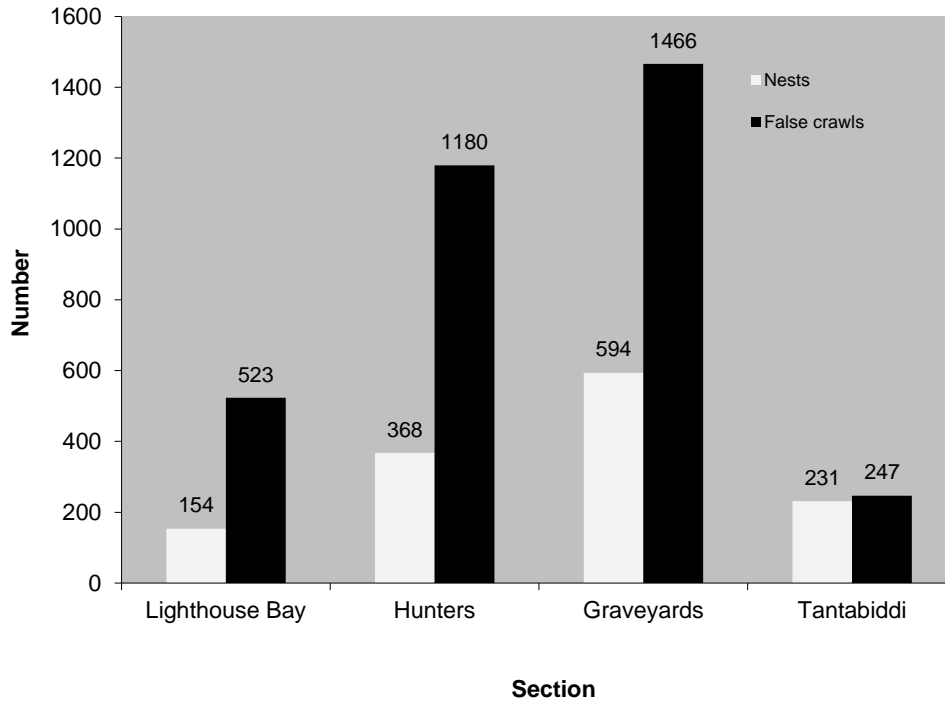
North West Cape Division	Turtle Species					Total
	Green	Hawksbill	Loggerhead	Flatback	Unidentified	
New nests	1175	52	114	1	5	1347
False crawls	3197	48	166	2	3	3416
<b>Total activity</b>	<b>4372</b>	<b>100</b>	<b>280</b>	<b>3</b>	<b>8</b>	<b>4763</b>



**Figure 1:** Percentage of activity by species within the North West Cape division, 2019-20 full season.



Numbers of nests and false crawls varied among the four NW Cape sections (Figure 2). For section lengths and locations, see Appendix 2. The Graveyards section had the most activity and the Lighthouse Bay section had the fewest nests. For individual nest locations see maps in Appendix 6 – 9. Green turtles were the most dominant species throughout all subsections on the North West Cape. The highest amount of loggerhead and hawksbill activities was found on the northern subsections.



**Figure 2:** Nesting activity (nests and false crawls) for all species in each section of the North West Cape division, 2019-20 full season.

Numbers of nests for each species changed through time across the season (Figure 3 - greens, Figure 4 - loggerheads, Figure 5 - hawksbill turtles). Note: there was no monitoring on 1 January. Peak season can be clearly seen for greens and loggerheads 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.

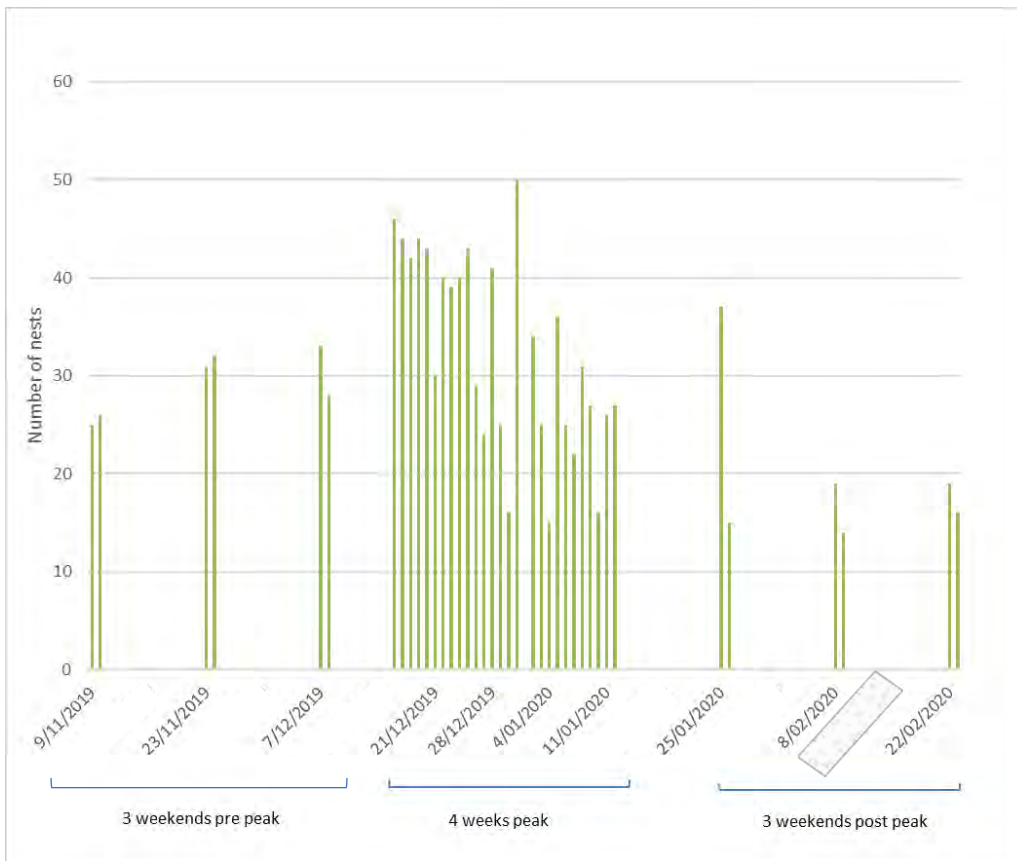


Figure 3: Number of green turtle nests recorded in the NW Cape Division per day in the 2019-20 season.

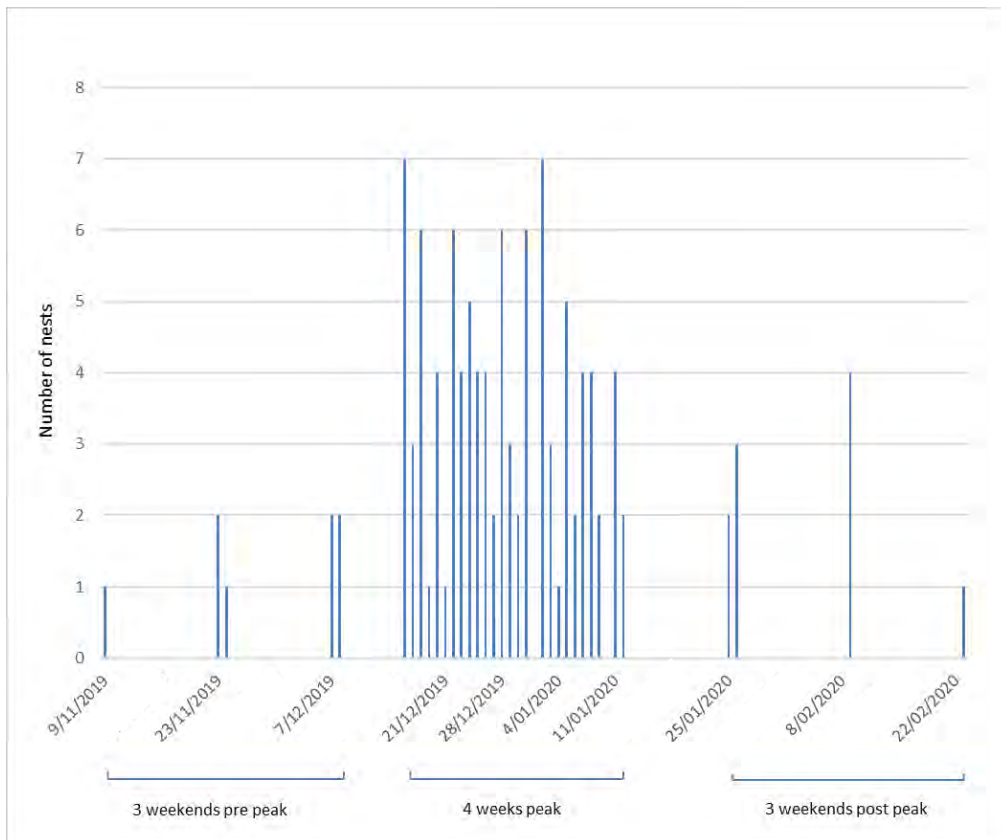
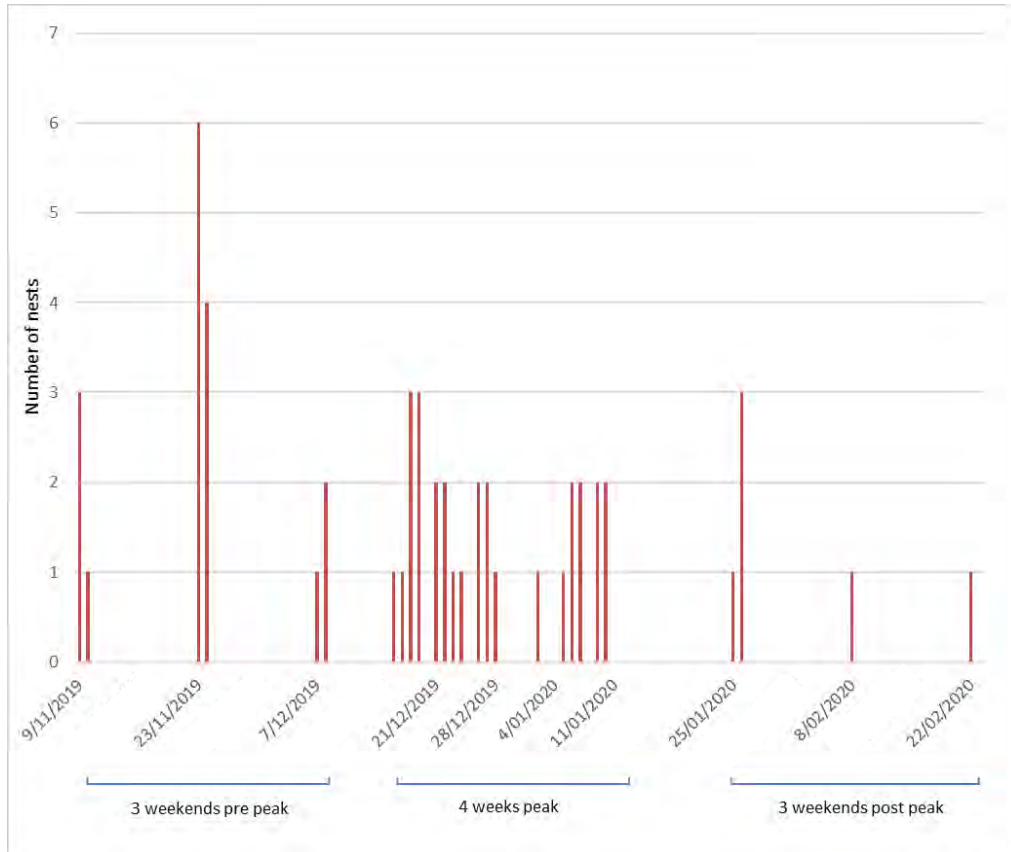


Figure 4: Number of loggerhead turtle nests recorded in the NW Cape Division per day in the 2019-20 season.



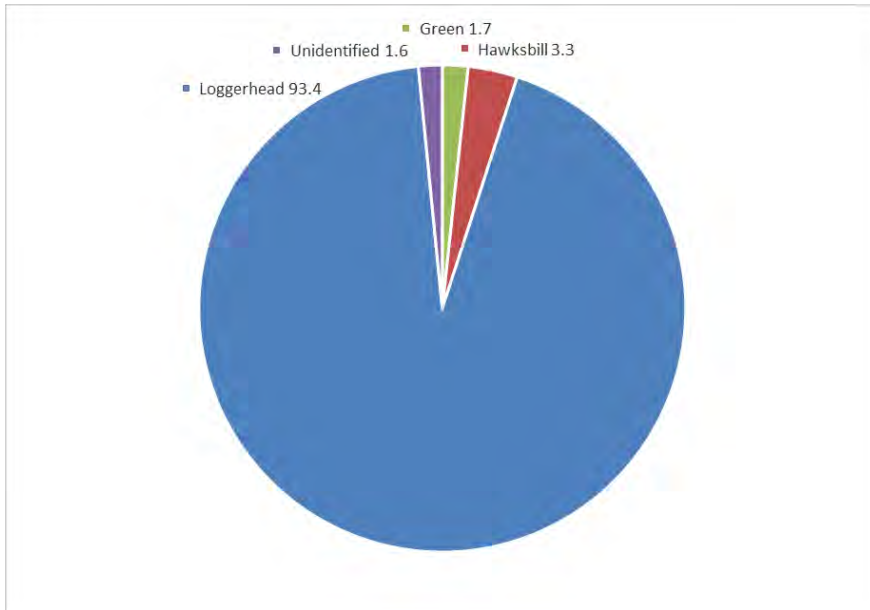
**Figure 5:** Number of hawksbill turtle nests recorded in the NW Cape Division per day in the 2019-20 season.

### 3.2.2 Cape Range division (Bungelup)

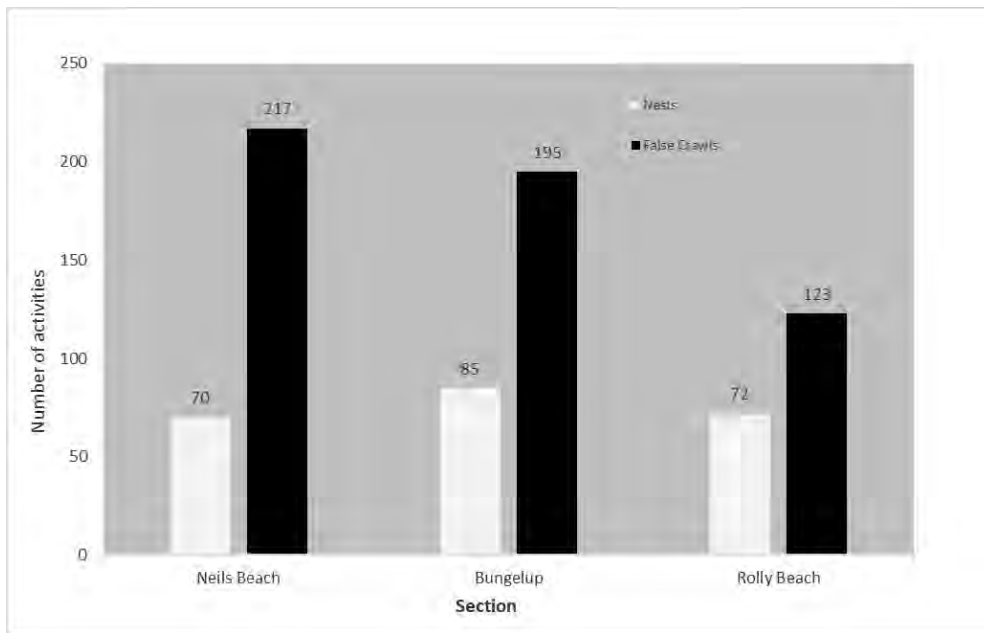
227 suspected nests and 535 false crawls were recorded in the Bungelup section during the 2019-20 NTP season (Table 2). Loggerhead turtles were the most active (93.4%), followed by hawksbill (3.3%), green (1.7%) and unidentified turtle species (1.6%) (Figure 6). Activity varied across the three sections at Bungelup (Figure 7); for individual nest locations see maps in Appendix 10). The northernmost subsection (Neils Beach) had the most activity.

**Table 2:** Total activities (suspected nests and false crawls) recorded for each species within the Cape Range division, NTP 2019-20 full season.

Cape Range Division	Turtle Species					Total
	Green	Hawksbill	Loggerhead	Flatback	Unidentified	
New nests	1	18	206	0	2	227
False crawls	12	7	506	0	10	535
<b>Total activity</b>	<b>13</b>	<b>25</b>	<b>712</b>	<b>0</b>	<b>12</b>	<b>762</b>

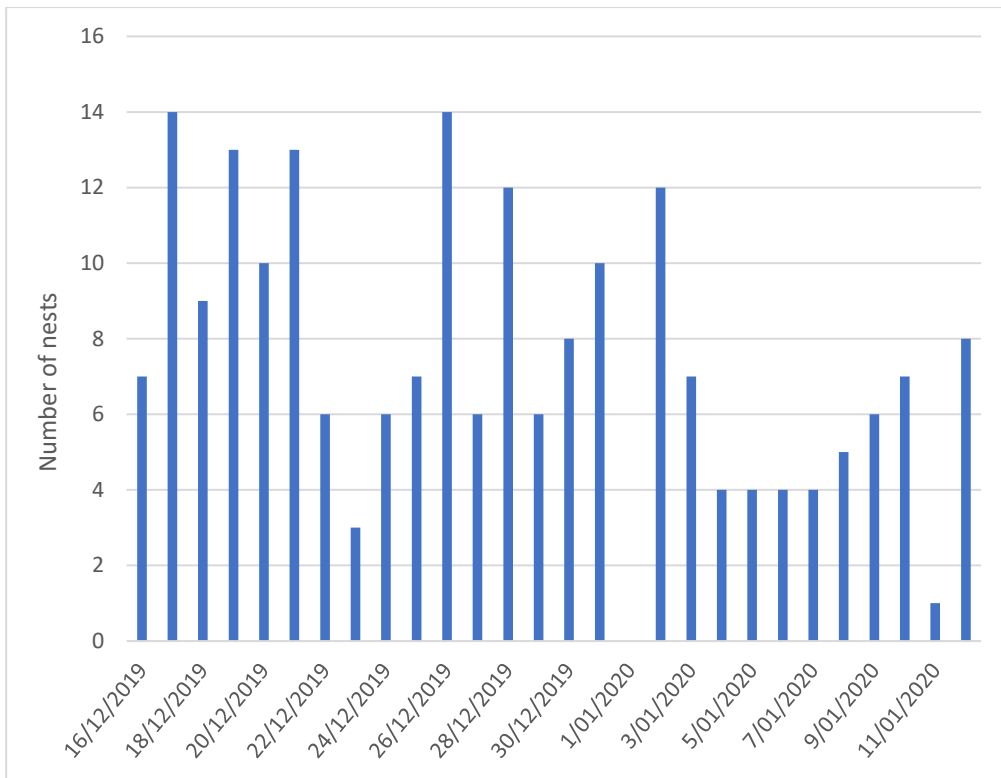


**Figure 6:** Percentage of turtle activity by species within the Cape Range division, 2019-20.



**Figure 7:** Numbers of suspected nests and false crawls within each Bungelup subsection (Cape Range division), 2019-20.

Numbers of loggerhead nests varied through the season at Bungelup (Figure 8).



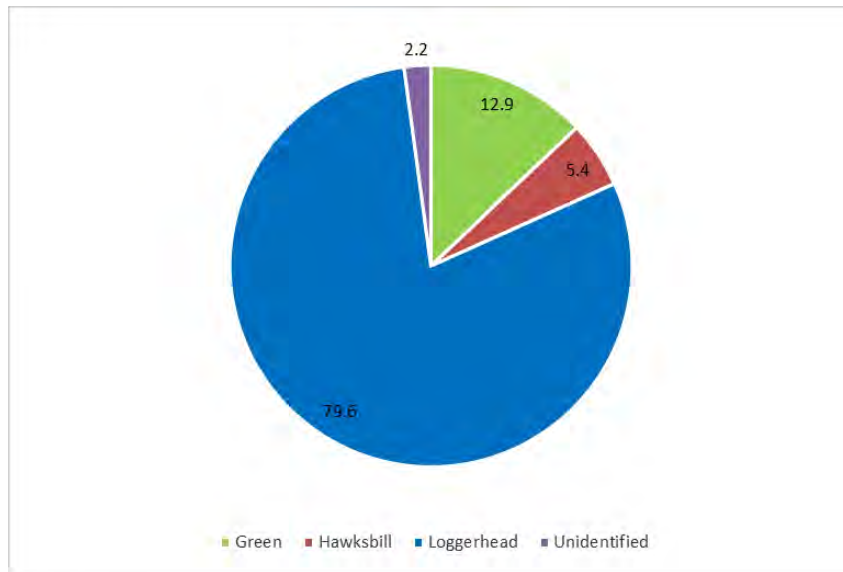
**Figure 8:** Number of loggerhead turtle nests recorded in the Cape Range Division (Bungelup) per day in the 2019-20 season. Note, no monitoring occurred on 1 January.

### 3.2.3 Ningaloo division (Janes Bay and Whaleback Beach)

48 suspected nests and 45 false crawls were recorded in the Janes Bay and Whaleback Beach subsections in the 17 days of monitoring in 2019/20 (Table 3). Unlike the previous year, loggerhead turtles were the most active (79.6% of activities) followed by greens (12.9%), hawksbills (5.4%) and unidentified species (2.2%) (Figure 9). 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 (Appendix 11). Whaleback beach had mostly loggerhead activity.

**Table 3:** Total number of activities (suspected nests and false crawls) recorded for each species within the Ningaloo division, 2019-20.

Bundera / Ningaloo Division	Turtle Species				Total
	Green	Hawksbill	Loggerhead	Unidentified	
New nests	7	2	38	1	48
False crawls	5	3	36	1	45
<b>Total activity</b>	<b>12</b>	<b>5</b>	<b>74</b>	<b>2</b>	<b>93</b>



**Figure 9:** Percentage of activity by species within the Bundera/Ningaloo division in 2019-20.

### 3.2.4 Gnarraloo division

24 suspected nests and 21 false crawls were recorded in the Gnarraloo Bay subsection in 17 days of monitoring in 2019/20 (Table 4). 84.4% of the activity observed was from loggerhead turtles, with 8.9% from suspected hawksbill turtles and 6.7% from green turtles.

**Table 4:** Total number of activities (suspected nests and false crawls) recorded for each species within the Gnarraloo division, 2019-20.

Gnarraloo Division	Turtle Species			Total
	Loggerhead	Hawksbill	Green	
<b>New nests</b>	21	2	1	24
<b>False crawls</b>	17	2	2	21
<b>Total activity</b>	38	4	3	45

Consistent with findings from previous monitoring (Hattingh et. al 2018), the majority of activity (84.4%) was between beach point 8 (BP8) and beach point 9 (BP9), in the northern area of Gnarraloo Bay (Appendix 12).

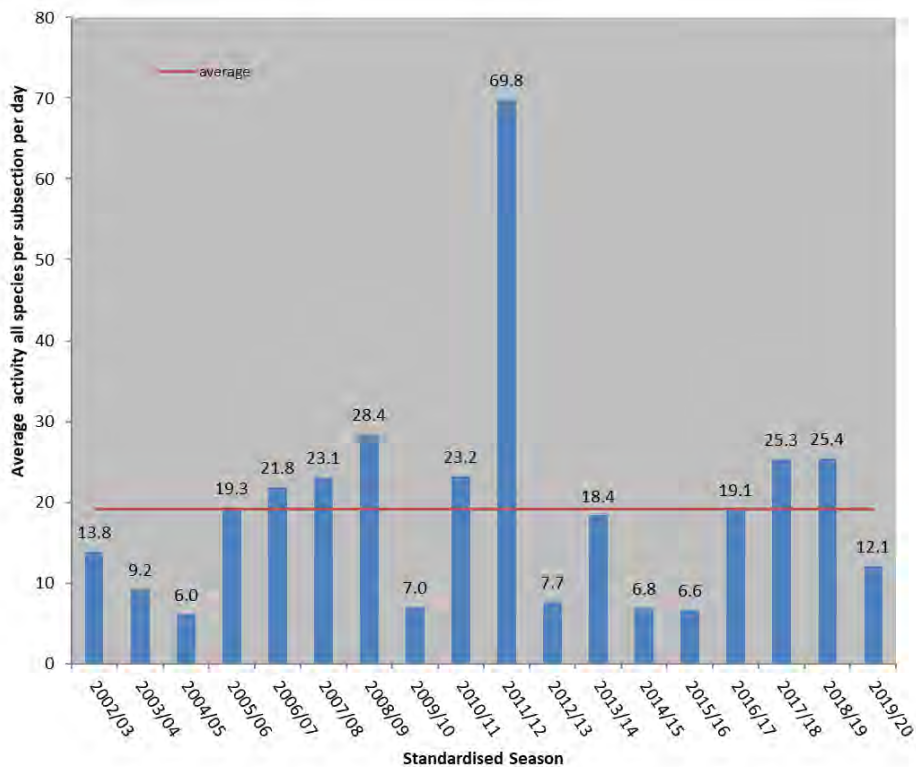
### 3.3 Long-term patterns of nesting – NW Cape and Cape Range divisions

NTP has recorded 58,634 suspected nests and 138,456 false crawls in total since commencement of the program in 2002 (full season data and all subsections included as per the survey effort in Appendix 1). Green turtles have been consistently and by far the most

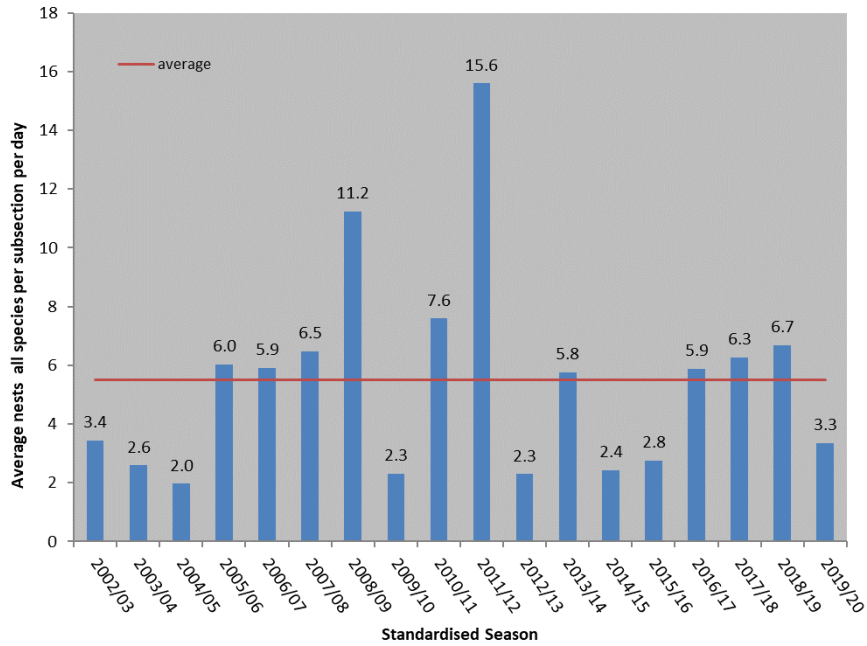
abundant species with 85.00% of activities, followed by loggerhead (12.66%), hawksbill (2.03%), unidentified species (0.30%) and flatback turtles (0.01%).

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 – 2019-20 including 18 seasons, within the intensive peak monitoring period (NW Cape and Cape Range divisions only), NTP has recorded 34,598 nests and 86,493 false crawls (total activity 121,091). Activity during the 2019-20 season was below average, with an average of 12.1 activities per subsection per day, compared to the long-term average of 19.1 (Figure 10). Number of nests was also below average, ranking the season 12<sup>th</sup> out of 18 for nests per subsection per day (Figure 11).



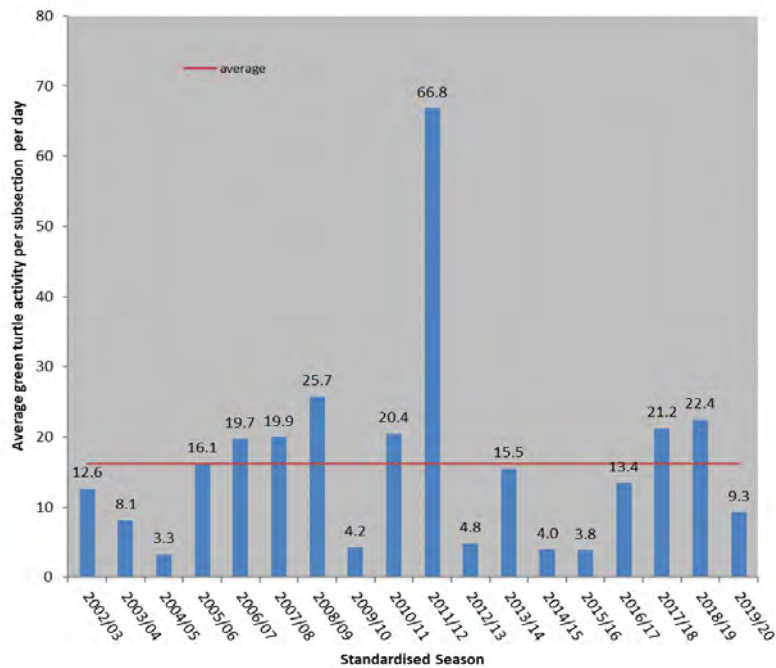
**Figure 10:** Turtle activity (nests and false crawls for all species) for each season standardised by survey effort during the intensive peak monitoring period (NW Cape and Cape Range divisions).



**Figure 11:** Nests (all species) for each season standardised by survey effort during the intensive peak monitoring period (NW Cape and Cape Range divisions).

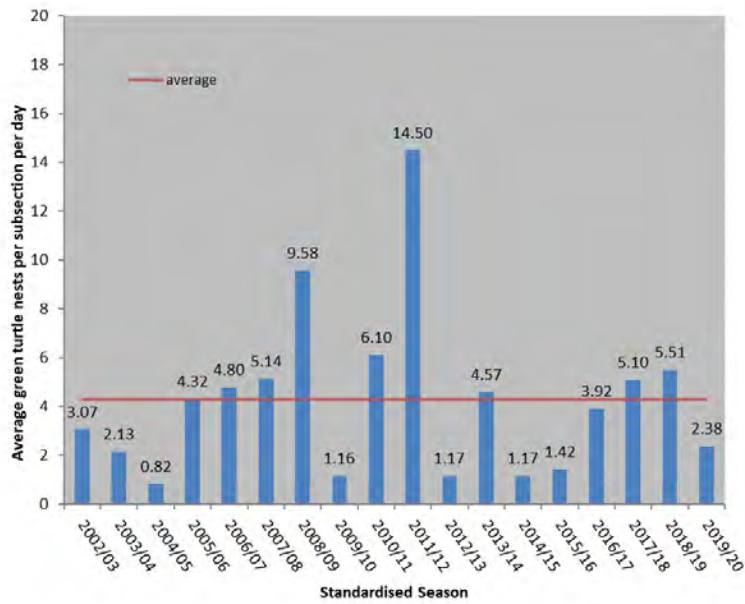
### Green turtles

Nesting activity by green turtles varies largely among years. Green turtle activity and nesting in 2019-20 were below the long-term average for standardised seasons (Figure 12 & Figure 13).



**Figure 12:** Green turtle activity (nests and false crawls) for each season standardised by survey effort during the intensive peak monitoring period.

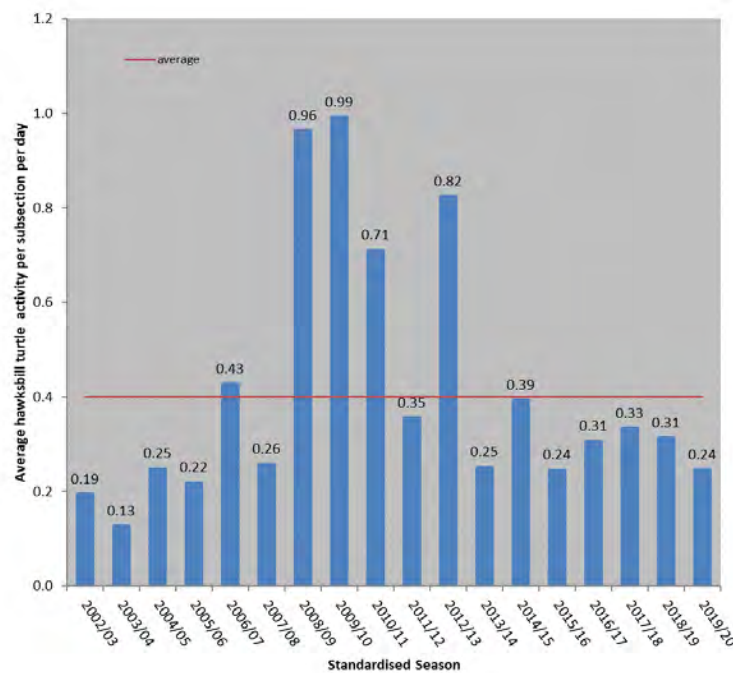




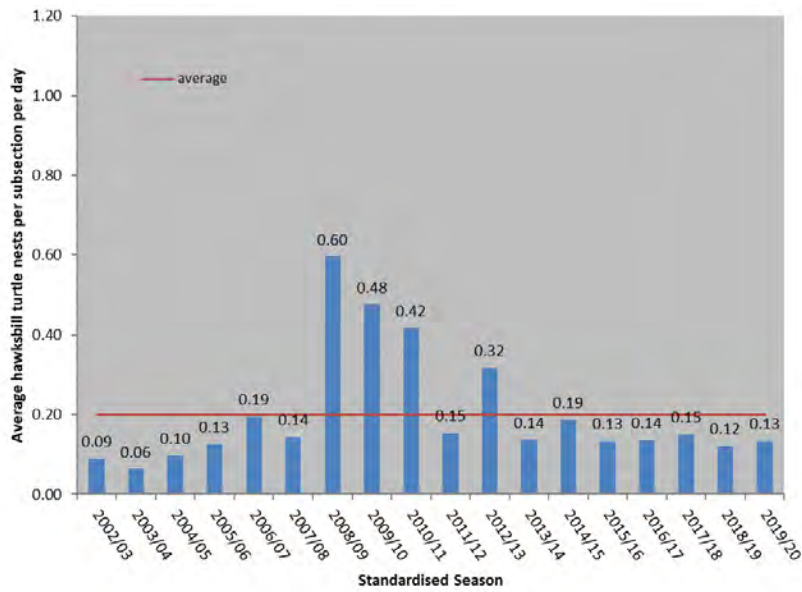
**Figure 13:** Green turtle nests for each season standardised by survey effort during the intensive peak monitoring period.

### Hawksbill turtles

The standardised levels of hawksbill turtle activity and nesting during the 2019-20 season were below average in comparison to other seasons (Figure 14 & Figure 15).



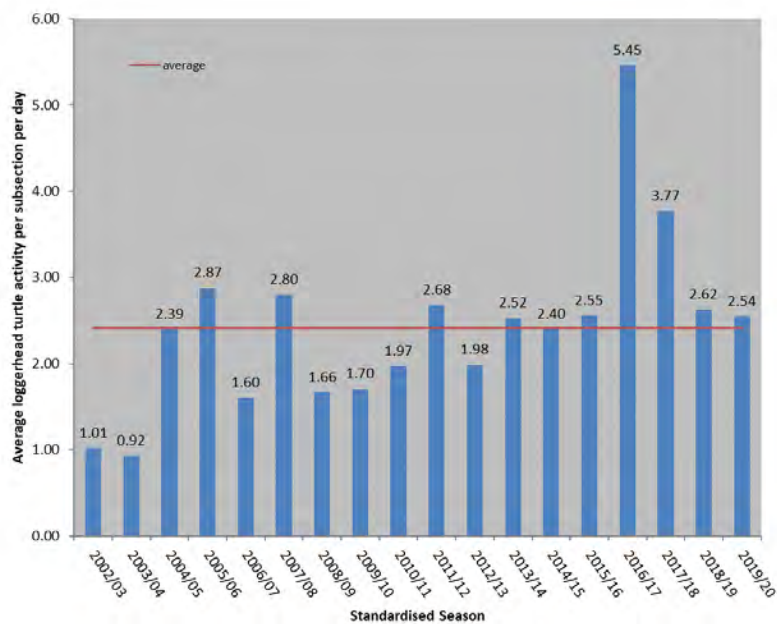
**Figure 14:** Hawksbill activity (false crawls and nests) for each season standardised by survey effort during the intensive peak monitoring period.



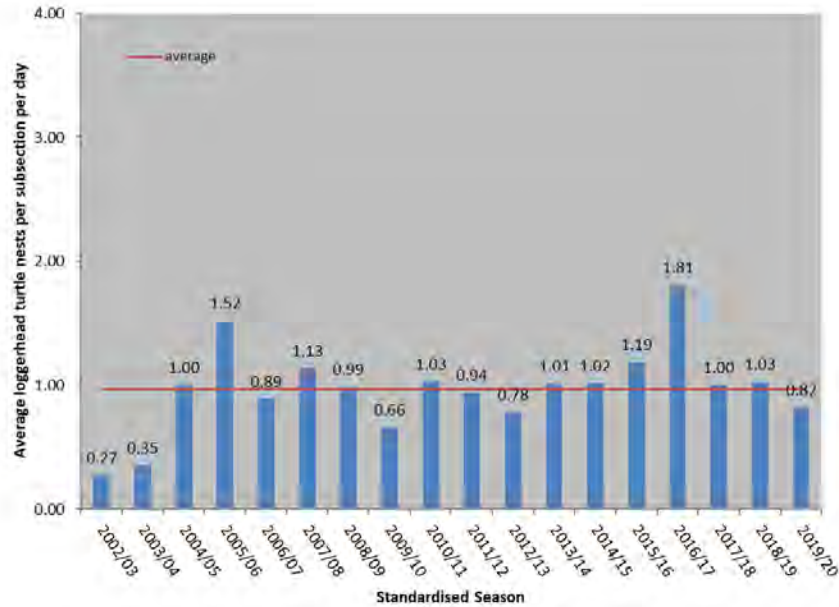
**Figure 15:** Hawksbill nests for each season standardised by survey effort during the intensive peak monitoring period.

### Loggerhead turtles

The standardised level of loggerhead turtle activity during the 2019-20 season was close to the long-term average (Figure 16). Standardised loggerhead nesting was close to but slightly below average (Figure 17).



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



**Figure 17:** Loggerhead nests for each season standardised by survey effort during the intensive peak monitoring period.

### 3.4 Nesting success

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

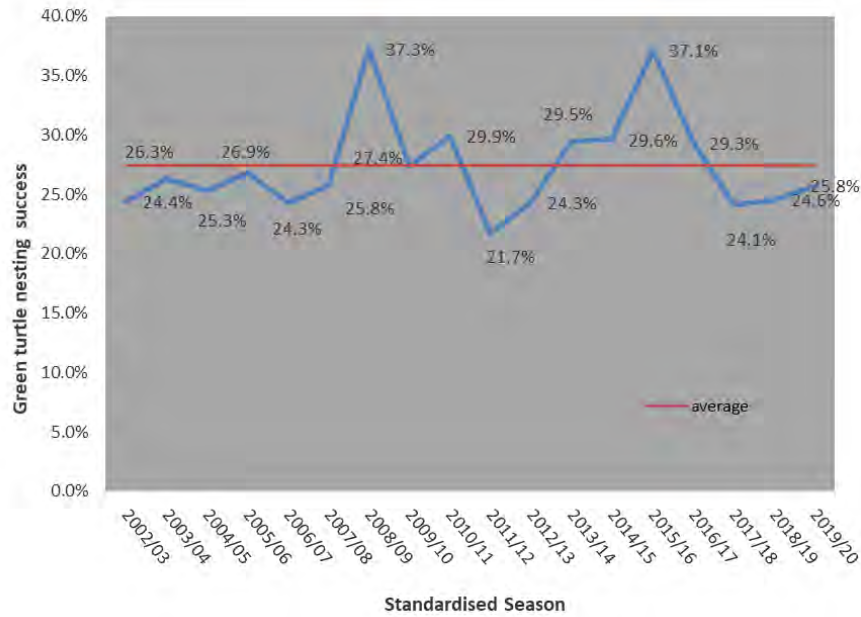
#### 3.4.1 NW Cape and Cape Range

Average nesting success for turtles has varied among years for all species of turtle (Figure 18; Figure 19; Figure 20). Nesting success for green turtles was 26.9% for the 2019-20 full season with 1184 nests from 4400 total activities. Hawksbill (55.2%) and loggerhead turtles (34.3%) had higher nesting success than greens, with 74 nests from 134 activities for hawksbills and 379 nests from 1104 activities for loggerheads (Appendix 1).

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 peaks for green turtles, it also peaks for loggerhead and hawksbill turtles. When nesting success declines for green turtles, it is also lower for loggerhead and hawksbill turtles.

#### Green turtles

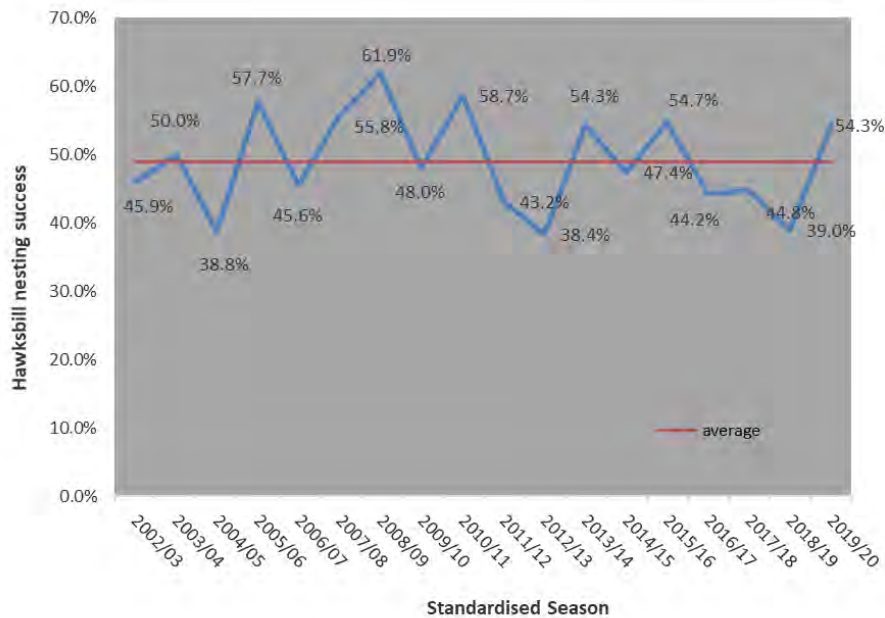
Nesting success for green turtles is generally lower than those of loggerhead and hawksbill turtles. Nesting success for green turtles has ranged from a maximum of 37.3% in 2008-09 to a minimum of 21.7% in 2011-12 (Figure 18). Nesting success of 25.8% in the 2019-20 standardised season was just below the long term average of 27.4%.



**Figure 18:** Nesting success (%) for green turtles averaged across the intensive peak monitoring periods each season.

### Hawksbill turtles

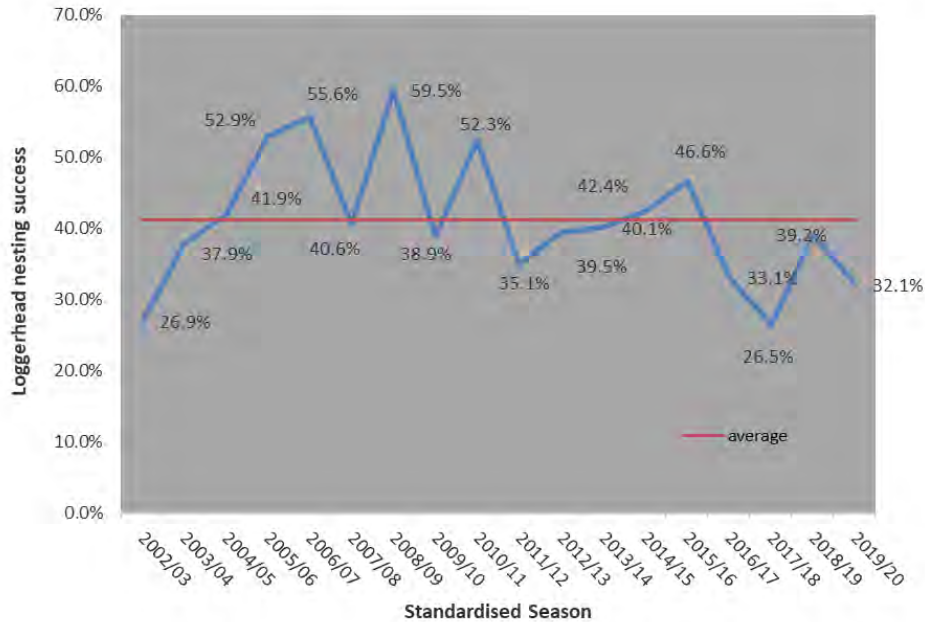
Nesting success for hawksbill turtles has ranged from a maximum of 61.9% in 2008-09 to a minimum of 38.4% in 2012-13 (Figure 19). Nesting success of 54.3% in the 2019-20 standardised season was above the long-term average of 49%.



**Figure 19:** Nesting success (%) for hawksbill turtles during 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 20). Nesting success of 32.1% in the 2019-20 standardised season was lower than average (41.2%).



**Figure 20:** Nesting success (%) for loggerhead turtles during the intensive peak monitoring period each season.

### 3.4.2 Ningaloo division (Janes Bay and Whaleback Beach)

Green turtles had a nesting success of 58.3%, which was a lot higher than the NW Cape and Cape Range divisions for this season (25.8%) and also higher than the long-term average for these divisions (27.4%). It should be noted that these estimates of nesting success are based on a relatively small sample size (Table 3; total of 12 activities) and should be interpreted with caution.

Loggerheads also had a higher success rate in the Ningaloo division (51.4%) compared to the NW Cape and Cape Range divisions (32.1% this season and 41.2% long-term).

Hawksbills (40%) had a lower nesting success than recorded in the NW Cape and Cape Range divisions for this season (54.3%). Their nesting success was also noticeably lower than the long-term averages at NW Cape and Cape Range (49%). It should be noted that these estimates of nesting success are based on a very small sample size (Table 3; total of 5 activities) and should be interpreted with caution.

### 3.4.3 Gnarraloo division

Nesting success in Gnarraloo Bay for loggerheads was higher than in all other NTP divisions at 55.3%. In comparison, the long-term average nesting success for loggerhead turtles in the standardised season in the NW Cape and Cape Range divisions is 41.2%.

## 3.5 Nest damage and predation

Eight nests were recorded with damage in the 2019-20 full season in the NW Cape and Cape Range divisions (equating to 0.51% of total recorded nests)<sup>3</sup>. Three of these nests were in the Cape Range division and 5 were within the North West Cape division. Two were attributed to ghost crabs, 2 to turtles excavating other turtles' nests and 2 to unknown causes. Two nests were damaged by either a dingo or introduced predator (possibly a dog other than a dingo)<sup>4</sup>.

In the Ningaloo division, one nest was recorded as being damaged and having signs of predation (cause obscured by crab prints). In the Gnarraloo division, no nests were recorded as being damaged.

### 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, to help inform targeted management efforts.

In 2019/20, volunteers recorded the tracks of dogs (all 11 subsections in NW Cape division, all 3 subsections in the Cape Range division, 2 of 4 subsections in the Ningaloo division, and 2 of 3 subsections in the Gnarraloo division); cats (5 of the 11 subsections in NW Cape division, 1 of 3 subsections in the Cape Range division and 2 of 4 subsections in the Ningaloo division) and foxes (2 of 11 subsections in NW Cape division, 1 of 4 subsections in the Ningaloo division).

Parks and Wildlife have recorded a reduction in predation of nests by introduced predators in recent years through a rigorous introduced predator control program including aerial and ground baiting and trapping (Figure 21).

<sup>3</sup> 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.

<sup>4</sup> 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.

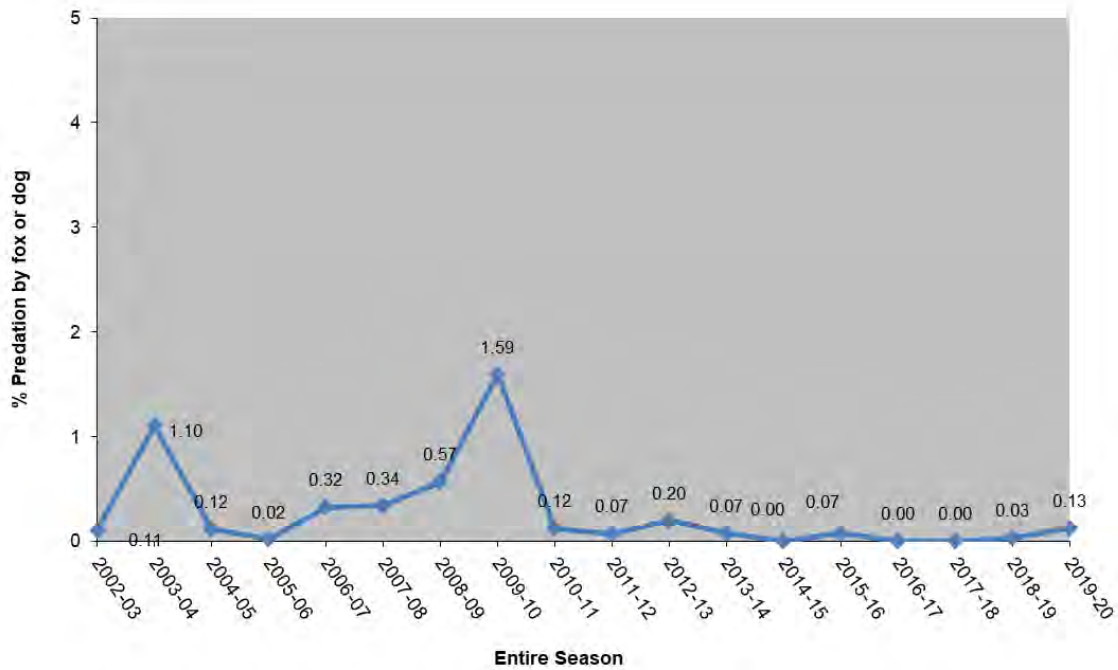


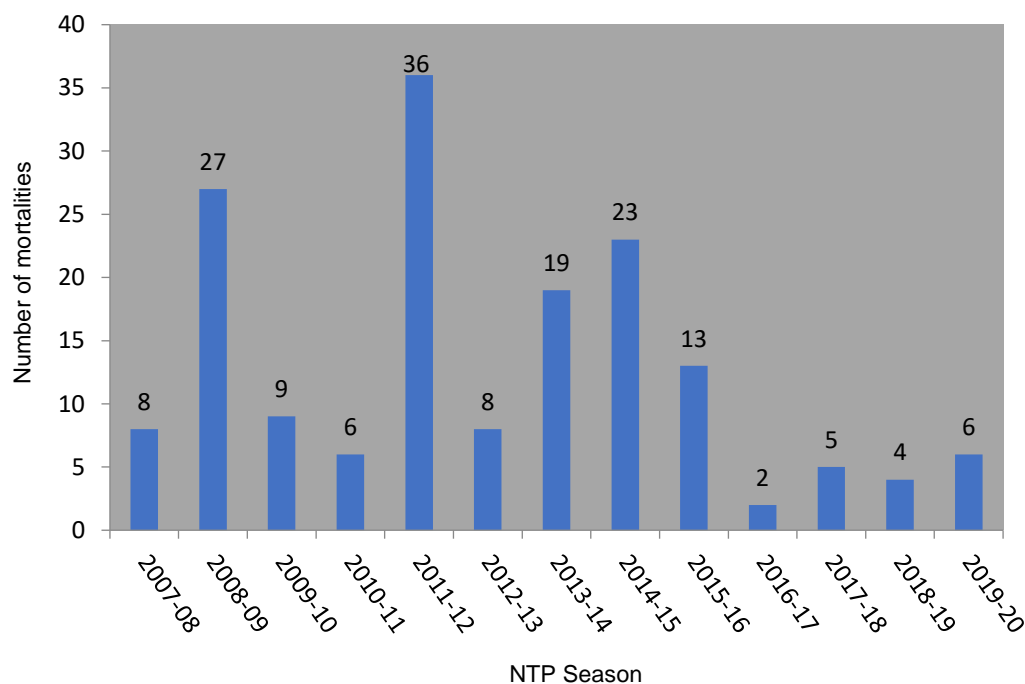
Figure 21: Percentage of new nests damaged by fox or dog per season, NW Cape and Cape Range divisions.

### 3.6 Other observations and data

#### 3.6.1 Turtle mortalities

Turtle mortalities have been recorded as part of NTP since 2007-08 (Figure 22). Six dead turtles were recorded by NTP volunteers during the 2019-20 season in the NW Cape and Cape Range divisions. A further 3 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 highest level of turtle activity recorded since the commencement of the program. 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 22:** Turtle mortalities recorded during the NTP per season, from NW Cape and Cape Range divisions.

### 3.6.2 Rescues of stranded turtles

Five turtles were rescued during the 2019-20 monitoring by NTP volunteers and staff: 4 in the NW Cape and Cape Range divisions; and 1 in the Ningaloo division (Janes Bay subsections). At least 281 stranded marine turtles 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 are not reported here, e.g., Parks and Wildlife staff routinely “flip” stranded turtles that have been turned over by the waves on the shoreline while patrolling remote beaches.

### 3.6.3 Re-sightings of tagged turtles

Four tagged turtles were re-sighted during the 2019-20 season by NTP volunteers (Table 5).

**Table 5:** Tagged turtle re-sighting details during NTP 2019-20 season.

Tag	Species	Gender	Date tagged	Location tagged	CCL when tagged	Date resighted	Location resighted	CCL when resighted
WA7573	Green	Female	23/11/98	Wobiri	1025mm	13/12/19 & 21/01/20	Hunters	1040mm
WA21742	Green	Female	7/12/93	Wobiri	980mm	7/12/19	Five Mile	990mm
WA78094	Green	Female	-	-	-	28/12/19	Trisel	-
WA28654	Green	Female	14/01/96	Five Mile	1040mm	26/01/20	Five Mile	-



### **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 2019-20 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 continued 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.

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- Personal communications
- Clausen L. Department of Biodiversity, Conservation and Attractions, Exmouth District, 20 Nimitz St Exmouth, Western Australia
- Whiting A. Consultant. PO Box 1212, Bentley, Western Australia

## 6.0 APPENDICES

### Appendix 1: Survey effort and turtle activity raw data

#### Survey effort\* 2002/03 – 2019/20 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	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			
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	4015	
	Hunters	248	263	271	271	256	252	173	117	114	109	111	117	120	123	111	121	116	117	3010	
	Lighthouse Bay	127	137	215	260	222	251	147	83	93	97	106	113	113	119	106	100	115	115	2519	
	Navy Pier	-	86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	86
	Tantabiddi	115	3	-	85	86	84	58	38	37	36	41	38	43	41	39	41	39	39	39	863
Cape Range	Bloodwood	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	
	Bungelup	1	49	152	114	120	140	124	72	87	91	78	114	91	85	82	81	81	80	1642	
	Turquoise Bay	-	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16	
	Boat Harbour	-	-	203	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	203
Bundera/ Ningaloo	Carbaddaman	7	-	204	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	211	
	Janes Bay	13	24	12	29	22	4	-	-	-	-	-	-	-	-	-	-	17	17	138	
	Norwegian Bay	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	
Coral Bay	Whaleback Beach	-	7	8	-	-	-	-	-	-	-	-	-	-	-	-	-	17	17	49	
	Batemans Bay	103	100	117	51	76	47	34	-	-	-	-	-	-	-	-	-	-	-	528	
	Lagoon	103	100	116	51	76	47	34	-	-	-	-	-	-	-	-	-	-	-	527	
Gnaraloo	Turtle Beach	56	100	66	49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	271	
	Gnaraloo Bay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17	17	34	
Total survey effort	940	1265	1738	1278	1199	1161	804	470	484	477	498	554	552	561	512	514	556	556	14119		
Number subsections monitored	22	29	28	20	19	19	18	14	14	14	14	14	14	14	14	14	21	21	323		

\* 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 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	TOTAL or AVERAGE
<b>Survey Dates for entire season</b>	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	
Green nests	1539	1552	788	4695	4349	5254	6297	571	2732	6594	585	2276	628	759	1856	2518	2733	1184	<b>46910</b>
Green false crawls	5404	3086	2533	9948	14395	13156	12608	1451	6507	22865	1769	4960	1465	1357	4243	7306	8082	3216	<b>124351</b>
Green activity	6943	4638	3321	14643	18744	18410	18905	2022	9239	29459	2354	7236	2093	2116	6099	9824	10815	<b>4400</b>	<b>171261</b>
<b>Green activity adjusted by survey effort per day</b>	<b>7.39</b>	<b>3.67</b>	<b>1.91</b>	<b>11.46</b>	<b>15.63</b>	<b>15.86</b>	<b>23.51</b>	<b>4.30</b>	<b>19.09</b>	<b>61.76</b>	<b>4.73</b>	<b>13.06</b>	<b>3.79</b>	<b>3.77</b>	<b>11.91</b>	<b>19.11</b>	<b>19.45</b>	<b>7.91</b>	<b>13.80</b>
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%	<b>28.2%</b>
Hawksbill nests	48	81	100	108	157	156	336	202	189	65	125	69	91	75	67	70	63	74	<b>2076</b>
Hawksbill false crawls	49	60	139	71	153	145	207	202	132	84	192	51	108	65	89	99	104	60	<b>2010</b>
Hawksbill activity	97	141	239	179	310	301	543	404	321	149	317	120	199	140	156	169	167	134	<b>4086</b>
<b>Hawksbill activity adjusted by survey effort per day</b>	<b>0.10</b>	<b>0.11</b>	<b>0.14</b>	<b>0.14</b>	<b>0.26</b>	<b>0.26</b>	<b>0.68</b>	<b>0.86</b>	<b>0.66</b>	<b>0.31</b>	<b>0.64</b>	<b>0.22</b>	<b>0.36</b>	<b>0.25</b>	<b>0.30</b>	<b>0.33</b>	<b>0.30</b>	<b>0.24</b>	<b>0.34</b>
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%	<b>50.0%</b>
Loggerhead nests	288	387	777	1068	540	795	580	288	405	382	304	430	436	519	696	392	481	379	<b>9147</b>
Loggerhead false crawls	429	359	1040	925	477	954	486	471	388	715	466	595	580	583	1395	1086	730	725	<b>12404</b>
Loggerhead activity	717	746	1817	1993	1017	1749	1066	759	793	1097	770	1025	1016	1102	2091	1478	1211	1104	<b>21551</b>
<b>Loggerhead activity adjusted by survey effort per day</b>	<b>0.76</b>	<b>0.59</b>	<b>1.05</b>	<b>1.56</b>	<b>0.85</b>	<b>1.51</b>	<b>1.33</b>	<b>1.61</b>	<b>1.64</b>	<b>2.30</b>	<b>1.55</b>	<b>1.85</b>	<b>1.84</b>	<b>1.96</b>	<b>4.08</b>	<b>2.88</b>	<b>2.18</b>	<b>1.99</b>	<b>1.75</b>
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%	<b>42.8%</b>
Unidentified nests	29	123	59	42	33	61	38	8	18	7	7	20	19	4	7	6	12	8	<b>501</b>
Unidentified false crawls	44	20	82	45	19	29	12	8	9	4	12	17	14	3	3	7	17	14	<b>359</b>
Unidentified activity	73	143	141	87	52	90	50	16	27	11	19	37	33	7	10	13	29	22	<b>860</b>
Total all species nests	1904	2143	1724	5913	5079	6266	7251	1069	3344	7048	1021	2795	1174	1357	2626	2986	3289	1645	<b>58634</b>
<b>Total new nests (all three species) adjusted by survey effort per day</b>	<b>2.03</b>	<b>1.69</b>	<b>0.99</b>	<b>4.63</b>	<b>4.40</b>	<b>5.40</b>	<b>9.02</b>	<b>2.27</b>	<b>6.91</b>	<b>14.78</b>	<b>2.05</b>	<b>5.05</b>	<b>2.13</b>	<b>2.42</b>	<b>5.13</b>	<b>5.81</b>	<b>5.92</b>	<b>2.96</b>	<b>4.64</b>
Total all species false crawls	5925	3536	3794	10989	15044	14284	13314	1451	7038	23668	2439	5623	2167	2008	5730	8498	8933	4015	<b>138456</b>
Total activity	7829	5679	5518	16902	20123	20550	20565	2520	10382	30716	3460	8418	3341	3365	8356	11484	12222	5660	<b>197090</b>
<b>Total turtle activity adjusted by survey effort per day</b>	<b>8.3</b>	<b>4.5</b>	<b>3.2</b>	<b>13.2</b>	<b>16.9</b>	<b>17.7</b>	<b>25.6</b>	<b>5.4</b>	<b>21.4</b>	<b>64.4</b>	<b>7.0</b>	<b>15.2</b>	<b>6.1</b>	<b>6.0</b>	<b>16.3</b>	<b>22.3</b>	<b>22.0</b>	<b>10.2</b>	

### Survey effort\* 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	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	
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	1828
	Hunters	72	78	84	81	75	75	72	50	81	84	78	81	84	84	78	81	81	81	1400
	Lighthouse Bay	53	34	56	77	75	75	72	39	77	84	78	81	84	83	78	80	81	81	1288
	Tantabiddi	9	-	-	27	25	25	24	17	27	28	26	27	28	28	28	27	27	27	400
Cape Range	Bungelup	0	11	71	66	69	60	60	30	79	84	75	78	84	82	79	80	81	80	1169
Total survey effort*		191	223	323	358	344	335	324	206	372	392	361	375	392	389	370	376	378	376	6085
Number subsections monitored		11	12	12	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	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	15/12/14-11/1/15	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	
Green new nests	587	475	266	1548	1650	1721	3103	239	2270	5683	422	1714	459	554	1449	1919	2082	896	27037
Green new nests adjusted by survey effort per day	<b>3.07</b>	<b>2.13</b>	<b>0.82</b>	<b>4.32</b>	<b>4.80</b>	<b>5.14</b>	<b>9.58</b>	<b>1.16</b>	<b>6.10</b>	<b>14.50</b>	<b>1.17</b>	<b>4.57</b>	<b>1.17</b>	<b>1.42</b>	<b>3.92</b>	<b>5.10</b>	<b>5.51</b>	<b>2.38</b>	<b>4.27</b>
Green false crawls	1821	1328	785	4217	5138	4959	5226	634	5322	20501	1314	4098	1092	939	3495	6051	6397	2582	75899
Green activity	2408	1803	1051	5765	6788	6680	8329	873	7592	26184	1736	5812	1551	1493	4944	7970	8479	3478	102936
Green activity adjusted by survey effort per day	<b>12.61</b>	<b>8.09</b>	<b>3.25</b>	<b>16.10</b>	<b>19.73</b>	<b>19.94</b>	<b>25.71</b>	<b>4.24</b>	<b>20.41</b>	<b>66.80</b>	<b>4.81</b>	<b>15.50</b>	<b>3.96</b>	<b>3.84</b>	<b>13.36</b>	<b>21.20</b>	<b>22.43</b>	<b>9.25</b>	<b>16.18</b>
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%	27.4%
Hawksbill new nests	17	14	31	45	67	48	193	98	155	60	114	51	73	52	50	56	46	50	1220
Hawksbill new nests adjusted by survey effort per day	<b>0.09</b>	<b>0.06</b>	<b>0.10</b>	<b>0.13</b>	<b>0.19</b>	<b>0.14</b>	<b>0.60</b>	<b>0.48</b>	<b>0.42</b>	<b>0.15</b>	<b>0.32</b>	<b>0.14</b>	<b>0.19</b>	<b>0.13</b>	<b>0.14</b>	<b>0.15</b>	<b>0.12</b>	<b>0.13</b>	<b>0.20</b>
Hawksbill false crawls	20	14	49	33	80	38	119	106	109	79	183	43	81	43	63	69	72	42	1243
Hawksbill activity	37	28	80	78	147	86	312	204	264	139	297	94	154	95	113	125	118	92	2463
Hawksbill activity adjusted by survey effort per day	<b>0.19</b>	<b>0.13</b>	<b>0.25</b>	<b>0.22</b>	<b>0.43</b>	<b>0.26</b>	<b>0.96</b>	<b>0.99</b>	<b>0.71</b>	<b>0.35</b>	<b>0.82</b>	<b>0.25</b>	<b>0.39</b>	<b>0.24</b>	<b>0.31</b>	<b>0.33</b>	<b>0.31</b>	<b>0.24</b>	<b>0.41</b>
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%	49.0%
Loggerhead new nests	52	78	324	544	306	380	320	136	383	368	282	379	398	462	668	375	388	307	6150
Loggerhead new nests adjusted by survey effort per day	<b>0.27</b>	<b>0.35</b>	<b>1.00</b>	<b>1.52</b>	<b>0.89</b>	<b>1.13</b>	<b>0.99</b>	<b>0.66</b>	<b>1.03</b>	<b>0.94</b>	<b>0.78</b>	<b>1.01</b>	<b>1.02</b>	<b>1.19</b>	<b>1.81</b>	<b>1.00</b>	<b>1.03</b>	<b>0.82</b>	<b>0.97</b>
Loggerhead false crawls	141	128	449	484	244	557	218	214	349	681	432	566	541	530	1350	1042	603	649	9178
Loggerhead activity	193	206	773	1028	550	937	538	350	732	1049	714	945	939	992	2018	1417	991	956	14372
Loggerhead activity adjusted by survey effort per day	<b>1.01</b>	<b>0.92</b>	<b>2.39</b>	<b>2.87</b>	<b>1.60</b>	<b>2.80</b>	<b>1.66</b>	<b>1.70</b>	<b>1.97</b>	<b>2.68</b>	<b>1.98</b>	<b>2.52</b>	<b>2.40</b>	<b>2.55</b>	<b>5.45</b>	<b>3.77</b>	<b>2.62</b>	<b>2.54</b>	<b>2.41</b>
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%	41.2%
Unidentified new nests	1	10	14	21	13	17	21	3	15	3	6	16	19	4	6	5	7	5	186
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	0.03
Unidentified false crawls	2	7	36	18	9	12	7	3	9	4	9	17	11	1	3	4	4	11	167
Unidentified activity	3	17	50	39	22	29	28	6	24	7	15	33	30	5	9	9	11	16	353
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	0.06
Flatback new nests	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	1	5
Flatback false crawls	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	4	1	6
Flatback activity	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	6	2	11
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	0.001
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%	
Total new nests (all species)	657	577	635	2158	2036	2166	3637	476	2823	6114	826	2160	949	1072	2173	2355	2525	1259	34598
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	5.47
Total false crawls (all species)	1984	1477	1319	4752	5471	5566	5571	957	5789	21265	1938	4724	1725	1513	4911	7166	7080	3285	86493
Total activity	2641	2054	1954	6910	7507	7732	9208	1433	8612	27379	2764	6884	2674	2585	7084	9521	9599	4542	121091
Total turtle activity adjusted by survey effort per day	<b>13.8</b>	<b>9.2</b>	<b>6.0</b>	<b>19.3</b>	<b>21.8</b>	<b>23.1</b>	<b>28.4</b>	<b>7.0</b>	<b>23.2</b>	<b>69.8</b>	<b>7.7</b>	<b>18.4</b>	<b>6.8</b>	<b>6.6</b>	<b>19.1</b>	<b>25.3</b>	<b>25.4</b>	<b>12.1</b>	<b>19.10</b>



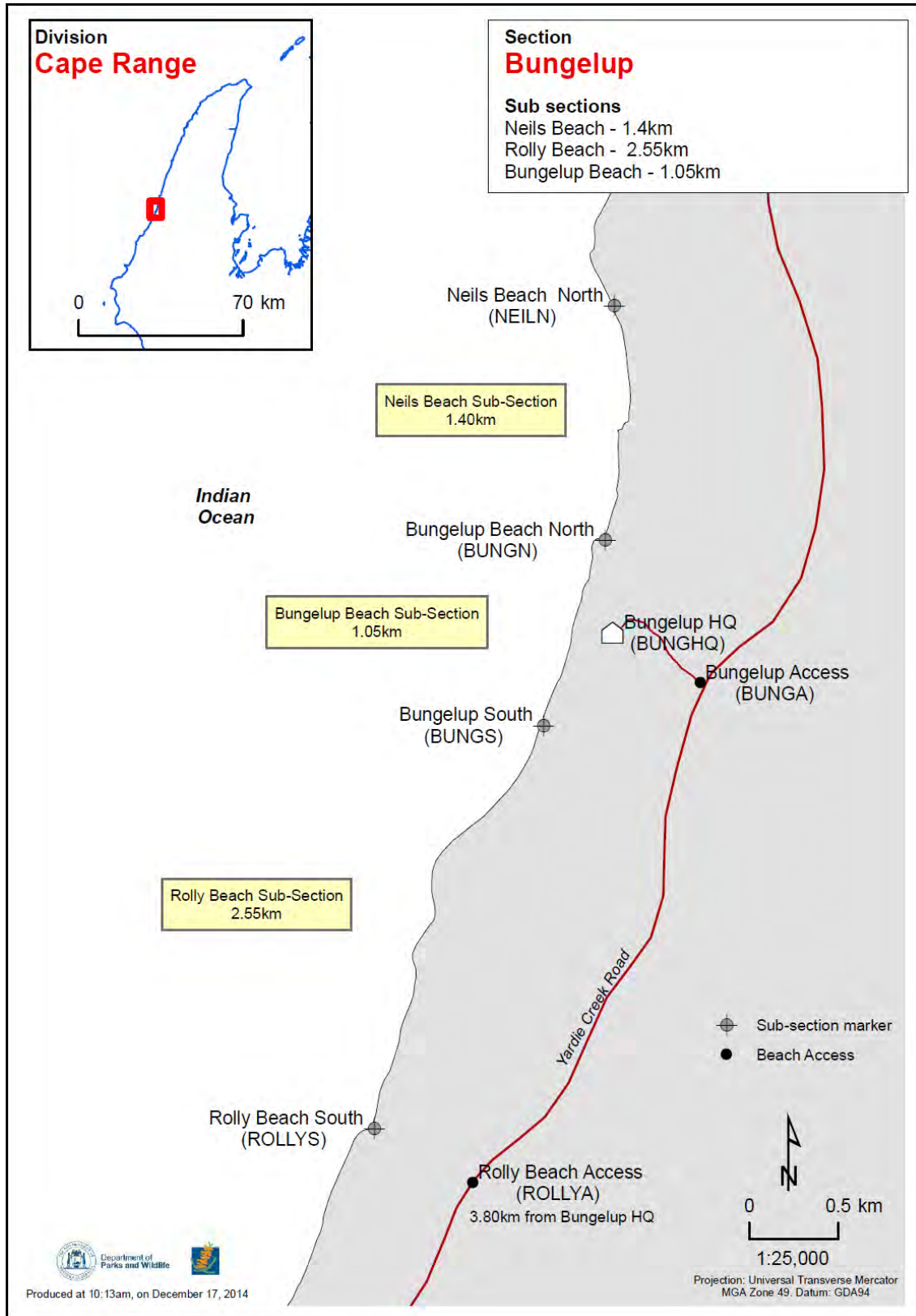


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**Location and distance of each subsection within NW Cape division.**

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

**Appendix 3: Zoning and subsection details Cape Range division.**



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**Location and distance of each subsection within Cape Range division.**

<b>Subsection</b>	<b>Location of northern totem</b>	<b>Location of southern totem</b>	<b>Distance (m)</b>
<b>Neils Beach North - Bungelup Beach North</b>	22.26489 S; 113.83277 E	22.27674 S; 113.83231 E	1400
<b>Bungelup North - Bungelup Beach South</b>	22.27674 S; 113.83231 E	22.28613 S; 113.8292 E	1050
<b>Bungelup Beach South - Rolly Beach South</b>	22.28613 S; 113.8292 E	22.30650 S; 113.82062 E	2550



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**Location and distance of each subsection within Janes Bay section.**

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

## Appendix 5: Zoning and subsection details Gnarraloo division



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**Location and distance of each subsection within Gnarraloo division.**

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

## Appendix 6: Lighthouse Bay section - New nests (NTP 2019-20) 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  
2019-2020 (new nests)**

**LIGHTHOUSE SECTION**

Map 2 of 2

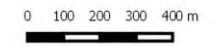
**Legend**

- Subsection locations
- Turtle Nests 2019 -2020
- Green
- Hawksbill
- Loggerhead
- Unidentified
- Flatback



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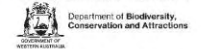
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Projection: MGA Zone 49  
Datum: GDA94



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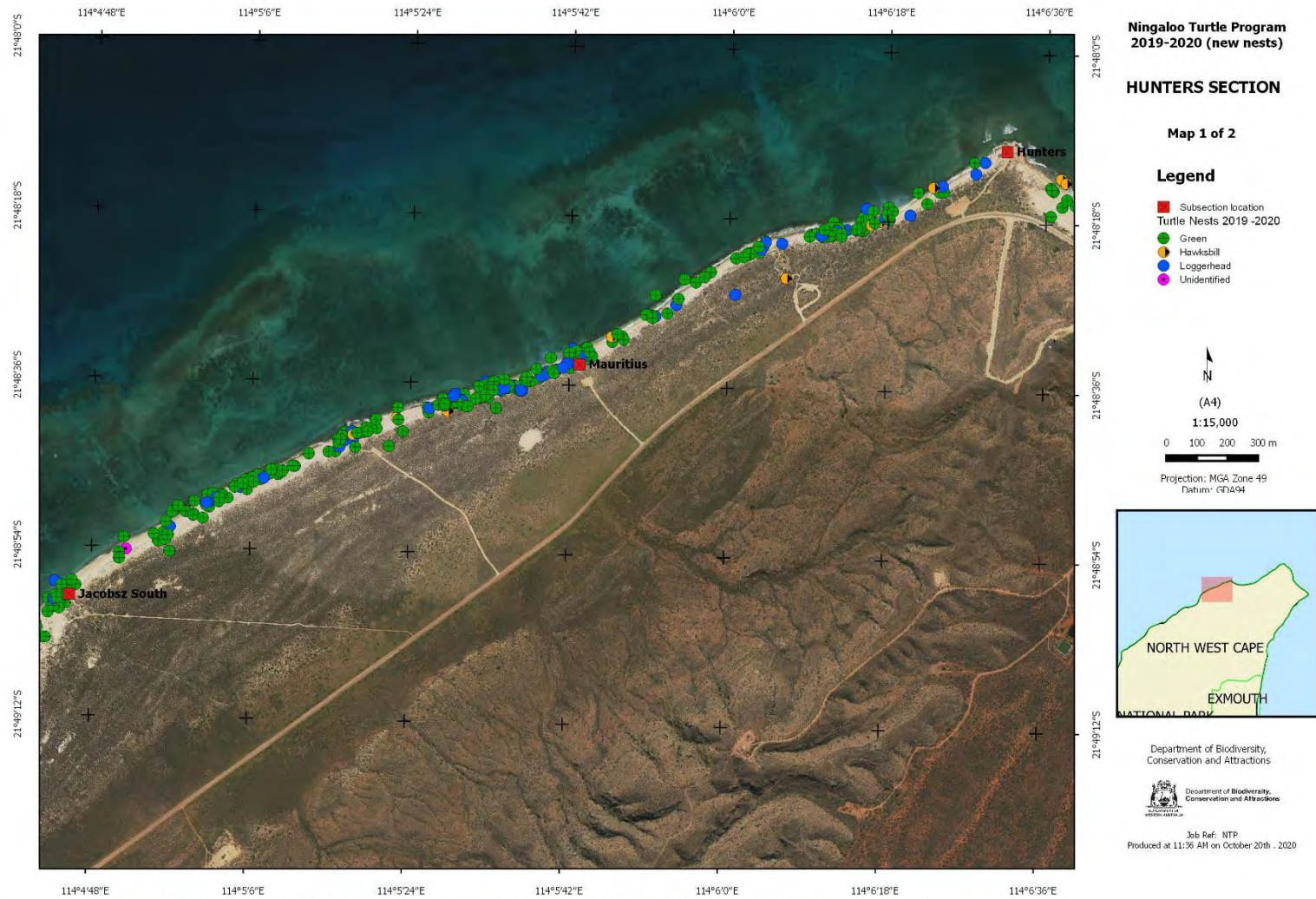
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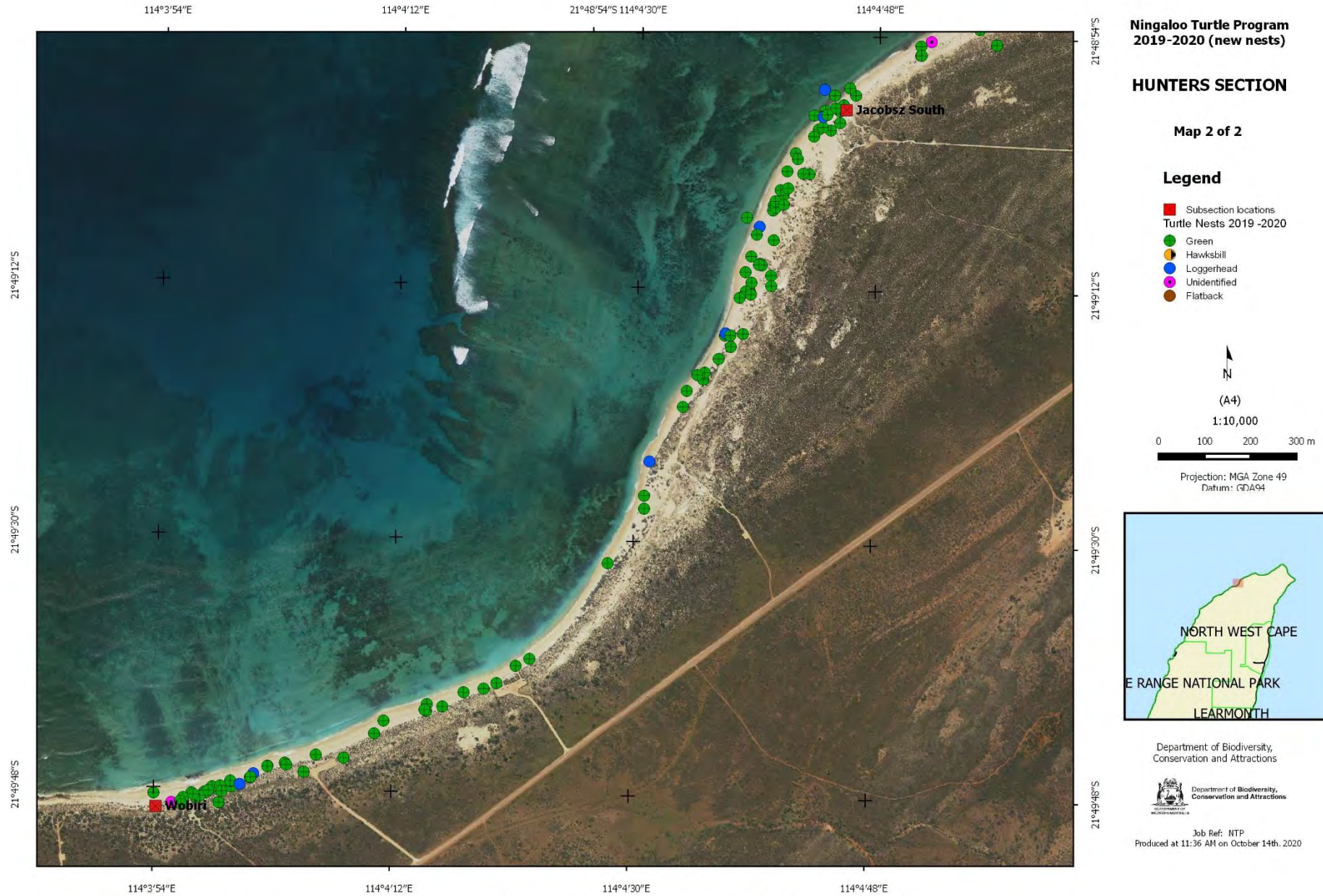
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## Appendix 7: Hunters section - New nests (NTP 2019-20) Map 1 & 2

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.



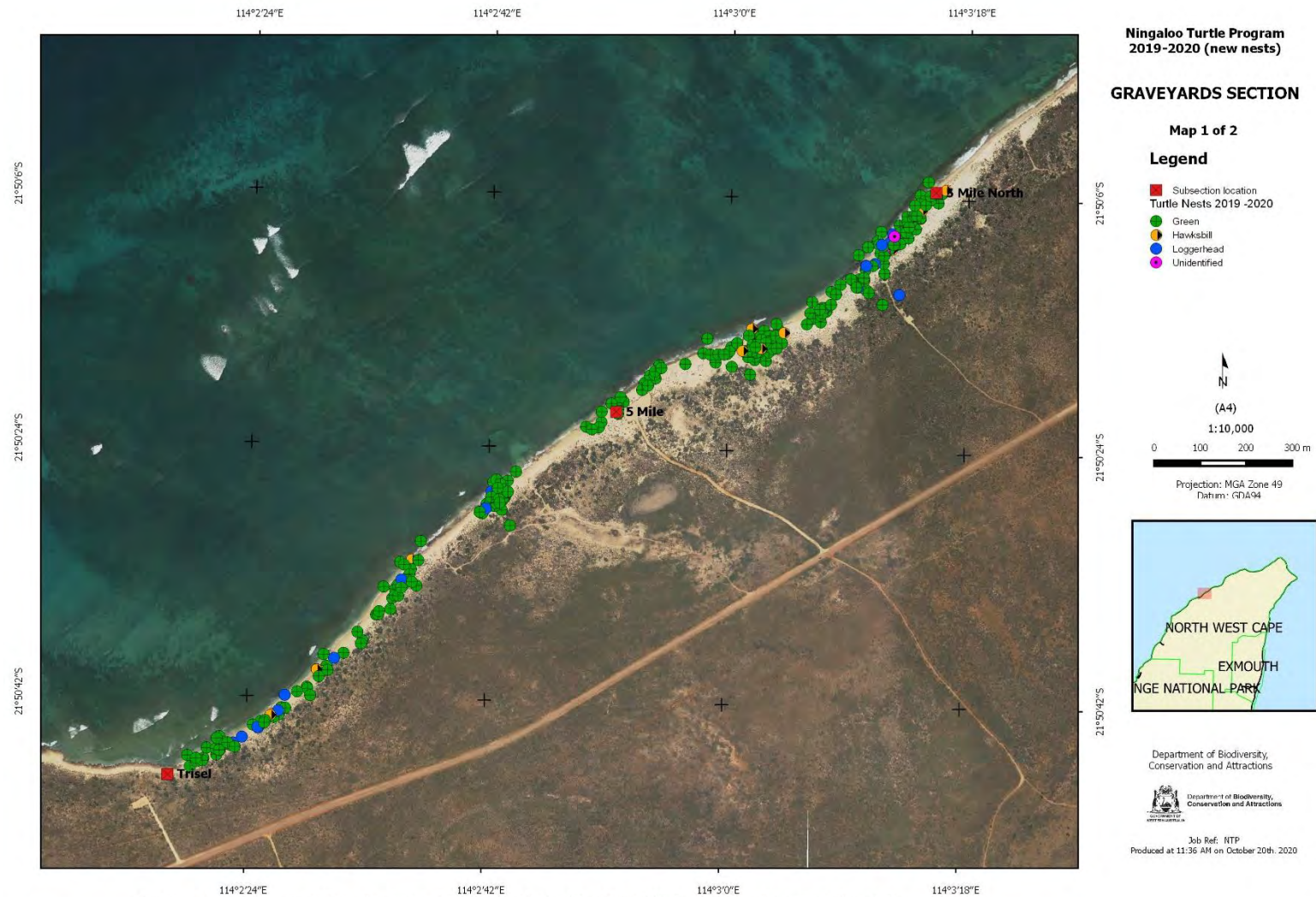
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## Appendix 8: Graveyards section - New nests (NTP 2019-20) Map 1 & 2

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  
2019-2020 (new nests)**

**GRAVEYARDS SECTION**

Map 2 of 2

**Legend**

Turtle Nests 2019 -2020

- Green
- Hawksbill
- Loggerhead
- Unidentified



(A4)

1:12,500

0 100 200 300 m

Projection: MGA Zone 49  
Datum: GDA94



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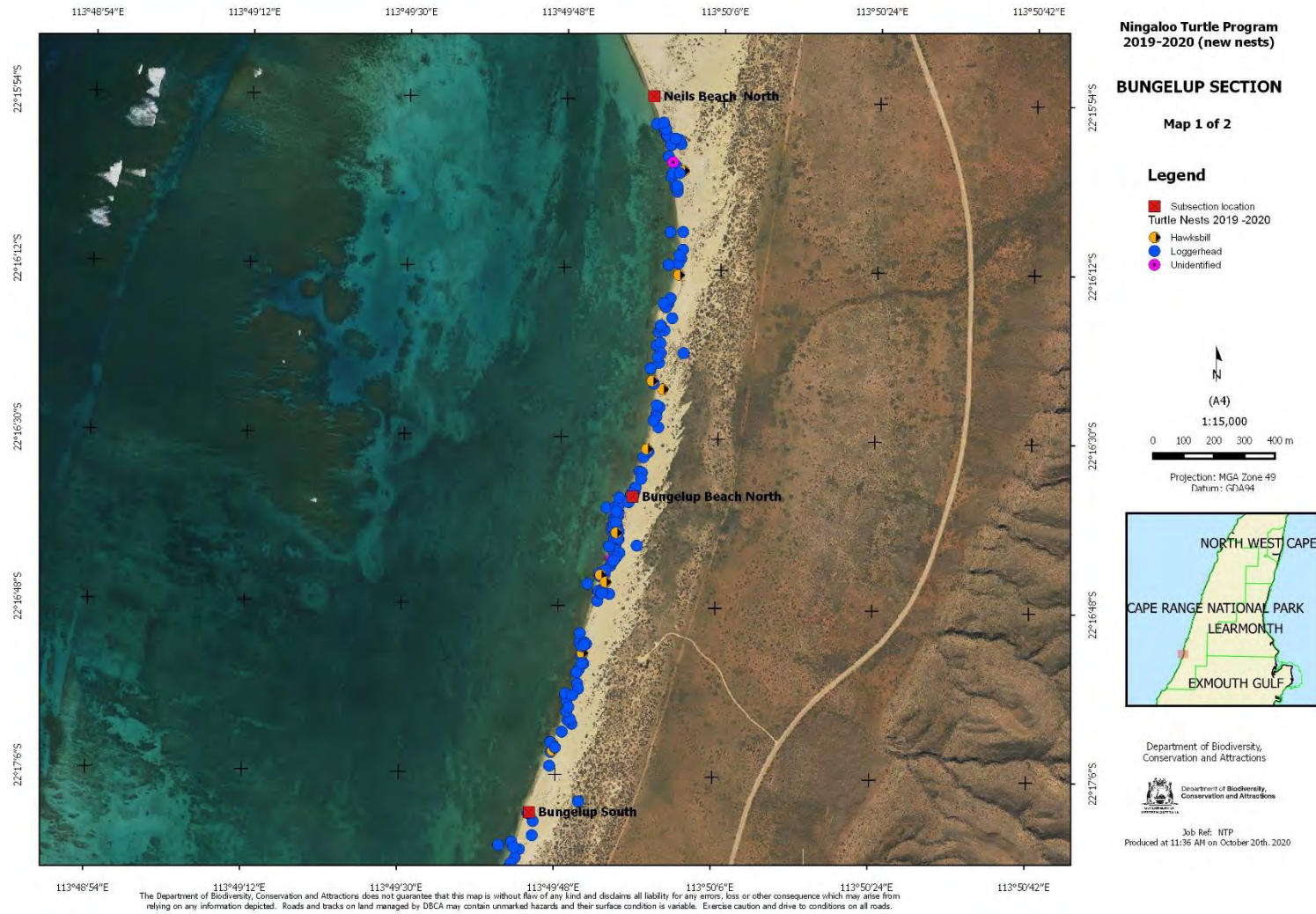
## Appendix 9: Tantabiddi section - New nests (NTP 2019-20) Map 1

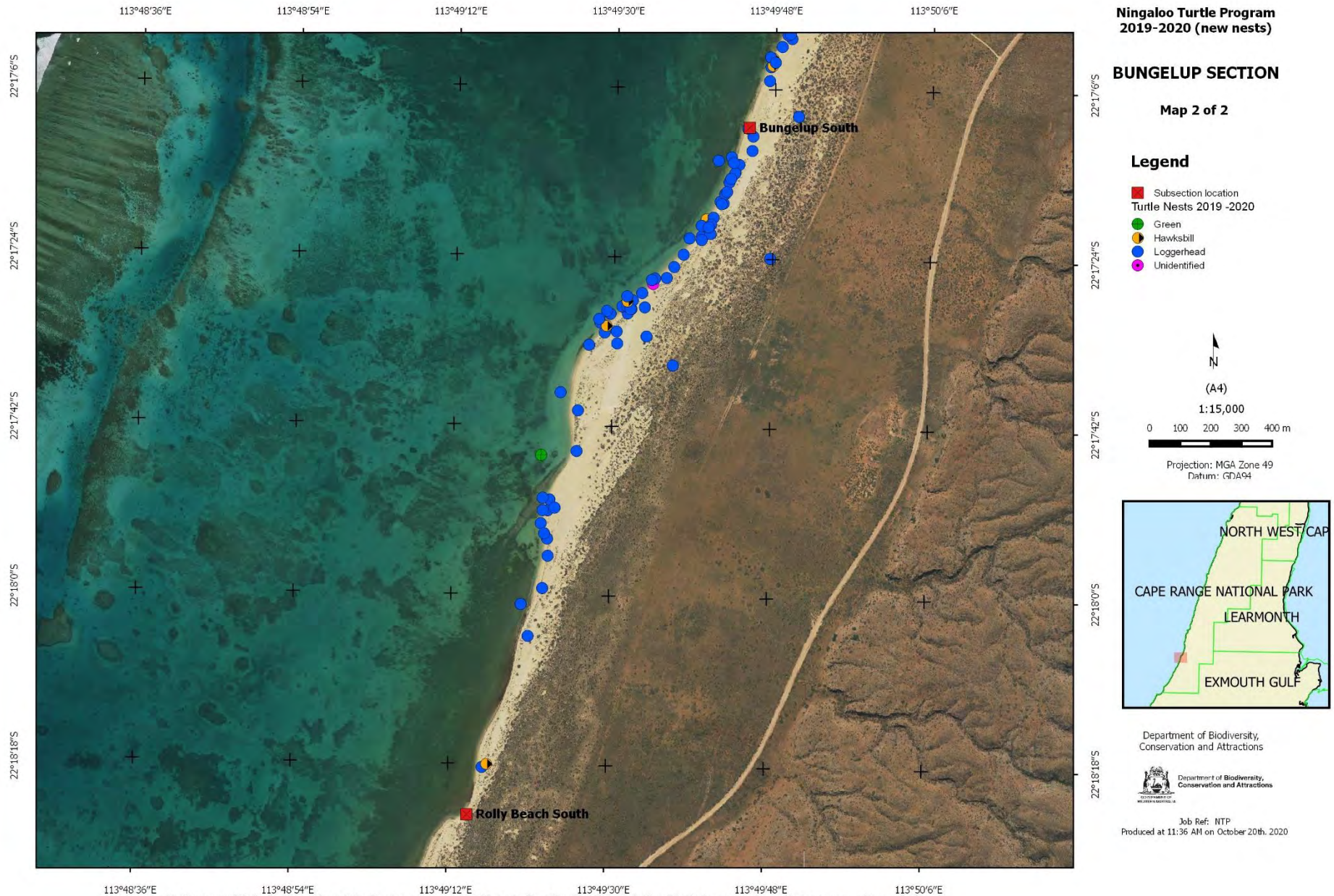
Note: Locations of some nests in the figure may vary from actual locations due to occasional inaccuracies in the GPS. Inaccuracies are considered unlikely to affect illustrations of overall patterns of nesting across the section.



## Appendix 10: Bungelup section - New nests (NTP 2019-20) 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.



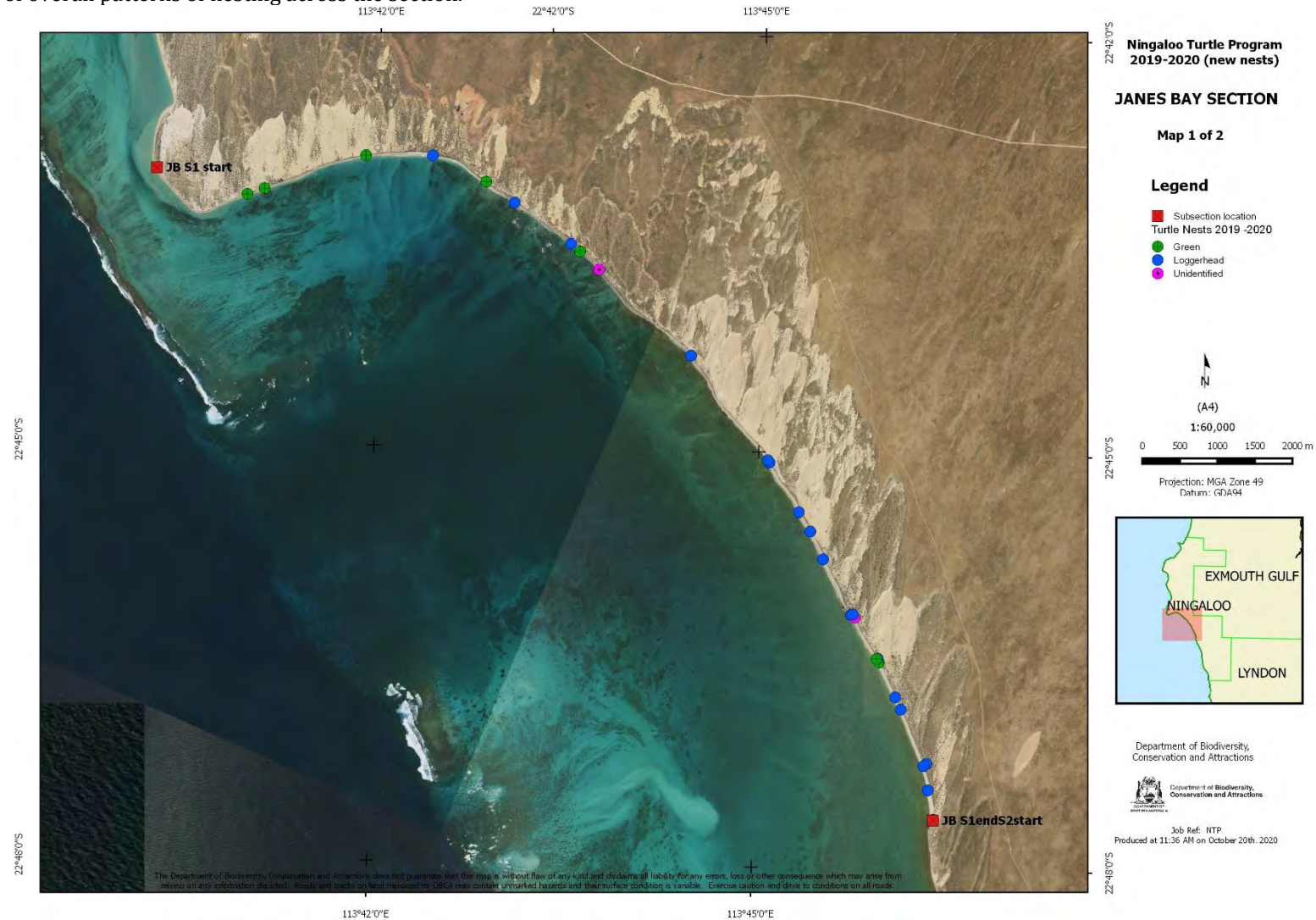


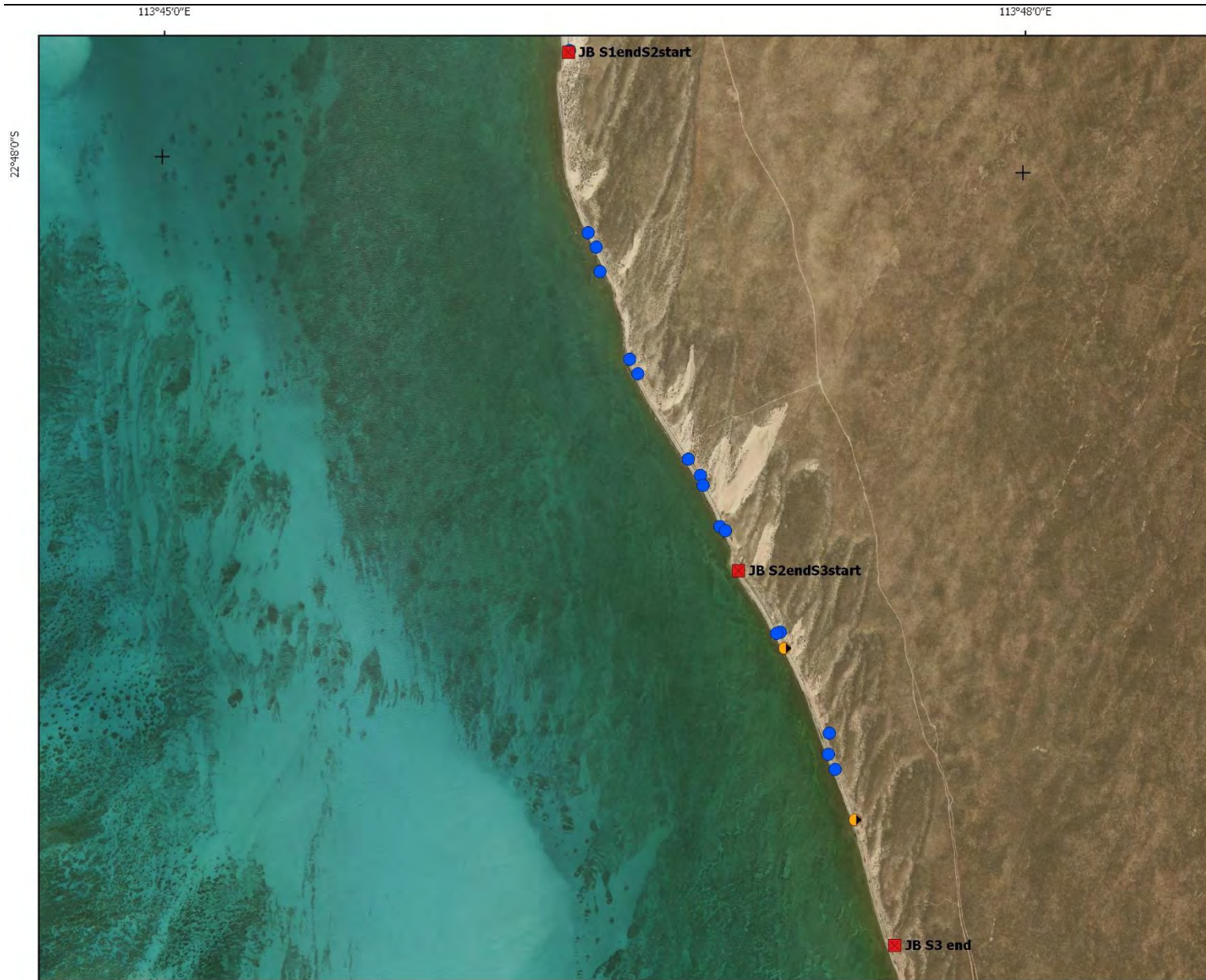
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## Appendix 11: Janes Bay section – New nests (NTP 2019-20) Map 1 & 2 and Whaleback section Map 1

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.





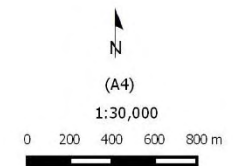
**Ningaloo Turtle Program  
2019-2020 (new nests)**

**JANES BAY SECTION**

**Map 2 of 2**

**Legend**

- Subsection location
- Turtle Nests 2019 -2020**
- Hawksbill
- Loggerhead



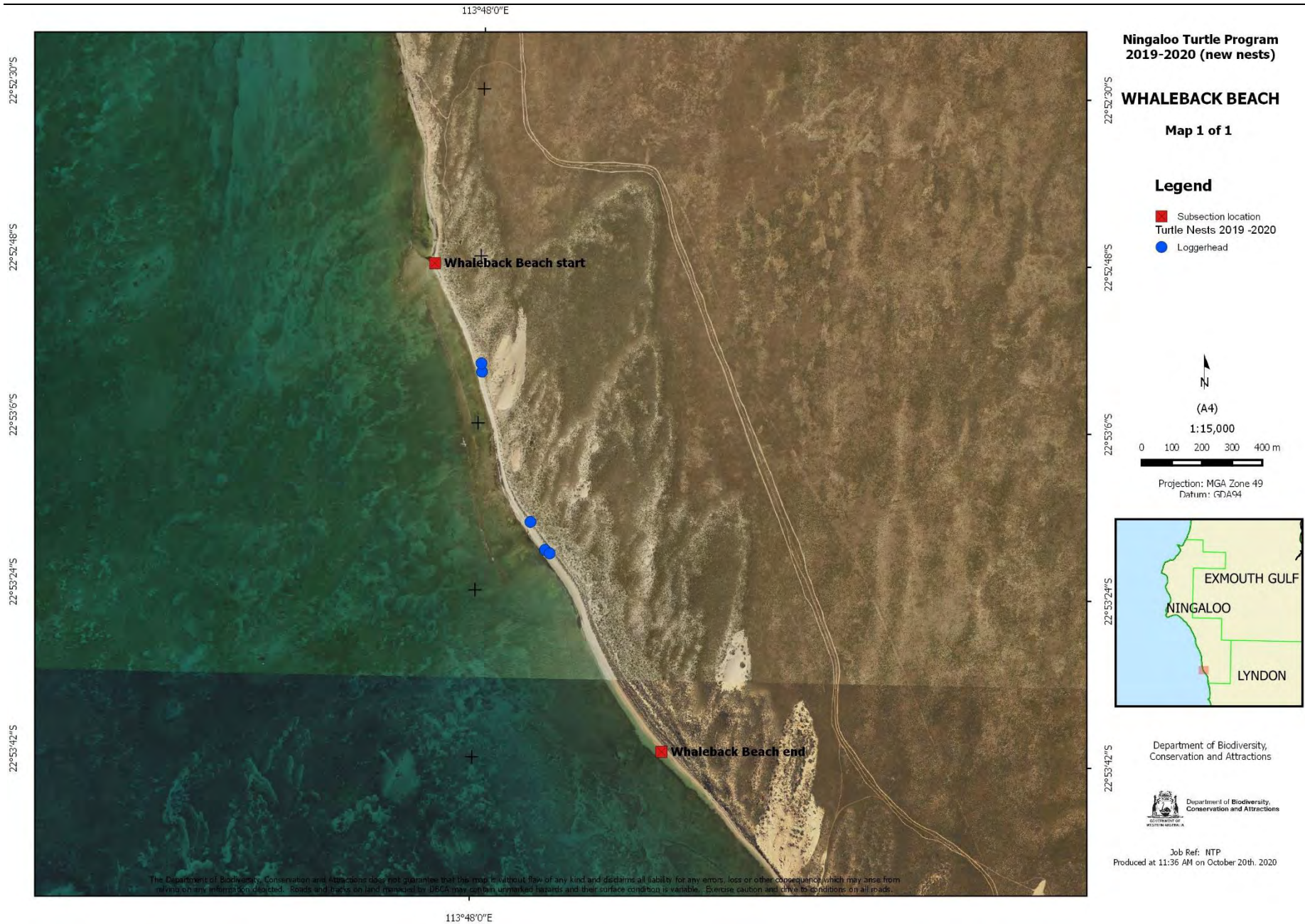
Projection: MGA Zone 49  
Datum: GDA94



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## Appendix 12: Gnarraloo Bay section – New nests (NTP 2019-20) – 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.

