



Ningaloo Turtle Program

Annual Report 2021-22



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DBCA (2022) *Ningaloo Turtle Program Annual Report 2021-2022*. Department of Biodiversity, Conservation and Attractions and the Ningaloo Turtle Program, Exmouth, Western Australia.

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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: the peak period was identified by Whiting (2016) 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** A period which only includes the intensive peak monitoring period to make data comparisons possible between seasons that 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	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
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 Department of Biodiversity, Conservation and Attractions (DBCA), Exmouth District. During the 2021-22 season, NTP sponsors Woodside Energy Ltd made a significant financial contribution to the program and BHP provided support toward the hire of the 'turtle bus.' The program is now run by DBCA, and the primary aim of the NTP is to support the conservation of marine turtles along the Ningaloo coast.

The monitoring design was consistent with previous recent seasons. This included 4 weeks of daily monitoring of turtle activity (nests and false crawls) during the predicted peak period of nesting at both the North West Cape (NW Cape) and Cape Range divisions (referred to hereby as the standardised season) and 3 weekends pre-peak and 3 weekends post-peak at the NW Cape sections only. Janes Bay (Ningaloo Division) and Gnarraloo Bay were not monitored in 2021-22.

The Ningaloo Region recorded 2715 suspected nests and 6037 false crawls over the full 2021-22 season. In the NW Cape division, 94.7% of activities were from green turtles. In the Cape Range division (Bungelup), 93.1% of activities were from loggerhead turtles.

Turtle activity has shown variation across the years since the monitoring program commenced in 2002. Relatively large variations in activity have been particularly evident for green turtles, but less variation in activity is evident for loggerhead and hawksbill turtles. There have been two clear peaks in activity since NTP began, one in 2011-12 and the other in 2020-21. Interestingly, these seasons were both characterised by La Nina weather patterns.

In the 2021-22 standardised season (4 weeks of peak season monitoring), turtle activity for all species combined (nests and false crawls) was below average for both NW Cape and Cape Range divisions. In comparison to long-term averages, for the NW Cape division there were close to the average number of nests by green turtles, above average number of nests for loggerhead turtles and fewer than average nests by hawksbill turtles. For the Cape Range division, there was a below average number of green and hawksbill nests, but slightly above average number of loggerhead nests, compared to long-term averages.

Nesting success was above average for all three species in both divisions.

In the NW Cape division standardised season, an average of 5.8 new green turtle nests were recorded per subsection per day, which is slightly higher than the long-term average of 5.7 nests per day (range from 1.1 to 18.1 since 2002). Nesting success for green turtles was 28.5% (average 26.9%). Loggerhead turtles laid an average of 0.44 nests per subsection per day which is higher than the long-term average of 0.36 (range 0.24 to 0.68 since 2002). The nesting success rate was 46.1% (long-term average of 41%). Hawksbill activity remained relatively low, with 0.13 nests on average per subsection per day. The long-term average is 0.15 nests

per day and the range since 2002 is 0.06 to 0.53 nests per day. Nesting success for hawksbills was 54.2 (long-term average of 47.4%).

In the Cape Range division standardised season, an average of 3.9 loggerhead nests were recorded per subsection per day which is very close to the long-term average of 3.8 nests per day (range 2.5 to 6.4 nests since 2003). Nesting success was 44.6% (average 42.4%). Green turtles laid an average of 0.2 nests per subsection per day (range of 0 to 1.18 with an average of 0.28), and nesting success was 57.1%, well above the average of 30.6%. Hawksbill activity remained relatively small as expected, with 0.15 nests per subsection per day, lower than the average of 0.40 (range of 0.03 to 1.53 since 2003). Nesting success (75%) was above average (51.1%). Note the low number of nests for green and hawksbill turtles when interpreting nesting success.

The density of nesting varied throughout subsections. The highest density of green and hawksbill nests (nests per kilometre per day) was in the Five Mile to Five Mile North subsection in the NW Cape division. The Bungelup North to Bungelup South subsection (in the Cape Range division) had the highest density of loggerhead nests.

Forty six nests (all species combined) were assessed as being disturbed, which was 1.7% of the total recorded nests. Thirty six were attributed to ghost crabs, eight to a turtle excavating another turtle's nest, one to bird predation as the eggs were being laid and one unknown. No disturbances were attributed to introduced predators (dog, fox, cat) or dingo.

During 2021-22, volunteers rescued 15 stranded turtles, contributing to at least 345 recorded rescues since 2002. Nine mortalities and one tagged turtle were also reported.

Forty seven volunteers contributed 3460 hours to the Ningaloo Turtle Program in 2021-22. Since commencement of the program, volunteers have contributed over 80,758 hours. These hours demonstrate the effort and essential value of the volunteers over the life of the program. The Communications Internship position contributed to an increased social media following on Facebook, Instagram and YouTube and produced some high quality promotional videos for the NTP.

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 (DBCA), Cape Conservation Group Inc. (CCG), Murdoch University and the World Wildlife Fund – Australia (WWF). The primary aim of the program is to support the conservation of marine turtles along the Ningaloo coast, within the Ningaloo Marine Park and Ningaloo Coast World Heritage Area. This is accomplished through the collection of information such as nesting abundance, distribution and disturbance. This data informs management and conservation by DBCA 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.

Ningaloo Marine Park has regionally and globally significant nesting for ‘endangered’ loggerhead and ‘vulnerable’ green and hawksbill turtles, as listed under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* and *Biodiversity Conservation Act 2016* (State) (Whiting 2016). The loggerhead rookery in Cape Range National Park is regarded as the largest mainland rookery for the Eastern Indian Ocean loggerhead genetic stock (Rob et al 2019).

Volunteers are essential to the success of 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. The funding has contributed 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). Monitoring in the NW Cape and Cape Range divisions now occurs daily over the 28 days of the peak nesting period. Three weekends of monitoring during each of the pre and post peak nesting periods also occurs at NW Cape division.

Trend analyses of the NTP data have been undertaken 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. A more recent analysis incorporating data collected since 2016 is underway and will be available in 2023.

The goals and objectives listed below have been developed through a community-based steering committee (with DBCA and volunteer community representatives) 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 program 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
- Work with traditional owners to share knowledge and actively understand and manage turtles.
- 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

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 on paper data sheets to collecting data using the ODK Collect app, installed on Lenovo tablets (<https://getodk.org/>). This was part of a state-wide initiative across DBCA to standardise and coordinate the collection of data among turtle monitoring programs throughout WA. The app enables the location to be automatically saved when recording a turtle activity and has the benefit of eliminating human error in transcribing GPS coordinates from the GPS to the data sheet. The data from the app are 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 NTP. 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 2021-22. 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 start and end points 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 NW Cape division includes the Lighthouse Bay, Hunters, Graveyards and Tantabiddi sections, which are further divided into 11 subsections (Appendix 2). In 2021-22, each subsection was monitored for 37, 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 2021 to 13 January 2022 (with the exception of 1 Jan) and before the peak period on the weekends of the 6 and 7, 20 and 21 November and 4 and 5 December 2021 and after the peak period on the weekends of the 29 and 30 January and 12 and 13 and 26 and 27 February 2022.

Cape Range division

The Cape Range division includes the Bungelup section, this is divided into three subsections and the South Mandu section (Appendix 3). South Mandu was not monitored in 2021-22. Each subsection of the Cape Range division was monitored for 27 days during the intensive peak period from the 17 December 2021 to 13 January 2022.

Bundera/Ningaloo division

The Bundera/Ningaloo division includes six sections each divided into subsections. DBCA 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 the data have not been included.

Coral Bay division

The Coral Bay division includes two sections: Batemans Bay and The Lagoon, each divided into one or more subsections. This division has not been monitored by NTP since the 2008-09 season. DBCA 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 the 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 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 not monitored in Gnarraloo Bay in 2021-22.

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

3. RESULTS

3.1 Nesting Activity 2021/22

3.1.1 North West Cape division

The NW Cape division recorded 2368 suspected nests and 5629 false crawls during the full 2021-22 season (Table 1). Green turtles were the most active species (nests and false crawls) in the NW Cape division with 94.7% of total turtle activity recorded, followed by loggerheads (3.8%), hawksbills (1.2%), flatbacks (0.013%) and unidentified species (0.2%) (Figure 1).

Table 1: Total activities (suspected nests and false crawls) recorded for each species within the NW Cape division, NTP 2021-22 full season.

Activity	Turtle Species					Total
	Green	Hawksbill	Loggerhead	Flatback	Unidentified	
New nests	2166	50	142	0	10	2368
False crawls	5408	48	164	1	8	5629
Total activity	7574	98	306	1	18	7997

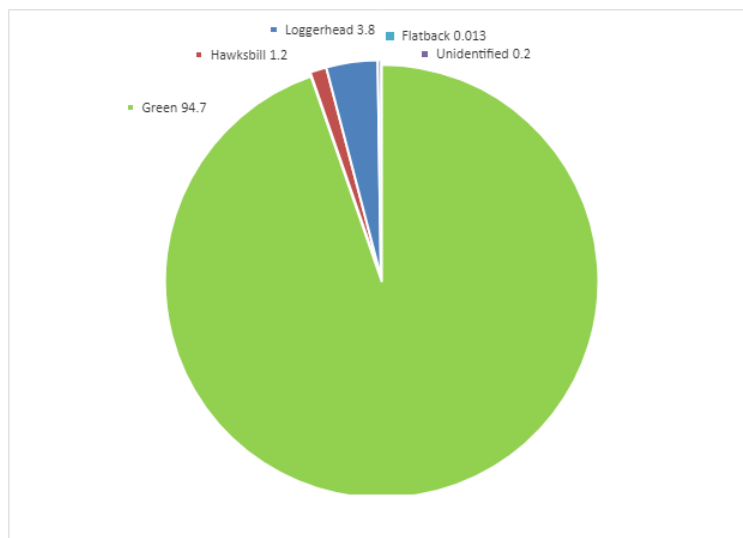


Figure 1: Percentage of activity by species within the NW Cape division, 2021-22 full season.

Nesting success is defined as the number of suspected nests laid as a percentage of total turtle activities. On the NW Cape in 2021-22 (full season), green turtles had a nesting success of 28.6%, loggerheads 46.4% and hawksbills 51%. For a comparison with long term averages, see section 3.2.1.

Green turtles were the most abundant species throughout all sections on the NW Cape. The Lighthouse Bay section had the highest percentage of loggerhead (16.8%) and hawksbill (3%) nests on the NW Cape (Figure 2).

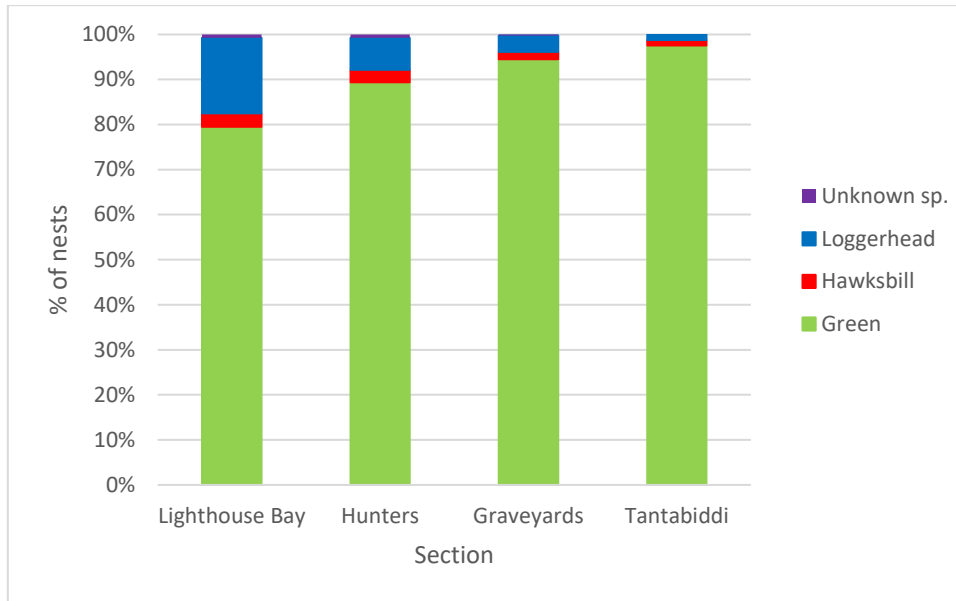


Figure 2: Percentage of nests for each species in each section of the NW Cape division, 2021-22 full season.

The number of nests and false crawls recorded varied among the eleven NW Cape subsections (Figure 3; for section lengths and locations, see Appendix 2). The Jacobzs South to Wobiri subsection had the highest activity, with an average of 8.5 nests and 22.2 false crawls recorded per day. The Mildura Wreck to NW Carpark subsection had the least activity, with an average of 0.7 nests and 3.1 false crawls per day. Jacobsz South to Wobiri and Burrows to Jurabi Point had the most nests with an average of 8.5 nests per day. For individual nest locations see maps in Appendix 4 - Appendix 7.

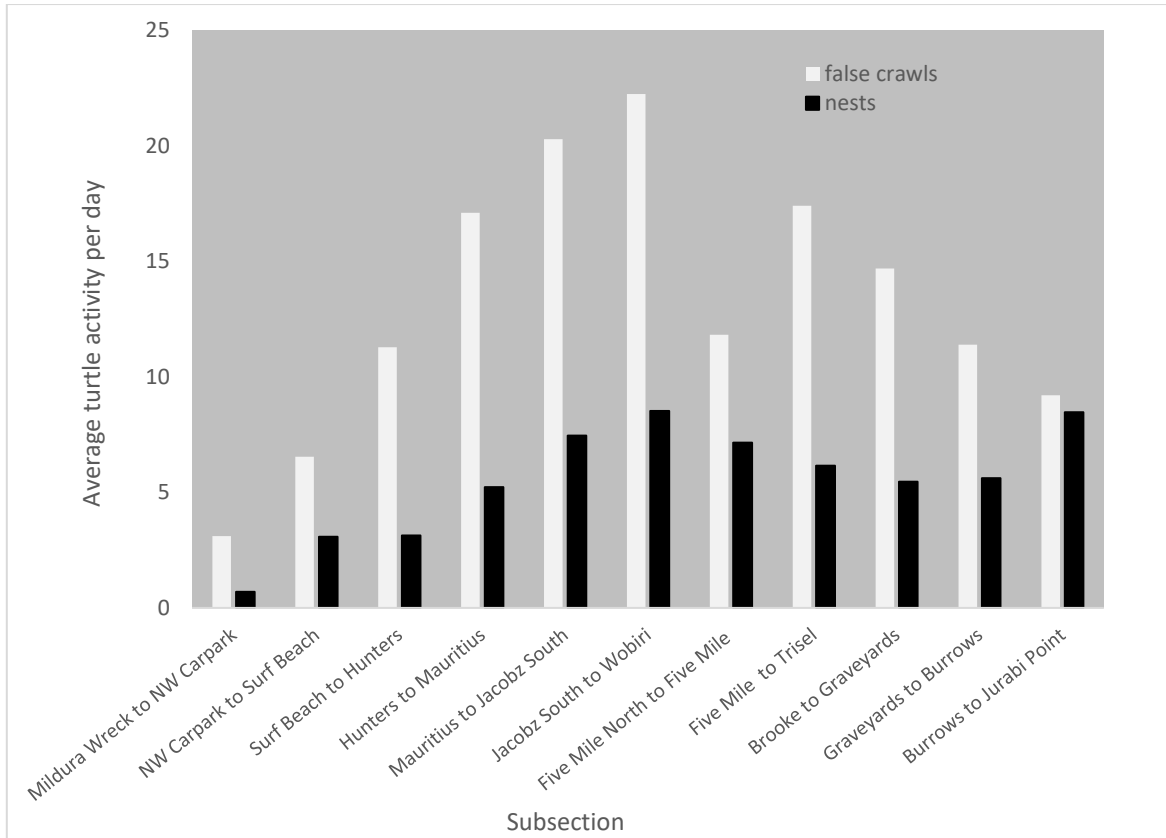


Figure 3: Average number of nests and false crawls per day for all species in each subsection of the NW Cape division, 2021-22 full season.

The density of the nests (nests per kilometre per day) was used to investigate the relative importance of each subsection of beach. The Five Mile North to Five Mile subsection had the densest nesting with an average of 8.9 nests per km per day, followed by the Five Mile to Trisel subsection with an average of 4.7 nests per km per day (Figure 4). Two of the northern subsections, Mildura Wreck to NW Carpark, and Surf Beach to Hunters had the lowest density of nests, with an average of 0.5 and 0.9 nests per km per day respectively.

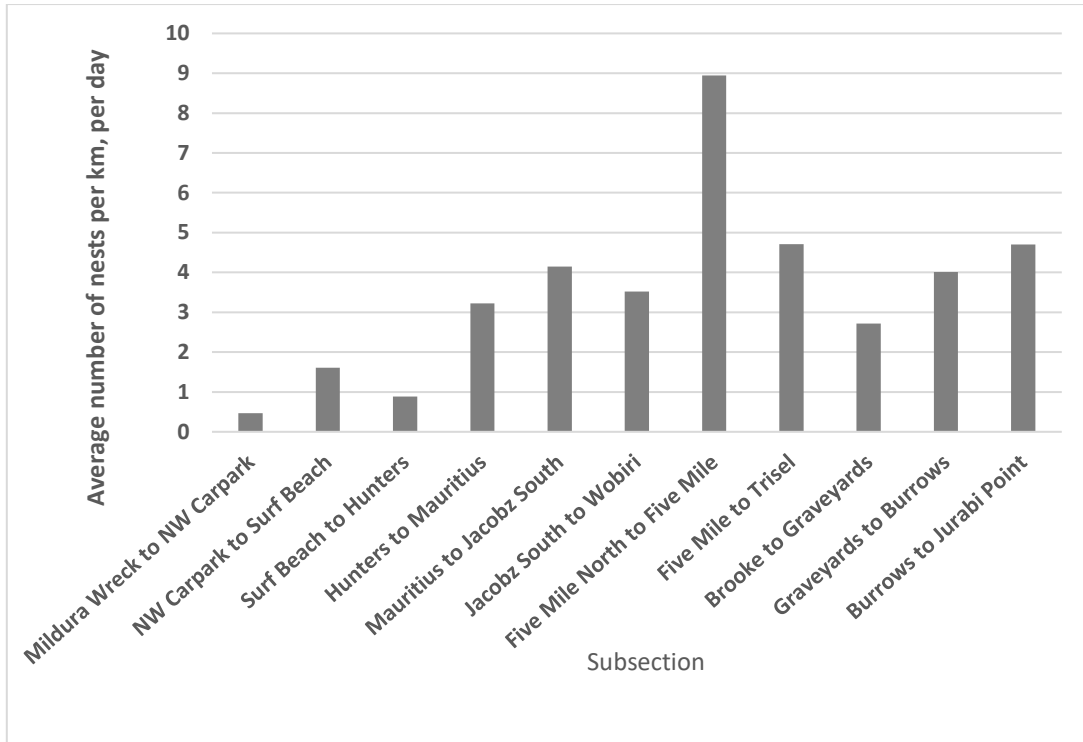


Figure 4: Density (nests per kilometre per day), for each subsection on the NW Cape, NTP 2021-22 full season.

The numbers of nests per day for each species varied during the season in the NW Cape division (Figure 5- green turtles, Figure 6- loggerhead turtles, Figure 7- hawksbill turtles). The peak timing for green and loggerhead turtles appears to be during the period of mid - late December and mid-January. The period of peak nesting for hawksbills appears to be slightly earlier in the season, mid to late December.

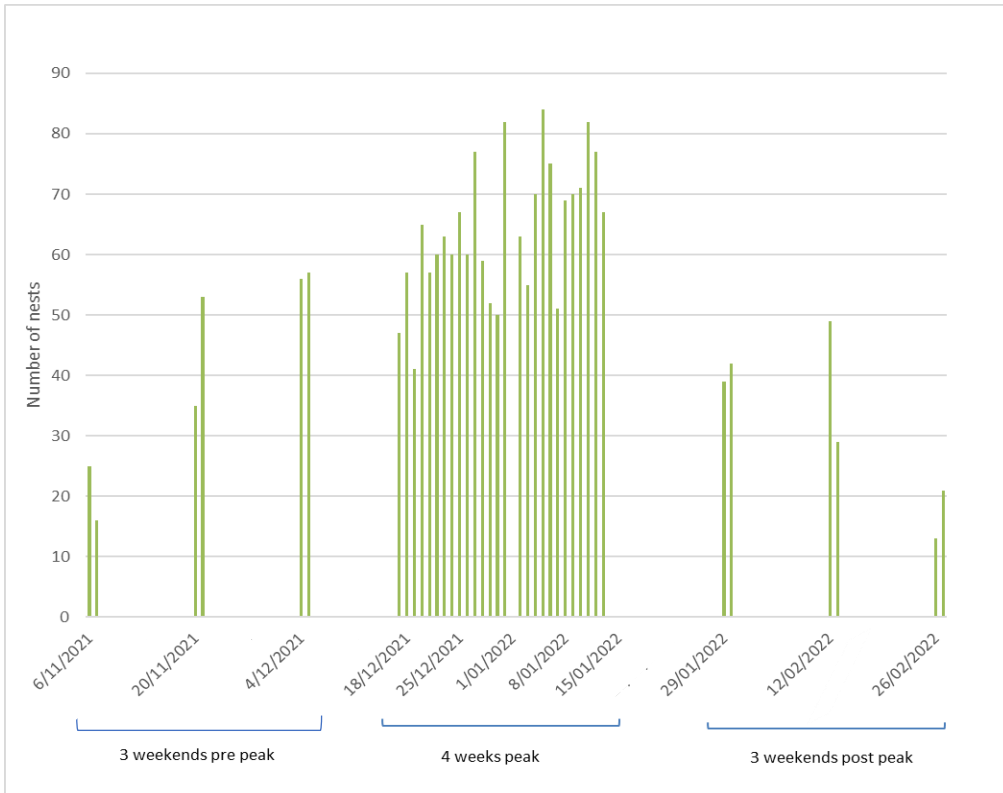


Figure 5: Number of green turtle nests recorded in the NW Cape division per day in the 2021-22 season. Note, no monitoring occurred on 1 January.

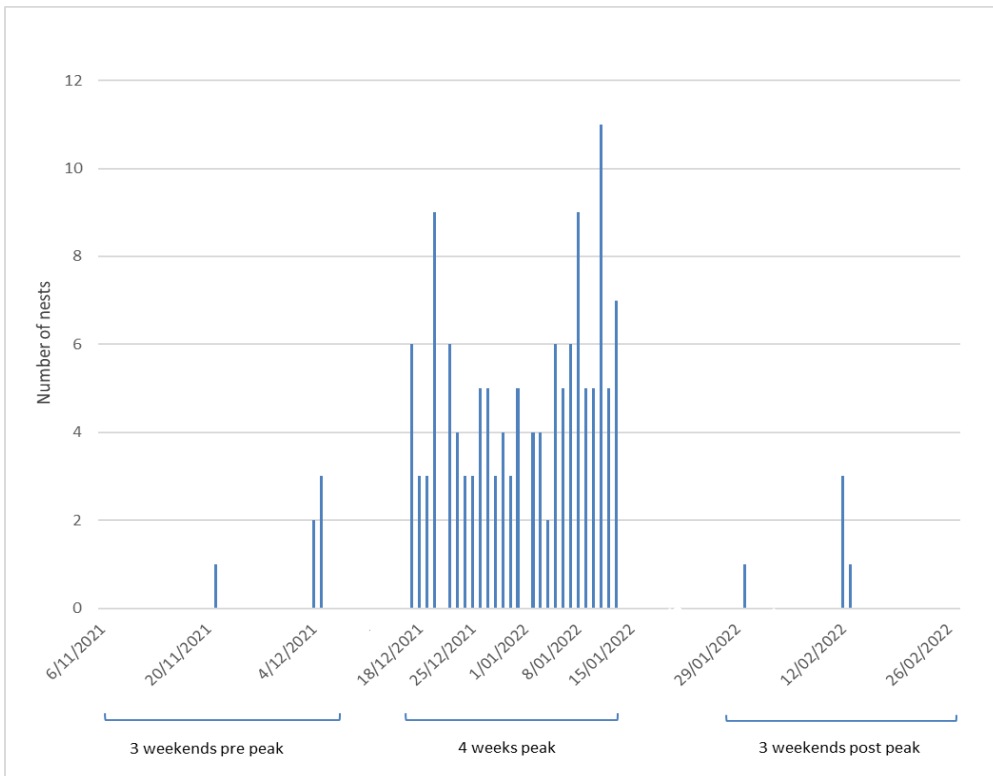


Figure 6: Number of loggerhead turtle nests recorded in the NW Cape division per day in the 2021-22 season. Note, no monitoring occurred on 1 January.

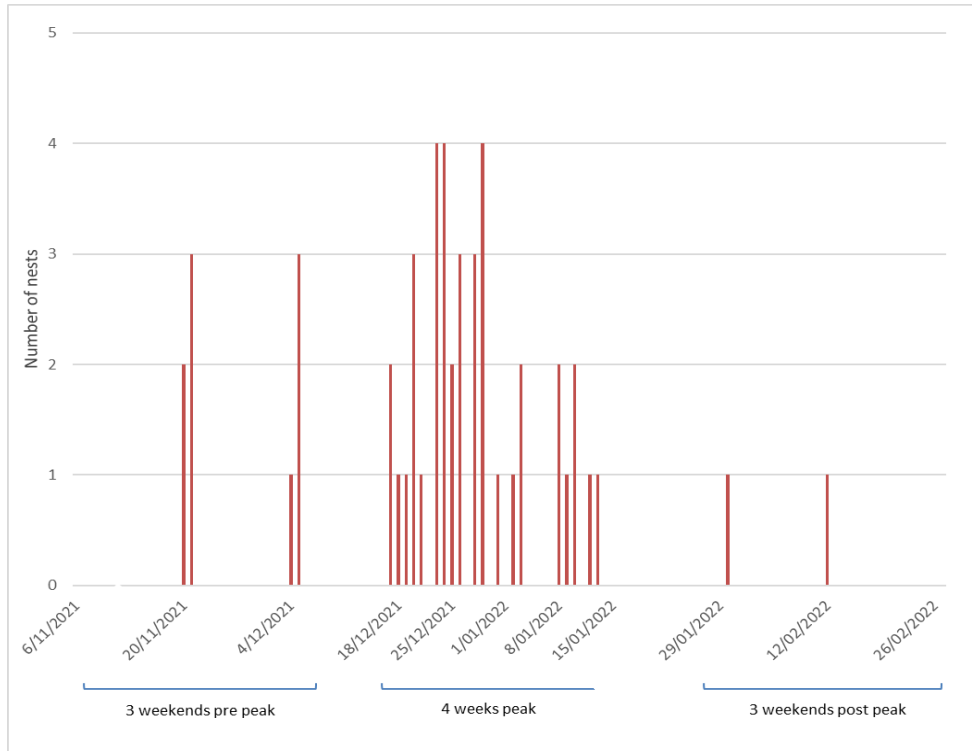


Figure 7: Number of hawksbill turtle nests recorded in the NW Cape division per day in the 2021-22 season. Note, no monitoring occurred on 1 January.

3.1.2 Cape Range division (Bungelup section)

In the Bungelup section, 347 suspected nests and 409 false crawls were recorded during the 2021-2022 NTP season (Table 2). Loggerhead turtle activities were the most common (93.1%), followed by green (3.7%), hawksbill (2.1%), and unidentified turtle species (1.1%) (Figure 8).

Table 2: Total activities (nests and false crawls) recorded for each species within the Bungelup section of Cape Range division, NTP 2021-22 full season.

Bungelup Section	Turtle Species					Total
	Green	Hawksbill	Loggerhead	Flatback	Unidentified	
New nests	16	12	314	0	5	347
False crawls	12	4	390	0	3	409
Total activity	28	16	704	0	8	756

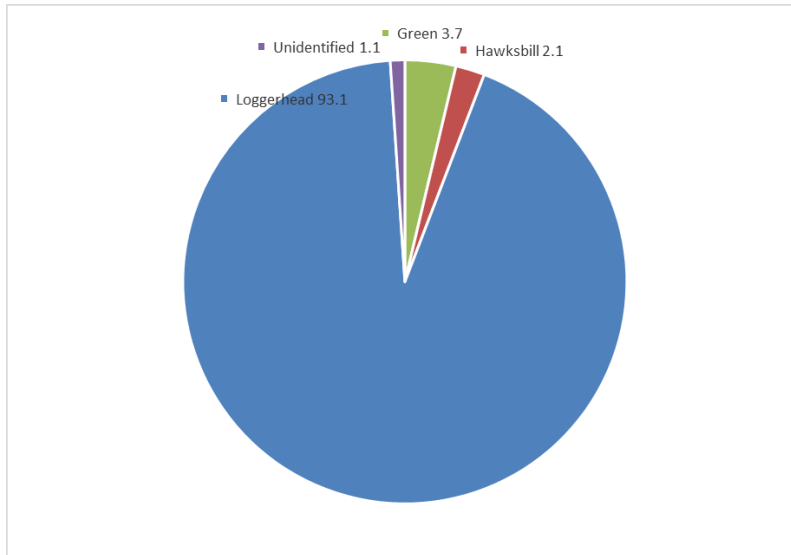


Figure 8: Percentage of turtle activity by species within the Bungelup section of the Cape Range division, 2021-22.

Nesting success (the number of suspected nests laid as a percentage of total turtle activities) in the Bungelup section for loggerhead turtles was 44.6%, green turtles 57.1% and hawksbill turtles 75% (noting small numbers of both green and hawksbill activities). For comparison to long term averages, see section 3.2.2).

Nests from loggerhead turtles were the most abundant throughout all subsections within the Bungelup section (Figure 9), highlighting this area as primarily a loggerhead rookery.

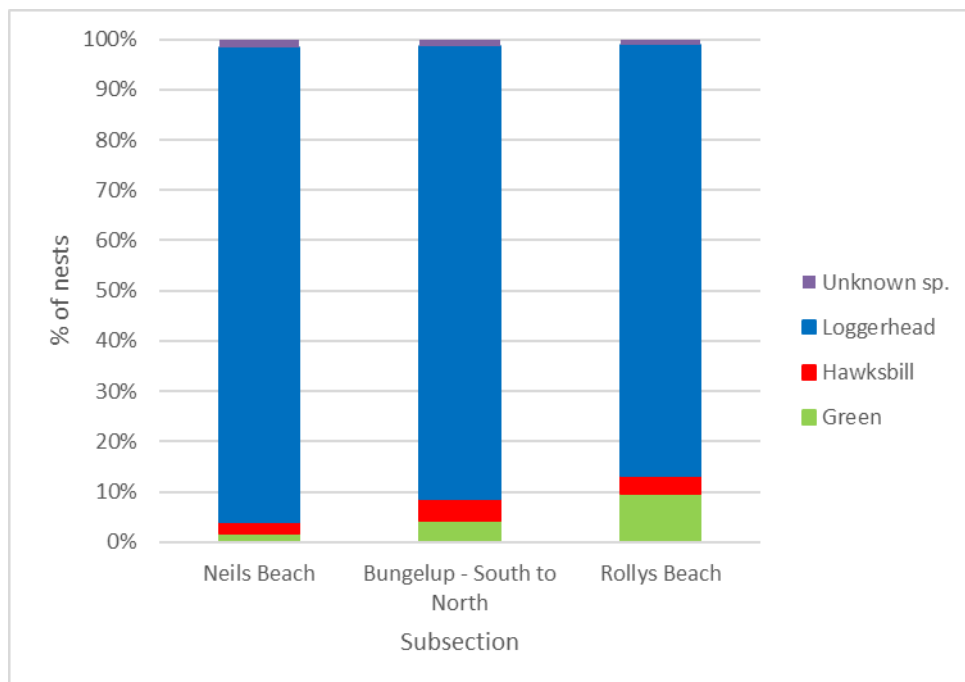


Figure 9: Percentage of nests for each turtle species in each subsection of the Bungelup section, 2021-22.

The number of nests and false crawls varied across the three subsections of the Bungelup section (Figure 10; for section lengths and locations, see Appendix 3). Bungelup South to North had the highest average turtle activity. Rolly’s beach subsection had the least activity. For individual nest locations see maps in Appendix 8.

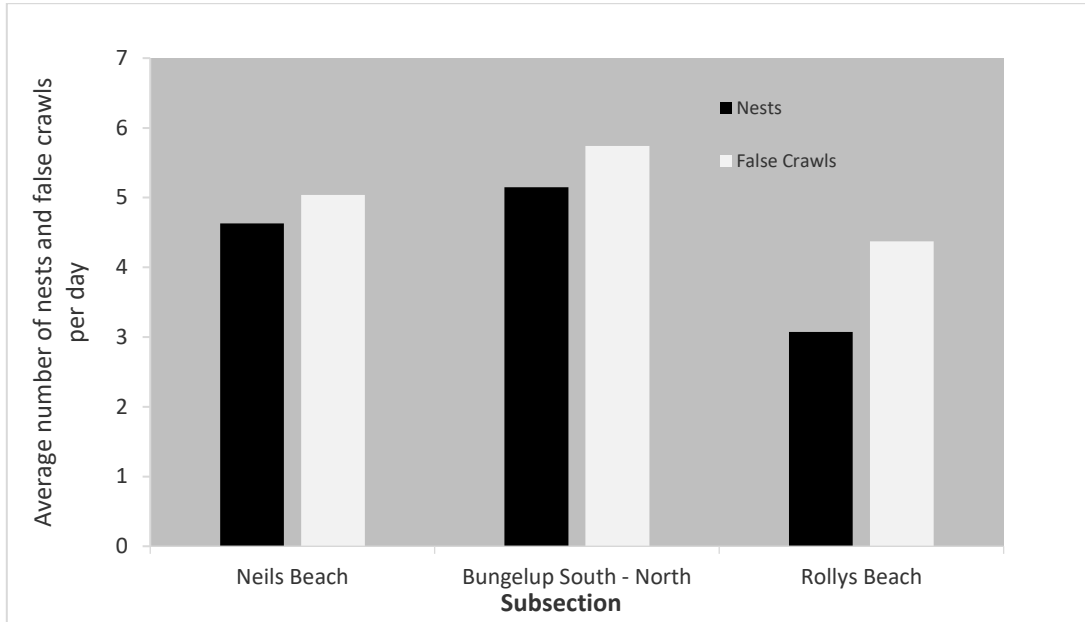


Figure 10: Average number of nests and false crawls per day within each subsection of the Bungelup section (Cape Range division), 2021-22.

The density of nesting (nests per kilometre per day) provides the relative importance of each subsection of beach. The Bungelup South to North subsection had the highest density of nesting with an average of 4.9 nests per km per day (Figure 11).

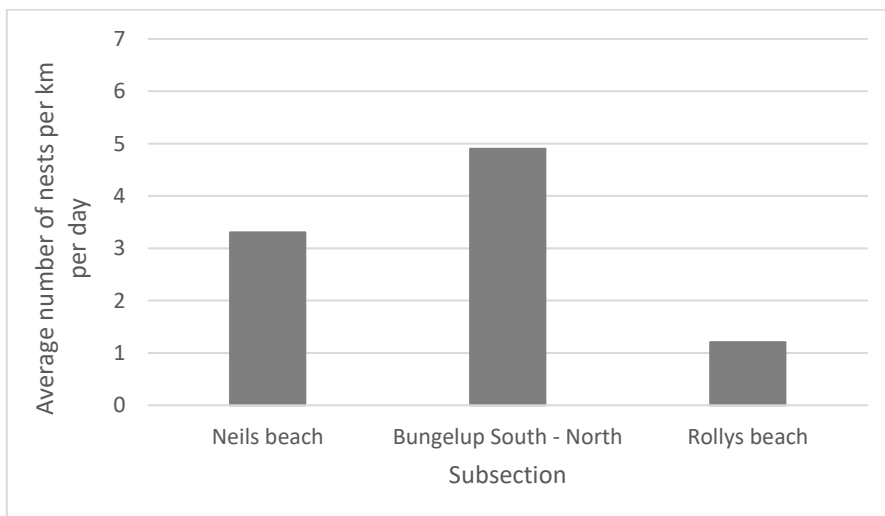


Figure 11: Number of nests per kilometre per day, for each subsection of the Bungelup section (Cape Range division), 2021-22.

Numbers of loggerhead nests per day varied through the season in the Bungelup section (Figure 12). 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).

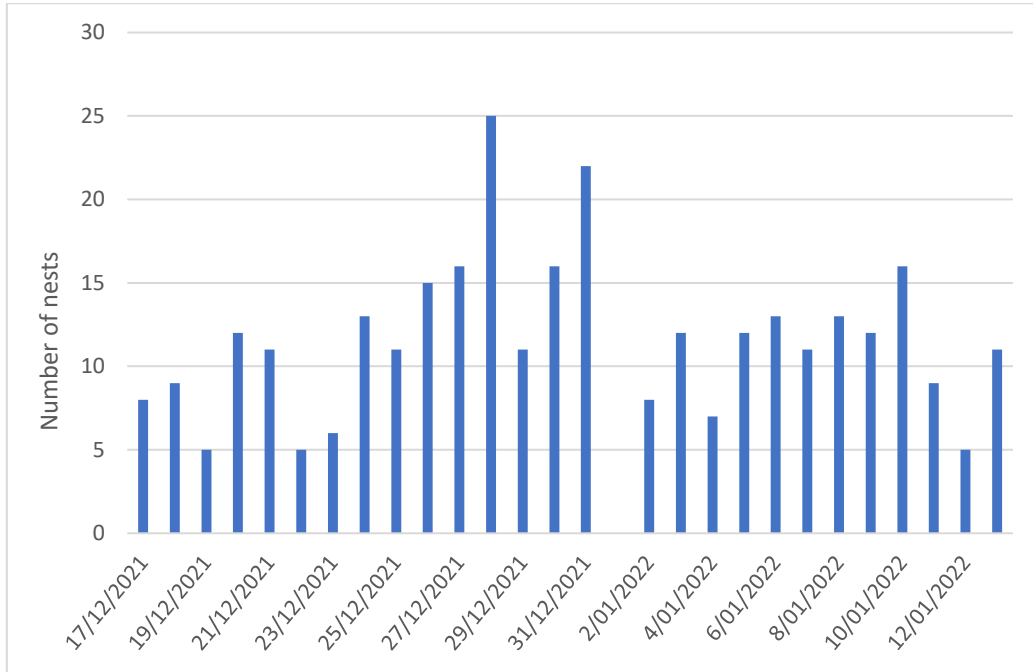


Figure 12: Number of loggerhead turtle nests recorded in the Bungelup section (Cape Range division) per day in the 2021-22 season. Note, no monitoring occurred on 1 January 2022.

3.1.3 Comparison of NW Cape and Bungelup rookeries

The beaches of the NW Cape division are primarily green turtle nesting beaches, as shown in Figure 1, whereas the Bungelup section in the Cape Range division is primarily a loggerhead rookery (Figure 8). To understand the relative importance of each subsection within both rookeries, for each species, the average density of nests per kilometre per day was compared.

The highest density of green turtle nests was recorded at the Five mile north to Five mile subsection in the NW Cape division, with an average of 8.1 green turtle nests per kilometre per day (Figure 13) and the lowest density was recorded in the three Bungelup subsections. The highest density of hawksbill nesting (Figure 14) was also recorded at the Five mile north to Five mile subsection with an average of 0.3 hawksbill turtle nests per kilometre per day. No hawksbill nests were recorded in two subsections, Mildura Wreck to NW Carpark, and Brooke to Graveyards. The highest density of loggerhead nests was recorded at the three Bungelup subsections (Figure 15), with as many as eight times the number of nests compared to the NW Cape subsections.

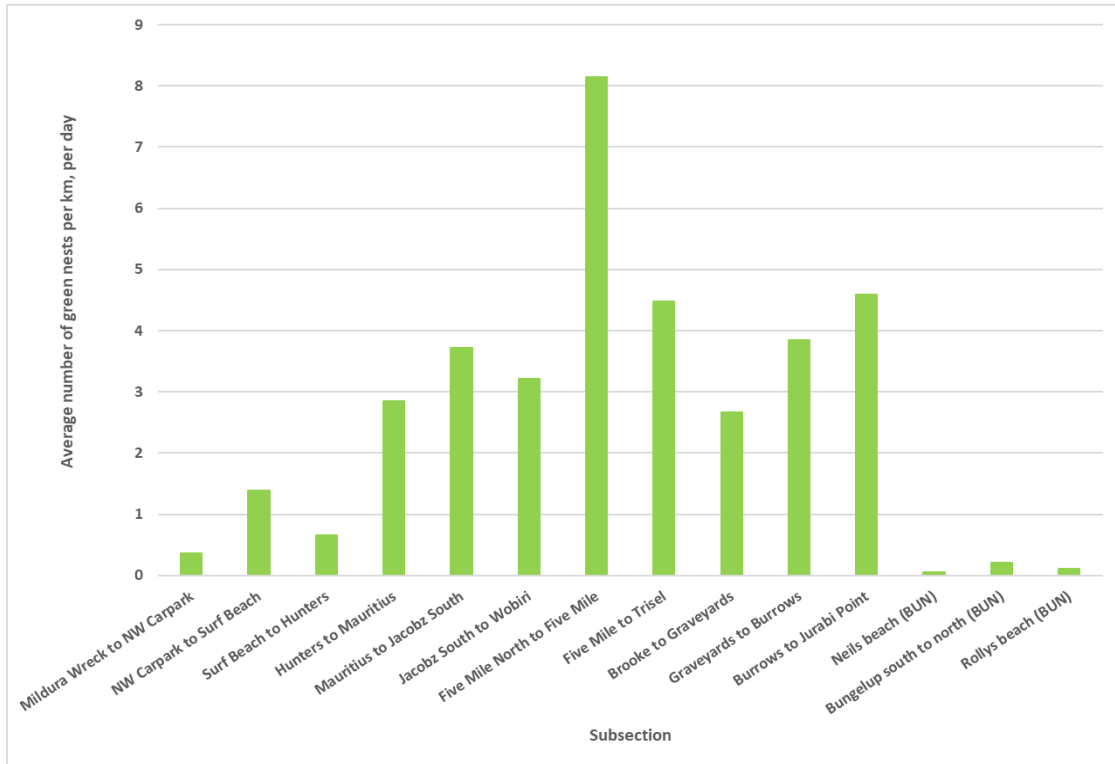


Figure 13: Green turtle nesting density (average number of nests per km per day) for each subsection within both the NW Cape and Cape Range (Bungelup section) divisions. Subsections within the Bungelup section are indicated with (BUN).

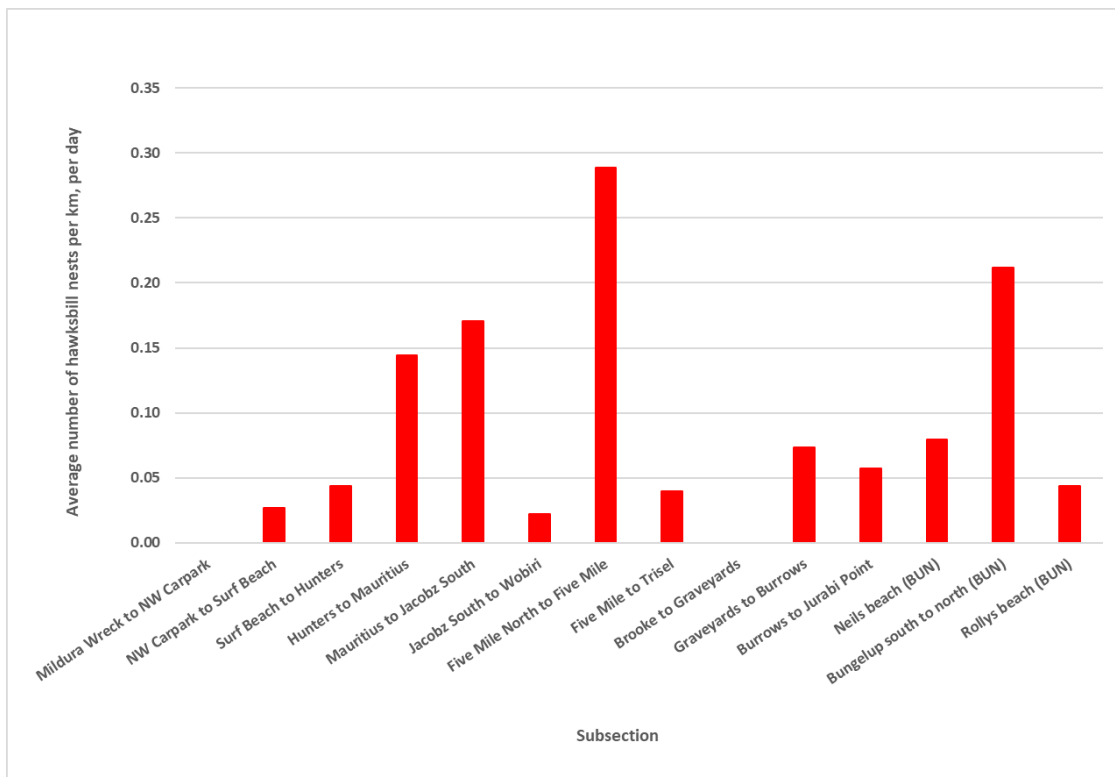


Figure 14: Hawksbill turtle nesting density (average number of nests per km per day) for each subsection within both the NW Cape and Cape Range (Bungelup section) divisions. Subsections within the Bungelup section are indicated with (BUN).

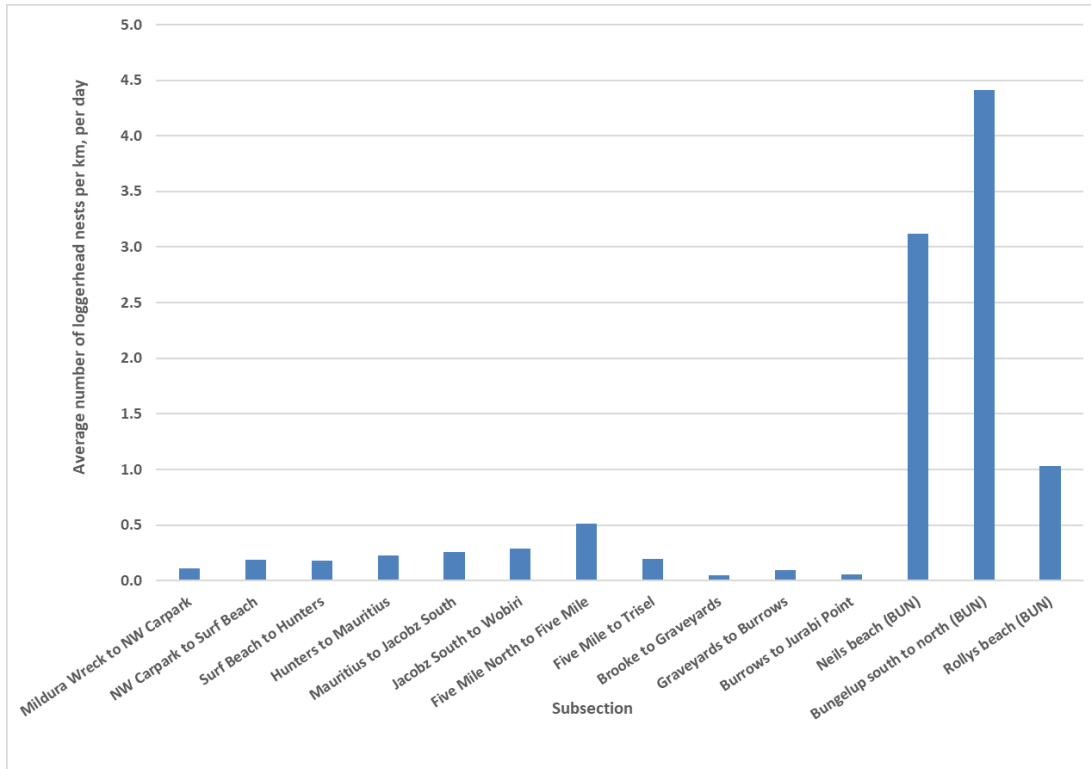


Figure 15: Loggerhead turtle nesting density (average number of nests per km per day) for each subsection within both the NW Cape and Cape Range (Bungelup section) divisions. Subsections within the Bungelup section are indicated with (BUN).

3.2 Long-term patterns of nesting

The NTP has recorded 67,157 suspected nests and 170,291 false crawls since commencement of the program in 2002 (full season data and all subsections, Appendix 1). Green turtles have consistently been the most abundant species with 87.6% of recorded turtle activities, followed by loggerhead (10.2%), hawksbill (1.8%), unidentified species (0.4%) and flatback turtles (0.001%).

Turtle activity for each season and subsection has 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). Long-term patterns for each division are compared separately due to NW Cape division being primarily a green turtle rookery, and Cape Range division a loggerhead rookery.

3.2.1 North West Cape

From 2002-03 to 2021-22 (20 seasons) within the intensive peak monitoring period, NTP has recorded 37,767 nests and 105,597 false crawls (total activity 141,364). 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 16). Activity during the 2021-22 season was mid-range with an average of 21.8 activities per subsection per day (range of 5.1 to 90.8). The long-term average is 24.7, noting that activity is highly variable each year.

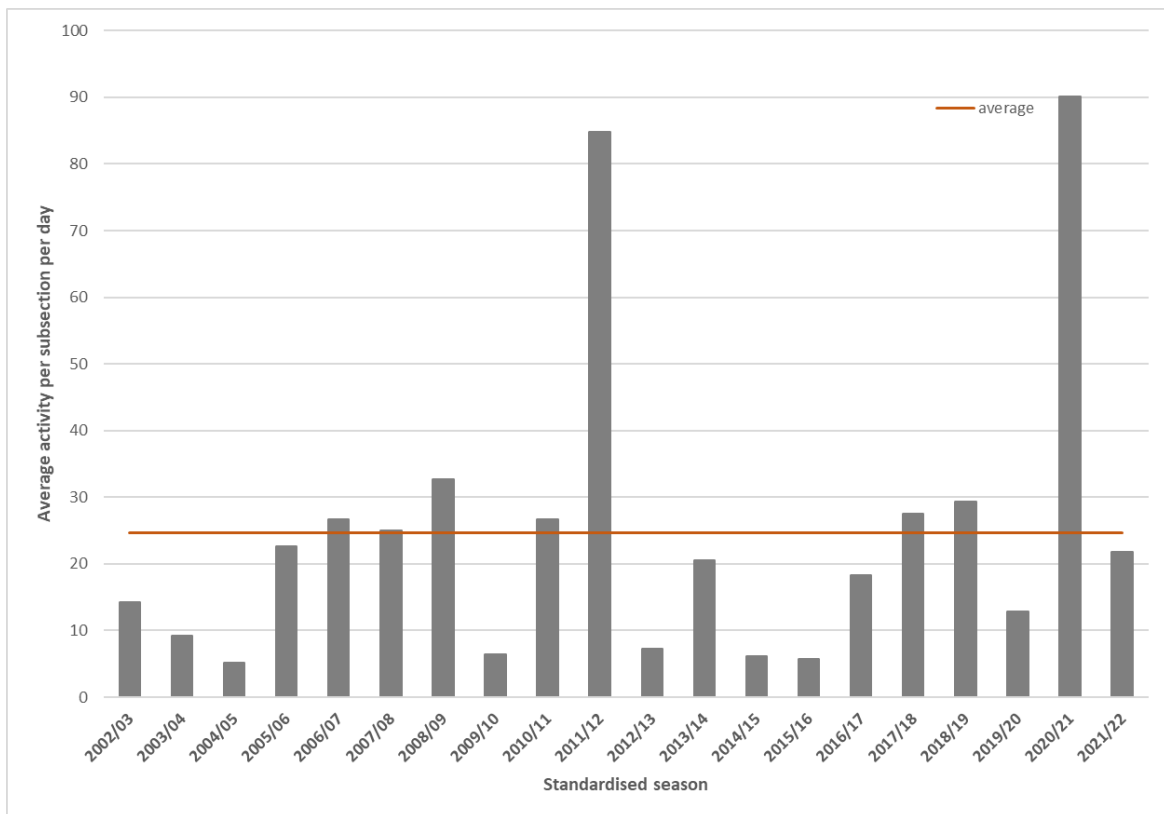


Figure 16: Turtle activity (average nests and false crawls for all species, per subsection per day) for each season standardised by survey effort during the intensive peak monitoring period at NW Cape division, 2002-03 to 2021-22.

Green turtles

The number of green turtle nests has varied largely among years (range of 1.06 to 18.13 nests per subsection per day, with an average of 5.77) . Green turtle nests in 2021-22 were very close to average with 5.87 nests per subsection per day (Figure 17).

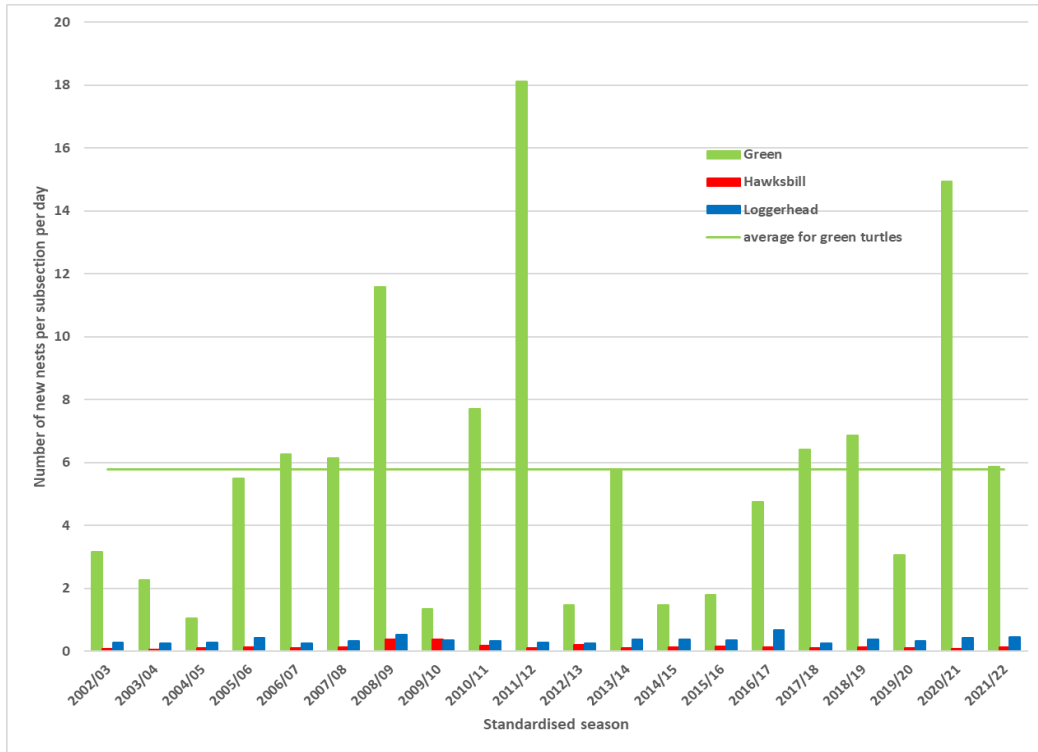


Figure 17: Number of new nests (each species, per subsection per day) for each season standardised by survey effort during the intensive peak monitoring period at NW Cape division, 2002-03 to 2021-22. See Figure 18 for further information on hawksbill and loggerhead nests.

Loggerhead turtles

The standardised level of loggerhead turtle nesting along the NW Cape over the last 20 seasons has ranged from 0.24 to 0.68 nests per subsection per day. With 0.44 nests per subsection per day, the 2021-22 season was above the long-term average (0.36) and the third highest since the program began (Figure 18).

Hawksbill turtles

Hawksbill turtle nesting remains lower than green and loggerhead turtle nesting on the NW Cape coastline, ranging from 0.06 to 0.38 nests per subsection per day since 2002-03 (Figure 18). The standardised level of hawksbill turtle nesting during the 2021-22 season (0.13 nests per subsection per day) was slightly below the long-term average (0.15).

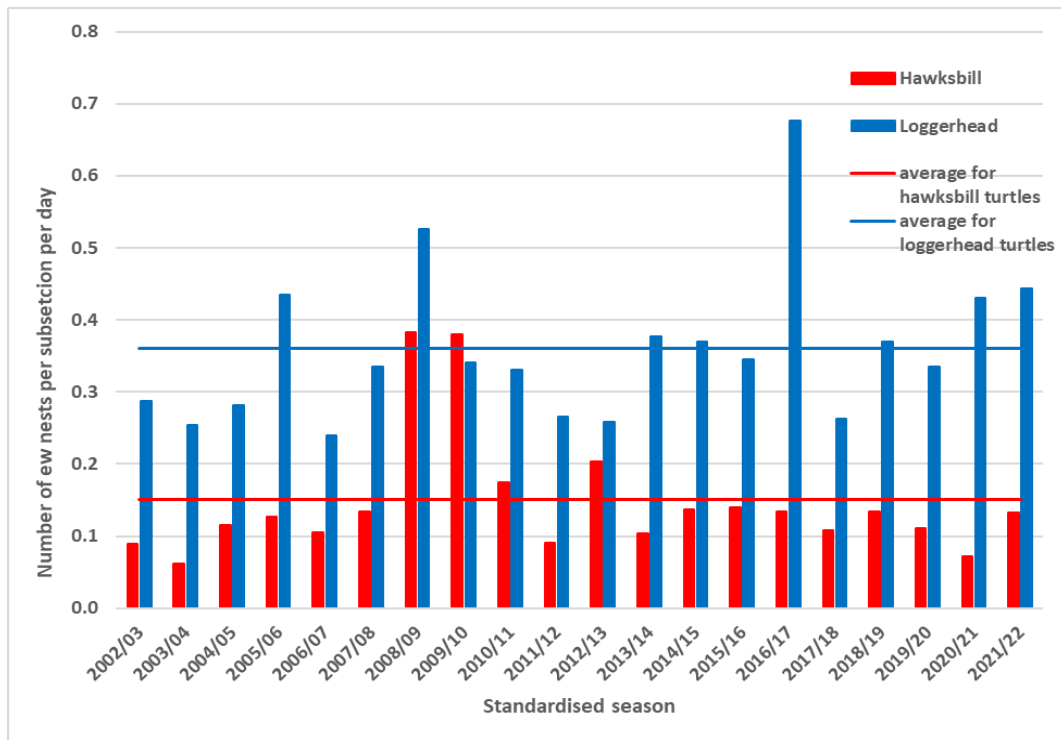


Figure 18: Number of new nests (per subsection per day) for hawksbill and loggerhead turtles for each season standardised by survey effort during the intensive peak monitoring period at NW Cape division, 2002-03 to 2021-22 (from Figure 17).

Nesting success

Patterns of nesting success of the three species have fluctuated in synchrony among seasons (Whiting 2016), as shown in long-term patterns of standardised seasons below (Figure 19). 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 2021-22 intensive peak season, nesting success for the NW Cape rookeries increased sharply from the previous season and was above the average for all three species.

Nesting success for green turtles has generally been lower than for loggerhead and hawksbill turtles. Nesting success of 28.5% in the 2021-22 standardised season was above average (26.9%) and mid-range (16.9 to 37.2% since 2002-03).

Nesting success for loggerhead turtles has ranged from a maximum of 53.9% in 2008-09 to a minimum of 27.5% in 2002-03. Nesting success of 46.1% in the 2021-22 standardised season was above the average (41%).

Hawksbill turtles have generally had the highest nesting success of the three species, ranging from 32.9% in 2006-07 to 61.2% in 2008-09. Nesting success of 54.2% in the 2021-22 season was above the average (47.4%).

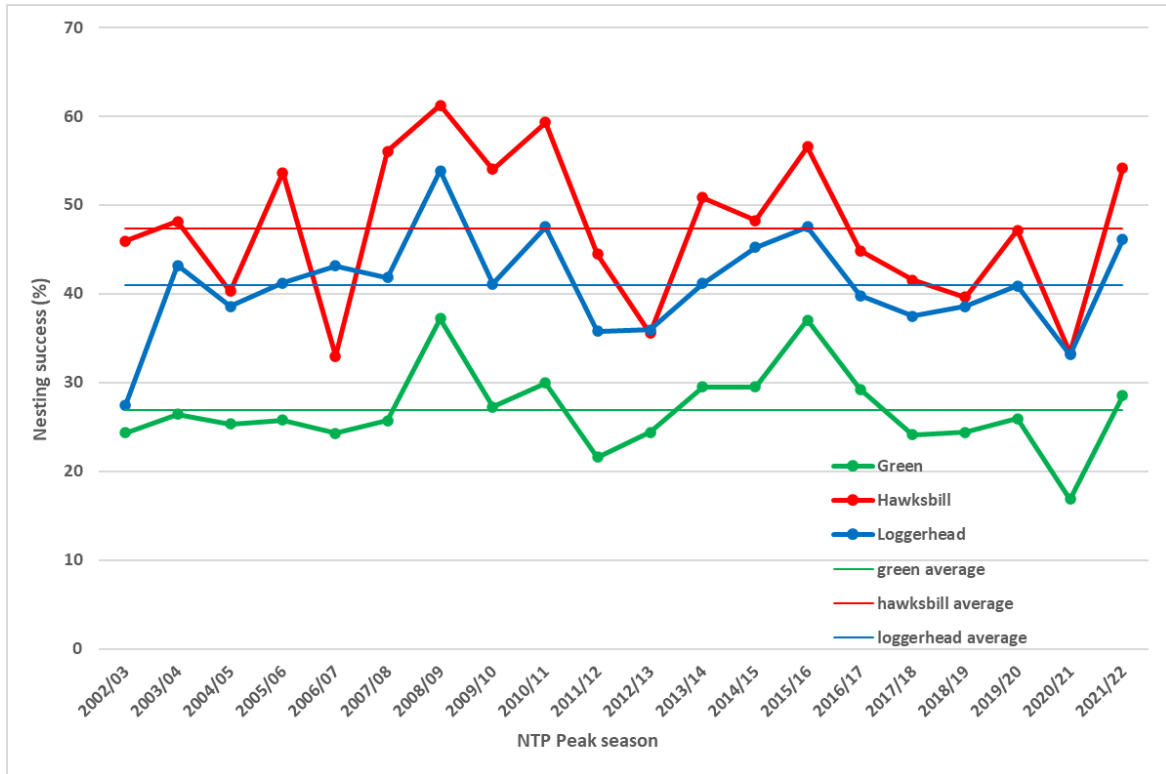


Figure 19: Nesting success (and long-term average) at NW Cape for all three species during the peak period of NTP seasons 2002-03 to 2021-22.

3.2.2 Cape Range

From 2003-04 to 2021-22 (19 seasons) during the intensive peak monitoring period, NTP has recorded 5990 nests and 9135 false crawls at Bungelup section (total activity 15,125). Levels of activity have been fairly consistent (and less variable compared to the NW Cape division) with the two busiest seasons being 2016-17 and 2017-18 (Figure 20). There have been no seasons with an extreme low level of nesting.

During the 2021-22 season, an average of 9.2 activities per subsection per day (range of 7.6 to 18.9) was recorded. This was lower than the long-term average of 11.2 activities per day.

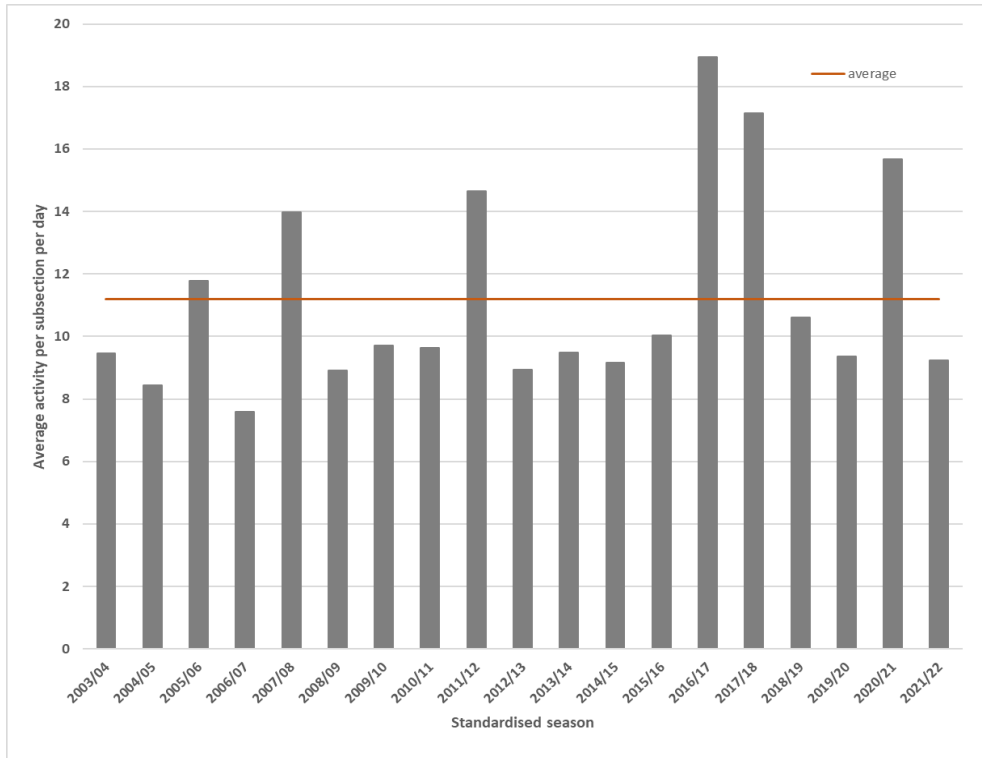


Figure 20: Turtle activity (average nests and false crawls for all species, per subsection per day) for each season, standardised by survey effort during the intensive peak monitoring period at Bungelup section, 2003-04 to 2021-22.

Loggerhead turtles

The standardised level of loggerhead turtle nesting at Bungelup section over the last 19 seasons has ranged from 2.53 to 6.44 nests per subsection per day. With 3.88 nests per subsection per day, the 2021-22 season was slightly above the long-term average (3.82) (Figure 21Figure 18).

Green turtles

The number of green turtle nests at Bungelup section has ranged from zero to 1.18 nests per subsection per day, with an average of 0.28. Green turtle nests in 2021-22 were slightly below average with 0.2 nests per subsection per day (Figure 21).

Hawksbill turtles

Hawksbill turtle nesting at Bungelup section ranged from 0.03 to 1.53 nests per subsection per day since 2002-03 (Figure 21). The standardised level of hawksbill turtle nesting during the 2021-22 season (0.15 nests per subsection per day) was below the long-term average (0.4).

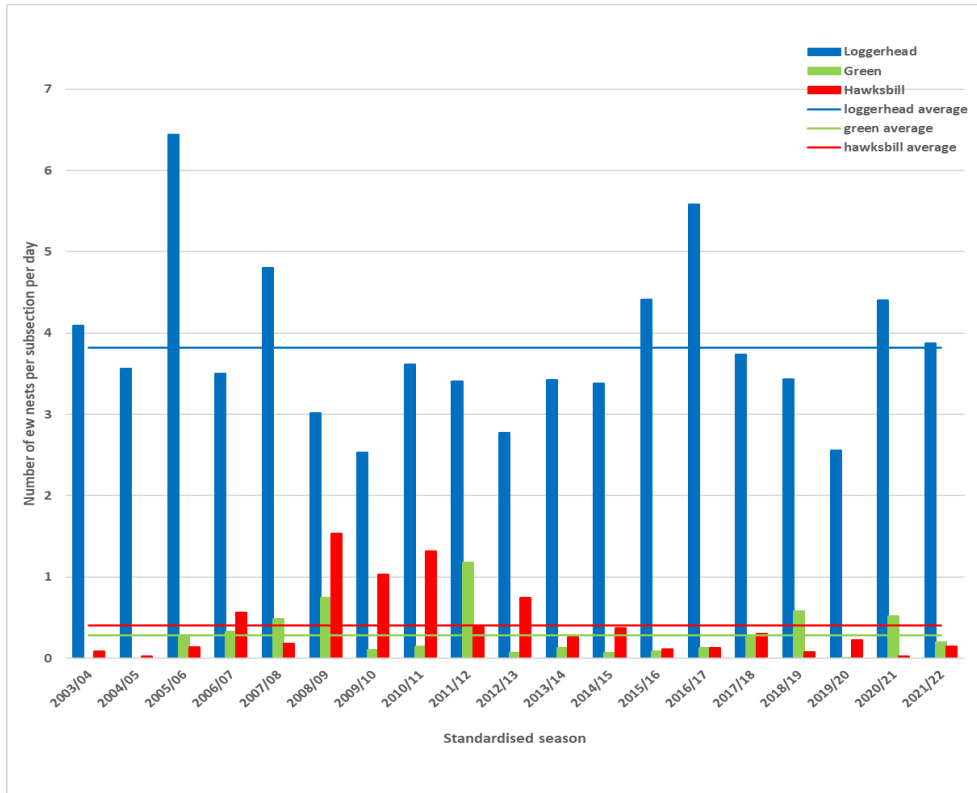


Figure 21: Number of new nests (each species, per subsection per day) for each season standardised by survey effort during the intensive peak monitoring period at Bungelup section, 2003-04 to 2021-22.

Nesting success

Patterns of nesting success of the three species at the Bungelup section do not fluctuate in synchrony among seasons like they do in the NW Cape division. Long-term patterns of standardised seasons (Figure 22) show that when nesting success peaked for one species, it didn't generally correlate with a peak for the other species. In the 2021-22 season, nest success was above average for all three species and a notable increase on the previous season.

During the 2021-22 season, loggerhead turtle nesting success was 44.6% (long-term average of 42.4%). This is similar to the long-term loggerhead nesting success of 41% in the NW Cape division. Nesting success for green turtles and hawksbill turtles should be interpreted with caution given the small number of activities for these species at the Bungelup section. Green turtles had a nesting success of 57.1% (long-term average 30.6%). Hawksbill turtles had a nesting success of 75% (long-term average 51.1%).

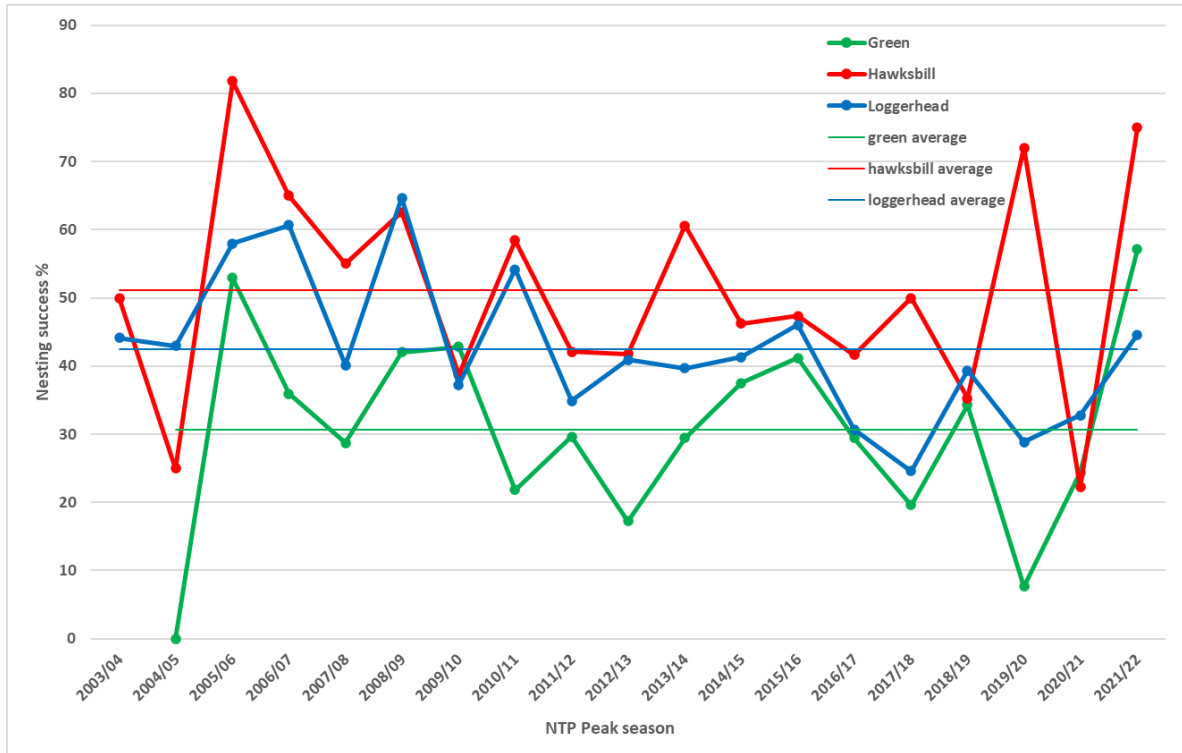


Figure 22: Nesting success (and long-term average) at Bungelup section for all three species during the peak period of NTP seasons 2003-04 to 2021-22.

3.3 Nest damage and predation

Forty six nests were recorded with damage in the 2021-22 full season in the NW Cape and Cape Range divisions (equating to 1.7% of total recorded nests)³. Thirty seven of these nests were in the North West Cape division and nine within the Cape Range division. Ghost crabs caused the majority of damage (36 nests). Other causes were turtles excavating other turtles’ nests (8), birds taking eggs as turtle was laying (1) and unknown causes (1). No nests were damaged by either a dingo or an introduced predator (fox, or possibly a dog other than a dingo)⁴.

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.

A reduction in predation of nests by introduced predators has been recorded in recent years coinciding with a rigorous introduced predator control program by DBCA’s Parks and Wildlife Service including aerial and ground baiting and trapping (Figure 23).

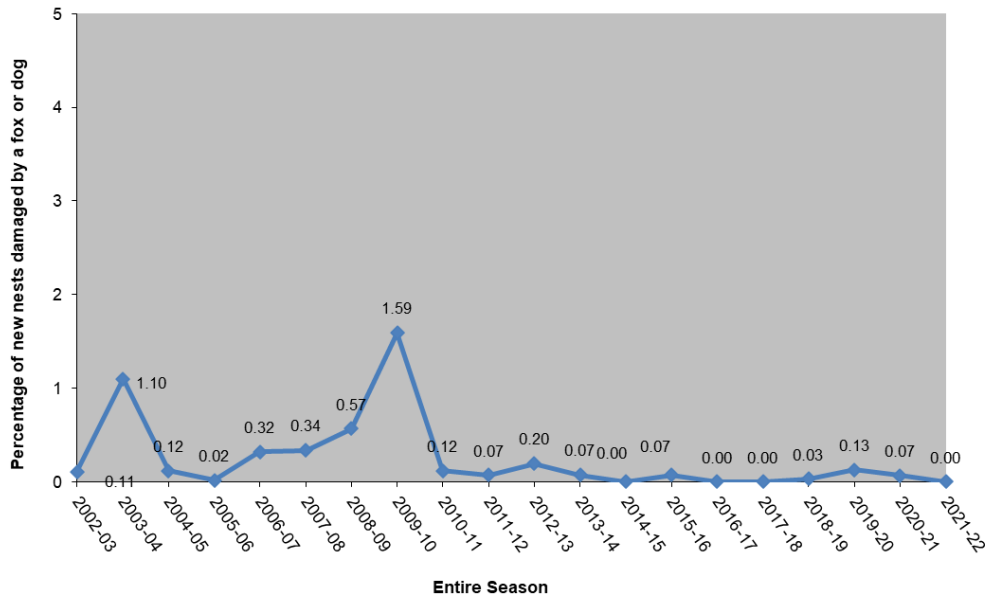


Figure 23: Percentage of new nests damaged by fox or dog per season, NW Cape and Cape Range divisions.

3.3.1 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 (based on long-term opportunistic observations by experienced DBCA staff and supported by NTP nest predation data). NTP volunteers routinely record the presence of prints and tracks from introduced species and dingoes to help inform targeted management.

In 2021-22, volunteers recorded the tracks of dogs in nine of the eleven subsections in NW Cape division and two of the three subsections in the Cape Range division. Cat tracks were observed in three of the eleven subsections in the NW Cape division and all three subsections in the Cape Range division. Interestingly, suspected fox tracks were recorded in two of the NW Cape subsections (none were observed last season).

3.4 Other observations and data

3.4.1 Turtle mortalities

Turtle mortalities have been recorded as part of NTP since 2007-08 (Figure 24). Nine dead turtles were recorded by NTP volunteers during the 2021-22 season in the NW Cape and Cape Range divisions.

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

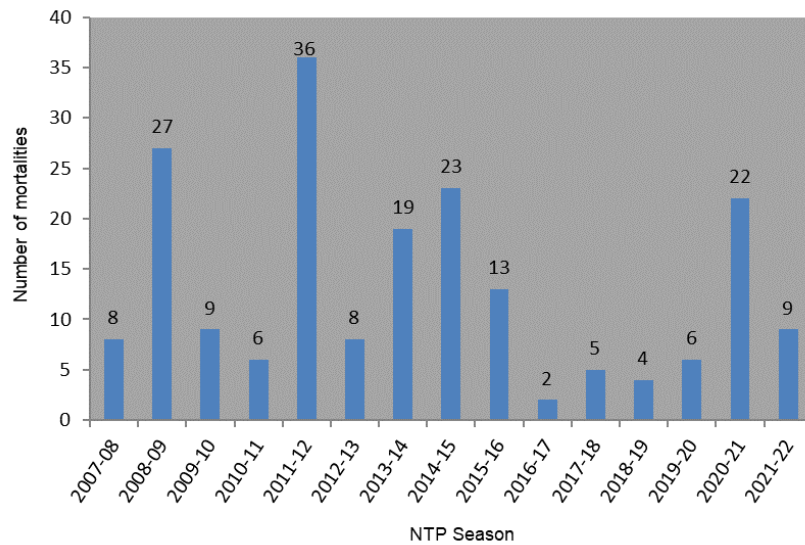


Figure 24: Turtle mortalities recorded during the NTP per season, from NW Cape and Cape Range divisions.

3.4.2 Rescues of stranded turtles

Fifteen turtles were rescued during the 2021-22 season by NTP volunteers and staff. All turtles were in the NW Cape division.

At least 345 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 conducted outside of the NTP monitoring dates are not reported here. For example, while patrolling remote beaches, DBCA staff routinely “flip” stranded turtles that have been turned over by the waves on the shoreline.

3.4.3 Re-sightings of flipper tagged turtles

One flipper-tagged turtle was re-sighted during the 2021-22 season by NTP volunteers (Table 3).

Table 3: Re-sightings of tagged turtles during NTP 2021-22 season.

Tag	Species	Gender	When tagged	Location tagged	CCL when tagged	Date resighted	Location resighted	CCL when resighted
WA21211 right	G	F	15/01/1993	Jacobsz	1000mm	30/01/2022	Graveyards	-

3.4.4 Weather events

Beaches surveyed in the NTP 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 2021-22 season there were no significant weather events and no disturbance to monitoring.

4. VOLUNTEER ENGAGEMENT AND COORDINATION

Forty seven volunteers contributed 3460 hours to the Ningaloo Turtle Program in 2021-22. Volunteers were coordinated, supervised and trained by DBCA staff and supported by volunteers from the local community.

Local Exmouth volunteers contributed 601 hours mainly through the pre-peak and post-peak monitoring weekends and external (visiting) volunteers contributed 2859 hours during the peak monitoring period.

Since commencement of the program in 2002, 80,758 hours of time from volunteers have contributed to the program. Volunteer time was primarily turtle monitoring and also included data uploading, training, education, school visits, turtle rescues, and weekend monitoring coordination.

4.1 Media and communications

Since the 2015-16 NTP season, a dedicated Communications Internship volunteer position has been filled. This role focuses on expanding public education, engagement and promotion of the NTP. The focus in the 2021-22 season was the production of short videos and regular social media posts and updates. The following outcomes were achieved:

- Production of a 5 minute 'What is NTP?' promotional video;
- Production of a Code of Conduct video, encouraging sustainable turtle viewing practices;
- Creation of a dedicated NTP YouTube channel;
- An educational school visit to Exmouth primary school for classes from kindergarten to year 4-5;
- Regular engaging Facebook and Instagram posts.

By the end of the 2021-22 season, the NTP had an increase of 66.5% Facebook followers and an increase of 155.1% Instagram followers.

4.2 Educational activities

A key goal of the NTP is to build a culture of awareness and stewardship regarding marine turtle conservation at Ningaloo. In addition to the communications role discussed in 4.1, DBCA staff conduct routine beach education patrols throughout the nesting season. The purpose of these patrols is to educate locals and visitors to the beaches on the most appropriate way to view nesting and hatching turtles with no disturbance to the animal. NTP volunteers are given the opportunity to assist DBCA staff with these patrols, as needed.

Other educational activities by DBCA staff not reported here include Turtle Education Tours at the Jurabi Turtle Centre, school holiday activities and distribution of Code of Conduct posters and handouts to local businesses and accommodation providers.

5. ACKNOWLEDGEMENTS

The NTP is conducted on the traditional lands of the Baiyungu, Thalanyji and Yinikurtura People. DBCA 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 (Carla Bruinsma, Eloise Wigger, Caroline Glass) and media intern (Jane Hammond). The program would not be able to function without the significant contribution of time, effort, passion and enthusiasm the volunteers contribute.

Thanks to the Cape Conservation Group Inc. for their 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. Thank you to BHP for assistance in funding the ‘Turtle Bus.’

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Personal communications

Whiting A. Consultant. PO Box 1212, Bentley, Western Australia

7. APPENDICES

Appendix 1: Survey effort and summaries of turtle activity

Survey effort* 2002/03 – 2021/22 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	2021/22	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	27/10/16-26/02/17	11/11/17-2/03/18	10/11/18-24/02/19	9/11/2019-23/02/20	7/11/2020-28/02/21	6/11/2021-27/02/22		
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	156	4327
	Hunters	248	263	271	271	256	252	173	117	114	109	111	117	120	123	111	121	116	117	116	116	3242
	Lighthouse Bay	127	137	215	260	222	251	147	83	93	97	106	223	113	119	106	100	115	115	117	115	2751
	Navy Pier	-	86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	86
	Tantabiddi	115	3	-	85	86	84	58	38	37	36	41	38	43	41	39	41	39	39	39	39	941
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	81	1802
	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
Coral Bay	Whaleback Beach	-	7	8	-	-	-	-	-	-	-	-	-	-	-	-	17	17	16	-	-	65
	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	507	15265	
Number subsections monitored	22	29	28	20	19	19	18	14	14	14	14	14	14	14	14	14	21	21	18	14		

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

Turtle activity 2002/03 – 2021/22 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	2021/22	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	6/11/2021-27/02/2022	
Green nests	1539	1552	788	4695	4349	5254	6297	571	2732	6594	585	2276	628	759	1856	2518	2733	1184	5212	2182	54304
Green false crawls	5404	3086	2533	9948	14395	13156	12608	1451	6507	22865	1769	4960	1465	1357	4243	7306	8082	3216	23945	5420	153716
Green activity	6943	4638	3321	14643	18744	18410	18905	2022	9239	29459	2354	7236	2093	2116	6099	9824	10815	4400	29157	7602	208020
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	14.99	15.64
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%	28.7%	27.7%
Hawksbill nests	48	81	100	108	157	156	336	202	189	65	125	69	91	75	67	70	63	74	28	62	2166
Hawksbill false crawls	49	60	139	71	153	145	207	202	132	84	192	51	108	65	89	99	104	60	64	52	2126
Hawksbill activity	97	141	239	179	310	301	543	404	321	149	317	120	199	140	156	169	167	134	92	114	4292
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	0.22	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%	54.4%	49.2%
Loggerhead nests	288	387	777	1068	540	795	580	288	405	382	304	430	436	519	696	392	481	379	540	456	10143
Loggerhead false crawls	429	359	1040	925	477	954	486	471	388	715	466	595	580	583	1395	1086	730	725	1065	554	14023
Loggerhead activity	717	746	1817	1993	1017	1749	1066	759	793	1097	770	1025	1016	1102	2091	1478	1211	1104	1605	1010	24166
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	1.99	1.80
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%	45.1%	42.5%
Unidentified nests	29	123	59	42	33	61	38	8	18	7	7	20	19	4	7	6	12	8	28	15	544
Unidentified false crawls	44	20	82	45	19	29	12	8	9	4	12	17	14	3	3	7	17	14	56	11	426
Unidentified activity	73	143	141	87	52	90	50	16	27	11	19	37	33	7	10	13	29	22	84	26	970
Total all species nests	1904	2143	1724	5913	5079	6266	7251	1069	3344	7048	1021	2795	1174	1357	2626	2986	3289	1645	5808	2715	67157
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	5.36	4.93
Total all species false crawls	5926	3525	3794	10989	15044	14284	13313	2132	7036	23668	2439	5623	2167	2008	5730	8498	8933	4015	25130	6037	170291
Total activity	7830	5668	5518	16902	20123	20550	20564	3201	10380	30716	3460	8418	3341	3365	8356	11484	12222	5660	30938	8752	237448
Total turtle activity adjusted by survey effort per day	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	17.3	17.8

Survey effort* 2002/03 – 2021/22 standardised season

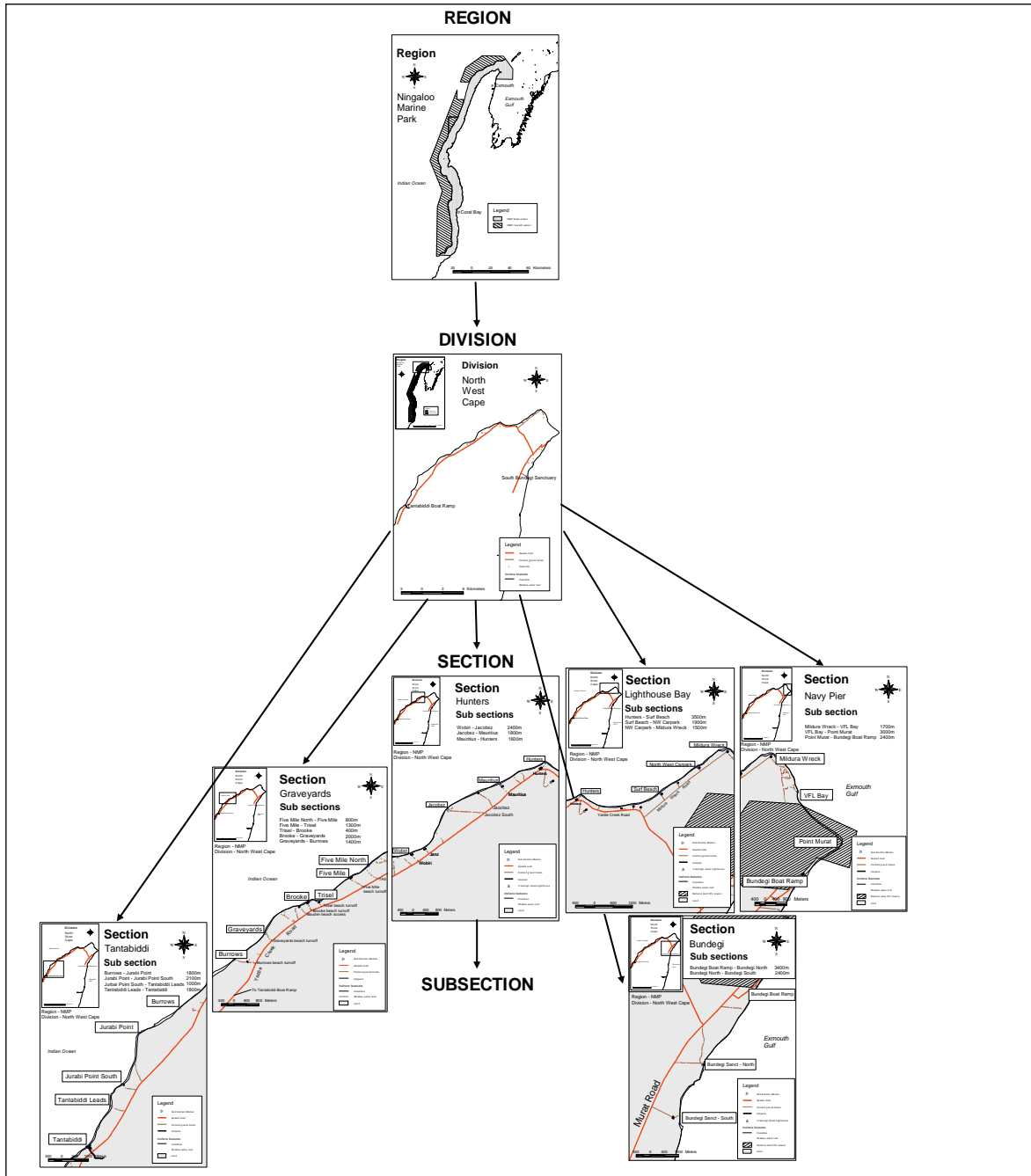
Standardised season	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22		
Survey Dates intensive peak period monitoring dates	16/12/02-12/01/03	15/12/03-11/01/04	20/12/04-16/01/05	19/12/05-15/01/06	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	17/12/21-13/01/22	TOTAL	
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	108	2043
	Hunters	72	78	84	81	75	75	72	50	81	84	78	81	84	84	78	81	81	81	80	80	1560
	Lighthouse Bay	53	34	56	77	75	75	72	39	77	84	78	81	84	83	78	80	81	81	81	80	1449
	Tantabiddi	9	-	-	27	25	25	24	17	27	28	26	27	28	28	28	27	27	27	27	27	454
Cape Range	Bungelup	0	11	71	66	69	60	60	30	79	84	75	78	84	82	79	80	81	80	79	81	1329
Total survey effort*	191	223	323	358	344	335	324	206	372	392	361	375	392	389	370	376	378	376	374	376	6835	
Number subsections monitored	11	12	12	14	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 – 2021/22 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	2021/22	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	17/12/12-13/01/13	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	17/12/21-13/01/22	
Green new nests	587	475	266	1548	1650	1721	3103	239	2270	5683	422	1714	459	554	1449	1919	2082	896	4452	1747	33236
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	4.60	4.67
Green false crawls	1821	1328	785	4217	5138	4959	5226	634	5322	20501	1314	4098	1092	939	3495	6051	6397	2582	21843	4353	102095
Green activity	2408	1803	1051	5765	6788	6680	8329	873	7592	26184	1736	5812	1551	1493	4944	7970	8479	3478	26295	6100	135331
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	16.22	18.89
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%	28.6%	26.9%
Hawksbill new nests	17	14	31	45	67	48	193	98	155	60	114	51	73	52	50	56	46	50	23	51	1294
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	0.14	0.19
Hawksbill false crawls	20	14	49	33	80	38	119	106	109	79	183	43	81	43	63	69	72	42	49	37	1329
Hawksbill activity	37	28	80	78	147	86	312	204	264	139	297	94	154	95	113	125	118	92	72	88	2623
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	0.23	0.39
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%	58.0%	48.6%
Loggerhead new nests	52	78	324	544	306	380	320	136	383	368	282	379	398	462	668	375	388	307	475	445	7070
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	1.18	0.99
Loggerhead false crawls	141	128	449	484	244	557	218	214	349	681	432	566	541	530	1350	1042	603	649	969	543	10690
Loggerhead activity	193	206	773	1028	550	937	538	350	732	1049	714	945	939	992	2018	1417	991	956	1444	988	17760
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	2.63	2.50
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%	45.0%	40.7%
Unidentified new nests	1	10	14	21	13	17	21	3	15	3	6	16	19	4	6	5	7	5	18	12	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	0.03
Unidentified false crawls	2	7	36	18	9	12	7	3	9	4	9	17	11	1	3	4	4	11	39	6	206
Unidentified activity	3	17	50	39	22	29	28	6	24	7	15	33	30	5	9	9	11	16	57	18	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	0.05	0.06
Flatback new nests	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	1	0	0	5
Flatback false crawls	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	4	1	1	0	7
Flatback activity	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	6	2	1	0	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	0.00	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%	n/a	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	2255	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	6.00	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	4939	109394
Total activity	2641	2054	1954	6910	7507	7732	9208	1433	8612	27379	2764	6884	2674	2585	7084	9521	9599	4542	27869	7194	148960
Total turtle activity adjusted by survey effort per day	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	19.1	22.00

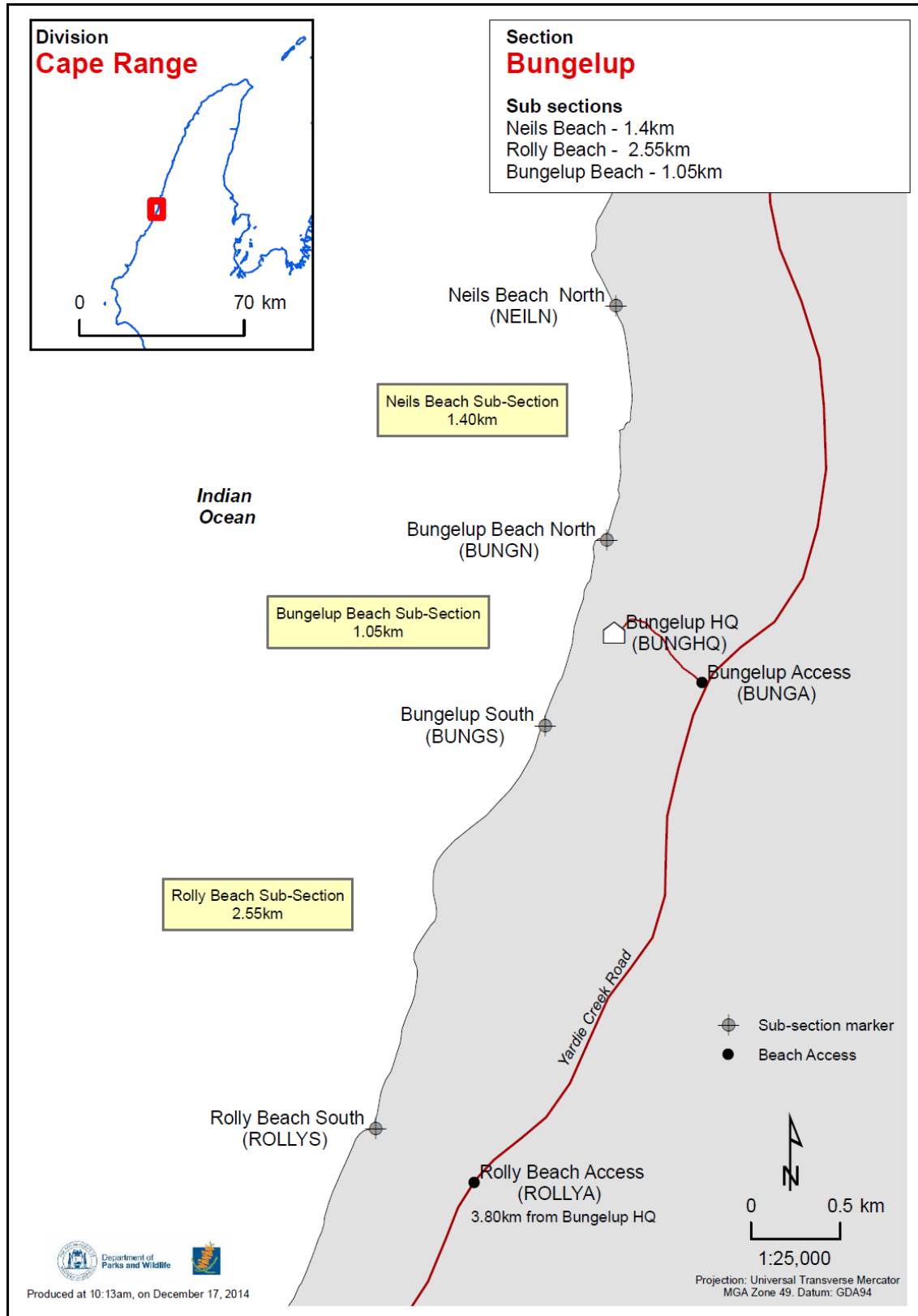
Appendix 2: Zoning and subsection details NW Cape division.



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's Beach South	22.28613 S; 113.8292 E	22.30650 S; 113.82062 E	2550

Appendix 4: Lighthouse Bay section - New nests (NTP 2021-22) Map 1 & 2



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**Ningaloo Turtle Program
2021-2022 (new nests)**

LIGHTHOUSE SECTION

Map 2 of 2

Legend

- Turtle Nests 2021- 2022
 - Green
 - Hawksbill
 - Loggerhead
 - Unidentified
 - Flatback
- Turtle Monitoring Sections
 - Subsection location



(A4)

1:17,500

0 100 200 300 400 m

Projection: MGA Zone 49
Datum: GDA94



Department of Biodiversity,
Conservation and Attractions



Job Ref: NTP turtle nesting 2022
Produced July 7th, 2022

114°6'36"E 114°7'12"E 114°7'48"E 114°8'24"E

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Appendix 5: Hunters section - New nests (NTP 2021-22) Map 1 & 2



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**Ningaloo Turtle Program
2021-2022 (new nests)**

HUNTERS SECTION

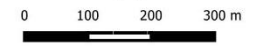
Map 2 of 2

Legend

- Turtle Nests 2021- 2022**
- Green
 - Hawksbill
 - Loggerhead
 - Unidentified
 - Flatback
- Turtle Monitoring Sections**
- ✕ Subsection location



(A4)



1:10,000

Projection: MGA Zone 49
Datum: GDA94



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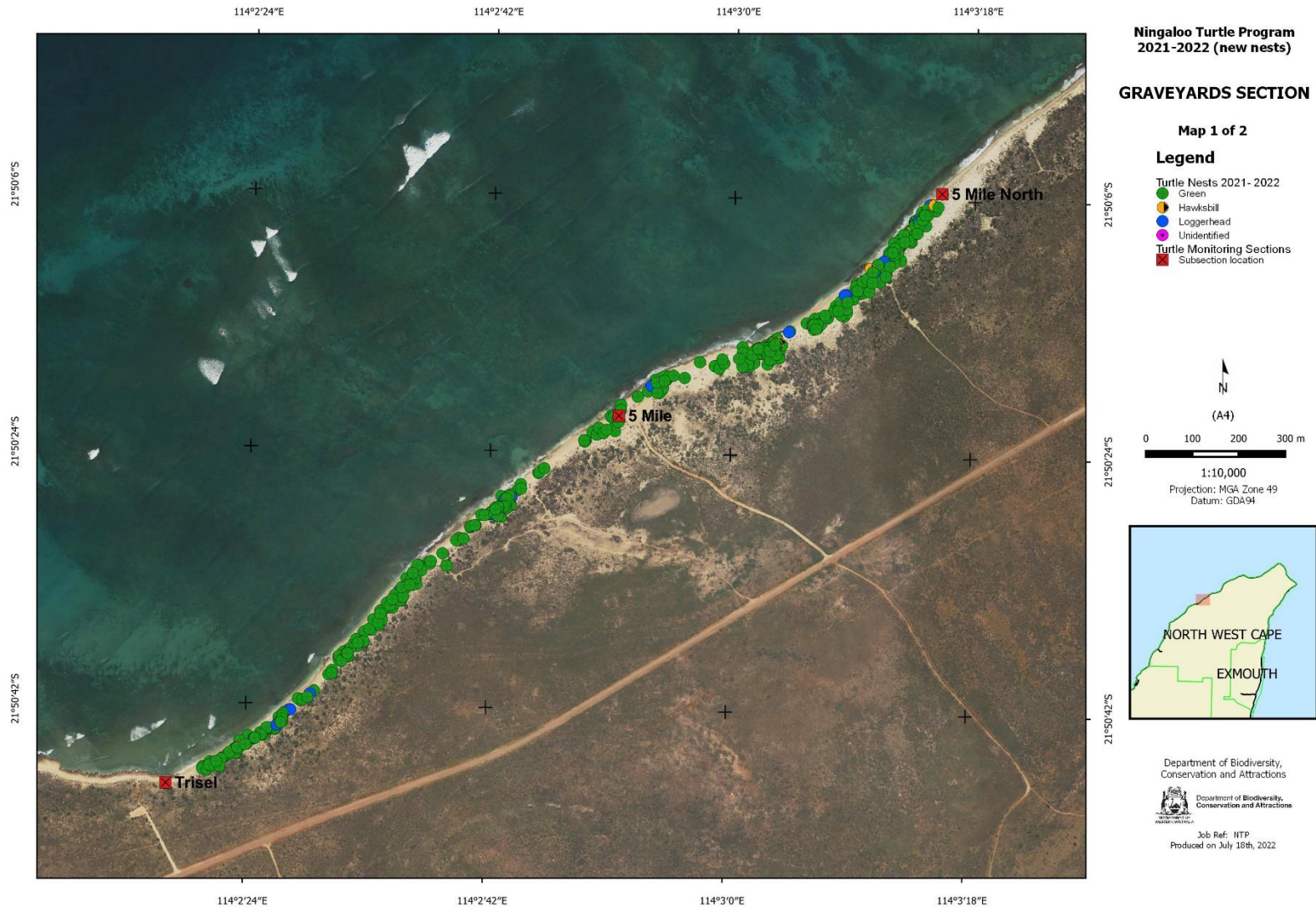


Job Ref: NTP 20220405 ITPReportingMaps2021-22
Produced on July 18th, 2022

114°3'54"E 114°4'12"E 114°4'30"E 114°4'48"E

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Appendix 6: Graveyards section - New nests (NTP 2021-22) Map 1 & 2



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Ningaloo Turtle Program
2021-2022 (new nests)

GRAVEYARDS SECTION

Map 2 of 2

Legend

- Turtle Nests 2021- 2022
 - Green
 - Hawksbill
 - Loggerhead
 - Unidentified
- Turtle Monitoring Sections
 - Subsection location



(A4)



1:12,500

Projection: MGA Zone 49
Datum: GDA94



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Job Ref: NTP 20220405 NTPReportingMaps2021-22
Produced on July 18th, 2022



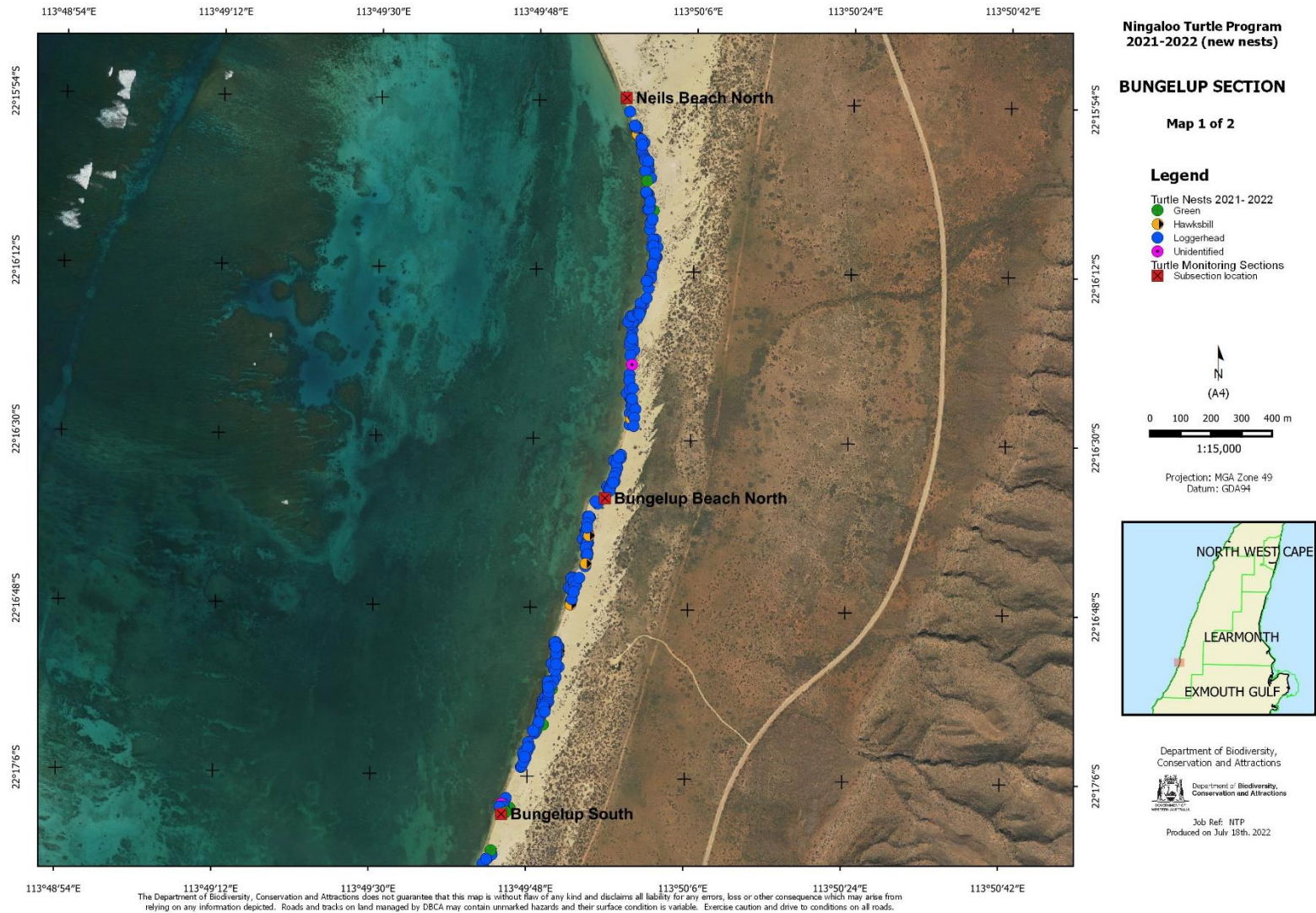
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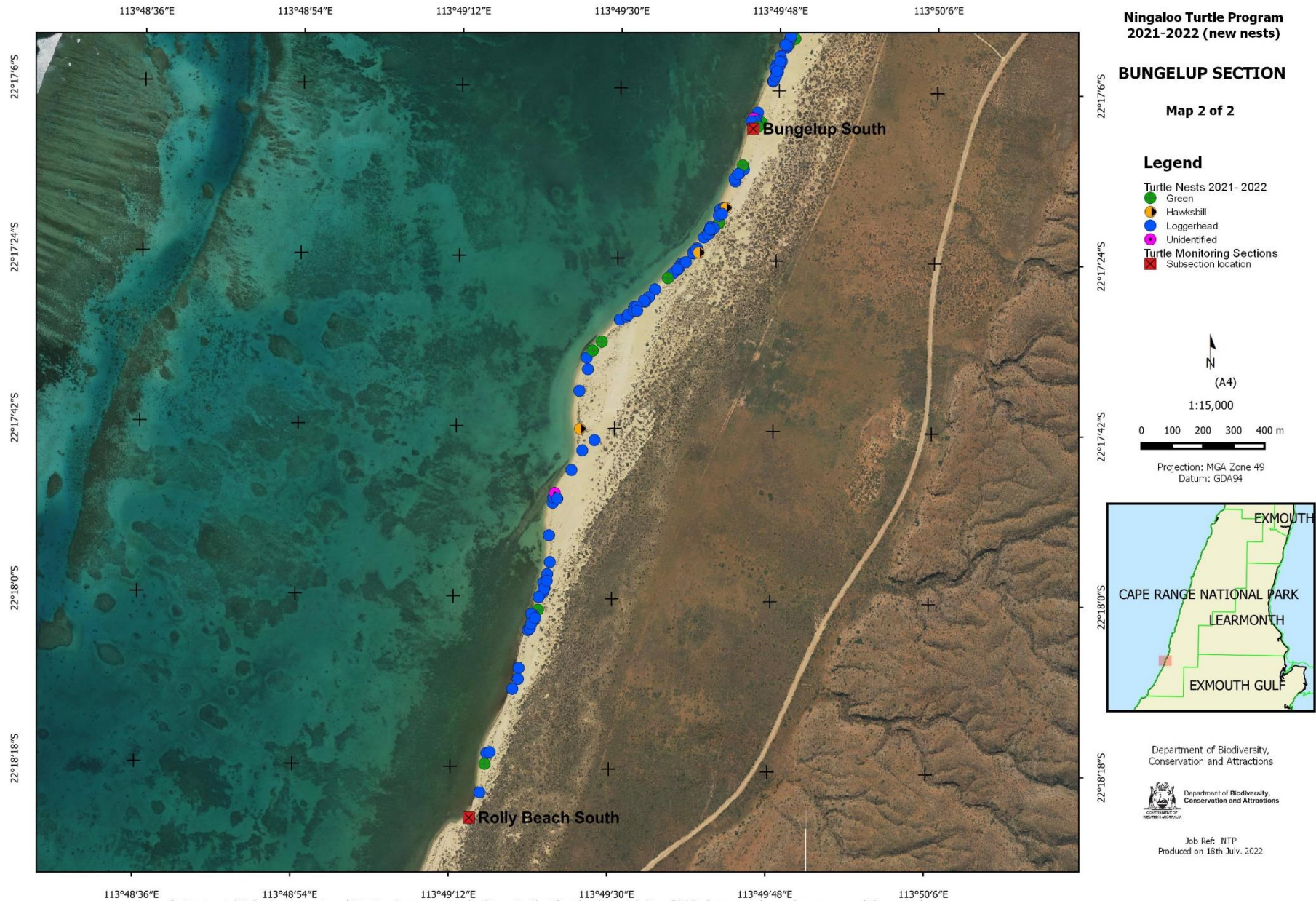
Appendix 7: Tantabiddi section - New nests (NTP 2021-22) Map 1



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Appendix 8: Bungelup section - New nests (NTP 2021-22) Map 1 & 2





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