Boskalis Cambridge Gulf Marine Sand Proposal s38 Referral WA EP Act

Referral Report No. 2 - *Proposal Setting & Existing Environment Descriptions*

ANNEX 12 - CAPE DOMETT TURTLE DATA REPORT - Boskalis Cambridge Gulf.

Analysis of Ten Years of Turtle Nesting Data from Cape Domett, Cambridge Gulf, Western Australia – 2013 to 2022 Inclusive

Data Collected by the Western Australia (WA) Department of Biodiversity Conservation & Attractions (DBCA).

Analysis & Report by Brae Price & Steve Raaymakers, EcoStrategic Consultants,

for DBCA and Boskalis Australia Pty Ltd (BKA).

August 2024

NOTE: The data analysed in section 5 of this report is owned by DBCA and its use by BKA is subject to the Data Sharing Agreement signed between DBCA and BKA, as contained in Annex 1 of this report.

CITATION: Price, B. & Raaymakers, S. (2024). *Analysis of Ten Years of Turtle Nesting Data from Cape Domett, Cambridge Gulf, Western Australia - 2013 to 2022 Inclusive*. Report to the Western Australia Department of Biodiversity Conservation & Attractions and Boskalis Australia Pty Ltd, EcoStrategic Consultants, Cairns.

Acknowledgments

Boskalis Australia Pty Ltd and the report authors thank the following DBCA staff for their support in progressing the Data Sharing Agreement, providing the turtle nesting data and advice on the survey design and methods used, and for reviewing drafts of this report; Margaret Byrne, Sabrina Fossette-Halot, Tony Tucker, James Gee, Scott Whiting, Ben Corey and Sean McGee.

CONTENTS

1. Introduction & Purpose of this Report

1. Boskalis Australia Pty Ltd (BKA) is currently assessing the feasibility of developing a marine sand sourcing operation in Cambridge Gulf (CG) near the Port of Wyndham in the northeast of Western Australia (WA) (Figure 1). The sand in CG is derived from natural terrestrial sources in the catchment, supplied via river inputs. The sand would be exported to Asian markets such as Singapore for use in construction projects.

2. The proposal is subject to the WA *Mining Act* including the comprehensive environmental assessment and management framework under that Act. BKA currently holds two sand exploration tenements in CG, shown as Block 4 (E80/5655) and Block 4A (E80/6009) on Figure 1. Based on sand distribution, the proposed operational area is the western part of Block 4 and all of Block 4A (Figure 1).

3. To support its feasibility assessment BKA has undertaken a wide range of environmental, engineering, economic and other studies since 2018. These studies find that the proposal is feasible and viable and unlikely to cause significant environmental impacts. However, as a responsible company with stringent environmental and social policies, BKA has committed to self-referring the proposal to the WA Environmental Protection Authority (EPA) under section 38 of the WA *Environmental Protection Act* (EP Act), and to the Commonwealth under Part 7 of the Commonwealth *Environmental Protection & Biodiversity Conservation Act* (EPBC Act), for their determination of what further environmental assessments might be required, if any.

4. In undertaking environmental studies and consultations, BKA has been informed by the WA Department of Biodiversity Conservation & Attractions (DBCA) that there is a globally significant nesting area for Flatback Turtles (*Natator depressus*) at Cape Domett Seaward Beach, near the eastern entrance to CG. The northward facing beach is 1.9 km long and located 12 km from the nearest point of the proposed operational area (Figures 1 & 2).

5. In addition to and including Cape Domett Seaward Beach, aerial drone surveys commissioned by BKA in July 2023 observed Flatback nesting at the following locations (Figures 1 & 2) (see section 5):

    - 1. Cape Domett Seaward Beach (1.9 km long) – the main nesting beach.
    - 1A. Cape Domett Small Beach (0.4 km long).
    - 2. Turtle Bay on NW side of Lacrosse Island (0.3 km long).
    - 3. Turtle Beach West to the west of Cape Dussejour (3 km long).
    - 4. Barnett Point within CG - No beach and the nesting occurs on sand ridges (cheniers) that are protected behind mangroves.

6. Flatback Turtles are endemic to the tropical marine waters of Australia, south-eastern Indonesia and Papua New Guinea, and are not found in global tropical waters like most other marine turtle species. They are protected under both the WA *Biodiversity Conservation Act* (BC Act) and the Commonwealth EPBC Act, being classified as 'vulnerable' under both Acts.

7. Initial surveys at Cape Domett Seaward Beach by Whiting et al (2008) estimated that the Flatback nesting population is one of the largest known, with mean peak nesting of 70.8 to 73.7 turtles per night (up to 290 turtle tracks per night) and an estimated yearly population in the order of several thousand turtles (estimated ~3,250). Peak nesting for Flatbacks at Cape Domett is in the winter dry-season August-September each year, which differs from the west coast of WA where peak nesting season is in summer.

8. The arrival of Europeans in the CG area in the late 1800s saw Traditional Owners (TOs) engaged in large scale commercial harvesting of turtles, for meat and also for shell for the European fashion industry (although the latter trade targeted Green and Hawksbill Turtles, as the softer shell of Flatbacks is not suitable for buttons and similar fashion items). Tens of thousands of turtles were harvested from northern Australia including in Cambridge Gulf until the industry was closed in 1973 (Halkyard 2014). Figure 3 shows a record haul of Flatback Turtles at Turtle Bay on Lacrosse Island in 1924.

9. Given the importance of Cape Domett and nearby beaches for nesting, the Commonwealth has designated a Biologically Important Area (BIA) for inter-nesting habitat for Flatbacks, within a 60 km radius around Cape Domett and Lacrosse Island as shown on Figure 4. Inter-nesting areas are where turtles rest on the seabed between nesting attempts to regain energy for the next nesting attempt. As can be seen on Figure 4, the inter-nesting BIA extends into CG and thus overlaps BKA's proposed operational area. The 60 km radius is based on satellite-tracking data in various areas of WA. However, BKA's assessment is that it would be difficult for any Fatback to 'rest' on the seabed inside CG, as there are 3 to 4 knot tidal currents. It seems more likely that they go straight offshore from the beaches into the more hospitable waters of the inner Joseph Bonaparte Gulf for inter-nesting. This assessment is detailed in BKA (2024d). Additional satellite-tracking data could confirm this hypothesis.

10. In assessing the feasibility of the proposed sand sourcing operation and undertaking related environmental studies, BKA is committed to thoroughly assessing all potential impacts on the environment and biodiversity, and ensuring that any unacceptable impacts (including on marine turtles) are prevented, avoided, minimized and mitigated.

11. Since 2012 DBCA has been undertaking annual monitoring of turtle nesting at the Cape Domett Seaward Beach, in cooperation with the TOs of the area. While a wealth of useful data has been collected, to date it had not been fully analysed. During consultations between DBCA and BKA in 2023, access was granted to DBCA's data, which ensured BKA's environmental assessment is based on the best available data, and thus optimizes scope for protection of marine turtles.

12. Use of the data is subject to the Data Sharing Agreement contained in Annex 2.

13. The purpose of this report is:
    - to present the findings of BKA's analysis of DBCA's data from the Cape Domett turtle nesting surveys,
    - to inform BKA's environmental assessment of the marine sand proposal; and
    - for use by DBCA as it wishes, as the owner of the data.

14. This report does not represent the full assessment of potential impacts of the proposed project on Flatbacks or other marine turtles, but simply provides data analysis to feed into that assessment. The full assessment is contained in BKA's EP Act Referral Reports, particularly BKA (2024c) and BKA (2024d), and is summarized in section 12 below.

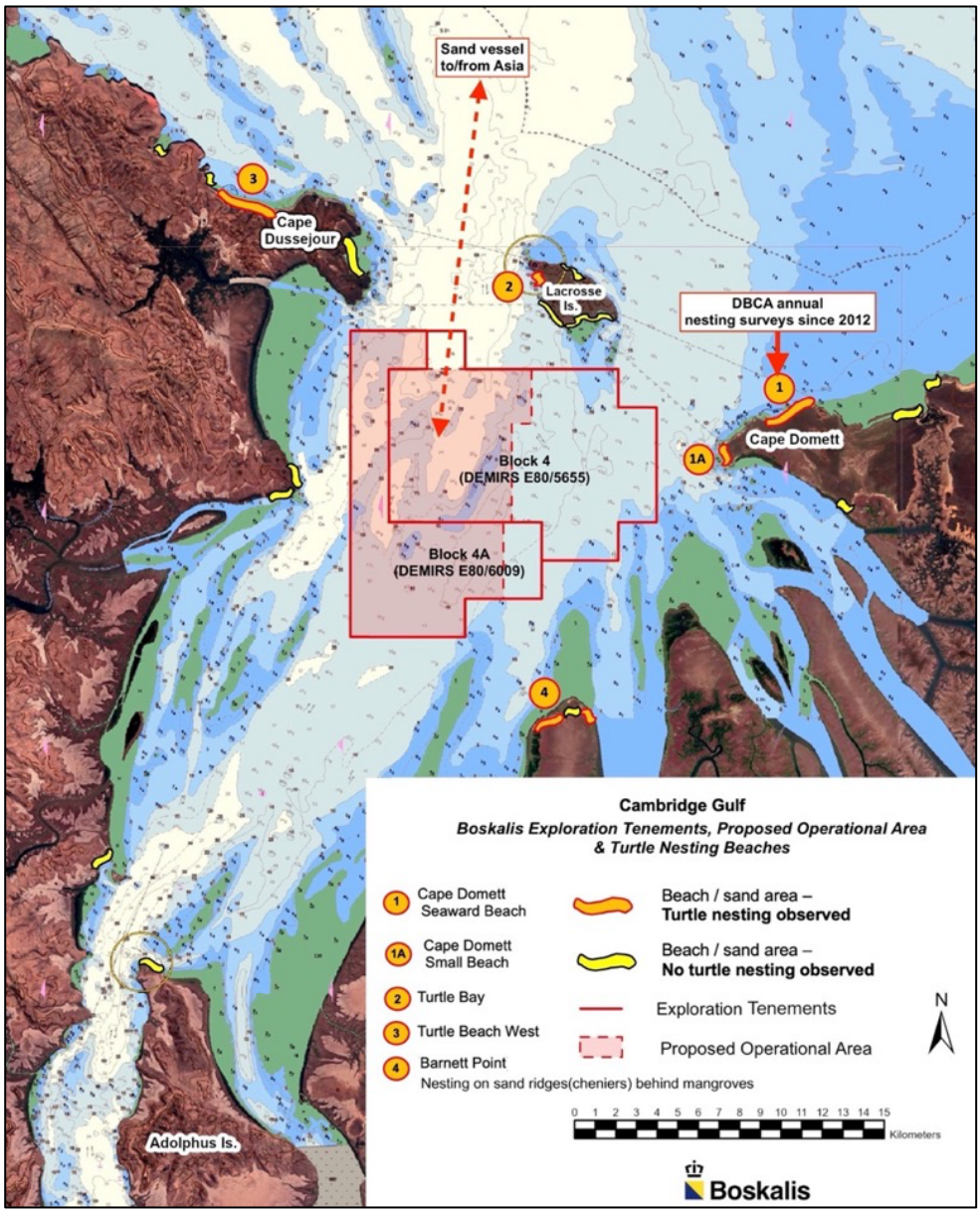


FIGURE 1: *Cambridge Gulf, Boskalis exploration tenements, proposed operational area and turtle nesting beaches as observed during aerial drone surveys commissioned by BKA in July 2023.*

1. Cape Domett Seaward Beach (looking west)

1. Cape Domett Seaward Beach (looking east - 2 crocs centre)

1A. Cape Domett Small Beach (looking to Lacrosse Island)

2. Turtle Bay (NW side of Lacrosse Island)

3. Turtle Beach West (looking west from Cape Dussejour)

4. Barnett Point (from east side)

FIGURE 2: *The five main Flatback Turtle nesting sites in the CG area. The top two images are both of Cape Domett Seaward Beach, where DBCA has surveyed annually since 2012. At Barnett Point (bottom right) there is no beach and nesting occurs on sand ridges (cheniers) behind mangroves (images: BKA 2023).*

FIGURE 3: *A haul of Flatback Turtles, placed on their backs to immobilise them, at Turtle Bay on Lacrosse Island in 1924. The commercial turtle harvesting industry was closed in 1973 (image: Alarmy)*

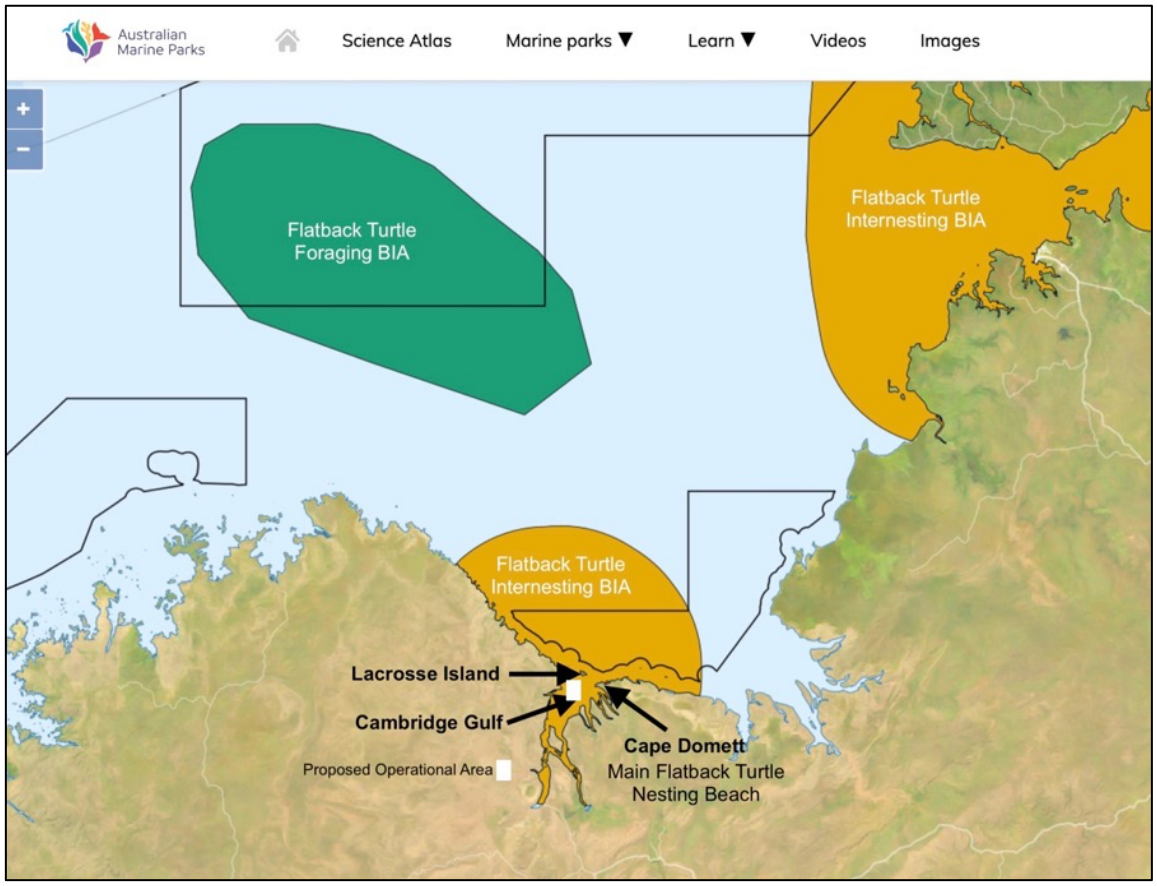


FIGURE 4: *The BIA for Flatback Turtle inter-nesting habitat declared for 60 km radius around Cape Domett and Lacrosse Island, extending into CG, and showing BKA's proposed operational area.*

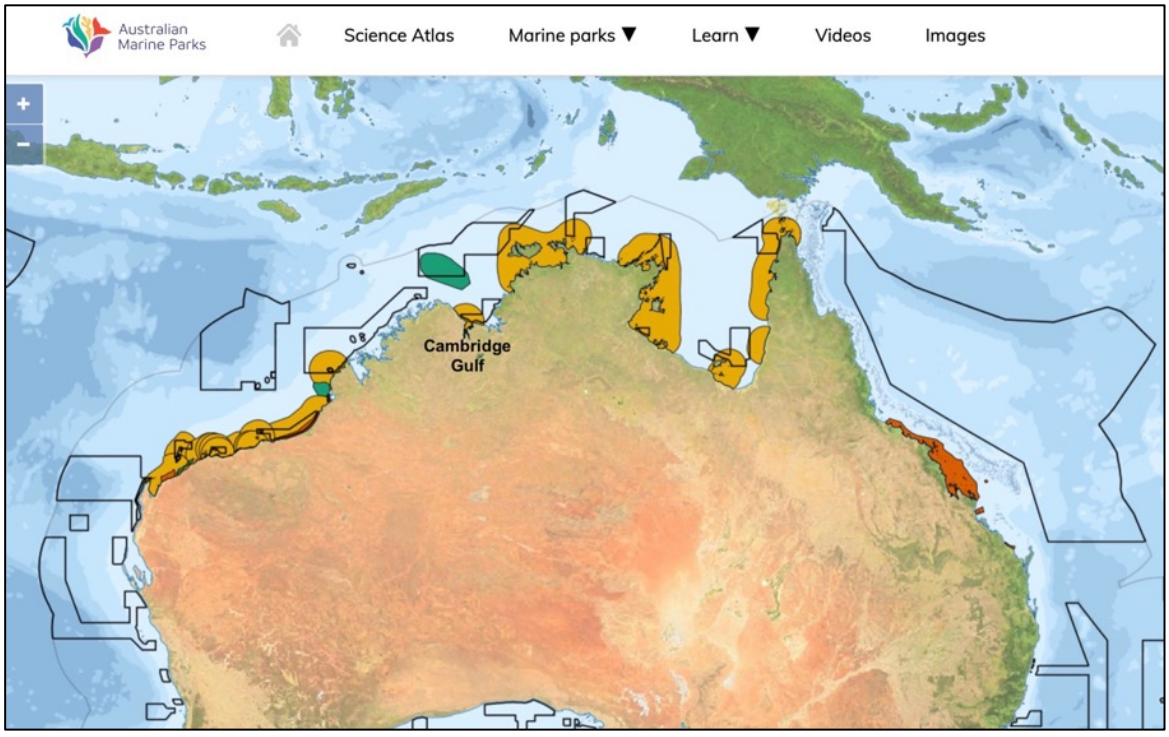


FIGURE 5: *BIAs for Flatback Turtles at national level.*

2. DBCA Survey Design & Methods

1. The DBCA survey design and methods are based on Whiting et al (2008). The surveys have been undertaken annually since and including 2012, starting in the first week of August each year (peak nesting season).

2. There is no road access to Cape Domett and the monitoring team accesses the beach by vessel and/or helicopter, usually setting up camp at the eastern end of the beach (Figure 6). Safety issues for survey personnel include numerous crocodiles that congregate in the area to feed on both nesting and hatching turtles (Figure 7).

3. To provide spatial structure to the survey effort the beach is divided into 19 sectors (S01 to S19), each being 100 m in length (Total beach length = 1.9 km) (Figure 6).

4. The number of sectors and survey nights per year to date were:

    - 2012: Only 6 sectors (S01 to S06), 8 nights.
    - 2013: All 19 sectors, 13 nights.
    - 2014: All 19 sectors, 13 nights.
    - 2015: All 19 sectors, 13 nights.
    - 2016: All 19 sectors, 14 nights.
    - 2017: All 19 sectors, 14 nights.
    - 2018: All 19 sectors, 14 nights.
    - 2019: All 19 sectors, 14 nights.
    - 2020: All 19 sectors, 14 nights.
    - 2021: All 19 sectors, 7 nights.
    - 2022: All 19 sectors, 14 nights.

5. Because only six sectors and eight nights were surveyed in 2012, the data is not directly comparable with the other years when all 19 sectors were surveyed – and the 2012 data is therefore excluded from the analysis in this report.

6. Because there were differences in the number of survey nights for the other years it is not possible to directly compare total observations between years (13 nights each in 2013, 2014 and 2015 and 14 nights each from 2016 to 2022, with the exception of 2021, which was only 7 nights). Given the differences in survey nights between years, mean overnight track count is used for the analysis to allow comparisons between years (see section 4 below).

7. Prior to the first survey night a line parallel to the shore and above the high-water mark was dragged along the entirety of the beach from east to west. This allows the tide to remove the previous night's turtle tracks from the sand below the high-water mark, and prevents track recounts the next morning (i.e. only new tracks would be counted).

8. Each morning every set of turtle tracks that crossed the line in each sector was counted (1 x outgoing track and 1 x returning track = 1 track set or 1 attempted nesting event), and identified to species based on track characteristics. Nests that had hatched or had been predated the night before were also documented each morning in each sector.

9. In order to avoid recounting hatched- and predated-nests after successive nights, the protocol was to find the nest cone and mark it with a stick or a circle or both.

10. Other animal species tracks (e.g. dingos/dogs) that had crossed the line in each sector were also recorded for the years 2013 to 2018 inclusive, but were not included in the reported data from 2019 to 2022 inclusive, due to data transmission issues.

11. After the survey was completed each morning, a fresh line was dragged along the beach above the highwater mark for the forthcoming night.

12. The raw data collected by DBCA during each annual survey therefore comprises the following, per sector per night:

    a) Number of nesting events (based on track pair sets) and species.
    b) Number of hatched nests (only 7 survey nights observed for this metric in 2013).
    c) Number of predated nests (only 7 survey nights observed for this metric in 2013).
    d) Number of tracks of other animals (it should be noted that as other animals may move between sectors, separate track counts could be the same animal moving along the beach, meaning that the actual total may be less than the counted tracks). As above animal tracks were not included in the reported data from 2019 to 2022 inclusive, due to data transmission issues.

13. Prior to this report, the raw data collected by DBCA had not been analysed and this report constitutes the first systematic analysis of the data attempting to deduce potential patterns and trends.

FIGURE 6: *Cape Domett seaward beach - DBCA Turtle Nesting Survey Sectors S01 to S19*

FIGURE 7: *Safety issues for survey personnel include numerous crocodiles that congregate in the area to feed on both nesting and hatching turtles (image: BKA 2023)*

3. Data Analysis Methods

1. Firstly, raw excel data provided by DBCA was processed and cleaned to remove any obvious anomalies and to standardise the data categories and formats between years. The raw data was reasonably clean, only requiring compilation for each parameter recorded (Flatback Turtle tracks, Green Turtle tracks, hatching nests, predated nests and animal tracks). Anomalies removed included all 2012 data (as only six sectors and eight nights were surveyed) and an extra survey night (15th night) that appeared to have been erroneously added in 2020.

2. Analysis was only conducted for Flatback Turtles. Green turtles were the only other marine turtle species observed in DBCA data and were observed at insufficient numbers (Less the 4 in any survey year) to allow a meaningful analysis.

3. The processed/cleaned data for 2013 to 2022 inclusive was then analysed to assess a number of potential trends and patterns.

4. As outlined in section 2, because there were differences in the number of survey nights between years it is not possible to directly compare total observations between years (years of greater survey effort = higher track counts) Therefore, to allow comparisons between years, mean overnight track count, mean overnight hatching nest count and mean overnight predated nest count was applied to the ten-years of data, as described in (Limpus, et al. 1984) (Figures 8 to 10).

5. For each of the three parameters, overnight counts for all sectors and nights each year were summed and divided by the number of nights surveyed that year, to provide a mean overnight count, as follows:

    - Mean overnight count = total number of counts that year / number of survey nights that year.

6. Total observations each year are important for providing an indication of total nesting numbers, and are presented in section 4. The number of nights surveyed each year is presented with the total counts as a qualifier of when higher counts might relate to higher number of survey nights.

7. Other analysis conducted included:

    a) Total and mean overnight hatched-nests observed each year, presented to show trends from 2013 to 2022 (Figures 9 & 13).

    b) Total and mean overnight predated-nests observed each year, presented to show trends from 2013 to 2022 (Figures 10 & 14).

c) Total and mean overnight track counts of other-animals observed each year, presented to show trend 2013 to 2022 (Figures 11 & 15) (noting the point above about animals possibly moving between sectors and thus introducing errors to the counts). These were recorded in the field as observations only and are therefore reported in this report to provided context only, as the data limitations do not allow meaningful statistical analysis.

d) Spatial representation of the total number of flatback turtle tracks occurring in each of the sectors, summed for all years (Figure 16) and broken down into individual years between 2013 and 2022 (Figure 17) (noting it excludes 2019 and 2020 as separate sector data was not recorded in those two years).

4. Data Analysis Results

1. Table 1 summarizes the data for each year for the 10-year monitoring period 2013 to 2022 inclusive, noting that data from 2012 was not included in the analysis for the reason stated above. Figures 8 to 17 present the graphs of the parameters described in section 3 above.

2. Green Turtles are excluded from further discussion as only 12 track sets were observed over the 10-year period, which does not permit meaningful analysis. These are considered opportunistic nesting attempts by the occasional Green Turtle and the area is not considered a Green Turtle rookery.

3. Key findings for Flatback Turtles from Table 1 are:

    a) Number of survey nights.

        - Total number of survey nights for all 10 years combined: 130.
        - Mean number of survey nights per annual survey: 130/10 = 13.

    b) Number of tracks:

        - Total tracks for all 10 annual surveys combined: 6,270.
        - Mean tracks per annual survey: 6,270/10 = 627.
        - Highest tracks per annual survey: 837 in 2019 (with 14 survey nights).
        - Lowest tracks per annual survey: 356 in 2014 (with 13 survey nights) (by contrast 2021 had only 7 survey nights but a total of 444 tracks).
        - Highest mean overnight tracks: 63.4 in 2021 (this compares to 70.8 to 73.7 from Whiting et al 2008).
        - Lowest mean overnight tracks: 27.4 in 2014.

    c) Number of hatched-nests:

        - Total hatched-nests for all 10 annual surveys combined: 858.
        - Mean hatched-nests per annual survey: 858/10 = 85.8.
        - Highest hatched nests per annual survey: 237 in 2019 (with 14 survey nights).
        - Lowest hatched nests per annual survey: 32 in 2022 (with 14 survey nights) (by contrast 2021 had only 7 survey nights but a total of 117 hatched nest counts).
        - Highest mean overnight hatched nests: 16.93 in 2019.
        - Lowest mean overnight hatched nests: 2.29 in 2022.

    d) Number of predated-nests (noting this was not recorded 2019 to 2022 inclusive):

        - Total predated nests for all 6 annual surveys when this parameter was recorded, combined: 84.
        - Mean predated nests per annual survey: 84/6 = 14.
        - Highest predated nests per annual survey: 18 in 2014 (with 13 survey nights).

- Lowest predated nests per annual survey: 10 in 2015 (with 13 survey nights).
- Highest mean overnight predated nests: 1.75 in 2017.
- Lowest mean overnight predated nests: 0.71 in 2014.

4. Figure 8 plots mean overnight track counts for each annual survey 2013 to 2022 inclusive and shows no obvious linear trend over the 10-year period with similar counts year-to-year.

5. Figure 9 plots mean overnight hatched-nest counts for each annual survey 2013 to 2022 inclusive and shows no obvious linear trend over the 10-year period, however mean overnight hatched nests spiked in 2015 and even more in 2019 and 2021 compared to other years, with dips before and after those three high years.

6. Figure 10 plots mean overnight predated nest counts for each annual survey 2013 to 2022 inclusive. It shows a downward trend from 2013 to 2015, then an upward trend from 2015 to 2017, then downward again to 2018, with no recordings in the following years. It should be noted that the differences between years are not large with a range of 0.71 to 1.75 and the scale of the Y axis makes dips and rises appear more significant than they actually are.

7. In addition to recording predated nests, during each survey up to 2018 observers made qualitative observations of predators and predation, with the following being of note:

    a) Birds and bird tracks were observed during all annual surveys.

    b) Crocodile tracks were observed during all annual surveys except 2014.

    c) Dingo/dog tracks were observed every night for all annual surveys, except for three nights only (14 August 2013, 9 August 2014 and 11 August 2016).

    d) There were no records of signs of wild pigs or predation by wild pigs.

8. As outlined in sections 2 and 3 the predator observations were not recorded in a manner that allows meaningful analysis. Qualitative observations of predators and predation were not recorded during the annual surveys in 2019 to 2022 inclusive.

9. Figure 16 shows the total number of track counts summed per beach sector for all years combined. This indicates that on average most nesting occurs towards the eastern end of the Cape Domett Seaward Beach. Figure 17 shows the same data for each annual survey except 2019 and 2020 when separate sector data was not recorded. These plots confirm that most nesting occurs towards the eastern end of the beach, although there are some years such as 2018 and 2021 where some sectors further west had higher numbers.

TABLE 1: *Summary data for each year in the 10-year monitoring period at the Cape Domett seaward beach 2013 to 2022 inclusive (excluding 2012).* * Denotes hatched nest and nest predation counts only occurred on 7 nights.

Blue = lowest value and Red = highest value for each parameter across all years

Year	No. of sectors surveyed	No. of survey nights	Flatback Turtles						Green Turtles	Other Animal Tracks	
			Total Track Counts	Mean Overnight Track Counts	Total Hatched Nests	Mean Overnight Hatched Nests	Total Predated Nests	Mean Overnight Predated Nests	Total Track Counts	Total Counts	Mean Overnight Counts
2013	All 19	13*	628	48.31 ± 7.31	42	6.00 ± 1.43	14	1.75 ± 0.45	3	179	13.77 ± 3.39
2014	"	13	356	27.38 ± 10.23	56	4.31 ± 1.08	18	1.38 ± 0.50	2	103	7.92 ± 2.09
2015	"	13	404	31.08 ± 8.70	140	10.77 ± 1.78	10	0.77 ± 0.28	0	285	21.92 ± 1.18
2016	"	14	731	52.22 ± 15.29	44	3.14 ± 0.84	15	1.07 ± 0.40	0	321	22.93 ± 1.75
2017	"	14	803	57.36 ± 13.51	73	5.21 ± 1.02	17	1.21 ± 0.37	2	402	28.71 ± 1.21
2018	"	14	699	49.93 ± 12.14	66	4.71 ± 1.04	10	0.71 ± 0.19	1	373	26.64 ± 1.21
2019	All 19 but no sector data recorded - only nightly all sectors combined.	14	837	59.79 ± 17.57	237	16.93 ± 2.02	Not recorded	Not recorded	Not recorded	Not recorded	Not recorded
2020	"	14	798	57.00 ± 11.60	51	3.64 ± 0.92	Not recorded	Not recorded	Not recorded	Not recorded	Not recorded
2021	All 19	07	444	63.43 ± 15.13	117	16.71 ± 2.81	Not recorded	Not recorded	Not recorded	Not recorded	Not recorded
2022	All 19	14	570	40.71 ± 10.98	32	2.29 ± 0.49	Not recorded	Not recorded	4	Not recorded	Not recorded
Totals/ Overall average (as relevant):		**130**	**6,270**	**48.72 ± 12.25**	**858**	**7.37 ± 1.34**	**84**	**1.15 ± 0.37**	**12**	**1,663**	**20.32 ± 1.81**

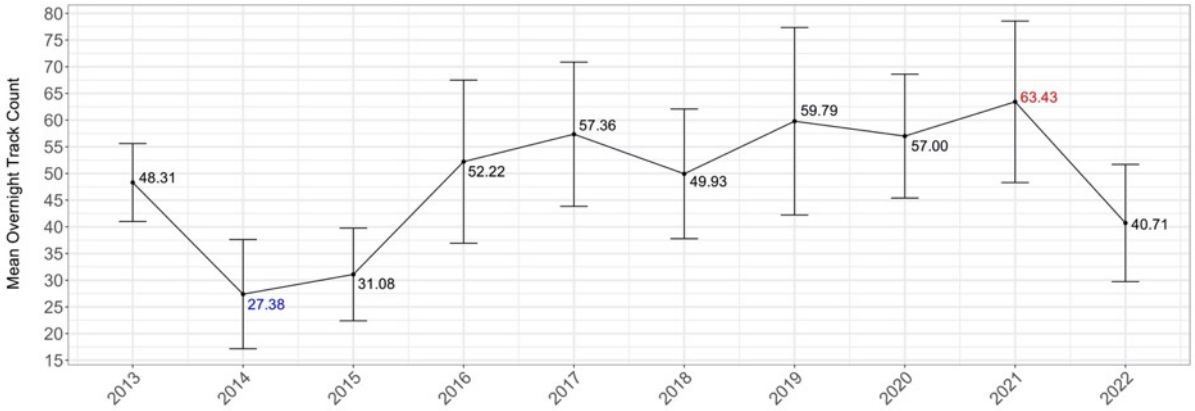


FIGURE 8: *Mean overnight track count per year 2013 to 2022 for Flatback Turtles at Cape Domett.*

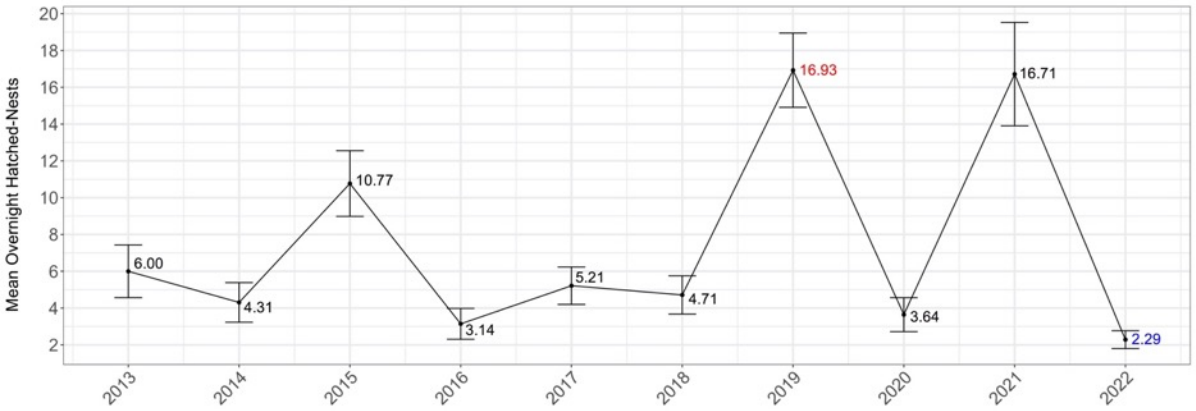


FIGURE 9: *Mean overnight hatched-nests per year 2013 to 2022 for Flatback Turtles at Cape Domett.*

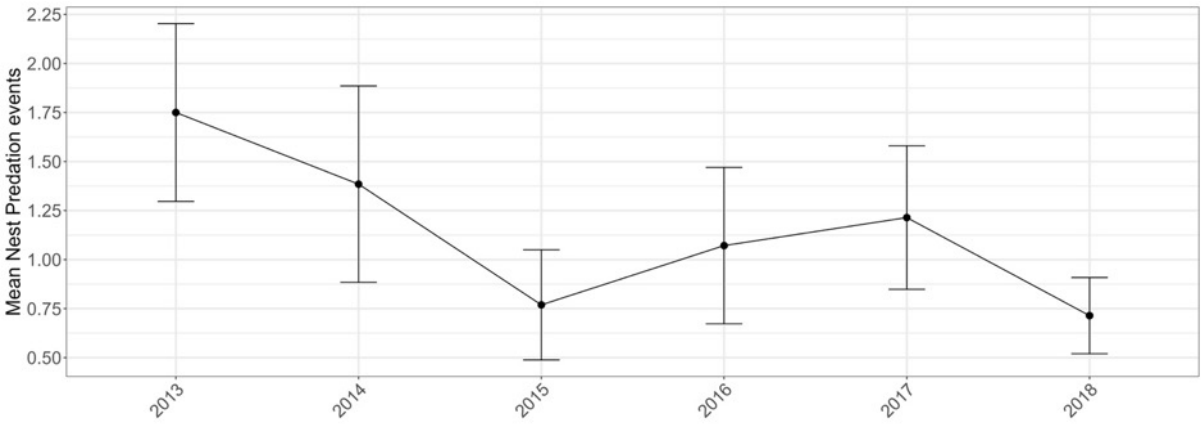


FIGURE 10: *Mean overnight predated-nests per year 2013 to 2022 for Flatback Turtles at Cape Domett.*

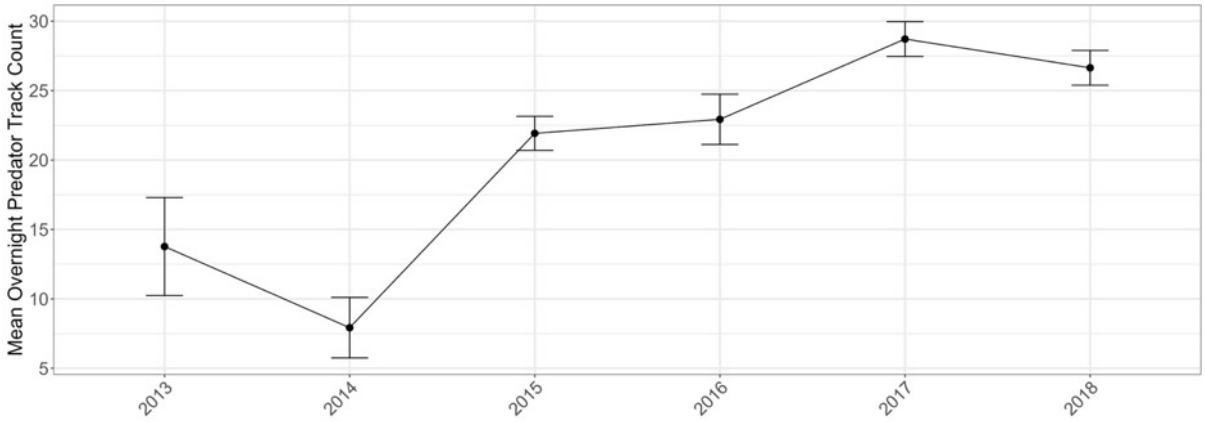


FIGURE 11: *Mean overnight track count per year 2013 to 2018 for all other animals at Cape Domett.*

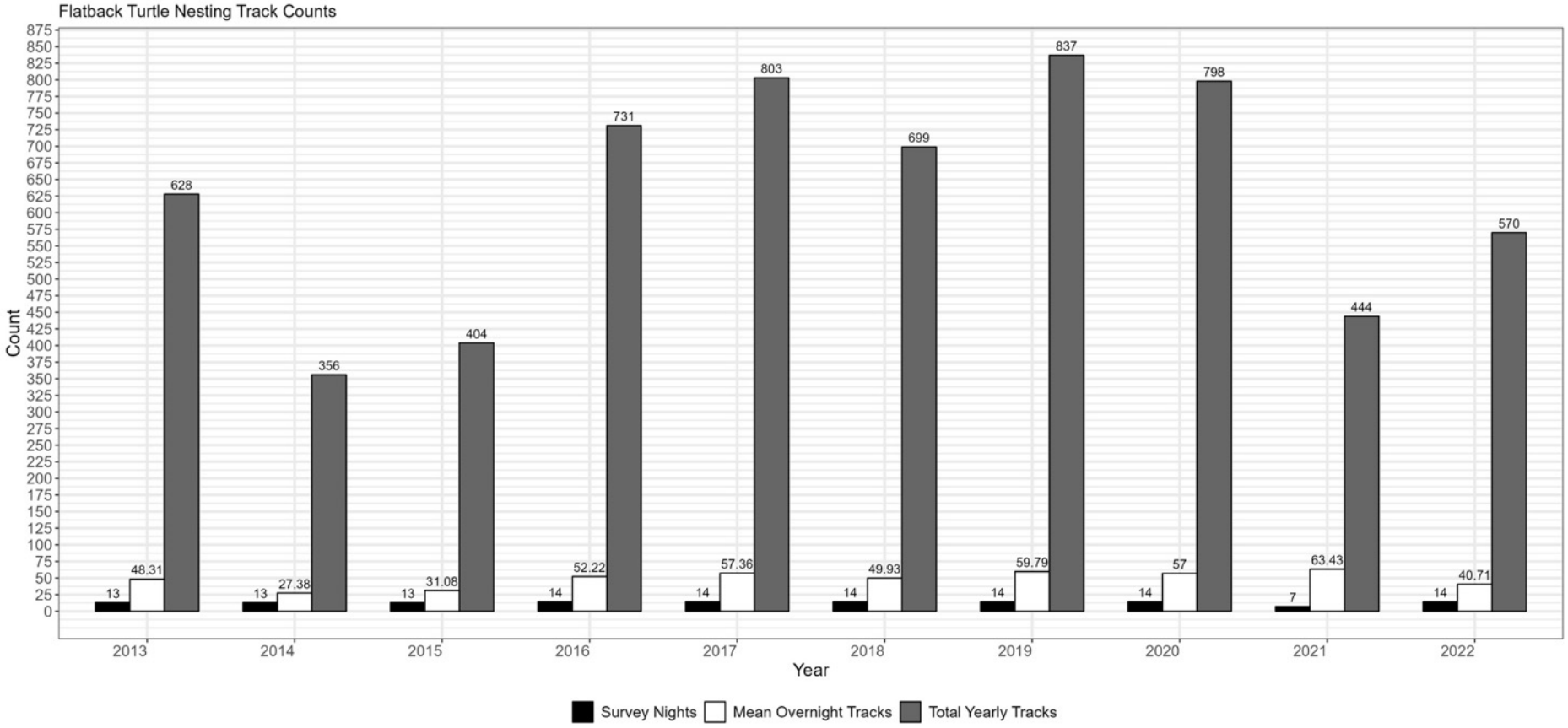


FIGURE 12: *Mean overnight track count, no. of survey nights and total yearly tracks per year 2013 to 2022 for Flatback Turtles at Cape Domett.*

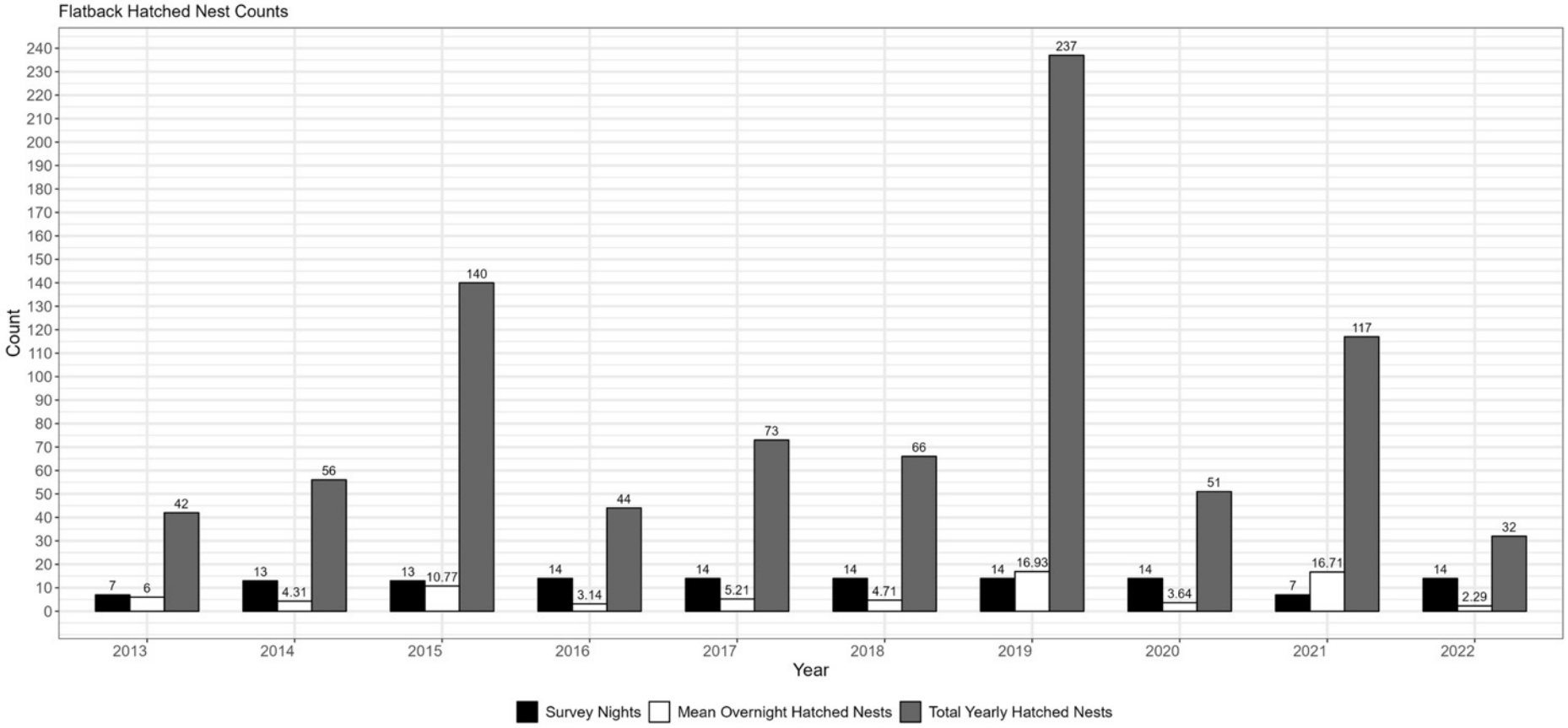


FIGURE 13: *Mean overnight hatched-nests, no. of survey nights and total yearly hatched-nests per year 2013 to 2022 for Flatback Turtles at Cape Domett.*

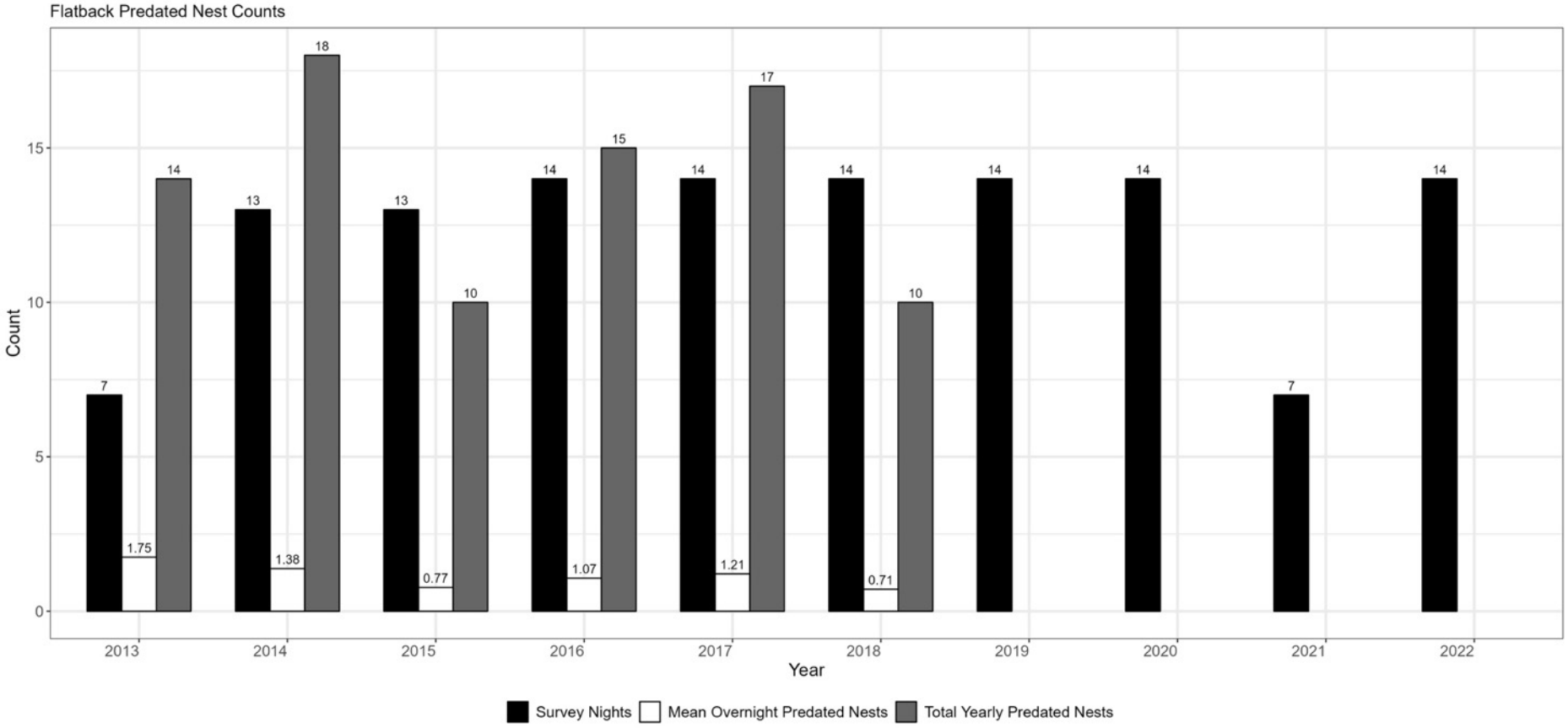


FIGURE 14: *Mean overnight predated-nests, no. of survey nights and total yearly predated-nests per year 2013 to 2022 for Flatback Turtles at Cape Domett.*

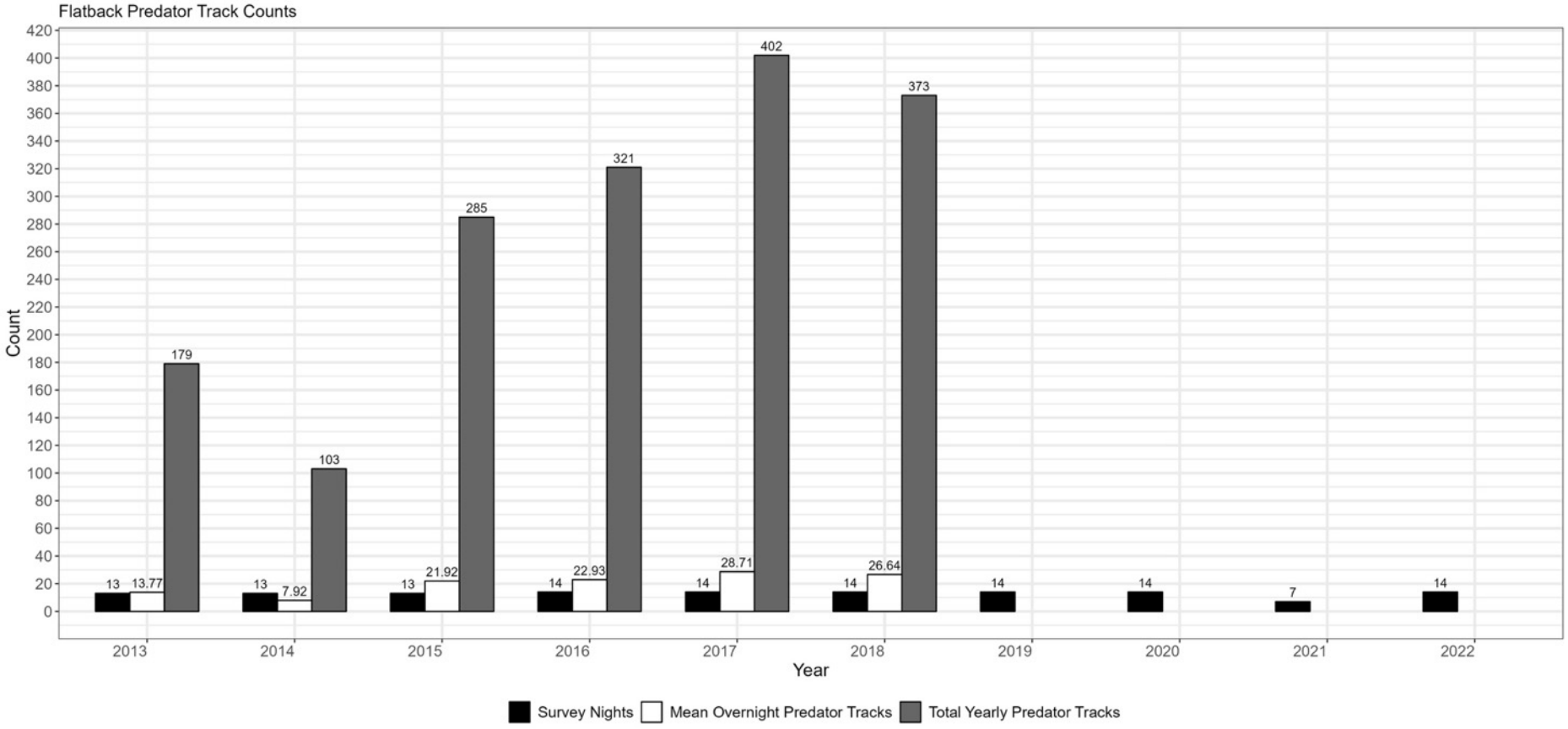


FIGURE 15: *Mean overnight predator track counts, no. of survey nights and total yearly predator track counts per year 2013 to 2022 for Flatback Turtles at Cape Domett.*

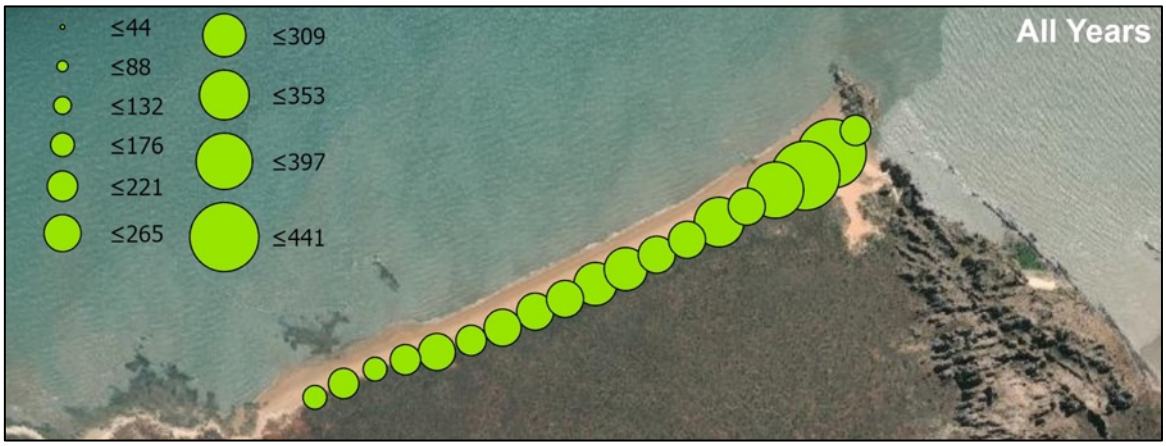


FIGURE 16: *Total number of tracks summed to sector for all years combined during the 10-year survey period (excludes 2019 and 2020 as separate sector data was not recorded in those two years).*

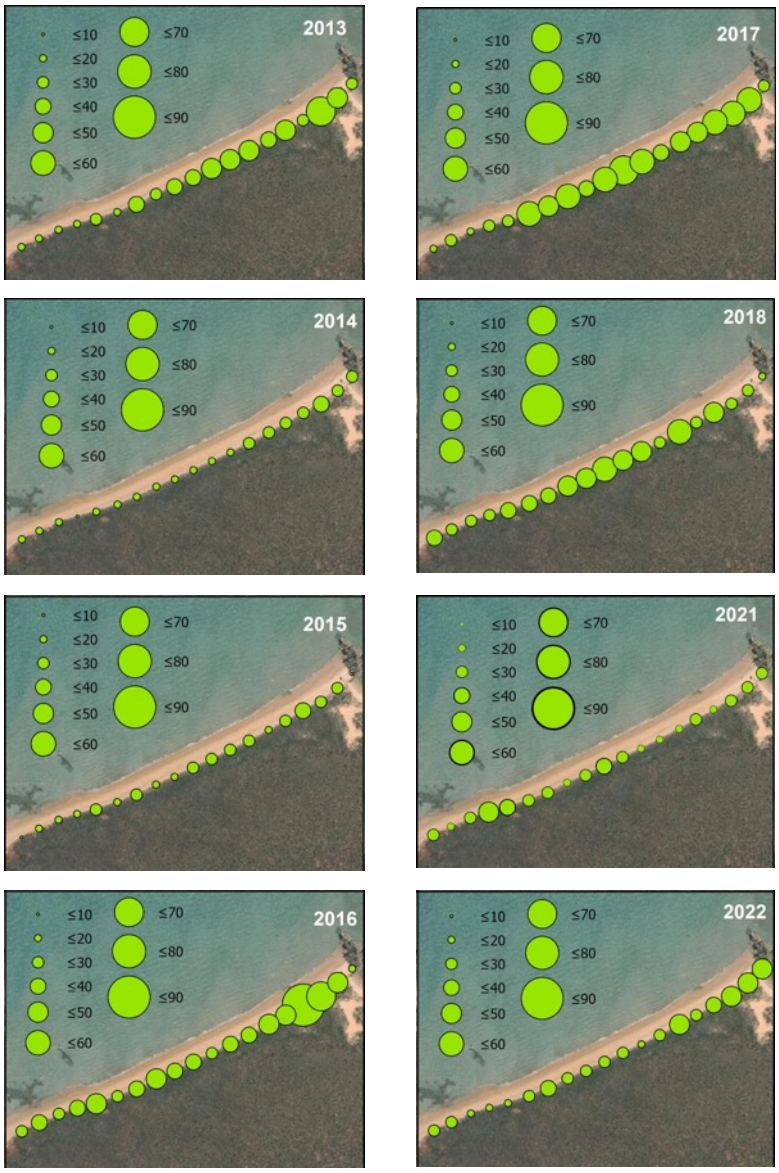


FIGURE 17: *Total number of tracks summed to sector for each year during the 10-year survey period (excludes 2019 and 2020 as separate sector data was not recorded in those two years).*

5. Boskalis Aerial Drone Video Survey July 2023

1. As part of BKA's environmental assessment program for the marine sand proposal, in late July 2023 close to the peak Flatback nesting season, aerial drone surveys of all beaches and coastal sand areas around CG that could potentially be turtle nesting areas were undertaken. These included both the orange and yellow areas shown on Figure 1, with the yellow areas having beach but with no signs of turtle nesting, and the orange areas having turtle tracks and nests.

2. The drone recorded high resolution video along transects that covered the full width of each beach area, timed to coincide with low tide to maximize the width of beach surveyed. The video was subsequently analysed to count turtle tracks and where visible, turtle nests, at each site. The videos are held on file by BKA and are available to DBCA. Full details are reported in Boskalis (2024c). Table 2 shows the track and nest counts at each site from analysing the drone imagery.

3. Figure 16 shows example of turtle tracks on Cape Domett Seaward Beach from the done survey in July 2023. Figures 17A and B show East Bank Point (Barnett Point) from the done survey in July 2023.

TABLE 2: *Turtle nest and track counts from aerial drone surveys in CG in July 2023.*

Site	Beach Length (km)	No. Nests	No. Track Sets	Likely Species*
1. Cape Domett Seaward Beach:	1.9	190	449	Flatback
1A. Cape Domett Small Beach:	0.4	7	7	"
2. Turtle Beach West (W of Cape Dussejour):	3	28	34	"
3. Turtle Bay (Lacrosse Island):	0.3	6	6	"
4. Barnett Point:	2.9**	13	82	"

*Based on track characteristics. **Approx. only. Separate sections combined.

FIGURE 18: *Example of turtle tracks on Cape Domett Seaward Beach from the done survey in July 2023 (BKA 2023).*

FIGURES 19A & B: *East Bank Point (Barnett Point) from the drone survey in July 2023 (BKA 2023).*

6. Boskalis Vessel-based Surveys July 2023 & Feb 2024

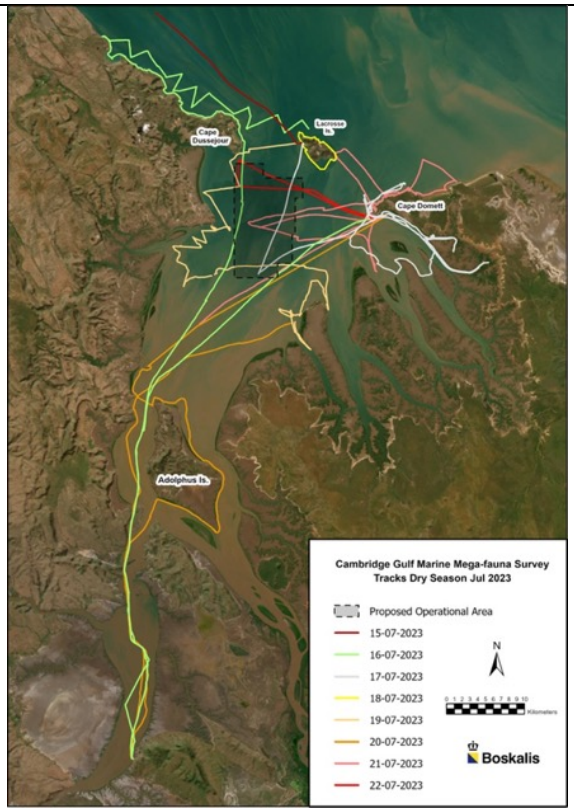
1. As part of BKA's environmental assessment program, in July 2023 and February 2024 vessel-based marine-megafauna (MMF) surveys were undertaken over eight and nine days respectuively, covering >800 km of transects during each survey, throughout and seaward of CG (Figure 20). The surveys targeted all MMF species found near and at the sea surface, including dugong, dolphins, crocodiles and marine turtles.

2. Full details are reported in Boskalis (2024c) and the results for sea turtles are summarized below:

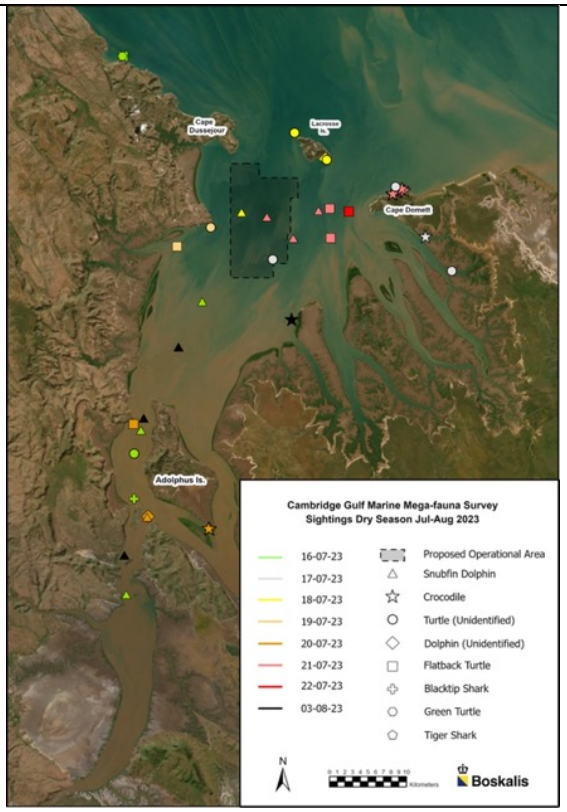
    a) February 2024:
        - Two unidentified turtle sightings in CG, one inside the proposed operational area, and no other sightings.

    b) Late July 2023 (near peak nesting period):
        - Five Flatback Turtle sightings (three near Cape Domett where the main nesting beach is, one near Adolphus Island and one on west side of CG).
        - Seven unidentified turtle sightings (one near Cape Domett, one near Adolphus Island, one on west side of CG, one on east side of CG, two near Lacrosse Island and one within the proposed operational area).

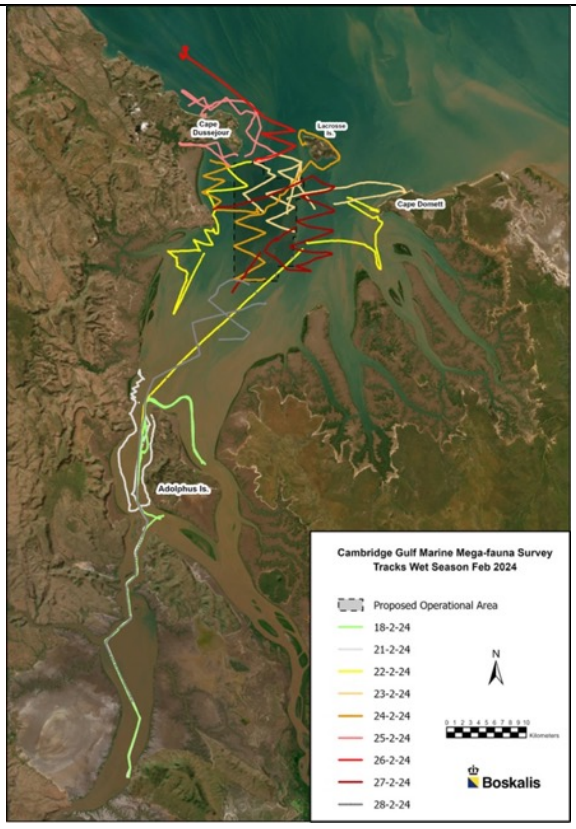
3. It should be noted that different sightings could be the same individual(s), so the actual number of turtles may be less than the number of sightings. These are very low numbers of on-water sightings considering the very large area covered, especially in late July 2023 near the peak nesting season, when hundreds of tracks and nests were observed on beaches.



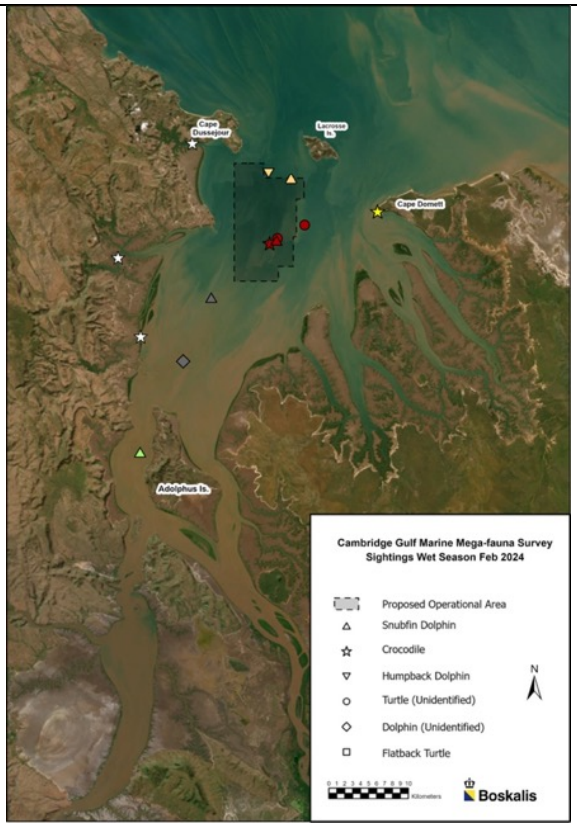
Dry-season MMF survey vessel tracks



Dry-season MMF survey sightings



Wet-season MMF survey vessel tracks



Wet-season MMF survey sightings

FIGURE 20: *Vessel-based Marine Mega-Fauna surveys. These are within the Cape Domett Flatback inter-nesting BIA.*

7. Boskalis Aerial Drone LiDAR and Photogrammetry Survey Feb 2024

1. As part of BKA's environmental assessment program, in February 2024 aerial drone high resolution (2 cm) LiDAR and photogrammetry surveys of the four main turtle nesting beaches in the CG area was undertaken at low tide. The LiDAR data was used to develop a Point Cloud, Digital Surface Model (DSM) and Digital Elevation Model (DEM) plus high-resolution photogrammetry of the four high priority beaches.

2. The LiDAR data and resulting outputs provide a powerful baseline for long-term monitoring of these areas. Figure 21 shows a Point Cloud output for Cape Domett Seaward Beach – full details and output for all beaches are reported in Boskalis (2024c). The data and outputs are available to DBCA.

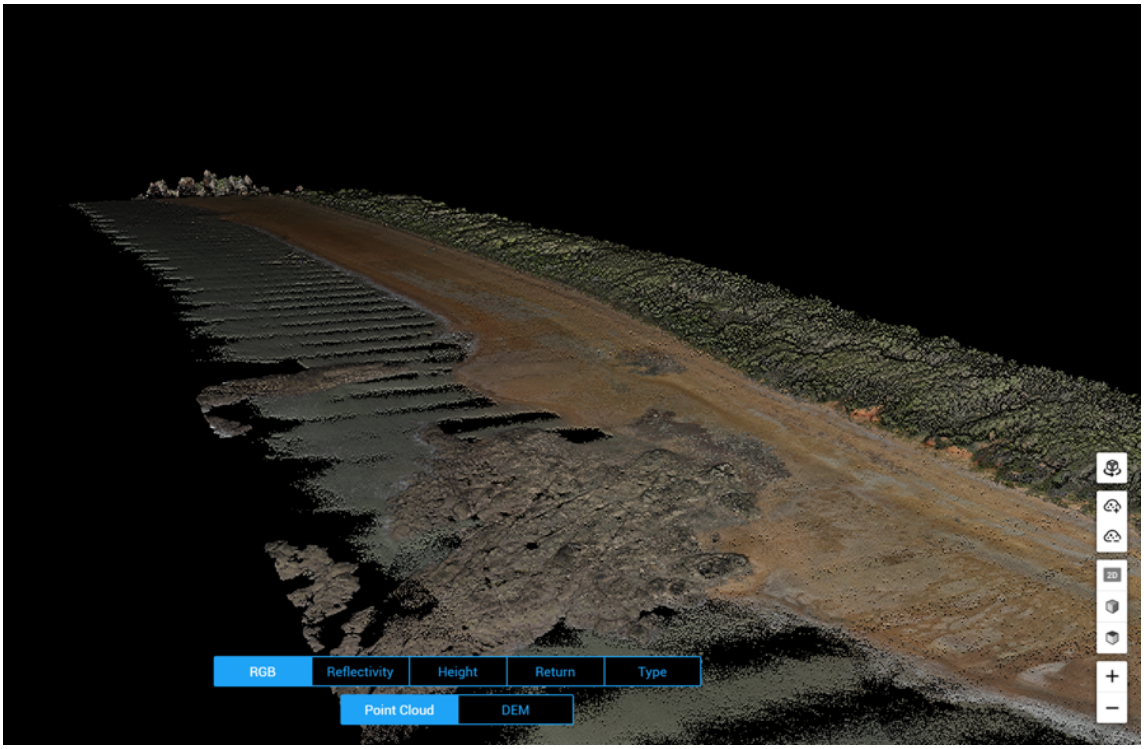


FIGURE 21: *Aerial drone LiDAR Point Cloud output for Cape Domett Seaward Beach at spring low tide. These were used to create high resolution Digital Surface Model (DSM) and Digital Elevation Model (DEM) plus high-resolution photogrammetry of the four high-priority beaches. This provides a powerful baseline for long-term monitoring of these areas. The data and outputs are available to DBCA.*

8. Discussion - DBCA Data

1. The 10-years of data from Flatback Turtle nesting surveys at the Cape Domett Seaward Beach by DBCA from 2013 to 2022 inclusive, as analysed in this report, provides a significant long-term dataset to inform the management and conservation of this globally significant nesting site for this protected and vulnerable species.

2. The data shows that over the ten-year period; a total of 130 nights were surveyed, the average number of nights surveyed annually was 13; a total of 6,270 track sets were counted, the average number of track sets counted per survey was 627; a total of 858 hatched nests were counted, the average number of hatched nests counted per survey was 85.7; a total of 84 predated nests were counted, and the average number of predated nests counted per survey was 8.4.

3. This data supports earlier, more comprehensive studies by Whiting et al (2008) which found that Cape Domett is a significant nesting site for Flatback Turtles. In addition, evidence of nesting by Green Turtles was counted on 12 occasions over 7 years within the ten-year period, equating to an average of 1.7 per year, indicating that Cape Domett is not a significant nesting site for this species.

4. Predators and signs of predators (tracks) including birds, crocodiles and dingos/dogs were observed during every annual survey from 2013 to 2018 inclusive (except no crocodiles in 2014). Records of predators were made from 2019 to 2022 inclusive, however were not included in the data-set due to transmission issues. The predator records were opportunistic and the data is not organized in a way that is suitable for quantitative analysis. There were no records of signs of wild pigs or predation by wild pigs, which is interesting given that the environment is ideally suited for wild pigs, and they have been

documented as a significant predator of eggs in turtle nests in similar remote coastal areas (Whytlaw et al 2013). Tracks were identified by local TOs and DBCA rangers who have strong track identification skills.

5. Due to differing numbers of survey nights between years it is not possible to use total numbers for each parameter surveyed to compare years and assess trends over time, or to use the data to make reliable estimates of total annual nesting numbers or population numbers. Some other aspects of the data that limit analysis were:

    a) In the first annual survey in 2012 only six of the 19 beach sectors were surveyed over eight nights only – the data from this year was therefore not included in the analysis in this report.

    b) For all other years, all 19 beach sectors were surveyed, but there were differences in the number of nights surveyed (due to the challenging logistics of operating at this extremely remote site), as follows:

    c) In 2013, 2014 and 2015 the survey duration was 13 nights.

    d) In 2016 to 2022 inclusive, except 2021, the survey duration was 14 nights.

    e) In 2021 the survey duration was only seven nights.

    f) Data was reported per sector for all years except 2019 and 2020, when data was actually collected by sector but all sectors were combined in the data provided to BKA for analysis.

    g) Observations of predated nests and signs of predators were made from 2019 to 2022 inclusive, but not included in the data provided to BKA for analysis.

6. As outlined in section 2, because there were differences in the number of survey nights between years it is not possible to directly compare total observations between years, thus allowing comparisons between years, mean overnight track count, mean overnight hatching nest count and mean overnight predated nest count was applied to the ten-years of data, as described in section 3.

7. It should be noted that many marine turtle species lay multiple clutches of eggs within a season. For Flatback Turtles the period between successive clutches, or the inter-nesting period, is ~ 15.67 days (Limpus et al. 1984). Flatbacks can also visit a beach multiple times in a period of a few days if the initial nesting was not successful. As such, observations of abundance should not be concluded from the total track observations, because it is likely to contain duplicate or even multiple counts of individuals across the survey period. The use of mean overnight track counts avoids this pseudo-replication, however this method underestimates population numbers (Limpus et al. 1984).

8. As outlined in section 4 and presented in Figure 8, for mean overnight track counts there is no obvious linear trend over the 10-year period with similar counts year-to-year. The highest mean overnight track count of 63.4 in 2021 compares to 70.8 to 73.7 from Whiting et al (2008), further indicating no significant changes over time.

9. As outlined in section 4 and presented in Figure 9, for mean overnight hatched-nest counts for each annual survey 2013 to 2022 inclusive and shows no obvious linear trend over the 10-year period, however mean overnight hatched-nests spiked in 2015 and even more in 2019 and 2021 compared to other years, with dips before and after those three high years.

10. As outlined in section 4 and presented in Figure 10, for mean overnight predated-nest counts for each annual survey 2013 to 2018 inclusive (with no records in the following years). It shows a downward trend from 2013 to 2015, then an upward trend from 2015 to 2017, then downward again to 2018, when recordings ended. It should be noted that the differences between years are not large with a range of 0.71 to 1.75 and the scale of the Y axis makes dips and rises appear more substantial than they actually are. It may therefore be concluded that there is no obvious linear trend over the 10-year period with similar counts year-to-year.

11. As outlined in section 4 and presented in Figures 15 and 16, most nesting occurs towards the eastern end of the Cape Domett Seaward Beach, although there are some years such as 2018 and 2021 where some sectors further west had higher numbers.

12. Overall, despite some minor limitations in the data, it appears that generally, Flatback Turtle nesting numbers at Cape Domett Seaward Beach may not have changed significantly since the surveys by Whiting et al (2008), although more rigorous data collection and analysis would be required to confirm this.

9. Discussion - BKA Data

1. As summarized in section 5, BKA's aerial drone surveys in July 2023 also observed Flatback Turtle nesting at Turtle Bay (Lacrosse Island), Turtle Beach West (west of Cape Dussejour) and East Bank Point (also known as Barnett Point). Counts of tracks and nests are presented in Table 2 in section 5.

2. Turtle Bay had very low numbers (six track sets and six nests observed) and this may be a result of the intensive commercial turtle harvesting that occurred at Turtle Bay historically, as described in section 1 and shown on Figure 3. Like most marine turtle species, female Flatbacks have a high fidelity to nesting beaches and will mostly (but not always) return to their hatching beach to nest, and will return to the same beach both within and between nesting seasons (Harmen et al 2009).

3. This means that historical mass harvesting at Turtle Bay may have broken the fidelity chain, depleting the population of females that return to this beach each year, resulting in the very low numbers seen even today. It is understood that similar mass harvesting did not occur at Cape Dommet or west of Cape Dussejour, as those areas are more remote in terms of access, and the supply at Turtle Bay met demand.

4. While Turtle Beach West (west of Cape Dussejour) is longer than Cape Domett Seaward Beach (3 km versus 1.9 km), the aerial drone surveys in July 2023 observed less nesting there than at Cape Domett.

5. An interesting finding from the aerial drone surveys in July 2023 was 82 tracks and 13 nests at East Bank Point (Barnett Point) inside CG, where Flatbacks nest on sand ridges (cheniers) protected behind a seaward mangrove fringe.

6. As outlined in section 6, the vessel-based MMF surveys in July 2023 and February 2024 observed very low numbers of on-water sightings of marine turtles, considering the very large area covered, especially in late July 2023 near the peak nesting season, when hundreds of tracks and nests were observed on the nesting beaches. These low sighting numbers tend to indicate that the area within CG is not used as an inter-nesting, resting or foraging area, and that most turtle activity is around and offshore from the seaward-facing nesting beaches.

7. Please refer BKA (2024c) for full report on BKA's surveys.

10. Recommendations - DBCA Surveys

1. Based on the findings of this report as outlined in the sections above, two recommendations are made as follows:

    - Recommendation 1 – Improving data utility: In order to improve the utility of the annual Cape Domett survey data to support species conservation and management, including to allow more accurate assessment of population numbers and trends over time, it is recommended that DBCA consider the following:

        - Endeavour as far as possible to standardise the number of nights surveyed each year, to either 13 or 14 (noting the logistical challenges of the area which may impede this in some years).
        - Ensuring that all data recorded is also reported in the data outputs, including:
            - always recording and reporting data for each beach sector separately; and
            - always recording and reporting predated-nests and presence of predators and signs of predators every year.
        - Adopting a more systematic, quantitative approach to recording predators and signs of predators.

    - Recommendation 2 - Expand Surveys: Given the findings of the BKA aerial drone surveys in July 2023, as summarized in section 5, it is recommended that annual Flatback Turtle nesting surveys be extended to include Turtle Bay (Lacrosse Island), Turtle Beach West (west of Cape Dussejour) and East Bank Point (also known as Barnett Point) (noting severe crocodile risks at this last site).

    - Recommendation 3 - Satellite Tagging: In order to understand inter-nesting movements and behaviour of the Flatback Turtles that nest in the Cape Domett area, and better define the related BIAs, undertake satellite tagging and monitoring studies.

2. Should the BKA marine sand proposal proceed, BKA is willing to support the strengthening and expansion of marine turtle surveys, monitoring and related studies in CG, in cooperation with DBCA and the local TOs, as outlined in section 11.

11. Implications for the BKA Marine Sand Proposal

1. It is clear from the studies by Whiting et al (2008), the DBCA data for Cape Domett 2013 - 2022 and the surveys by BKA in 2023 and 2024, that Cape Domett is extremely significant and that other sites near CG are significant as Flatback Turtle

nesting sites. BKA has therefore put significant effort into assessing potential impacts of the proposed marine sand operation on the nesting sites and marine turtles generally.

2. The assessment is reported in BKA (2024c & d) and finds that there is a low likelihood of the proposed project causing significant impacts on the nesting sites and marine turtles generally. A key factor is the distance, geography and aspect of the turtle nesting sites relative to the proposed operational area, and the fact that there will be zero operational activity in CG for 86% of the time during the project life-span (15 years). Please refer BKA (2024c & d) for the detailed assessment.

3. Never-the-less, should the proposal go ahead, BKA proposes to implement the following impact avoidance, prevention, minimization and mitigation measures in relation to marine turtles:

    a) The Sand Production Vessel (SPV) will be permanently fitted with turtle safe lighting in accordance with the *National Light Pollution Guidelines for Wildlife* (Commonwealth of Australia, 2020) (in any case SPV lighting in the proposed operational area will not be visible to nesting and hatching turtles due to distance, aspect and screening by geographical features).

    b) As an added precaution the SPV will enter and depart CG via West Entrance (west of Lacrosse Island), which is 16 km away from the most important nesting beach at Cape Domett, screened from the seaward nesting beach west of Cape Dussejour, and 22 km from the nesting site at Barnett Point.

    c) The SPV will operate at a very low speed (~2 knots) and will implement best-practice Marine Mega-fauna (MMF) observation and avoidance systems and procedures, in accordance with relevant guidelines.

    d) The SPV's drag-head will be fitted with marine-fauna deterrent / deflector chains ('turtle ticklers').

4. In addition, should the proposal go ahead, BKA will seek to implement a comprehensive environmental and biodiversity research and monitoring program, including for marine turtles, in consultation and cooperation with relevant stakeholders including DBCA and TOs. This would further assist protection and conservation of marine turtle species both in CG and in other areas.

References

Boskalis Australia (BKA) (2024c), Cambridge Gulf Marine Sand Proposal - WA EP Act s38 Referral Report No. 3: *Proposal Setting & Existing Environmental Descriptions.*

Boskalis Australia (BKA) (2024d), Cambridge Gulf Marine Sand Proposal - WA EP Act s38 Referral Report No. 4: *Impact Assessments of Relevant Environmental Factors.*

Halkyard, B. (2014). Exploiting Green and Hawksbill Turtles in Western Australia: The Commercial Marine Turtle Fishery. 10.1007/978-94-017-8727-7_11.

Harman, M., Limpus, CJ., Pendoley, K., Schauble, JS., Sperling, J., & Wyneken, J. (2009). The Flatback: Australia's Own Sea Turtle, SWOT Report No. 9 - www.seaturtlestatus.org

Limpus, CJ., Fleay, A., & Baker, V. (1984). The flatback turtle, *Chelonia depressa*, in Queensland: reproductive periodicity, philopatry and recruitment. *Wildlife Research,* (11), 579–587.

Whiting, A., Thomson, A., Chaloupka, M., & Limpus, C. (2008). Seasonality, abundance and breeding biology of one of the largest populations of nesting flatback turtles, *Natator depressus*: Cape Domett, Western Australia. *Australian Journal of Zoology*, *2008*(5), 297-303.

Whytlaw, P., Edwards, W., & Congdon, B. (2013) Marine turtle nest depredation by feral pigs (*Sus scrofa*) on the Western Cape York Peninsula, Australia: implications for management. *Wildlife Research*, 40(5), 377-384.

ANNEX 1: Data Sharing Agreement Between DBCA & BKA

GOVERNMENT OF WESTERN AUSTRALIA

Department of **Biodiversity, Conservation and Attractions**

DATA SHARING AGREEMENT

between

Biodiversity and Conservation Science
Western Australian Department of Biodiversity, Conservation and Attractions

and

Boskalis Australia Pty Ltd (including use of the data by their consultants EcoStrategic Consultants)

This agreement is valid from the date of the latest signature below. HEREBY AGREED as follows:

1.0 DEFINITION OF TERMS:

1.1 As this agreement is for a data exchange, the "Licensor" shall mean the Western Australian Department of Biodiversity, Conservation and Attractions (DBCA) and the "Licensee" shall mean Boskalis Australia Pty Ltd, including use of the data by their consultants EcoStrategic Consultants.

1.2 "Data" shall mean the computer/digital and/or printed data described in Annexure A, and any data derived there from (unless otherwise authorised in Annexure B).

1.3 "License" shall mean the right to use the Data, for and limited to the purposes specified in Annexure B, granted by the Licensor to the Licensee under the conditions of this Agreement.

2.0 LICENSE

2.1 The Licensor hereby grants the Licensee a non-exclusive and non-transferable License to use the Data described in Annexure A, subject always to the conditions in this Agreement.

2.2 The Data and copyright and other intellectual property rights in the Data are and shall remain the property of the Licensor.

2.3 No warranties or undertakings, expressed or implied, statutory or otherwise, as to the condition, quality or fitness are provided with the Data.

2.4 This License constitutes the entire agreement between the parties and supersedes all communications, negotiations, arrangements and agreements, either oral or written, between the parties with respect to the data outlined in Annexure A.

3.0 CONDITIONS OF USE

3.1 The Licensee shall only use the Data for the purposes specified in Annexure B.

3.2 The Licensee shall only copy and hold the Data in the manner specified in Annexure B.

3.3 The Licensee shall not further copy or hold the Data (including copies or translations into any medium or format) in whole or in part except for purposes directly related to those specified

GOVERNMENT OF WESTERN AUSTRALIA

Department of **Biodiversity, Conservation and Attractions**

in Annexure B.

3.4 The Data provided under this Licence shall not be provided to a third party in any form, except as detailed in Annexure B.

3.5 Adequate security measures must be enforced to safeguard the Data from access or use by third parties.

3.6 Any publications or other products derived from the use of the Data must acknowledge DBCA as the owner and supplier of the Data.

3.7 Before any publication or other product, including media or other external promotional publications, derived from the use of the Data is externally released, adequate opportunity shall be given to DBCA to evaluate the results to ensure the interpretation is consistent with the Data provided.

SIGNED:

Margaret Byrne

Date: 5/9/23

Executive director
Biodiversity and Conservation Science,
Department of Biodiversity, Conservation and Attractions

Date:

Peter Boere
General Manager
Boskalis Australia Pty Ltd

Date: 24 August 2023

Steve Raaymakers
EcoStrategic Consultants

GOVERNMENT OF WESTERN AUSTRALIA

Department of **Biodiversity, Conservation and Attractions**

ANNEXURE A

DATA TO BE PROVIDED

Computer/digital and/or printed data and any related reports and papers from the Licensor's annual monitoring of turtle nesting at Cape Domett near Camdridge Gulf in the East Kimberly region of Western Australia (WA), dating back to 2012.

ANNEXURE B

USE OF DATA PROVIDED

The data will be used by the Licensee and their consultants EcoStratgeic Consultants in supporting development of an Environmental Impact Assessment (EIA) for a marine sand proposal at Cambridge Gulf, in accordance with the Western Australian Environmental Protection Act 1986 and other relevant legislation.

Specifically the data will be used to assist in assessing potential impacts of the proposal on marine turtles, including the nesting beaches at Cape Domett, and in identifying possible impact prevention and mitigation measures, for consideration by the WA Environmental Protection Authority (EPA), the Licensor and other relevant regulatory agencies when assessing the proposal through the EIA process.

Relevant analysis outputs (not raw data) will be used in the EIA only, with full acknowledgment and citation of the source (as specified by the Licensor), and will be submitted to the EPA as part of the EIA documentation, and thus publicly available as per all EIAs in WA – there will be no other use of the data.