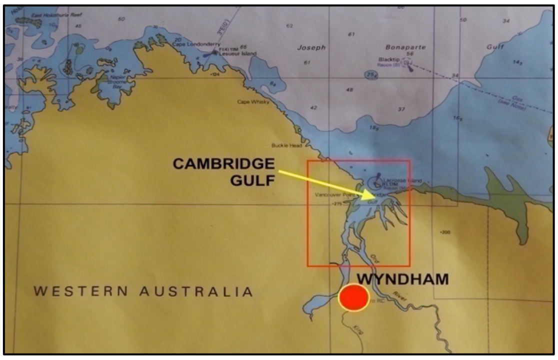
EPBC Referral Supplementary Report No. 4

Boskalis Cambridge Gulf Marine Sand Proposal

Western Australia

ADDITIONAL INFORMATION



Prepared for Boskalis Australia Pty Ltd by EcoStrategic Consultants

In support of Project Referral under Part 7 of Commonwealth *Environment Protection & Biodiversity Conservation Act*

AUGUST 2025

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REFERRAL DOCUMENTATION

This report is part of a larger set of documents submitted as part of Boskalis Australia's referral under Part 7 of the Commonwealth *Environment Protection & Biodiversity Conservation Act* (EPBC Act), as listed in the table below.

Doc No.	**Reference** (Author/yr)	**Electronic File Names (PDFs)** (except Doc No.s 9 & 10 which are Excel files). As required, these file names are how the reports are referenced in the online referral submitted via the EPBC Act Business Portal https://epbcbusinessportal.environment.gov.au
0	-	EPBC Referral - Boskalis Cambridge Gulf - *List of Preliminary Documents.*
1	BKA (2024a)	EPBC Referral Report No. 1 - Boskalis Cambridge Gulf - *Description of Proposed Action & Regulatory Framework.*
2	BKA (2024b)	EPBC Referral Report No. 2 - Boskalis Cambridge Gulf - *Setting & Existing Environment.* Includes in same document: • Annex 3 - *Drop Camera Video Extracts.* • Annex 4 - *Dry Season Sample Point Specs.* • Annex 5 - *Wet Season Sample Point Specs.* • Annex 6 - *Benthic Taxa per Sample Point - Dry Season Maps.* • Annex 7 - *Benthic Taxa per Sample Point - Wet Season Maps.* • Annex 8 - *Benthic Taxa per Sample Point - Dry Season Graphs.* • Annex 9 - *Benthic Taxa per Sample Point - Wet Season Graphs.* • Annex 11 - *Sediment Contamination Assessment.* • Annexes 1, 2, 10, 12, 13 and 14 are submitted as separate documents as listed below.
3	BKA (2024c)	EPBC Referral Report No. 2 - Boskalis Cambridge Gulf - Annex 1 - *Sand Assessment.*
4	MScience (2024)	EPBC Referral Report No. 2 - Boskalis Cambridge Gulf - Annex 2 - *MScience BCH Methods.*
5	Sensorem (2024)	EPBC Referral Report No. 2 - Boskalis Cambridge Gulf - Annex 10 - *Aerial Drone Lidar Report.*
6	Price & Raaymakers (2024)	EPBC Referral Report No. 2 - Boskalis Cambridge Gulf - Annex 12 - *Cape Domett Turtle Data Report.*
7	Univ. Canberra (2024)	EPBC Referral Report No. 2 - Boskalis Cambridge Gulf - Annex 13 - *Marine eDNA Report.*
8	BKA (2024d)	EPBC Referral Report No. 2 - Boskalis Cambridge Gulf - Annex 14 - *Marine Mega-fauna Surveys Report.* Includes in same document: • Appendix 1 - *MMF Sightings Master Data Tables.* • Appendix 2 - *MMF Images.* • Appendix 3 - *MMF Sighting Locations.* • Appendices 4 and 5 are submitted as separate Excel files as listed below.
9	BKA (2024e)	EPBC Referral Report No. 2 - Boskalis Cambridge Gulf - Annex 14 - *Appendix 4 - Species Data - Dry Season* (Excel).
10	BKA (2024f)	EPBC Referral Report No. 2 - Boskalis Cambridge Gulf - Annex 14 - *Appendix 5 - Species Data - Wet Season* (Excel).
11	BKA (2024g)	EPBC Referral Report No. 3 - Boskalis Cambridge Gulf - *Traditional Owner Matters.* Includes in same document: • Annex 1 - *BAC Native Title Determination Map.* • Annex 2 - *MG Native Title Determination Map.* • Annex 3 - *Letter from BAC.* • Annex 4 - *Letter from MG.*

Doc No.	Reference (Author/yr)	Electronic File Names (PDFs) (except Doc No.s 9 & 10 which are Excel files). As required, these file names are how the reports are referenced in the online referral submitted via the EPBC Act Business Portal https://epbcbusinessportal.environment.gov.au
12	BKA (2024h)	EPBC Referral Report No. 4 - Boskalis Cambridge Gulf - *Impact Assessments.* Includes in same document: • Annex 1 - *Main Datasets Used to Inform Impact Assessments.* • Annex 2 - *Shipping & Oil Spill Risk Assessment.* • Annex 3 - *Plume Mitigation Capability Statement.* • Annex 4 - *Marine Mega-fauna Capability Statement.*
13	PCS (2024a)	EPBC Referral Report No. 5 - Boskalis Cambridge Gulf - *Metocean & Sed Dynamics Initial Report.* • Includes in same document Annex 1 - *Supplementary Technical Note.* • Annex 2 is submitted as a separate document as listed below.
14	PCS (2024b)	EPBC Referral Report No. 5 - Boskalis Cambridge Gulf - Annex 2 - *Factual Data Report.* (NOTE: Superseded by *Updated Factual Data Report* - see Doc No. 19, Referral Report No. 8 - Annex B below).
15	BKA (2024i)	EPBC Referral Report No. 6 - Boskalis Cambridge Gulf - *Consultation.* • Includes in same document Annex 1 - *List of Meeting Minutes.*
16	BKA (2024j)	EPBC Referral Report No. 7 - Boskalis Cambridge Gulf - *Commonwealth Matters.* • Includes in same document Annex 1 - *PMST Report for POA & 10 Km Buffer.*
17	PCS (2025a)	EPBC Referral Report No. 8 - Boskalis Cambridge Gulf - *Metocean & Sed Dynamics Full Modelling Report.* • Appendices and Annexes are submitted as a separate document each, as listed below.
18	PCS (2025b)	EPBC Referral Report No. 8 - Boskalis Cambridge Gulf - *Appendices.* • Appendix A - *Model Calibration and Validation Plots.* • Appendix B - *Hydrodynamic and Wave Impact Plots.* • Appendix C - *Sediment Transport Impact Plots.* • Appendix D - *Sediment Plume Modelling Results.*
19	PCS (2025c)	EPBC Referral Report No. 8 - Boskalis Cambridge Gulf - *Annexes.* • Annex A - *Independent Expert Review.* • Annex B - *Updated Factual Data Report.*
NOTE: The documents listed above were submitted in the initial referral. The documents listed below were submitted after the initial referral.		
20	Nocterra (2025)	EPBC Referral Supplementary Report No. 1 - Boskalis Cambridge Gulf - *Light Assessment.*
21	Resonate (2025)	EPBC Referral Supplementary Report No. 2 - Boskalis Cambridge Gulf - *Noise Assessment.*
22	BKA (2025a)	EPBC Referral Supplementary Report No. 3 - Boskalis Cambridge Gulf - *Commonwealth Environmental Management Plan (C-EMP).*
23	BKA (2025b)	**THIS DOCUMENT:** EPBC Referral Supplementary Report No. 4 - Boskalis Cambridge Gulf - *Additional Information.* • *Current Speeds in the POA & Turtle Swimming Speeds.* • *Analysis of Turtle Satellite Tracking - Cape Domett.* • *Boskalis Capability Sheet - Trailer Suction Hopper Dredgers.*
24	BKA (2025c)	**THIS DOCUMENT:** EPBC Referral Supplementary Report No. 5 - Boskalis Cambridge Gulf - *Response to Request for Further Information (RFI).*

PROJECT LOCATION

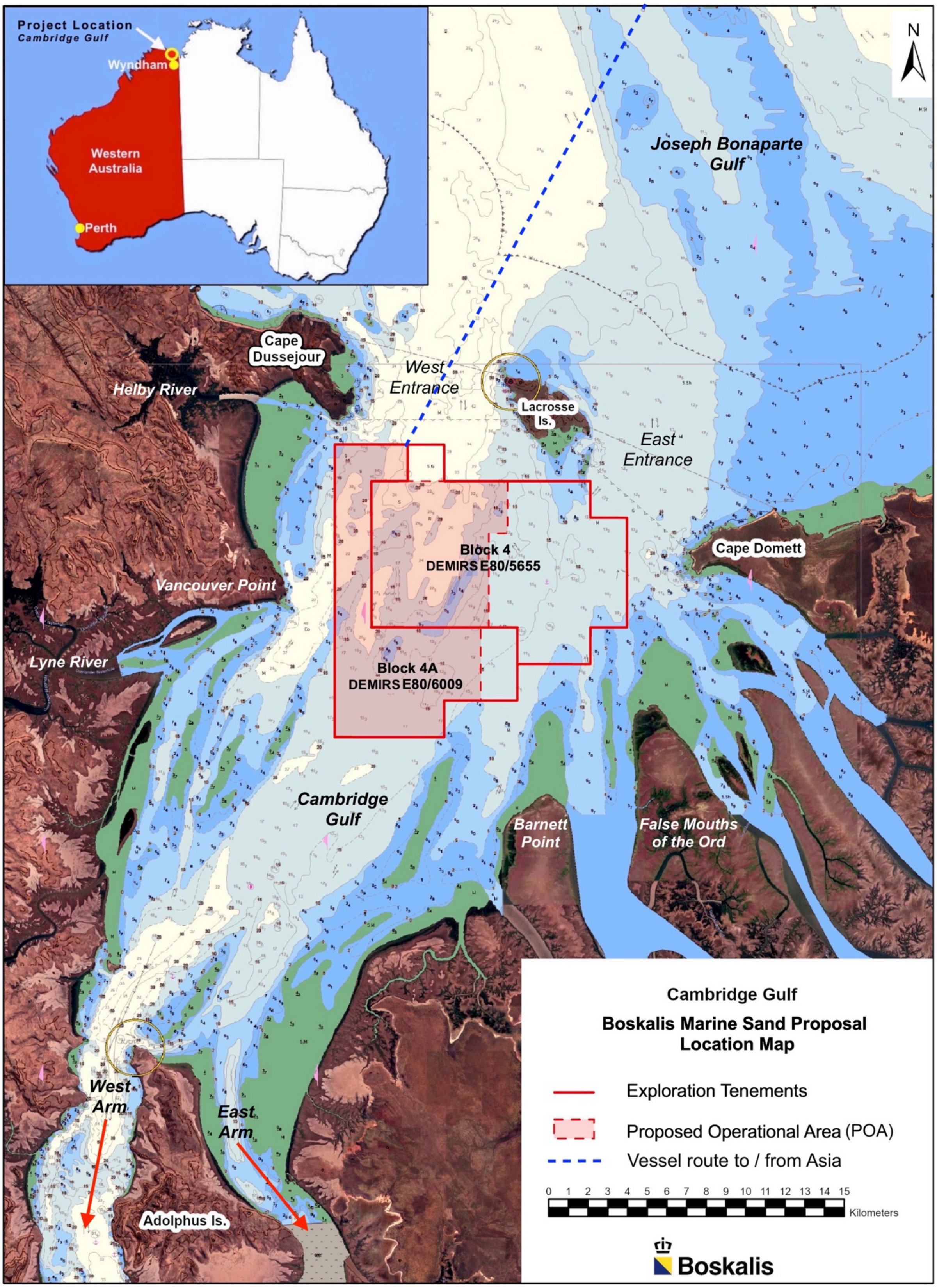


FIGURE 1: *Location of the proposed action in Cambridge Gulf near Wyndham in the northeast of Western Australia.*

1. BACKGROUND & PURPOSE OF THIS REPORT

1. Boskalis Australia Pty Ltd (BKA) is assessing the feasibility of developing a marine sand-sourcing operation (the proposed action) in Cambridge Gulf (CG) near Wyndham in the northeast of Western Australia (WA) (Figure 1). BKA currently holds two sand exploration tenements in CG under the WA *Mining Act*, as the basis for the proposed action.

2. A detailed description of the proposed action is presented in EPBC Referral Report No. 1 - *Description of the Proposed Action & Regulatory Framework* and is not repeated in this report for reasons of economy.

3. To support its assessment BKA has undertaken a wide range of comprehensive studies since 2018. These studies find that the proposed action is feasible and viable and unlikely to cause significant environmental impacts, as defined under the WA *Environmental Protection Act* (EP Act) and the Commonwealth *Environmental Protection & Biodiversity Conservation Act* (EPBC Act). Never-the-less, as a responsible company with stringent environmental and social policies, BKA self-referred the proposal to both the State and the Commonwealth under their respective Acts, for their determination of what further environmental assessments might be required, if any. The EPBC Act referral was submitted in January 2025.

4. Subject to the outcomes of the State and Commonwealth referral processes, BKA plans to apply to the WA Department of Energy, Mines, Industry Regulation & Safety (DEMIRS) to convert a reduced part of the two Exploration Tenements to a single Mining Tenement, shown as the 'proposed operational area' (POA) on Figure 1.

5. Since submission of the EPBC Act referral in January 2025, the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) sought clarifications on certain issues from BKA, including on:

    a) the risk to inter-nesting Flatback Turtles potentially entering the POA and being affected by the sand-sourcing operation (e.g. via vessel strike), especially during peak nesting season (August-September inclusive); and

    b) How the Sand Production Vessel (SPV) will remain on track within the POA and no enter into non-sand areas.

6. In response to item 5 a), BKA commissioned hydrodynamics experts Port & Coastal Solutions (PCS), to undertake an analysis of measured current speeds in the POA in relation to known turtle swimming speeds, so as to assess whether or not hydrodynamic conditions in the POA are conducive to inter-nesting resting by female Flatback Turtles. The analysis is presented in Section 2 - *Current Speeds in the POA & Turtle Swimming Speeds* below.

7. The analysis finds that it is unlikely that Flatback Turtles could effectively rest on the sandy seabed in the POA between nesting attempts, due to the relatively strong near-bed currents. The analysis also finds that based on the spatial distribution of current speeds in the CG area, it is likely that Flatback Turtles would choose an area with lower current speeds for inter-nesting resting (e.g. on the east side of CG, to the north or south of Lacrosse Island and adjacent to / offshore from the nesting beaches), and not in the main body of CG and especially not in the POA. This is borne out by site surveys and tracking of turtles in the CG area (see next paragraph).

8. In further response to item 5 a), BKA commissioned EcoStrategic Consultants to assess two previous satellite tagging and tracking programs of nesting female Flatback Turtles at Cape Domett, one in June 209 and one from August 2025 to August 2027, as reported on www.seaturtle.org. The analysis is presented in Section 3 - *Analysis of Turtle Satellite Tracking - Cape Domett*, below.

9. A total of 16 turtles were fitted with satellite trackers, comprising and five in the initial and 11 in the later study. The analysis shows that:

    - All 16 tracked turtles undertook inter-nesting movements immediately offshore from Cape Domett until the end of nesting, whereafter they headed further offshore into Joseph Bonaparte Gulf, then either NE towards Darwin and locations in the Arafura Sea beyond, or NW towards the Timor Sea and locations offshore from the West Kimberley.

    - Eleven of the 16 tracked turtles do not appear to have entered CG.

    - Two of the 16 tracked turtles appear to have entered CG, but on the far eastern side only, close to the coast near to Cape Domett, and do not appear to have entered the POA.

    - Two of the 16 tracked turtles may have 'possibly' entered CG, although the low resolution of the maps makes this difficult to ascertain, and again on the far eastern side only, close to the coast near to Cape Domett, and they do not appear to have entered the POA.

    - Only one of the 16 tracked turtles appears to have crossed the south-eastern corner of the POA.

10. The analysis therefore supports the assessment that the waters inside CG and especially in the POA do not provide suitable inter-nesting conditions, that most turtles head straight offshore to the inner waters of Joseph Bonaparte Gulf for their inter-nesting rest, and the few that do enter CG remain close to the coast on the far eastern side, nearest to Cape Domett, where currents are less.

11. In response to item 5 a), BKA provided DCCEEW with the Capability Sheet contained in Section 4 below, which includes a description of *DV Hopper Dredger*, the computerised, integrated positioning and dredging production module that is custom-tuned to each Boskalis Trailing Suction Hopper Dredger, which allows precise positioning of the vessel and the drag-head on the seabed to optimise sand production.

12. The purpose of this report is to present these three sets of additional information in a single document, comprising:

    – Section 2 - *Current Speeds in the POA & Turtle Swimming Speeds.*

    – Section 3 - *Analysis of Turtle Satellite Tracking - Cape Domett.*

    – Section 4 - *Boskalis Capability Sheet - DV Hopper Dredger.*

2. CURRENT SPEEDS IN THE POA & TURTLE SWIMMING SPEEDS

PORT & COASTAL SOLUTIONS

Technical Note

Date:	18/06/2025
To:	Boskalis Australia Pty Ltd
From:	Andy Symonds
Subject:	Cambridge Gulf: Current Speeds in the POA
Classification:	Project Related
Version:	2

1. Introduction

Boskalis Australia Pty Ltd (BKA) has requested Port and Coastal Solutions Pty Ltd (PCS) analyse the measured current data collected by BKA within and adjacent to the Proposed Operational Area (POA) of the Cambridge Gulf (CG) Marine Sand Proposal.

The analysis is to provide a better understanding of the currents at the seabed in the POA to inform whether female adult Flatback Turtles (*Natator depressus*) are likely to rest on the seabed in the POA between egg-laying events (inter-nesting intervals). In waters offshore from nesting beaches, Flatback Turtles are known to rest on the seabed for a few days between nesting attempts to help regain their energy (noting that they must also surface periodically to breath).

Regaining energy during inter-nesting intervals requires no significant net loss of energy reserves as a result of energy expended, including any energy expended from swimming that might be required against currents in the area. Like all marine turtles, Flatback Turtles do not feed during inter-nesting intervals, so energy expenditure must come from stored fat reserves during this period (Whittock pers. comms., 2025).

Therefore, should a turtle be required to expend excess energy during an inter-nesting interval, for example in order to swim against currents in order to remain on the seabed in an area, the 'resting' benefits of inter-nesting would be negated.

Overall, as ectothermic (cold blooded) reptiles, which cannot internally generate and maintain a constant body temperature like mammals and birds, marine turtles have a low average metabolism. Marine turtles also have relatively high resistance (drag) when moving through the sea, due to their cumbersome, heavy carapace (shell) (Kinoshita et al., 2021). As a result, they generally move quite slowly under routine conditions. Depending on the species, marine turtles are reported to typically swim at speeds of 0.25 to 2.5 m/s (0.9 to 9 km/hr), depending on their activity at the time.

They can swim faster for short bursts, for example to escape predators. Such high-speed bursts require an acute increase in metabolism and energy consumption, which cannot be sustained for more than an order of minutes (Smithsonian, 2025).

When 'resting', as per inter-nesting intervals, swim speeds would need to be as close to zero as possible in order to effect actual 'rest' (i.e lowest possible expenditure of energy). Several researchers have found that when resting, turtles will seek out areas with slower currents in order to remain on the seabed for longer periods, thus minimising the energy cost, including from less frequent surfacing and diving to breathe (Whittock et al., 2014; Hays et al., 2000; Houghton et al., 2002, Minamikawa et al., 2000) .

2. Measured Data on Currents in Cambridge Gulf

As part of environmental studies undertaken to support assessment of the CG Marine Sand Proposal, BKA has collected hydrodynamic data at 11 sites around CG, with more than 4 months of measured data at a site within the northern half of the POA (AWAC-01) and immediately to the south of the POA (AWAC-

11) (Figure 1). At both sites currents were measured through the water column using bed mounted Acoustic Doppler Current Profilers (ADCPs). Data were also measured within the POA at AWAC03 and AWAC04, but the measurements at these sites were only 1 to 2 days in duration and so are not of sufficient duration for this assessment. The following data were available at the AWAC01 and AWAC11 sites for this analysis:

- AWAC01, located in 26 m water depth
  - 09/06/2023 to 21/07/2023 (41.7 days, including 2.5 sets of spring tides and 3 sets of neap tides);
  - 03/03/2024 to 08/05/2024 (66.2 days, including 4.5 sets of spring tides and 5 sets of neap tides); and
  - 29/06/2024 to 09/08/2024 (41.1 days, including 3 sets of spring tides and 2.5 sets of neap tides).
- AWAC11, located in 20 m water depth
  - 02/03/2024 to 08/05/2024 (66.8 days, including 4.5 sets of spring tides and 5 sets of neap tides);
  - 10/05/2024 to 23/06/2024 (43.9 days, including 3 sets of spring tides and 3 sets of neap tides); and
  - 24/06/2024 to 11/08/2024 (48.0 days, including 3.5 sets of spring tides and 3 sets of neap tides).

Analysis of the measured data showed a dominant astronomical tidal signal, with limited variation in currents between the different deployments. Based on this, the measured data from the June to August 2024 period have been used for the analysis as this is the closest to peak turtle nesting season (August - September inclusive) in the CG area.

For the June to August 2024 deployments a Nortek Signature 500 ADCP was deployed at the seabed at both sites. The ADCP head was located 1.2 m above the seabed, and with an instrument blanking distance of 0.5 m, the first 1 m bin was located between 1.7 and 2.7 m above the seabed (mid-point of this bin was 2.2 m above the seabed). The instruments were configured to measure the current speed and direction in 1 m bins from the bottom bin to the water surface.

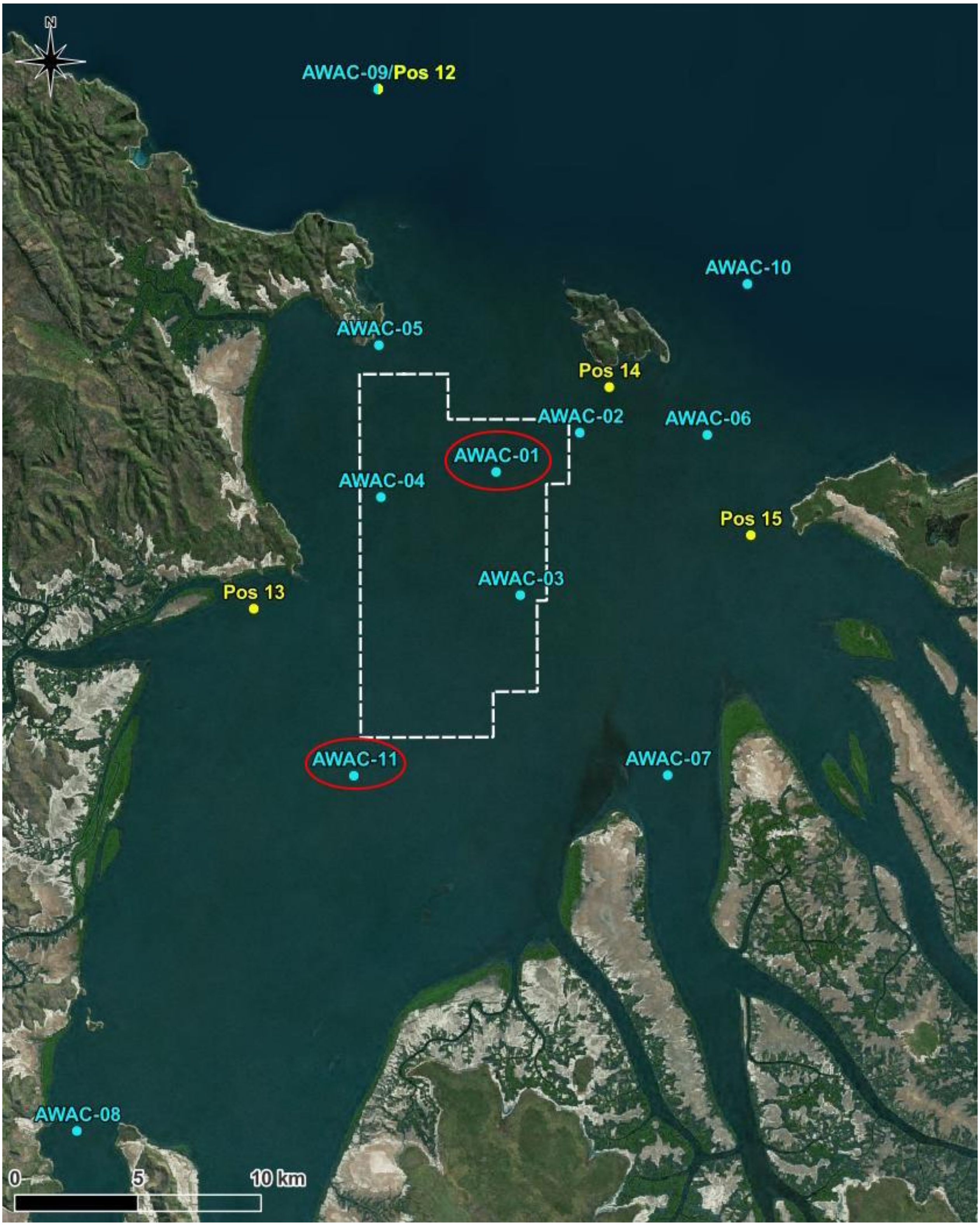


Figure 1. Locations of hydrodynamic measurement sites (blue dots) and water quality measurement sites (yellow dots), with the sites used for this assessment circled in red (PCS, 2025).

3. Data Analysis

The measured current speeds in the bin located approximately 10 m above the seabed were used to predict the current speeds in the bin located 2.2 m above the seabed (i.e. the bin closest to the seabed that the ADCP measured the currents) using the Power Law (Soulsby, 1997). The Power Law Exponent was derived to give the optimum agreement between the measured data in the bin 2.2 m above the seabed and predicted data based on the measured currents 10 m above the seabed. This approach allows the local influences of bed roughness and turbulence to be accounted for at both sites. The correlation between the measured and predicted currents in the bin 2.2 m above the seabed at AWAC01 and AWAC11 are shown in Figure 2 and Figure 3.

Using the derived Power Law Exponents the current speed at 0.5 m above the seabed (i.e. near-bed current speed) was calculated at both AWAC01 and AWAC11. The height of an adult Flatback Turtle is reported by Dimensions (2025) as being approximately 0.4 m and so a current speed 0.5 m above the seabed will influence any Flatback Turtle resting on the seabed.

However, it should be noted that marine turtles must surface and dive through the whole water column periodically to breathe during the inter-nesting period (whence they are subject to current velocities at all depths during inter-nesting 'resting' period). The current speeds at 10 m above the seabed can be considered to indicate the depth-averaged current speeds through the water column which the turtles would be swimming through.

Rose plots of currents over the entire June to August 2024 deployments at 10 m, 2 m and 0.5 m above the seabed are shown at AWAC01 and AWAC11 in Figure 4 and Figure 5. The plots show limited variability in current direction at both sites, with currents occurring in two directions at both sites due to the flood and ebb stages of the tide. This shows that the currents are predominantly controlled by the astronomical tide, with limited influence from other factors such as local winds.

At AWAC01 the flood current is to the south and the ebb current is to the north, while at AWAC11 the flood current is to the south to south-southwest and the ebb current is to the north-northeast. There is a clear reduction in current speed through the water column due to the bed friction, with current speeds 10 m above the seabed being above 0.6 m/s for the majority of the time at both sites, while the current speeds 0.5 m above the seabed remained below 0.6 m/s for the majority of the time.

A statistical summary of the currents at the three heights above the seabed over the entire June to August 2024 deployments is shown for AWAC01 in Table 1 and for AWAC11 in Table 2. The statistics show that at AWAC01 the mean current speed 0.5 m above the seabed is 0.28 m/s while 10 m above the seabed it is 0.57 m/s while at AWAC11 its 0.26 m/s at 0.5 m above the seabed and 0.61 m/s at 10 m above the seabed. The similarity between the current statistics at the two sites indicates that the strong astronomical tidal forcing in the area results in consistent currents through the POA region.

Timeseries plots of the currents during July 2024 at 10 m, 2 m and 0.5 m above the seabed are shown at AWAC01 and AWAC11 in Figure 6 and Figure 7. The plots show how the current speed varies over time and through the water column at both sites, with similar near-bed currents at both sites. The plots show that during spring tides the near-bed currents at both sites can exceed 0.6 m/s, while during neap tides the currents remain below 0.4 m/s. The similarity of the currents at these two sites indicates that the near-bed current speeds throughout the POA are likely to be similar to these two sites. This is also shown by the modelled depth-averaged currents from PCS (2025) in Figure 8 and Figure 9.

For the female Flatback Turtles to rest on the seabed to help regain their energy between nesting attempts the current speed would either need to be sufficiently low to ensure the turtles didn't need to use any energy to remain in place or there would need to be a rocky seabed which the turtles could use to anchor themselves to the seabed. The seabed over the majority of the POA is made up of sand and so in the absence of a rocky seabed relatively low currents would be required for the turtles to be able to rest.

A current speed threshold of 0.25 m/s has been adopted (the lower end of the speeds that turtles typically swim at when not 'resting' – i.e. when foraging) to provide an indication of the duration of time the current speeds close to the seabed in the POA are low and a turtle could potentially rest on the sandy seabed, without having to actively swim against the current.

The duration and percentage of time this current speed threshold was exceeded 0.5 m above the seabed, 2 m above the seabed and 10 m above the seabed (indicative of depth-averaged currents) at AWAC01 and AWAC11 over July 2024 and over 7 days of spring tides and 7 days of neap tides is shown in Table 3. The near-bed current speed (0.5 m above seabed) exceeds the 0.25 m/s threshold for 76% and 73% of the time during spring tides and 50% and 41% of the time during neap tides. Overall, the 0.25 m/s current threshold is exceeded 63% and 60% of the time over a month at 0.5 m above the seabed. The times when the threshold isn't exceeded are either during slack water between the flood and ebb stages of the tide or during very small neap tides when the peak current speed remains below 0.25 m/s. The table also shows how over a month the 0.25 m/s threshold is exceeded for 73% to 76% of the time at 2 m above the seabed and 81% to 83% of the time at 10 m above the seabed. This shows how the current speed increases above the seabed and how the higher current speeds through the water column could potentially result in increased energy consumption by turtles when they surface and dive.

Table 1. Current speed statistics at AWAC01 over the entire June to August deployment period.

Period	AWAC01 Current Speed (m/s)		
	0.5 m Above Bed	2 m Above Bed	10 m Above Bed
Minimum	0.00	0.00	0.00
Mean	0.33	0.42	0.57
Maximum	0.82	1.17	1.43
5^{th} Percentile	0.06	0.08	0.11
10^{th} Percentile	0.09	0.12	0.16
20^{th} Percentile	0.15	0.21	0.27
50^{th} Percentile	0.33	0.41	0.58
80^{th} Percentile	0.49	0.62	0.85
90^{th} Percentile	0.55	0.72	0.96
95^{th} Percentile	0.60	0.79	1.05
99^{th} Percentile	0.67	0.92	1.16

Table 2. Current speed statistics at AWAC11 over the entire June to August deployment period.

Period	AWAC11 Current Speed (m/s)		
	0.5 m Above Bed	2 m Above Bed	10 m Above Bed
Minimum	0.00	0.00	0.00
Mean	0.31	0.43	0.61
Maximum	0.84	1.08	1.62
5^{th} Percentile	0.05	0.10	0.11
10^{th} Percentile	0.09	0.15	0.17
20^{th} Percentile	0.15	0.23	0.30
50^{th} Percentile	0.31	0.43	0.61
80^{th} Percentile	0.45	0.62	0.88
90^{th} Percentile	0.53	0.71	1.04
95^{th} Percentile	0.60	0.77	1.17
99^{th} Percentile	0.68	0.88	1.33

Table 3. Percentage of time the 0.25 m/s current speed was exceeded at different heights above the seabed.

Period	AWAC01			AWAC11		
	0.5m	2m	10m	0.5m	2m	10m
July 2024 (31 days)	63%	73%	81%	60%	76%	83%
Spring Tides (7 days)	76%	84%	87%	73%	85%	87%
Neap Tides (7 days)	50%	61%	76%	41%	63%	76%

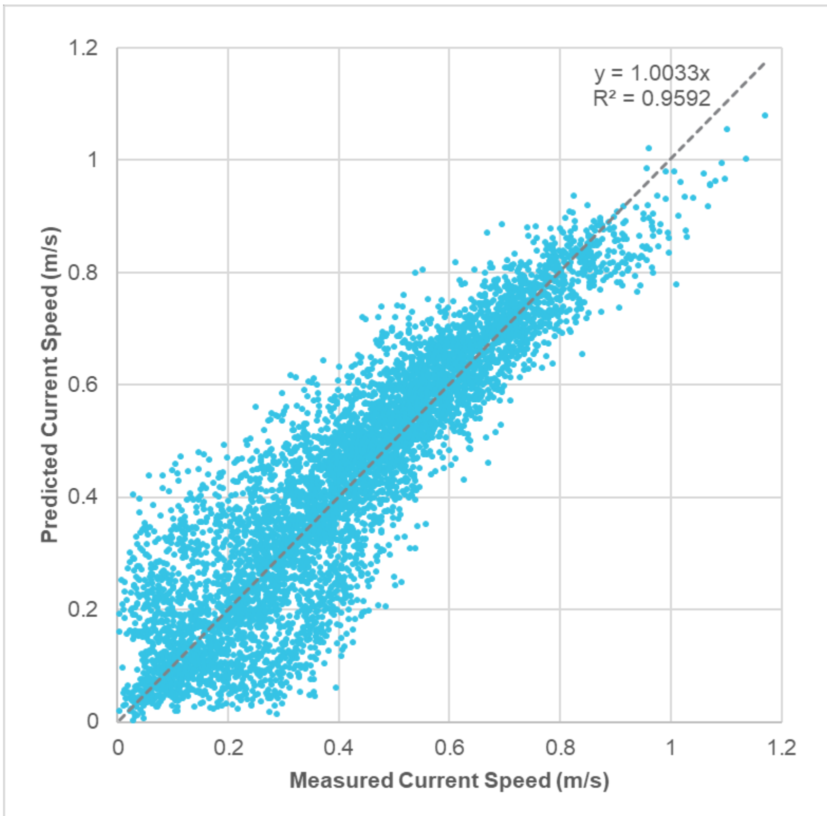


Figure 2. Correlation between measured and predicted current speed at the bin 2.2 m above the seabed at AWAC01.

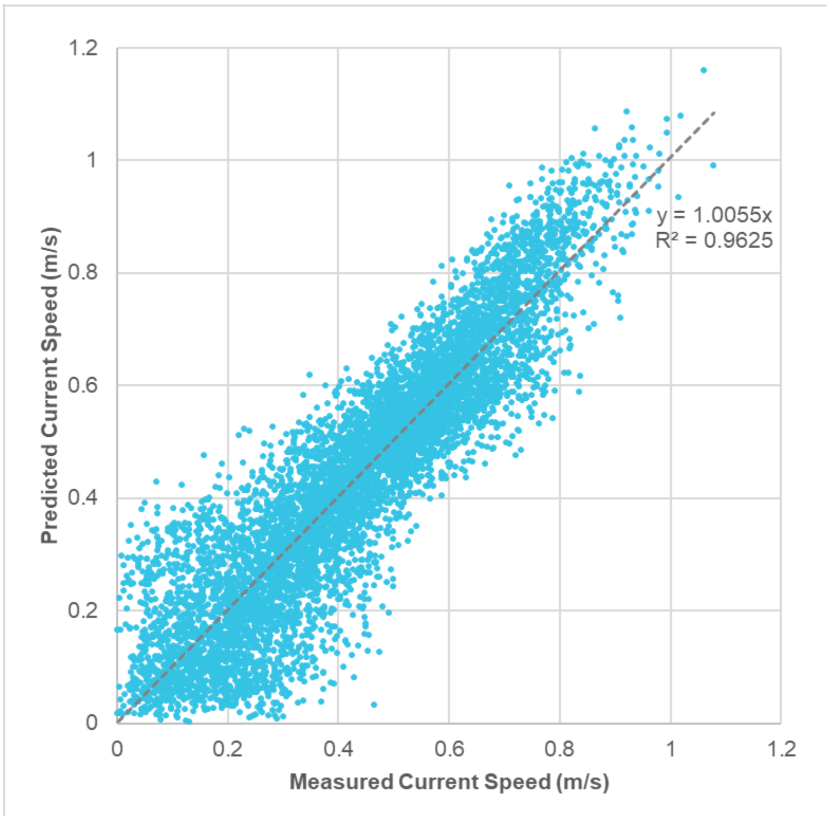


Figure 3. Correlation between measured and predicted current speed at the bin 2.2 m above the seabed at AWAC11.

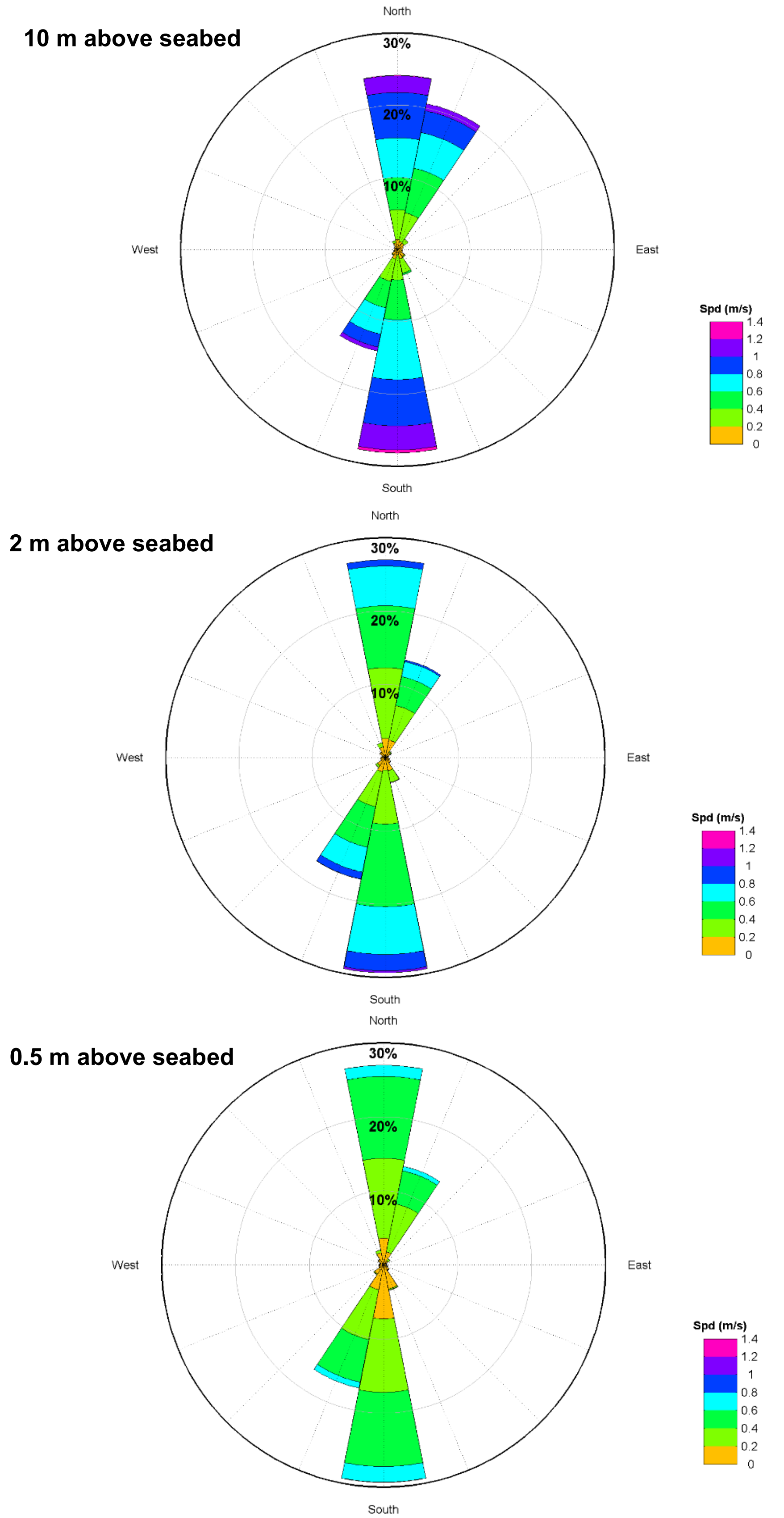
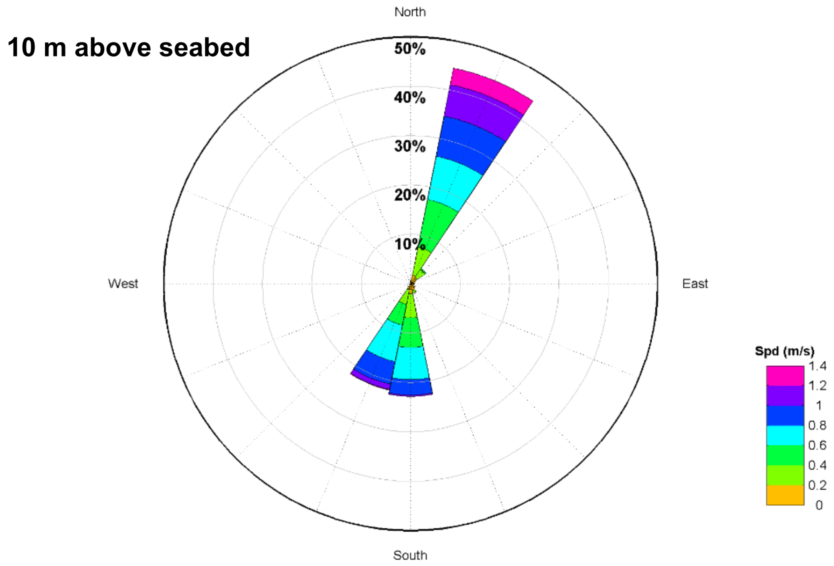
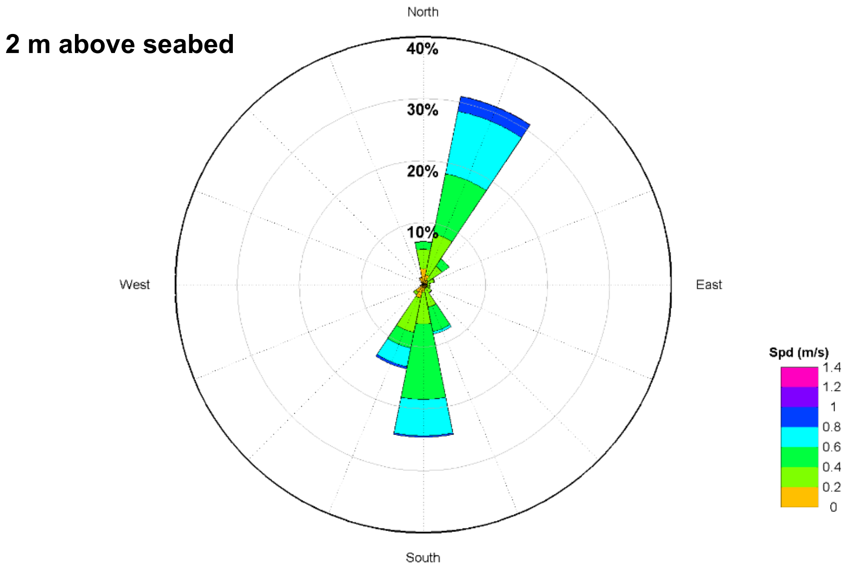


Figure 4. Current roses at varying depths above the seabed at AWAC01.





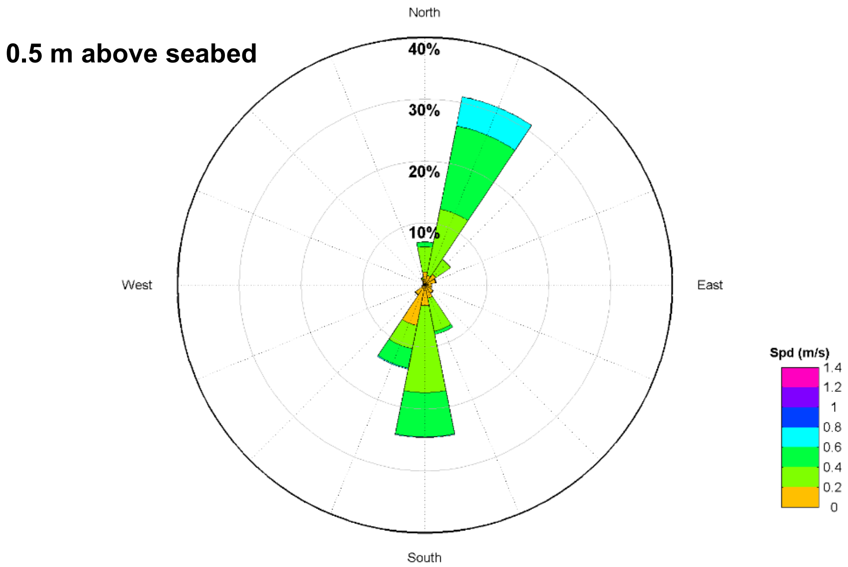


Figure 5. Current roses at varying depths above the seabed at AWAC11.

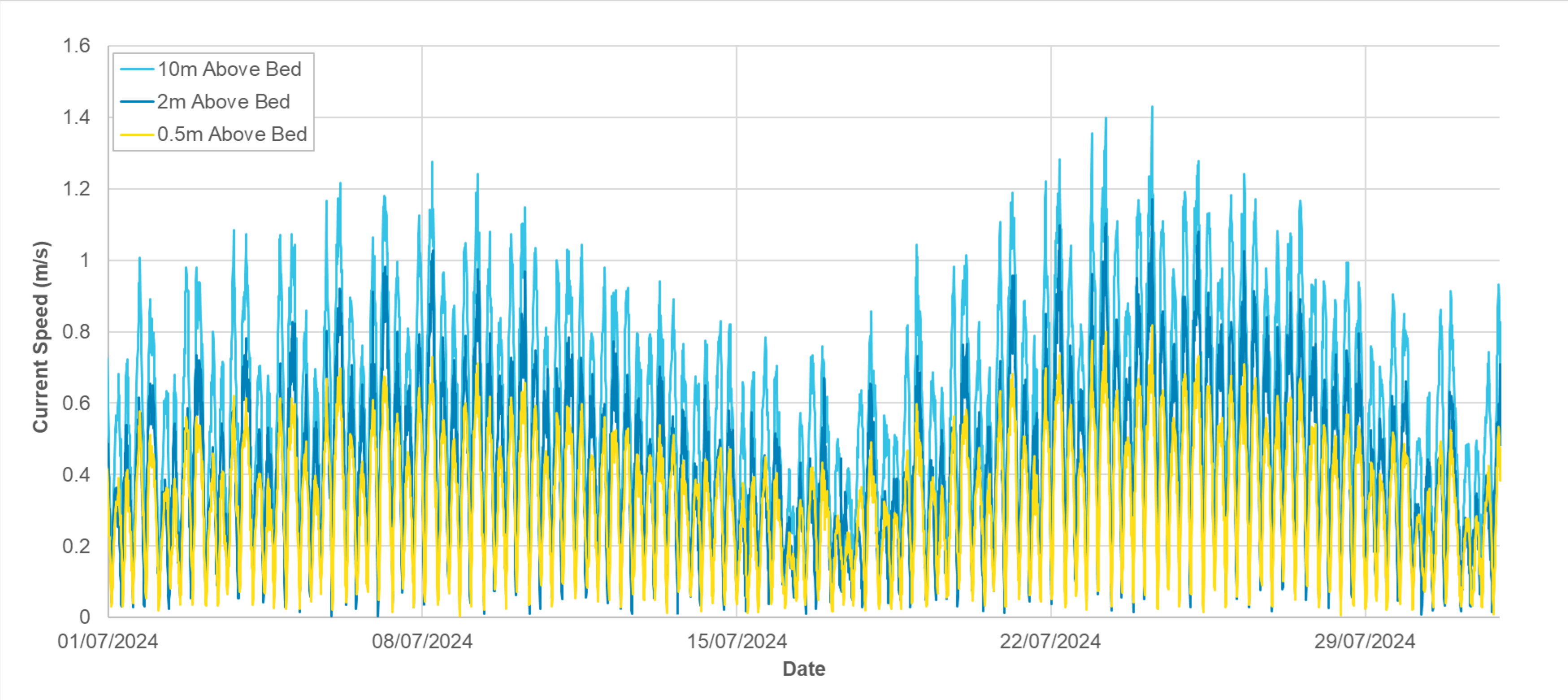


Figure 6. Timeseries of current speed in July 2024 at varying depths above the seabed at AWAC01.

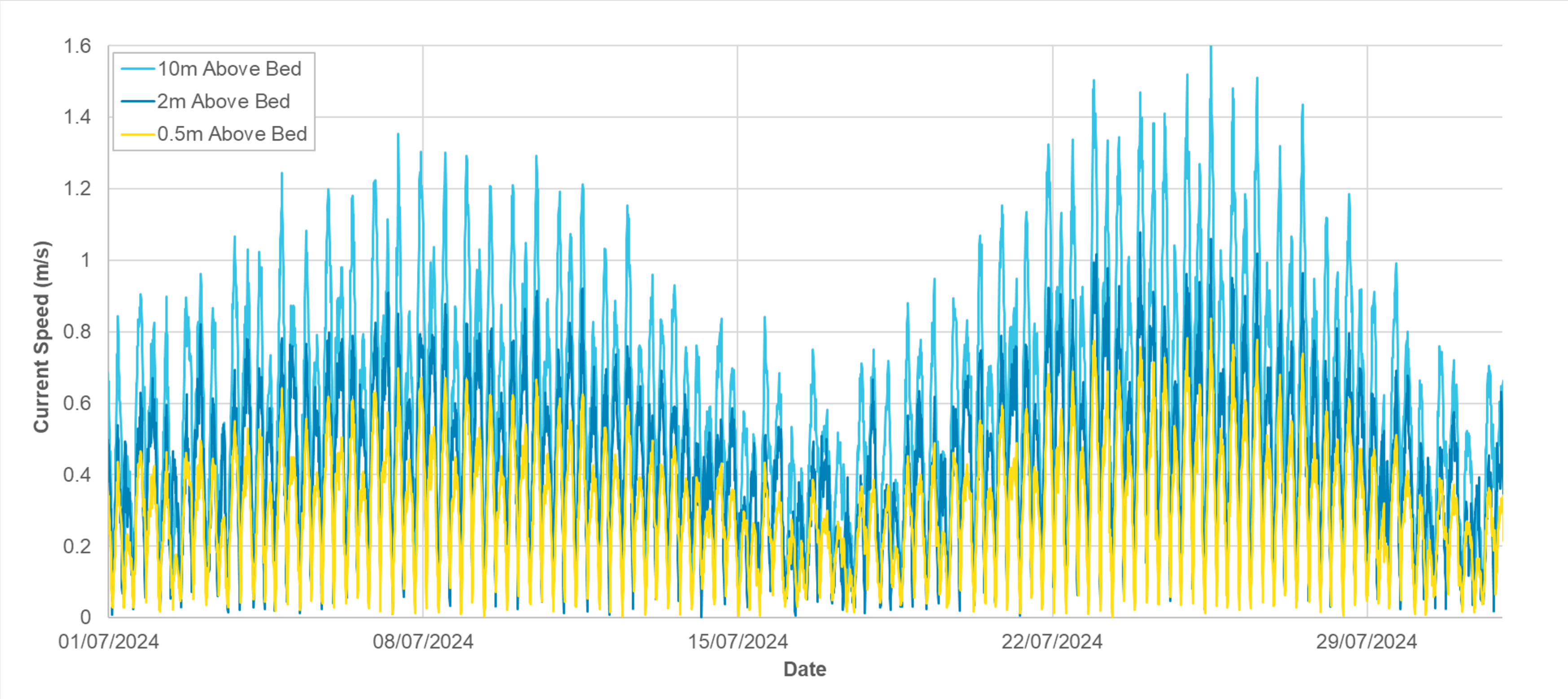


Figure 7. Timeseries of current speed in July 2024 at varying depths above the seabed at AWAC11.

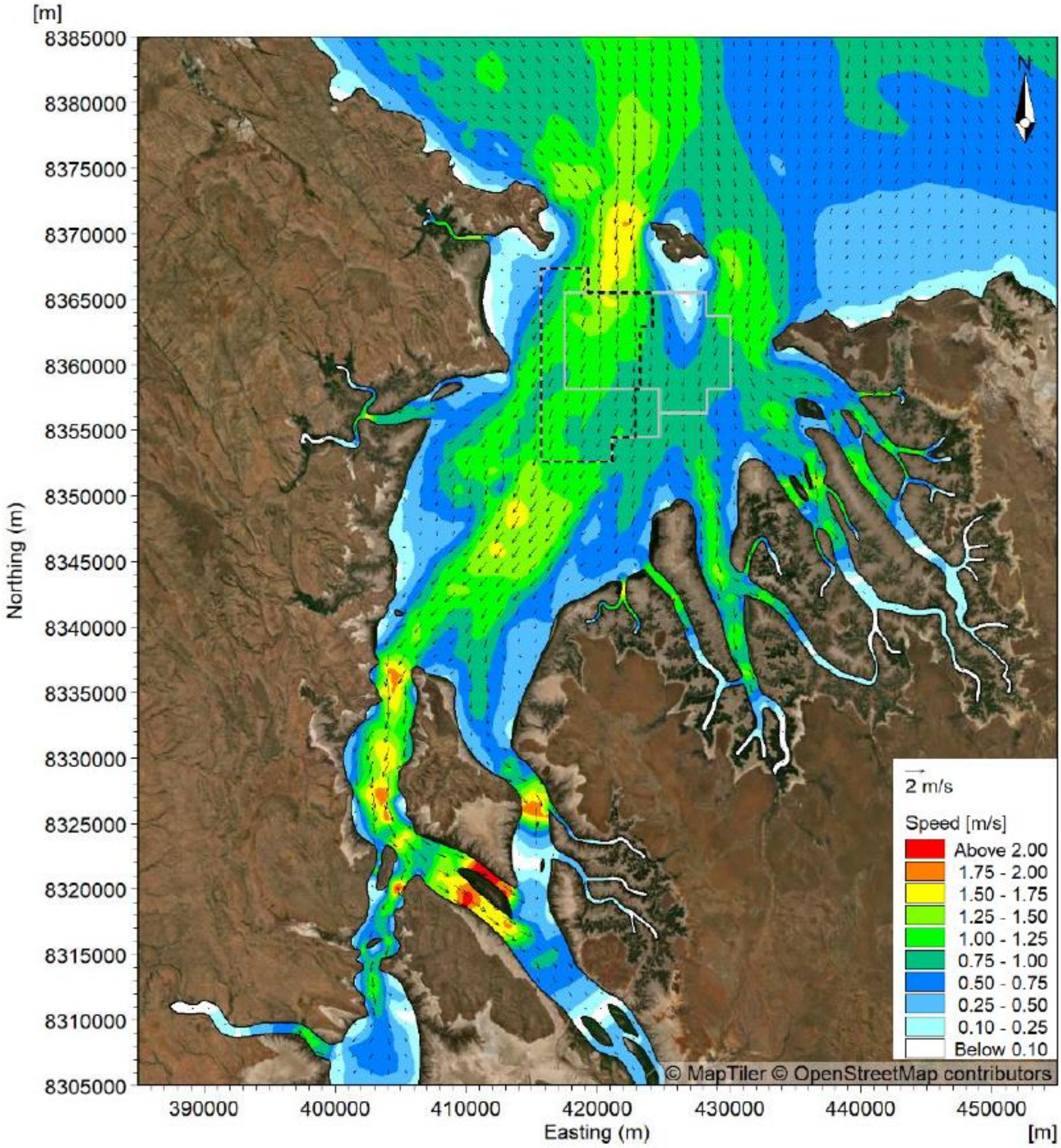


Figure 8. Modelled depth-averaged current speed in CG at peak flood on a spring tide (PCS, 2025).

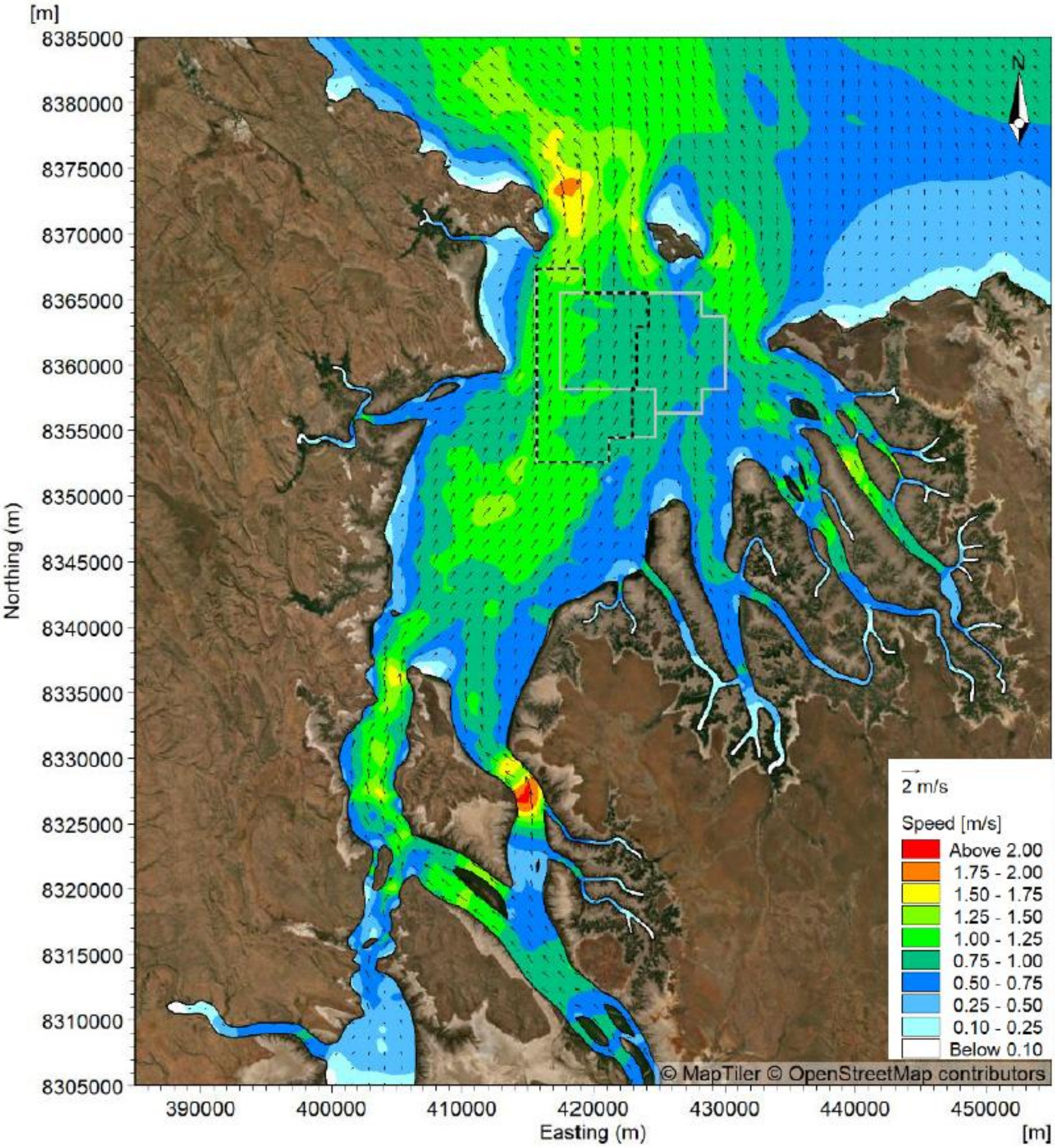


Figure 9. Modelled depth-averaged current speed in CG at peak ebb on a spring tide (PCS, 2025).

4. Overall Summary Finding

Based on the currents in the POA it is considered unlikely that Flatback Turtles could effectively rest on the sandy seabed between nesting attempts, as the relatively strong near-bed currents would likely result in them using energy to remain in place.

Spatial maps of the modelled depth-averaged current speed around CG during the peak flood and peak ebb stages of a spring tide are shown in Figure 8 and Figure 9. These show that the POA is located within the main flow into and out of CG, with depth-averaged current speeds of more than 1 m/s throughout much of the area during either the flood or ebb stage of the tide (or both). Based on the spatial distribution of the current speeds it is likely that any Flatback Turtles wanting to rest on the seabed would either choose an area with lower current speeds (e.g. on the east side of CG, in the shallower bays, to the north or south of Lacrosse Island, adjacent to the beaches offshore of CG etc) or an area with a rocky seabed where the turtles can anchor themselves to the seabed (which generally do not exist in CG).

5. References

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3. ANALYSIS OF TURTLE SATELLITE TRACKING - CAPE DOMETT

Analysis of Turtle Satellite Tracking - Cape Domett

steve@eco-strategic.com

1. The movements of marine turtles and other large marine fauna can be tracked using satellite trackers, attached by straps or epoxy glue, as shown in Figure 1. Transmission occurs until the battery dies, the unit becomes damaged or dislodged, the turtle dies and sinks to the seabed or a similar disruption. Transmission periods can exceed 800 days, although are typically in the order of 200 to 300 days.

2. Signal is only available when the animal is on the surface of the sea. Marine turtles are air breathers and must surface periodically to breath. The priority species in the CG area is the Flatback Turtle (*Natator depressus*), which has a range of breath-hold times depending on their activity level - whether they are resting or actively foraging. During routine activity, they typically dive for 4-5 minutes, but can stay submerged for several hours when inactive.

3. Female Flatbacks lay to three clutches per nesting season with an inter-nesting interval between lays of three to 15 days. Clutches contain approximately 40 to 60 eggs, which means that a they can lay up to approximately 180 eggs per season.

4. During the inter-nesting intervals, Flatbacks move offshore from the nesting beach up to 60 km, but often much closer, and spend most of their time submerged, remaining inactive on the seabed to regain energy for the next nesting event. They can remain submerged for up to several hours when resting, with an average dive duration of ~50 minutes.

5. Two separate satellite tagging programs of nesting, adult, female Flatback Turtles at Cape Domett were identified, as presented on www.seaturtle.org:

   a) Aug 2015 - Aug 2017: DPAW Cape Domett Flatback Turtles Project: Led by WA Department of Parks & Wildlife (DPAW) (now DBCA) in partnership with Miriuwung-Gajerrong Indigenous Rangers. 11 turtles tracked.

   b) June 2009: DEC Flatback Turtles Cape Domett Coastcare Project: Led by WA Department of Environment & Conservation (DEC) (now split into DWER and DBCA) in partnership with NT Government. Five turtles tracked.

6. Table 1 presents the summary results of both of these programs. Track analyses are based on the maps in Annex 1 taken from www.seaturtle.org, which are low resolution and large scale, which limits accuracy significantly. Overall summary results based on the available data, and noting the data resolution limitations, are as follows:

   a) A total of 16 turtles were fitted with satellite trackers, comprising 11 in the DPAW study and five in the DEC study.

   b) The DPAW study fitted satellite trackers to one turtle in August 2017, five turtles in August 2016 and five turtles in August 2015, all in the peak nesting season for Cape Domett.

   c) The DEC study fitted satellite trackers to five turtles in late June 2009, just over a month before the start of the peak nesting season for Cape Domett.

   d) All 16 tracked turtles undertook inter-nesting movements immediately offshore from Cape Domett until the end of nesting, whereafter they headed offshore into Joseph Bonaparte Gulf, then either NE towards Darwin and the Arafura Sea beyond, or NW towards the Timor Sea and locations offshore from the West Kimberley.

   e) Eleven of the 16 tracked turtles do not appear to have entered Cambridge Gulf (CG).Two of the 16 tracked turtles appear to have entered CG, but on the far eastern side only, closest to Cape Domett, and do not appear to have entered the POA. These were Sally and Rena in August 2015.

   f) Two of the 16 tracked turtles may have ‘possibly’ entered CG, although the low resolution of the maps makes this difficult to ascertain, and again on the far eastern side only, closest to Cape Domett, and they do not appear to have entered the POA. These were Snookie in August 2016 and Boondoolng in June 2009.

   g) One of the 16 tracked turtles appears to have crossed the SE corner of the POA, Myrtle in August 2016.

   h) All of the five turtles that appear to have entered or may have possibly entered CG, were released on or near neap ride, when currents are less, except for one, Boondoolng, which was released on spring tide.

   i) These results, including that only one out of 16 tracked turtles crossed only slightly into the SE corner of the POA, indicate that a complete temporal closure of operations of the SPV during peak nesting season August-September is not warranted, and that a spatial mitigation measure, where the SPV is restricted to the western side of the POA during peak nesting season, would be more relevant and reasonable.

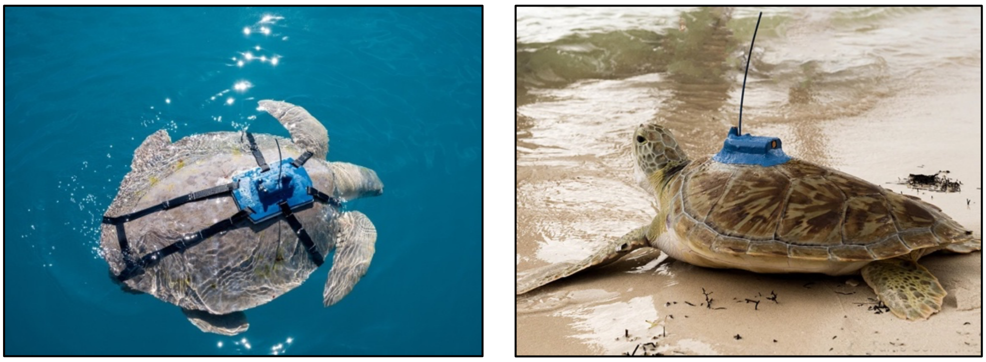


FIGURE 1: *Examples of satellite trackers attached to marine turtles - attached by straps (left) or epoxy glue (right).*

TABLE 1: *Summary results for each satellite tagged turtle (blue = track entered CG / red = track entered POA)*

NOTES: Listed in reverse chronological order from most recent release date. Release date / tracking start point is at Cape Domett. Track analyses are based on maps in Annex 1 from www.seaturtle.org, which are low resolution and large scale, which limits accuracy significantly.

Turtle	Release Date	Peak Nesting Season	Tide Phase on Release Date	Last Transmission Date	Last Transmission Location	Distance from CG (straightline)	Days Transmitted	Track Description (see maps in Annex 1)	In CG (see Annex 1)	In POA (see Annex 1)	Time in CG
DPAW Cape Domett Flatback Turtles Project											
1. Mangkuru	8 Aug 2017	Yes	**Spring** (full moon)	26 Mar 2018	South coast Melville Is. offshore Darwin	~450km	230	Inter-nesting movements immediately offshore Cape Domett over 39 days from release until 16 Sept 2016 (end of nesting) then head NE towards Darwin & Melville Is.	No	No	N/a
2. Riley	12 Aug 2016	"	**Neap** (1 day >1st quarter moon)	10 Nov 2018	Offshore from Arnhemland.	~900km	820	Inter-nesting movements immediately offshore Cape Domett (no. days not clear) then head NE towards Darwin at end of nesting and on to offshore from Arnhemland.	No	No	N/a
3. Snookie	11 Aug 2016	"	**Neap** (1st quarter moon)	20 Sept 2017	JBG offshore from Wadeye.	~200km	405	Inter-nesting movements immediately offshore Cape Domett (no. days not clear) then head NE into JBG offshore Wadeye.	Possibly – north-east side only (map not clear)	No	Not discernable
4. Stretch	11 Aug 2016	"	"	16 Oct 2016	North of Melville Is. offshore Darwin.	~500km	66	Inter-nesting movements immediately offshore Cape Domett (no. days not clear) then head NNE to north of Melville Is.	No	No	N/a
5. Squirtle	9 Aug 2016	"	**Neap** (2 days <1st quarter moon)	13 Jul 2017	Offshore from West Kimberley.	~600km	338	Inter-nesting movements immediately offshore Cape Domett (no. days not clear) then head NW to offshore West Kimberley.	No	No	N/a
6. Myrtle	9 Aug 2016	"	"	4 Feb 2017	NW into Timor Sea.	~420km	179	Inter-nesting movements immediately offshore Cape Domett and in CG – (appears to be east side only and no. days not clear) then head NW into Timor Sea.	Appears to be yes - east side only (map not clear)	Appears to be yes - SE corner (map not clear)	Not discernable
7. Ope	16 Aug 2015	"	**Spring** (2 days >full moon)	22 Nov 2016	Arafura Sea offshore from Nhulunbuy.	~950km	464	Inter-nesting movements immediately offshore Cape Domett (no. days not clear) then head NE towards Darwin at end of nesting and eastwards on to Arafura Sea offshore from Nhulunbuy.	No	No	N/a
8. Sally	15 Aug 2015	"	**Spring** (1 day >full moon)	17 April 2016	JBG offshore from Wadeye.	125km	246	Inter-nesting movements immediately offshore Cape Domett and in False Mouths of Ord (far east of CG) (no. days not clear) then head NE into JBG offshore Wadeye.	Appears to be yes - far east side only (False Mouths of Ord) (map not clear)	No	Not discernable

Turtle	Release Date	Peak Nesting Season	Tide Phase on Release Date	Last Transmission Date	Last Transmission Location	Distance from CG (straightline)	Days Transmitted	Track Description (see maps in Annex 1)	In CG (see Annex 1)	In POA (see Annex 1)	Time in CG
9. Brooke	14 Aug 2015	"	**Spring** (full moon)	12 Nov 2016	Arafura Sea offshore from Nhulunbuy.	~1,000km	456	Inter-nesting movements immediately offshore Cape Domett (no. days not clear) then head NE towards Darwin at end of nesting and eastwards to Arafura Sea offshore from Nhulunbuy.	No	No	N/a
10. Rena	8 Aug 2015	"	**Neap** (1 day >last quarter moon)	25 Aug 2016	NW into Timor Sea.	~400km	383	Inter-nesting movements immediately offshore Cape Domett and in False Mouths of Ord (far east of CG) (no. days not clear) then head NW into Timor Sea.	Appears to be yes– far east side only (False Mouths of Ord) (map not clear)	No	Not discernable
11. Tracey	7 Aug 2015	"	**Neap** (last quarter moon)	28 Jul 2016	NW into JBG.	~200km	356	Inter-nesting movements immediately offshore Cape Domett, Lacrosse Island and Cape Dussejour (no. days not clear) then head NW into JBG.	No	No	N/a
DEC Cape Domett Flatback Turtles Coastcare Project											
12. Dawn	24 Jun 2009	~1-month before	**Spring** 1 day <full moon	20 Jan 2010	NW into JBG.	~60km	210	Inter-nesting movements immediately offshore Cape Domett (no. days not clear) then head NW into JBG then return to Cape Domett over 7 months.	No	No	N/a
13. Pebbles	24 Jun 2009	"	"	22 May 2010	Arafura Sea offshore from Nhulunbuy.	~1,000km	332	Inter-nesting movements immediately offshore Cape Domett (no. days not clear) then head NE towards Melville Is. at end of nesting and eastwards to Arafura Sea offshore from Nhulunbuy.	No	No	N/a
14. Shelley	24 Jun 2009	"	"	26 April 2-10	NW into JBG & Timor Sea.	~350km	306	Inter-nesting movements immediately offshore Cape Domett (no. days not clear) then head NW into JBG & Timor Sea.	No	No	N/a
15. Boondoolng	23 Jun 2009	"	**Spring** 2 days <full moon	19 May 2010	South coast Cobourg Peninsula		330	Inter-nesting movements immediately offshore Cape Domett (no. days not clear) then head NE towards Darwin then Cobourg Peninsula.	Possibly – north-east side only (map not clear)	No	Not discernable
16. Ninja	23 Jun 2009	"	"	19 Mart 2010	South coast Melville Is. offshore Darwin	~450km	269	Inter-nesting movements immediately offshore Cape Domett (no. days not clear) (end of nesting) then head NW along clast and then NE towards Darwin & Melville Is.	No	No	N/a

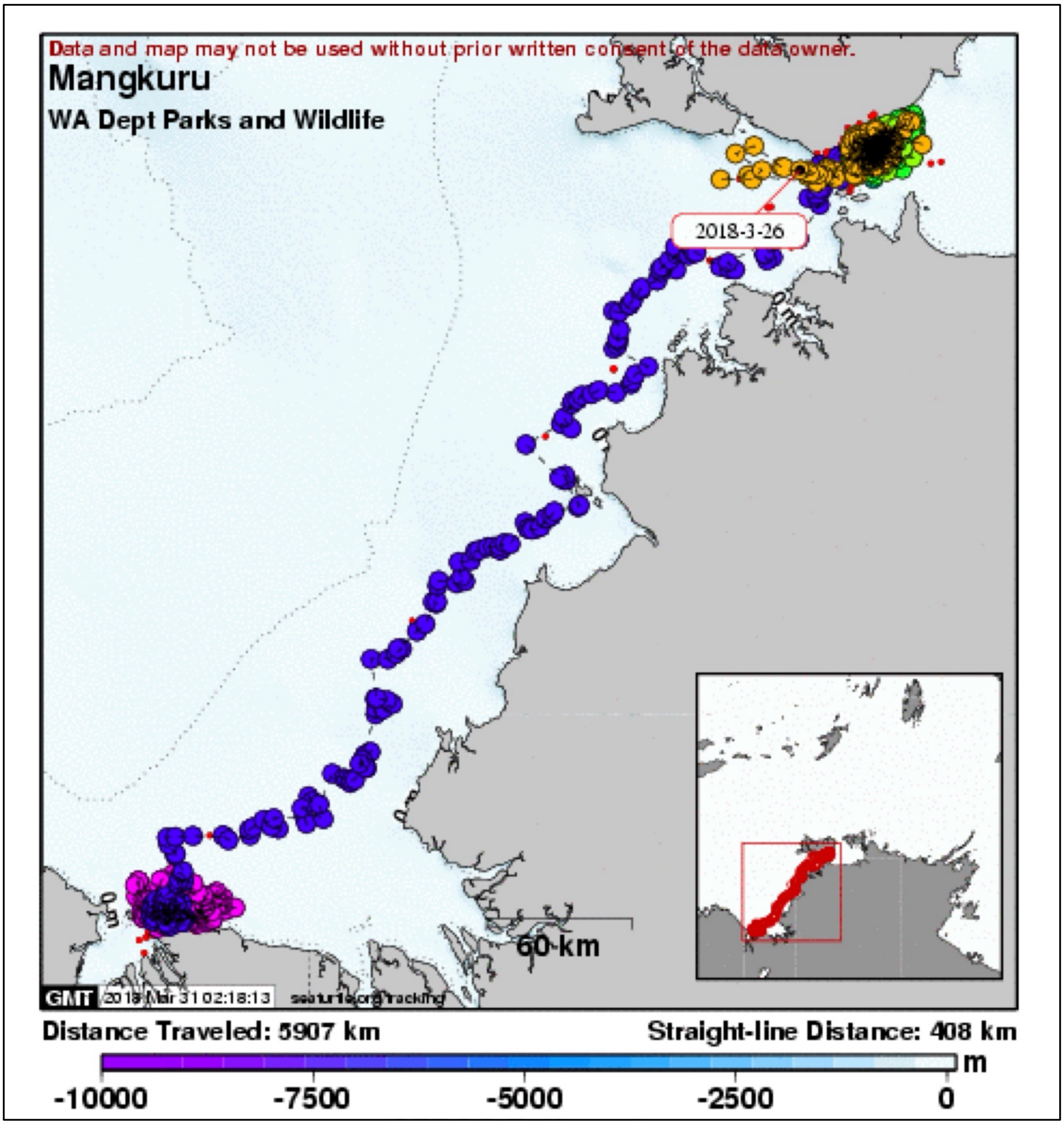
ANNEX 1: Maps

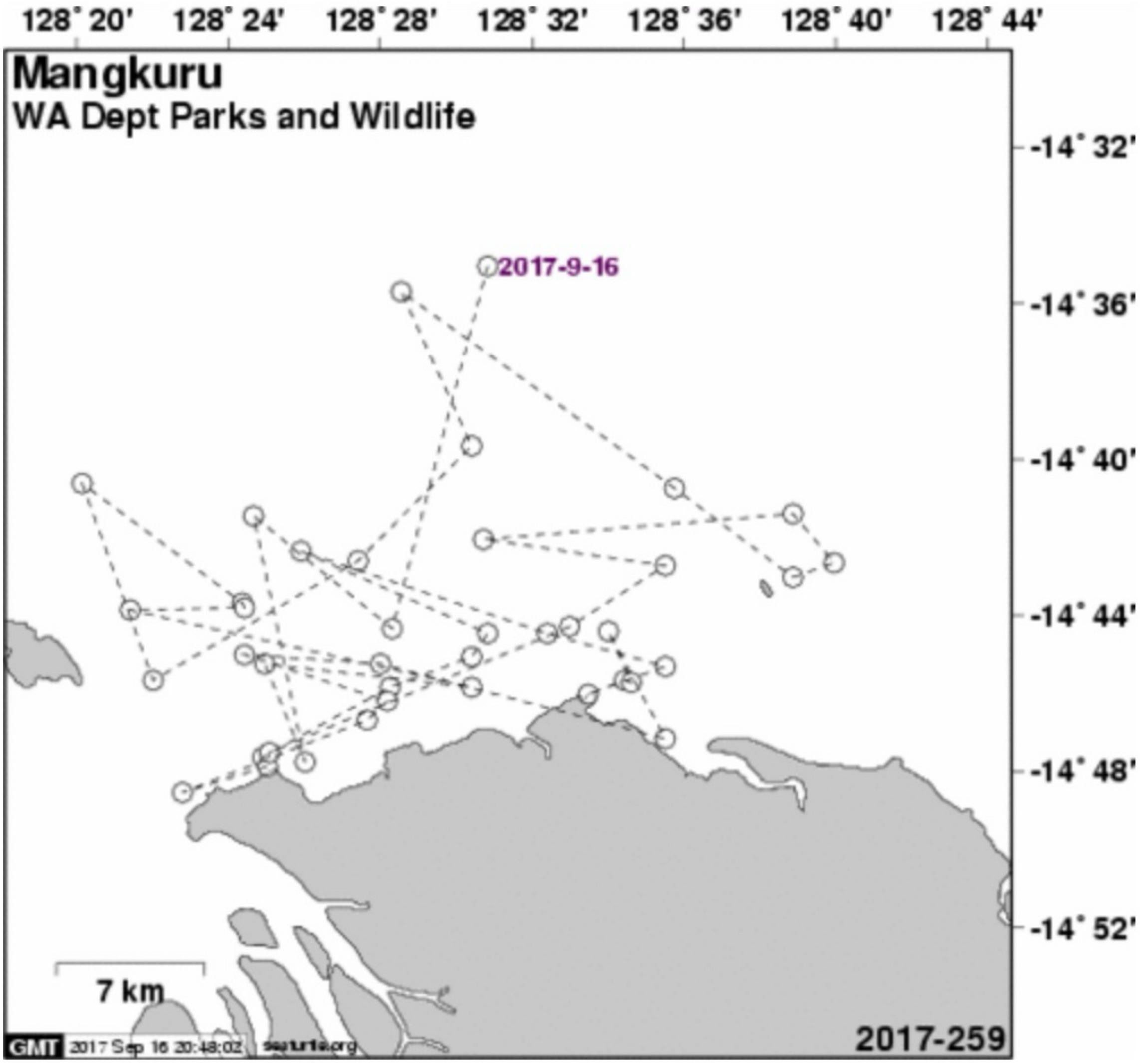
From www.seaturtle.org

Listed in same order as in Table 1 - reverse chronological order from most recent release date.

Mangkuru

Released 8 Aug 2017. Did not enter CG.

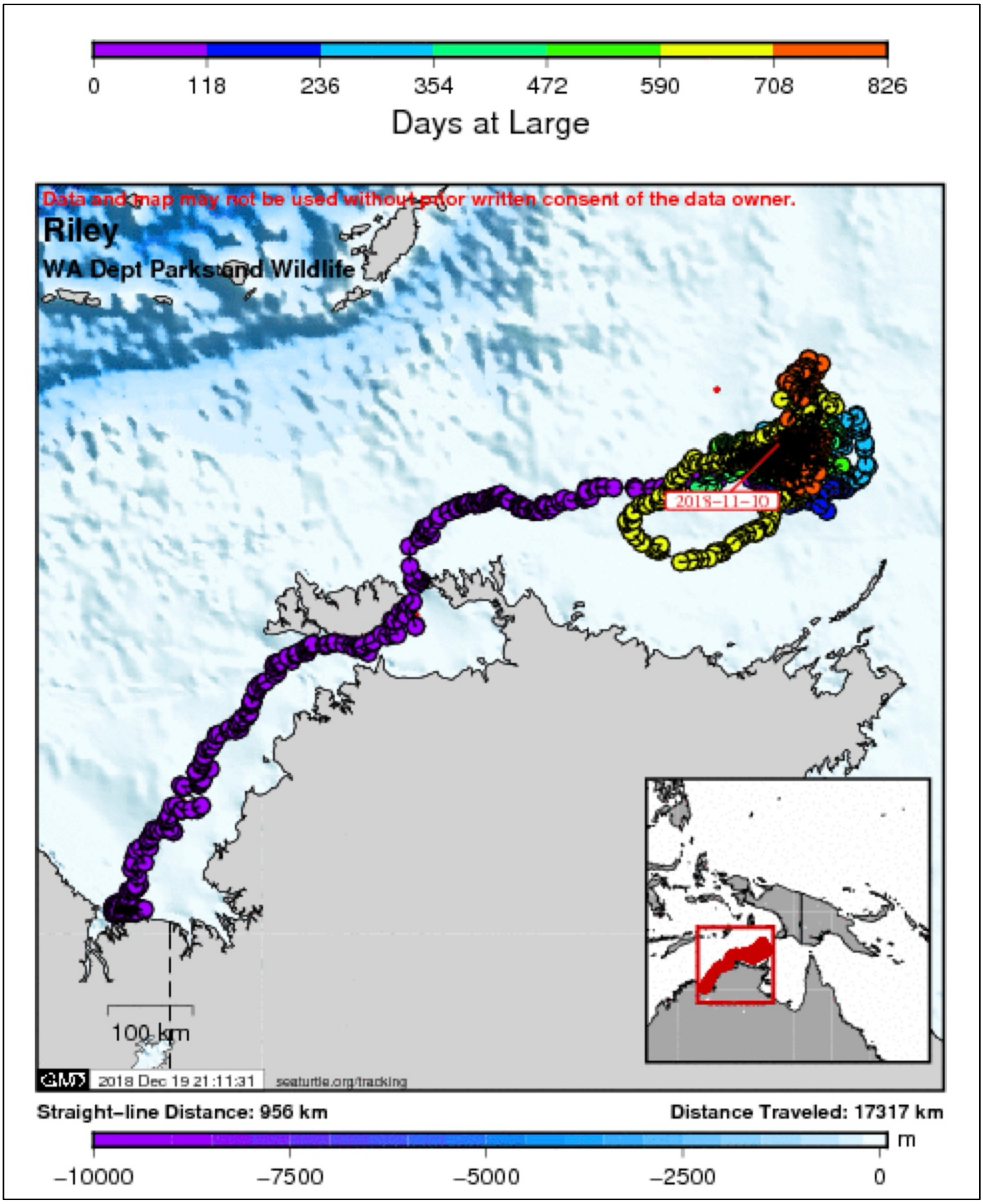




128° 20'
128° 24'
128° 28'
128° 32'
128° 36'
128° 40'
128° 44'
Mangkuru
WA Dept Parks and Wildlife
-14° 32'
-14° 36'
-14° 40'
-14° 44'
-14° 48'
-14° 52'
2017-9-16
7 km
GMT 2017 Sep 16 20:48:02
seaturtle.org
2017-259

Riley

Released 12 Aug 2016. Did not enter CG.



Riley - Cape Domett flatbacks

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Static Map | Zoom Map | **Animated Map**

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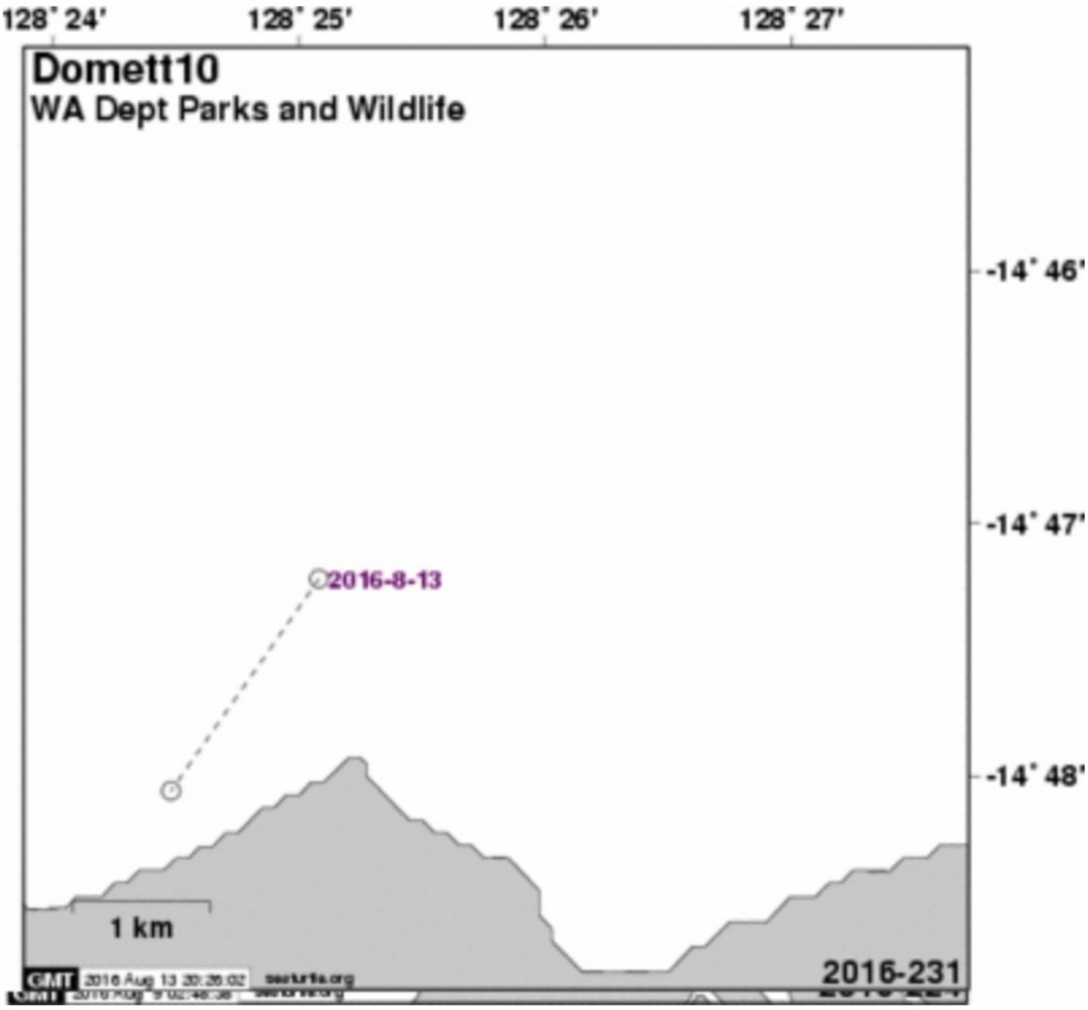
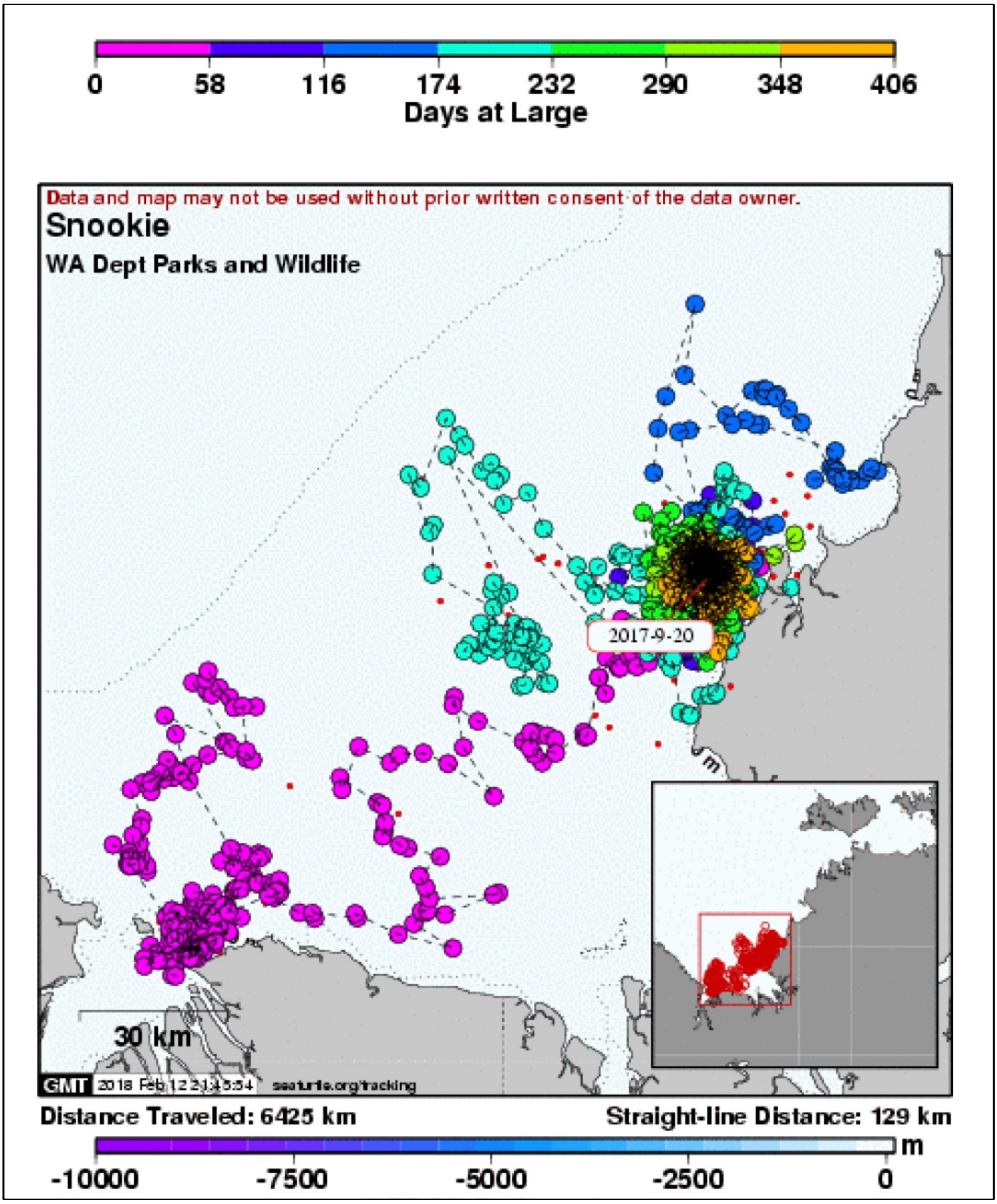


Snookie

Released 11 Aug 2016. May have 'possibly' entered CG - north-east side only (map not clear).



Snookie - Cape Domett flatbacks

A project of **WA Dept Parks and Wildlife**.

Static Map | **Animated Map**

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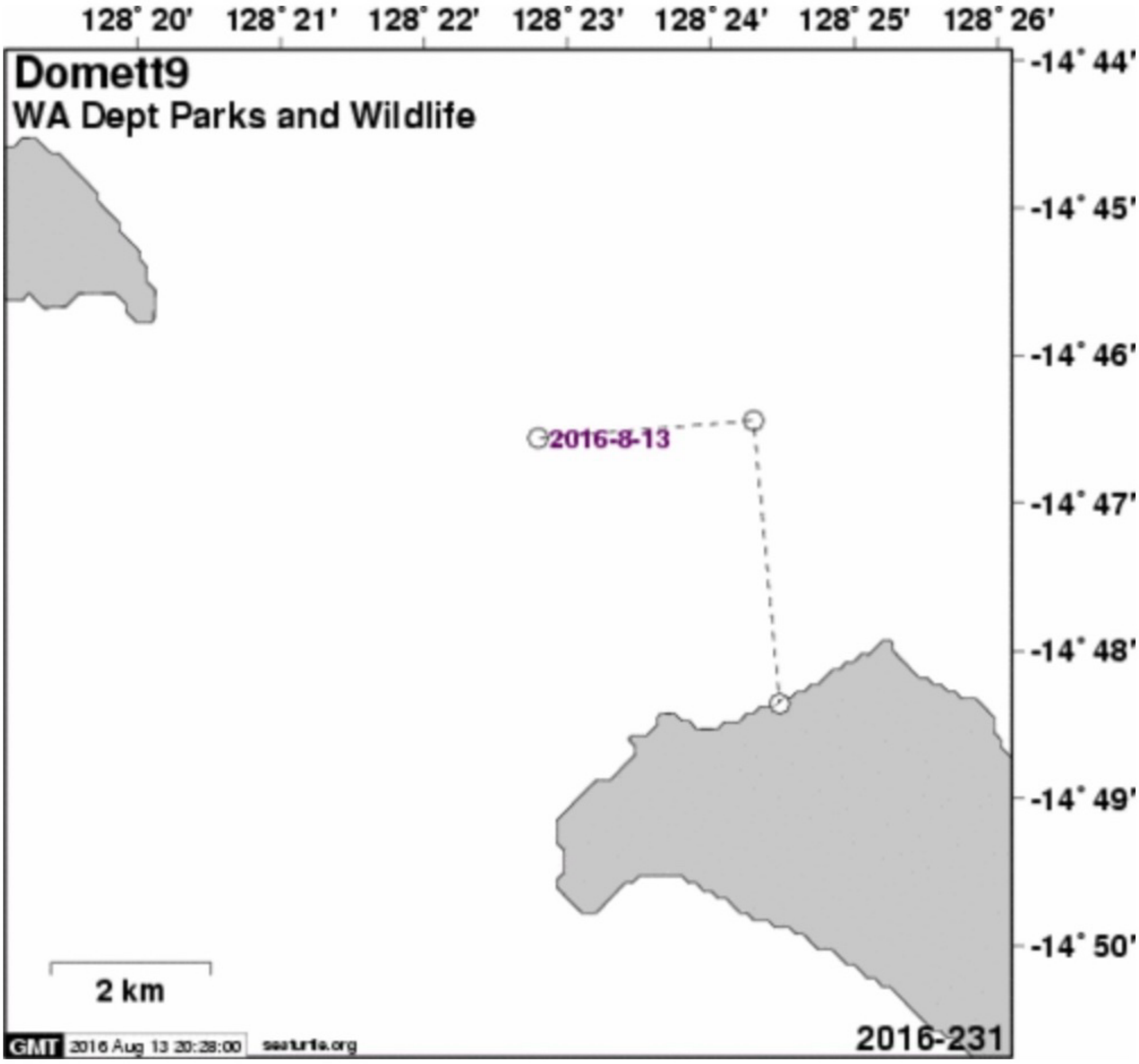
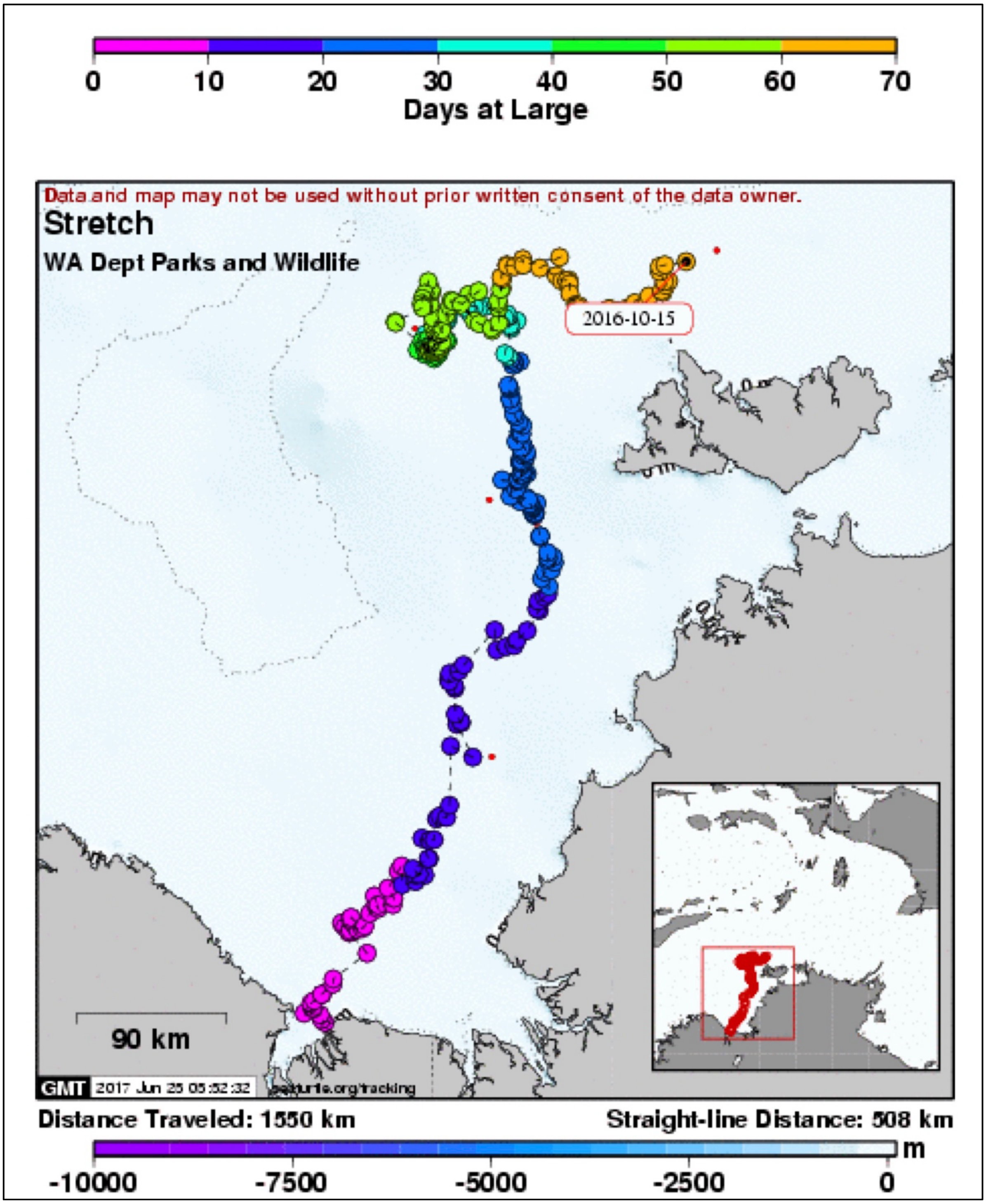
Last 14 Days

Full Animation 26KB



Stretch

Released 11 Aug 2016. Did not enter CG.



Stretch - Cape Domett flatbacks

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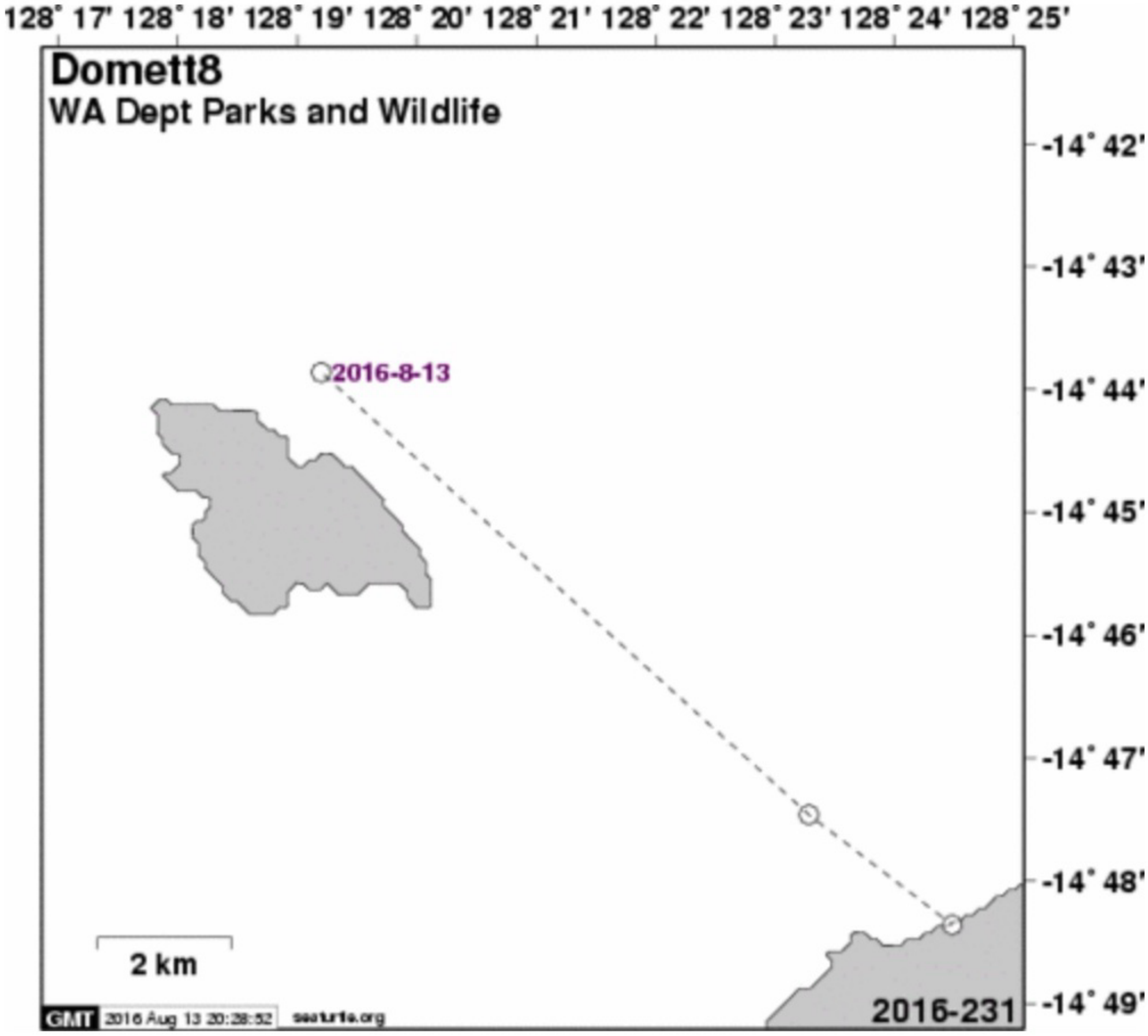
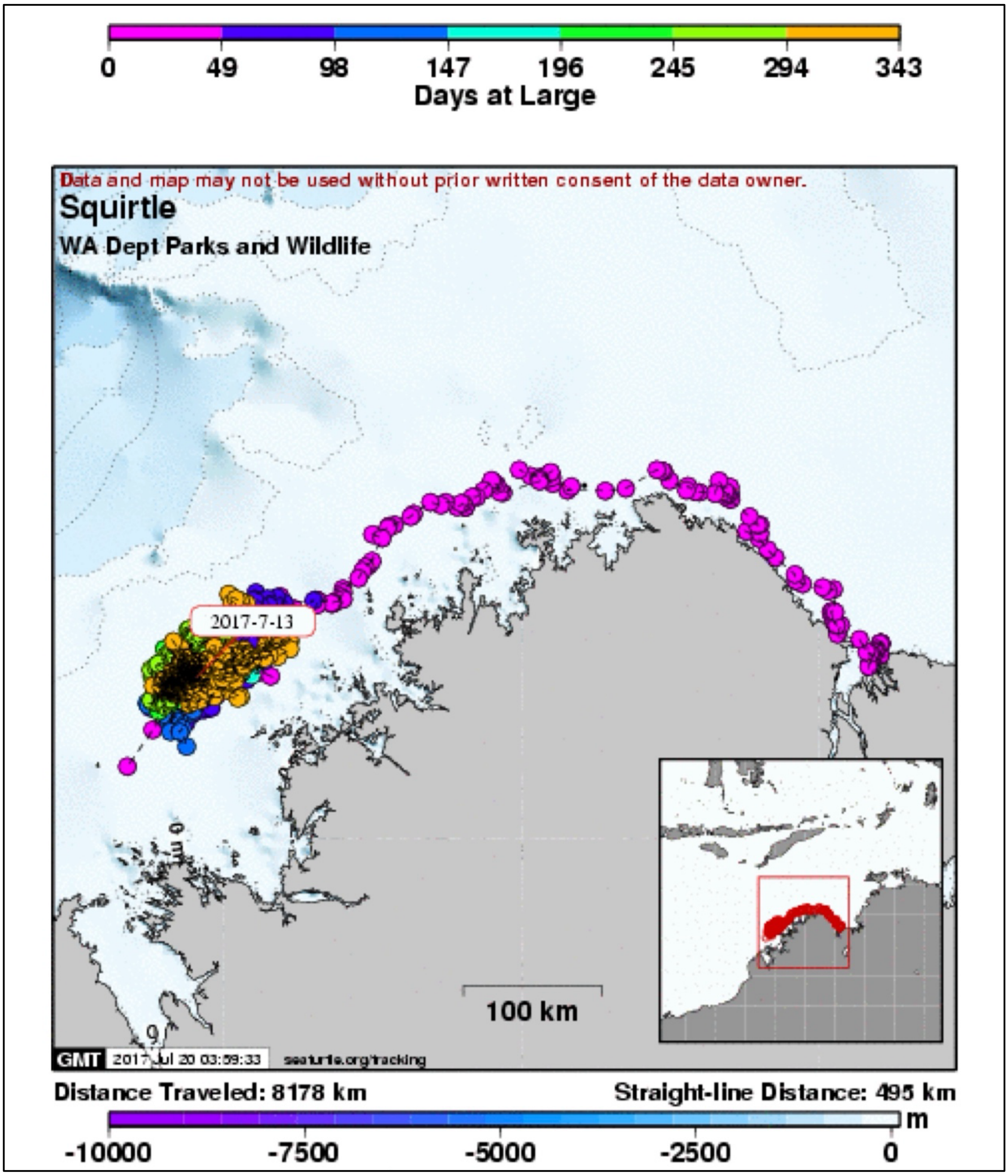
Last 14 Days

Full Animation 24KB



Squirtle

Released 9 Aug 2016. Did not enter CG.



Squirtle - Cape Domett flatbacks

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Static Map | Zoom Map | **Animated Map**

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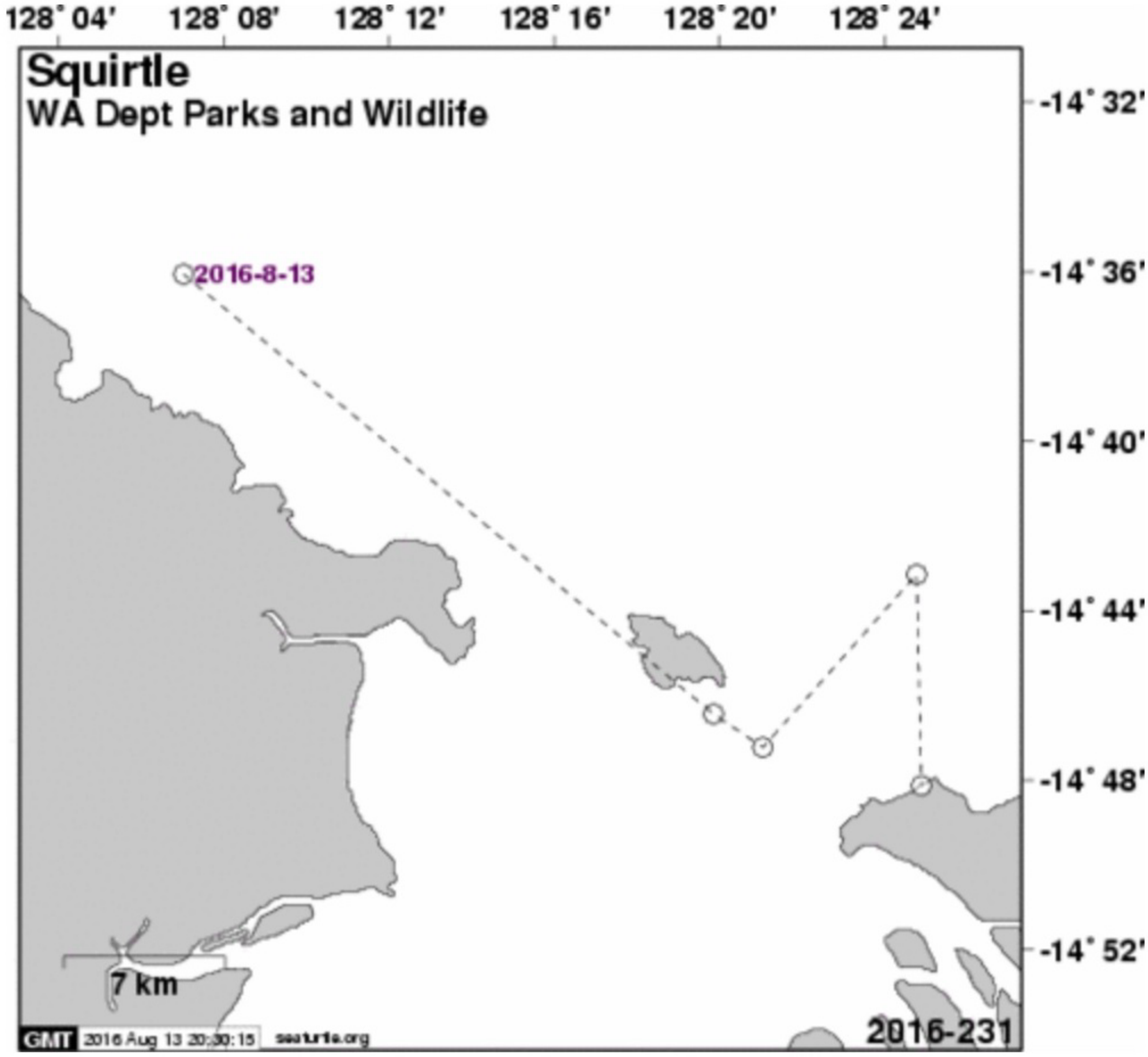
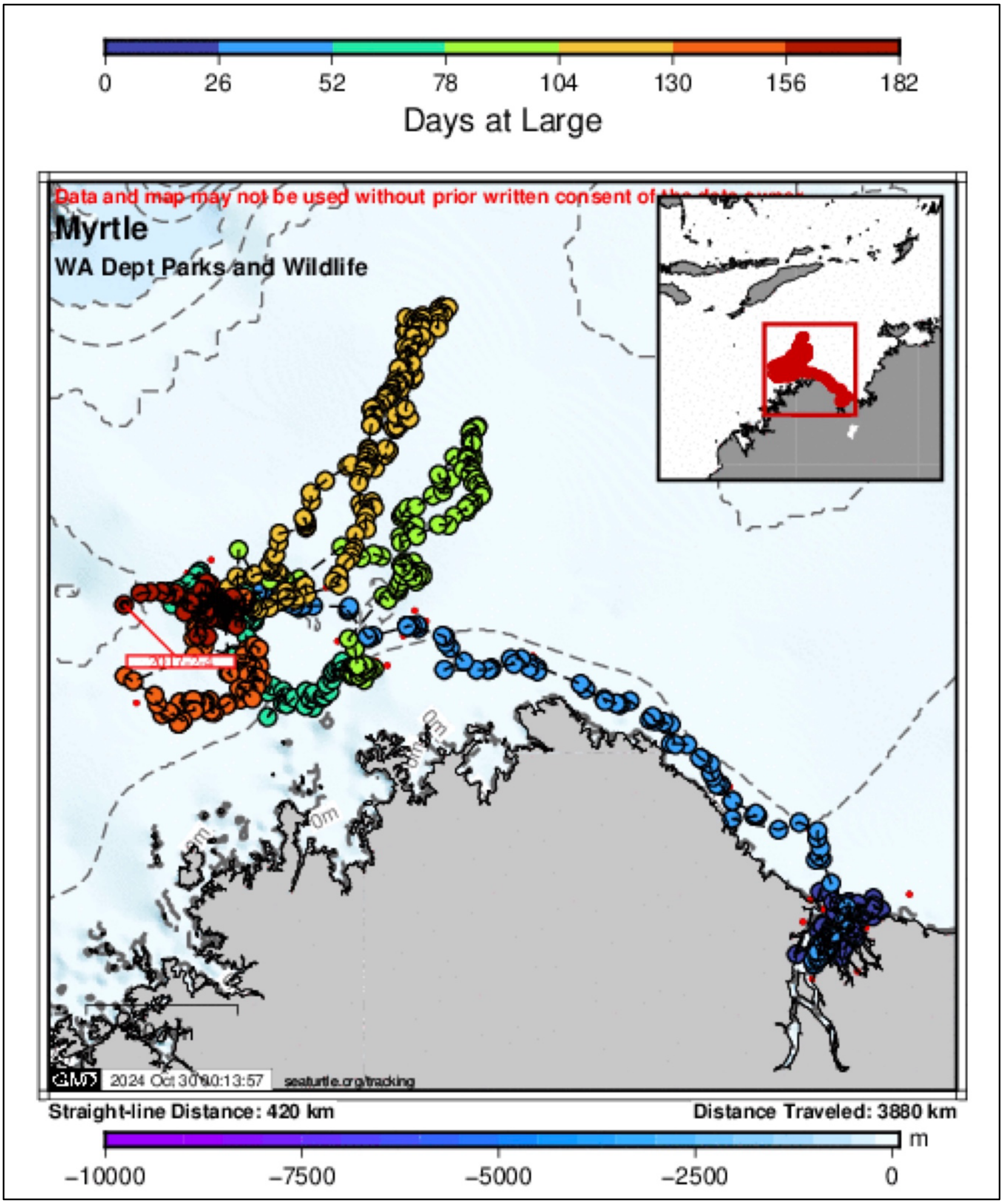
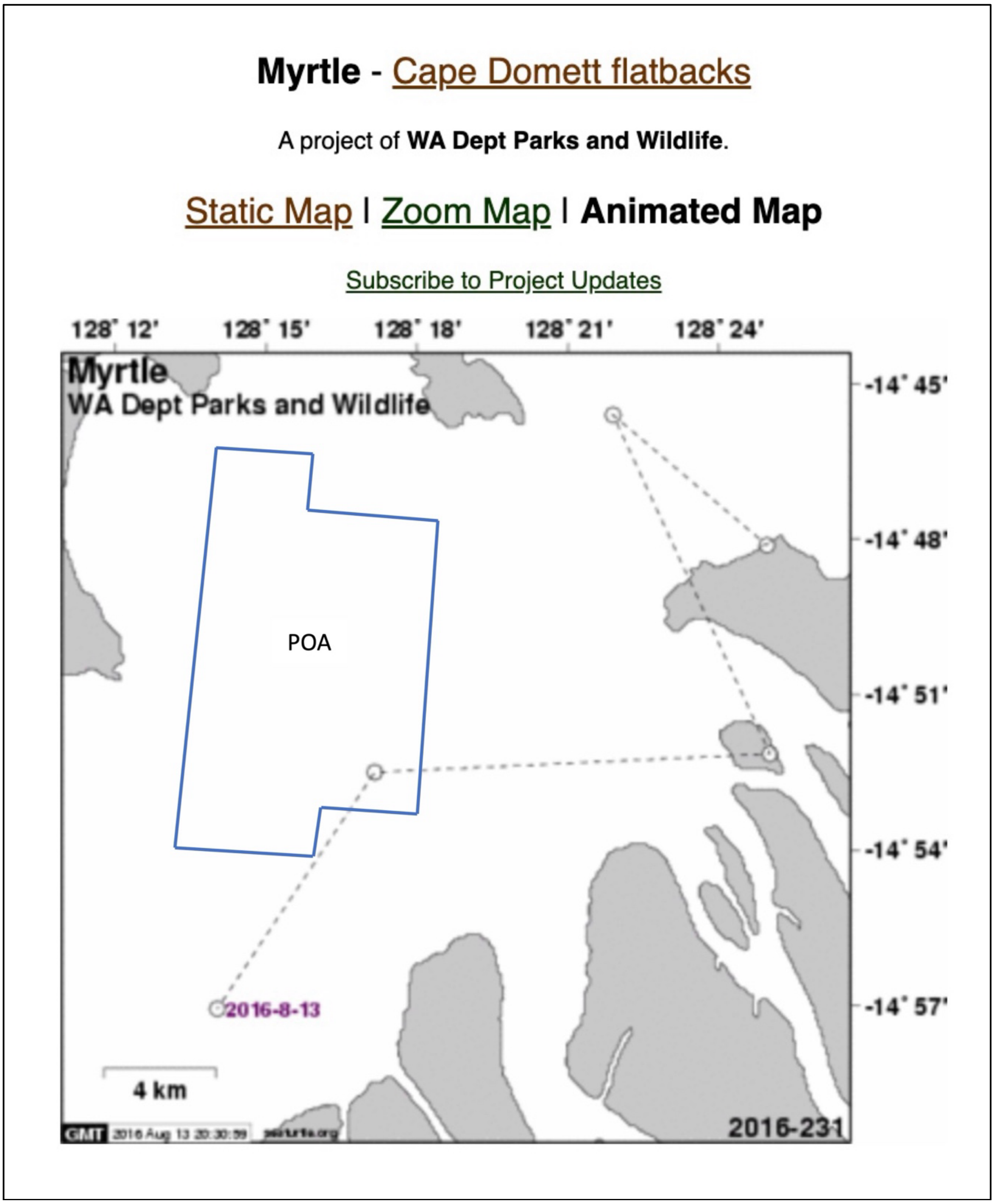
Full Animation 29KB



Myrtle

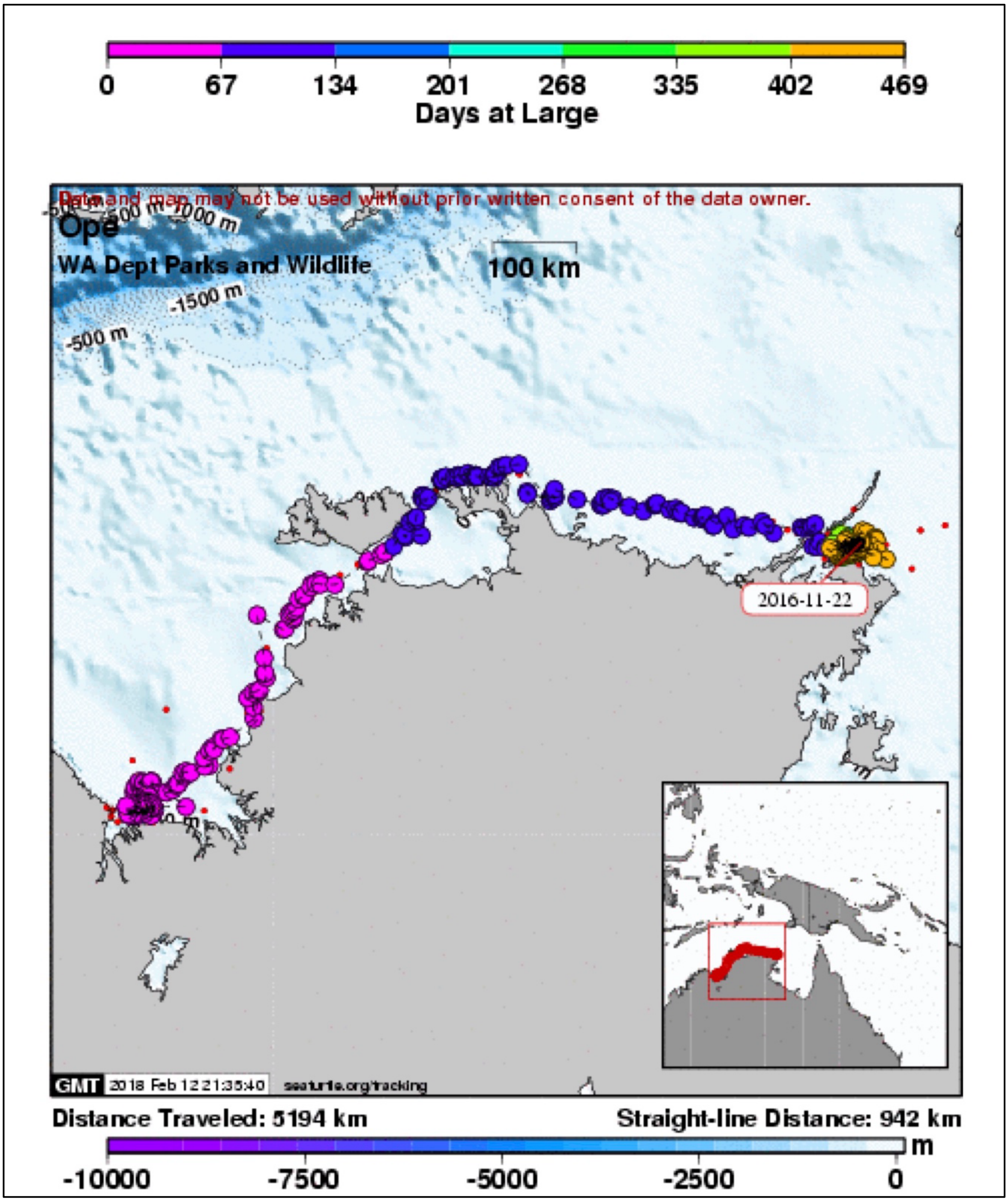
Released 9 Aug 2016. Appears to have entered CG - east side only, including SE corner of POA (map not clear).




Myrtle - Cape Domett flatbacks
A project of WA Dept Parks and Wildlife.
Static Map | Zoom Map | Animated Map
Subscribe to Project Updates
128° 12'
128° 15'
128° 18'
128° 21'
128° 24'
-14° 45'
-14° 48'
-14° 51'
-14° 54'
-14° 57'
Myrtle
WA Dept Parks and Wildlife
POA
2016-8-13
4 km
2016-231

Ope

Released 16 Aug 2015. Did not enter CG.



Ope - Cape Domett flatbacks

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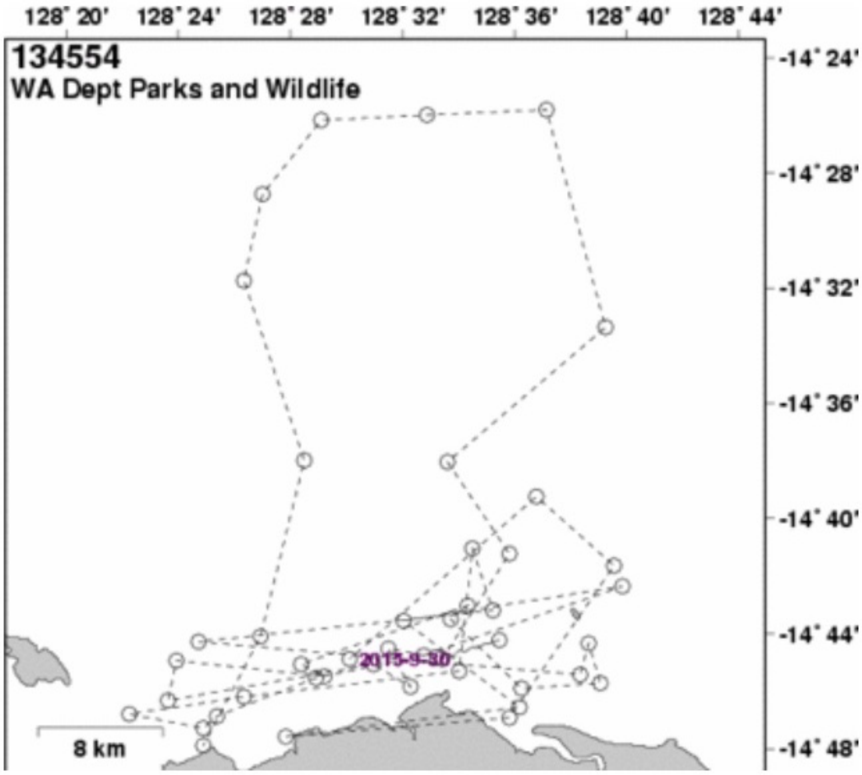
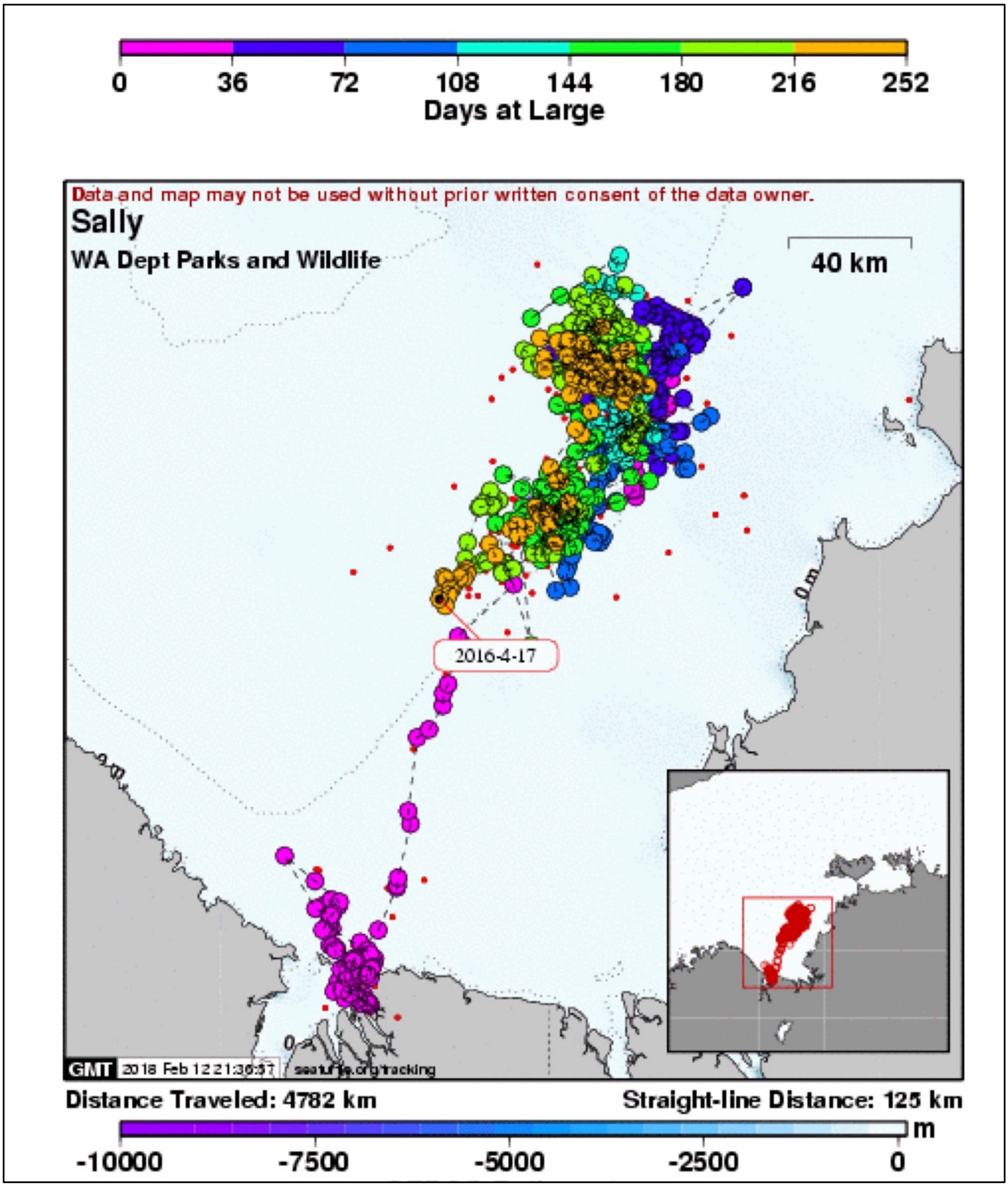


Ope (Flatback Turtle) is on the coast of Australia and 614 km from Darwin

Sally

Released 15 Aug 2015. Appears to have entered CG - far east side only (False Mouths of Ord) (map not clear).



Sally - Cape Domett flatbacks

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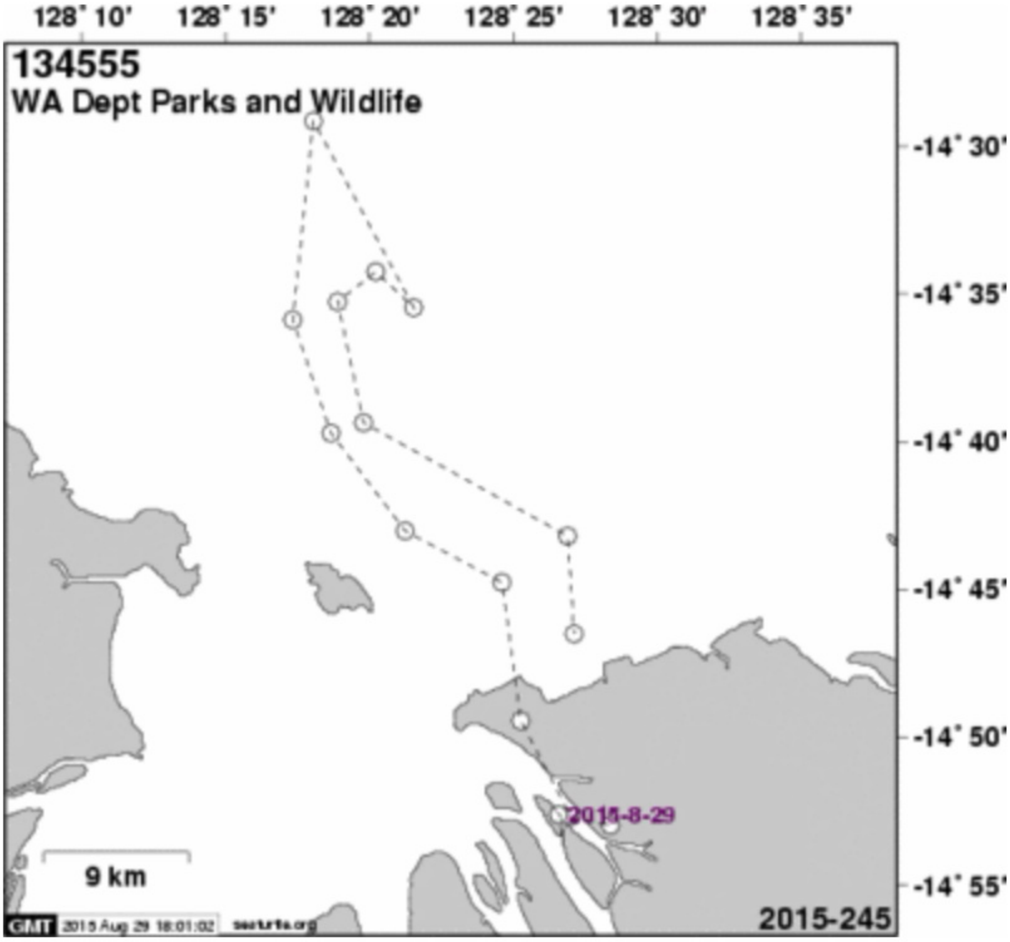

Sally (Flatback Turtle) is 96 km NW off the coast of Australia and 277 km from Darwin

Sally - Cape Domett flatbacks

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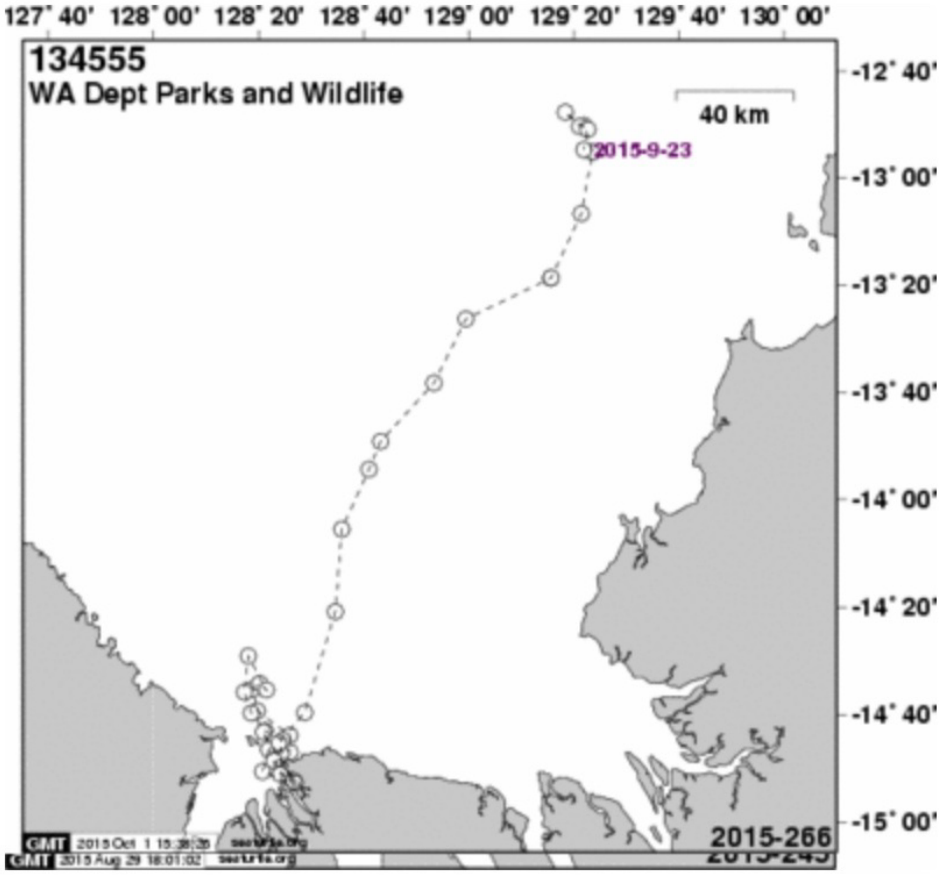
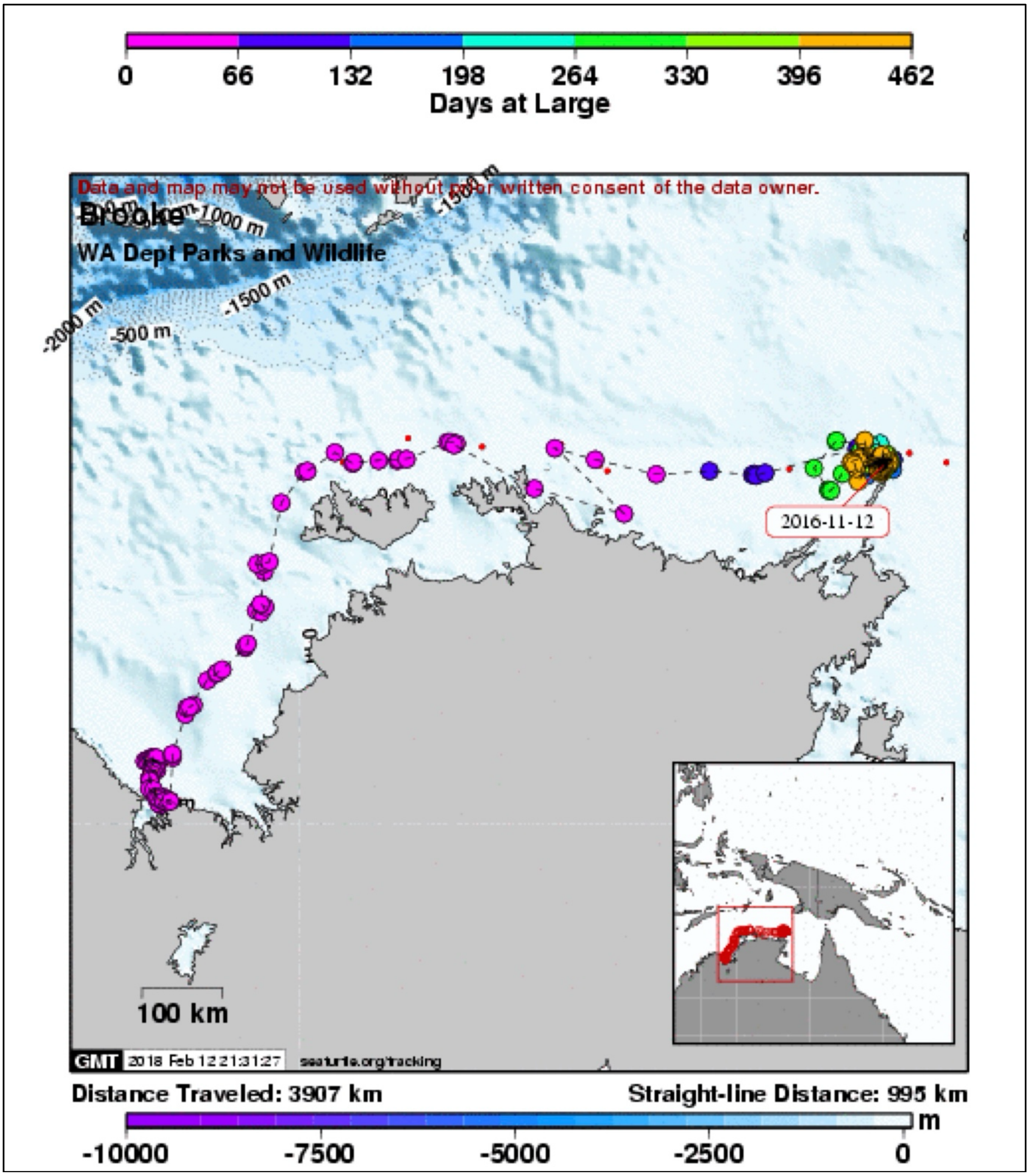


Sally (Flatback Turtle) is 96 km NW off the coast of Australia and 277 km from Darwin

Brooke

Released 15 Aug 2015. Did not enter CG.



Brooke - Cape Domett flatbacks

A project of **WA Dept Parks and Wildlife**.

Static Map | Zoom Map | **Animated Map**

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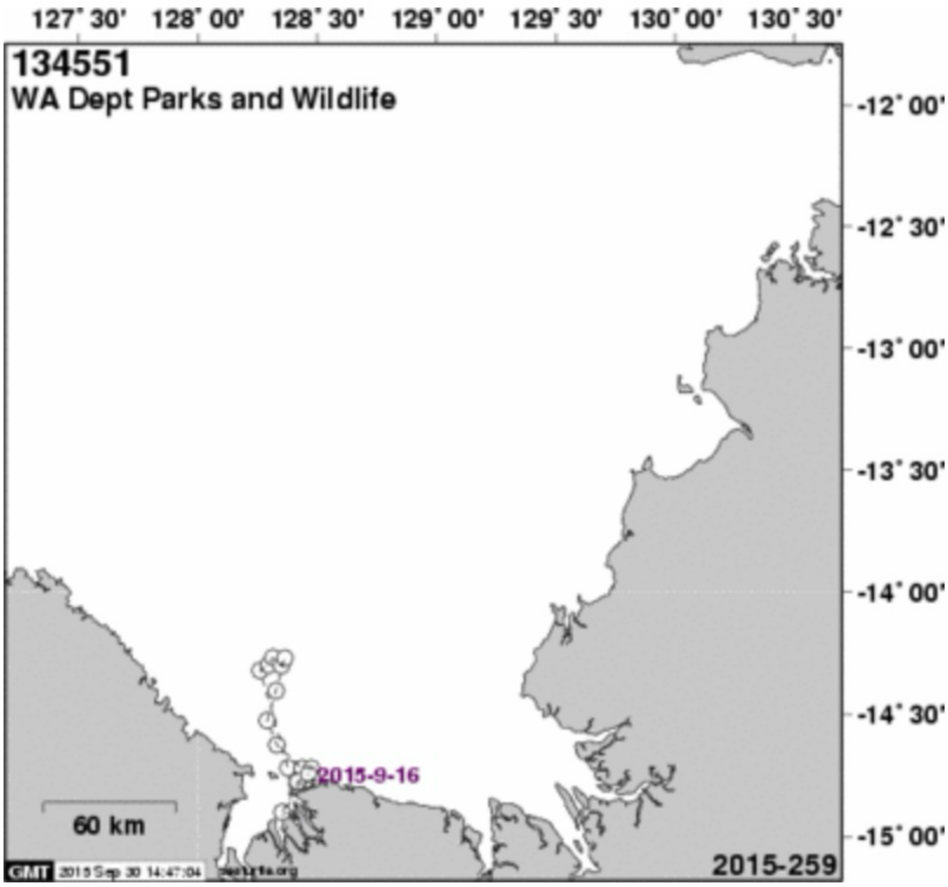
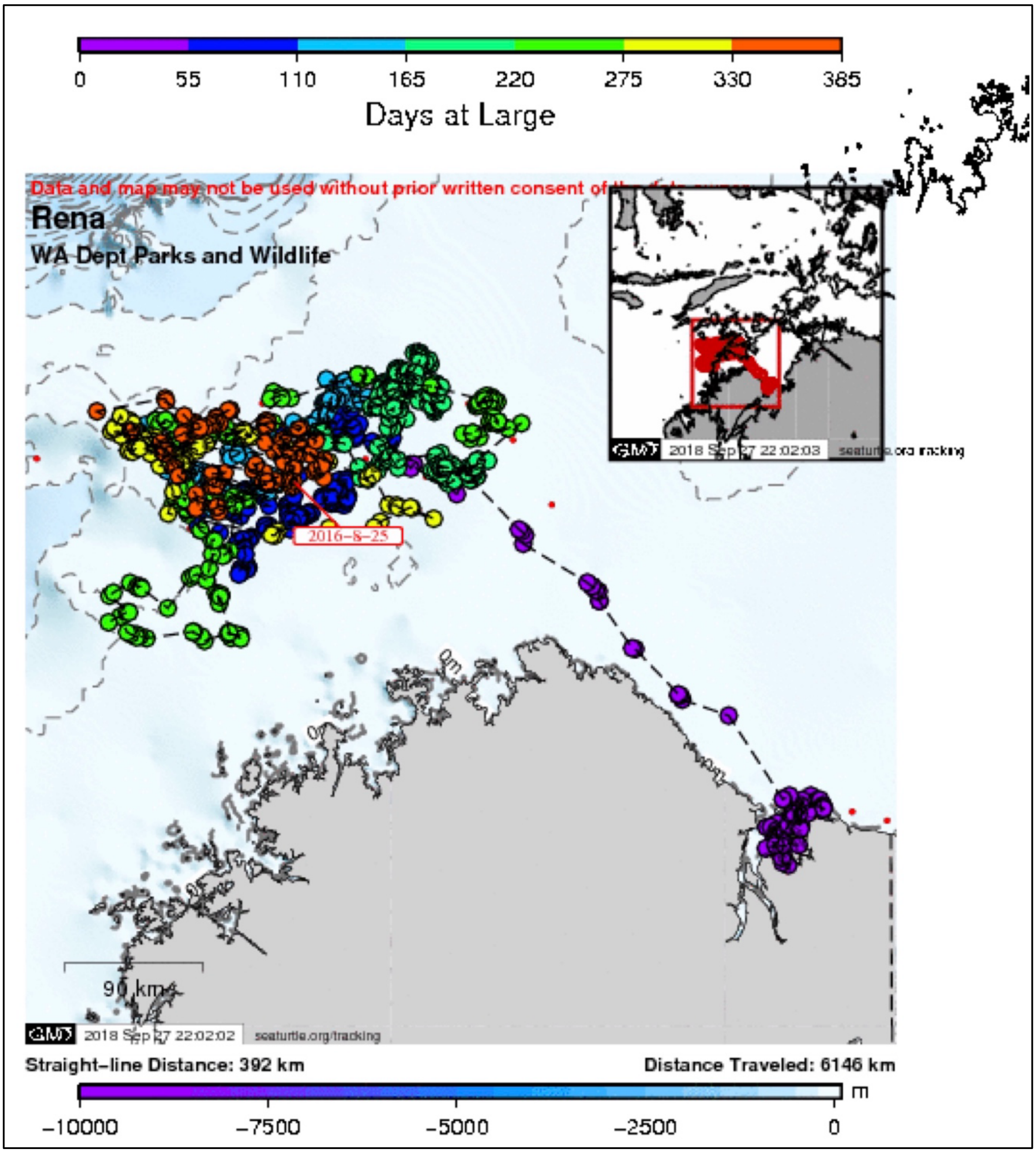


Brooke (Flatback Turtle) is 15 km NW off the coast of Australia and 640 km from Darwin

Rena

Released 8 Aug 2015. Appears to have entered CG - far east side only (False Mouths of Ord) (map not clear).



Rena - Cape Domett flatbacks

A project of **WA Dept Parks and Wildlife**.

Static Map | Zoom Map | **Animated Map**

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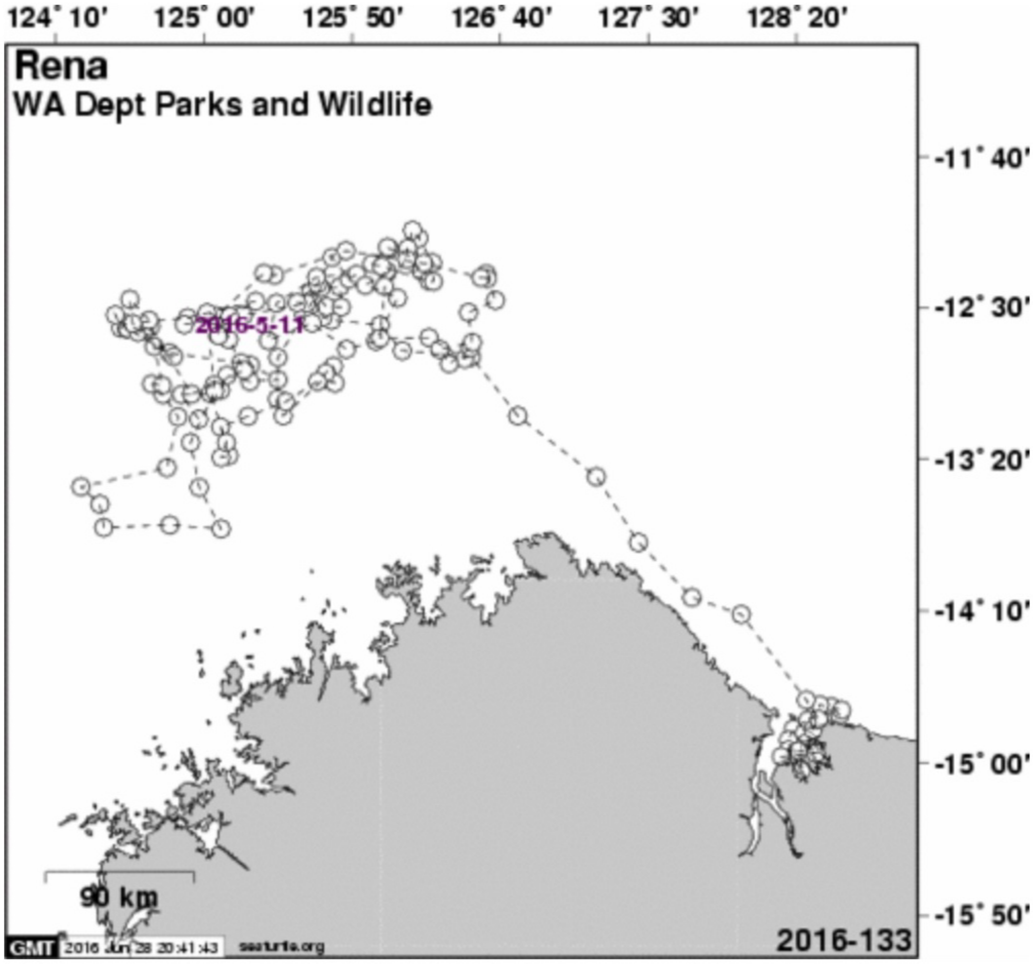
Last 14 Days

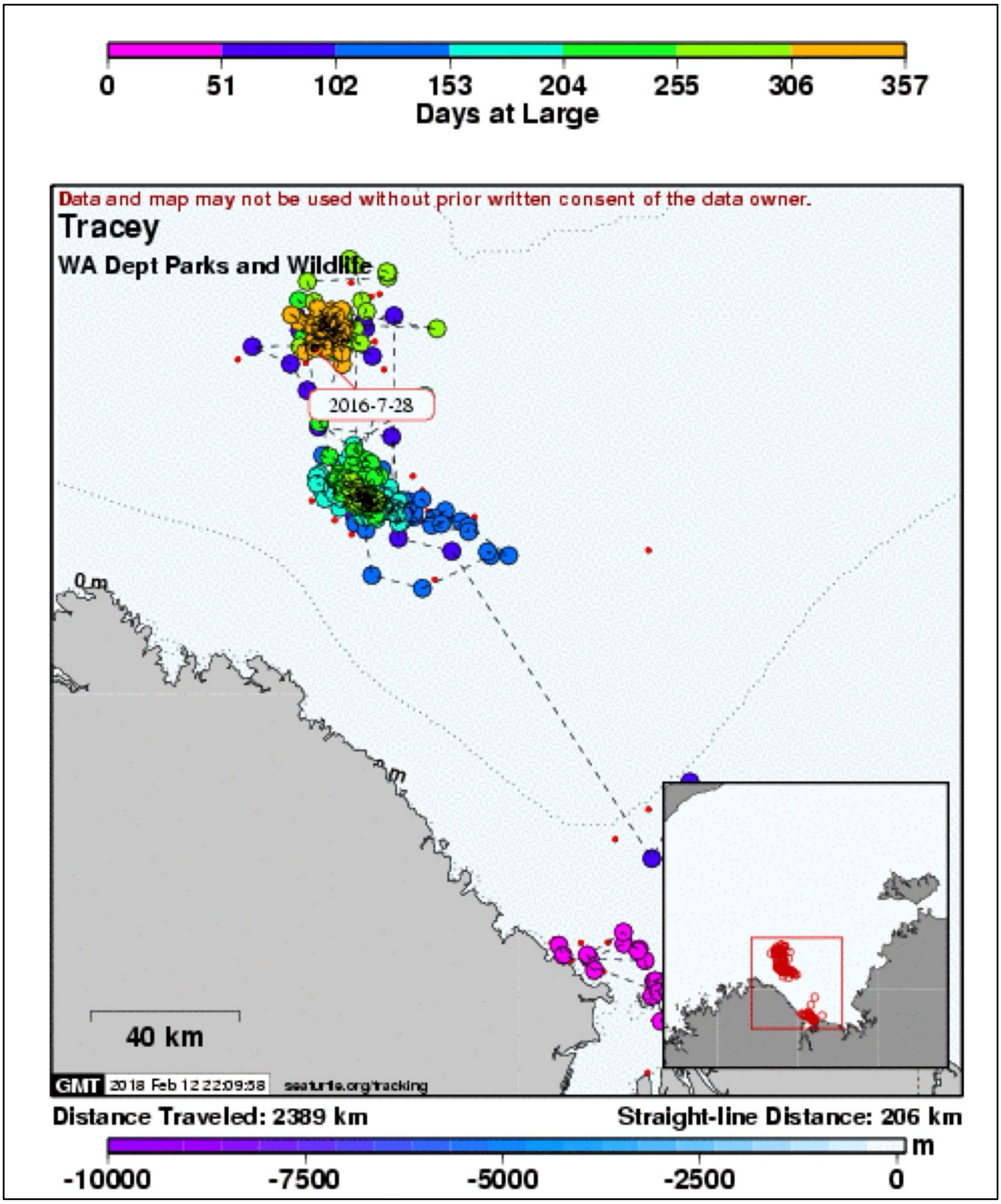
Full Animation 1MB



Rena (Flatback Turtle) is 144 km NW off the coast of Australia and 339 km from Kupang

Tracey

Released 8 Aug 2015. Did not enter CG.



Tracey - Cape Domett flatbacks

A project of **WA Dept Parks and Wildlife**.

Static Map | Zoom Map | **Animated Map**

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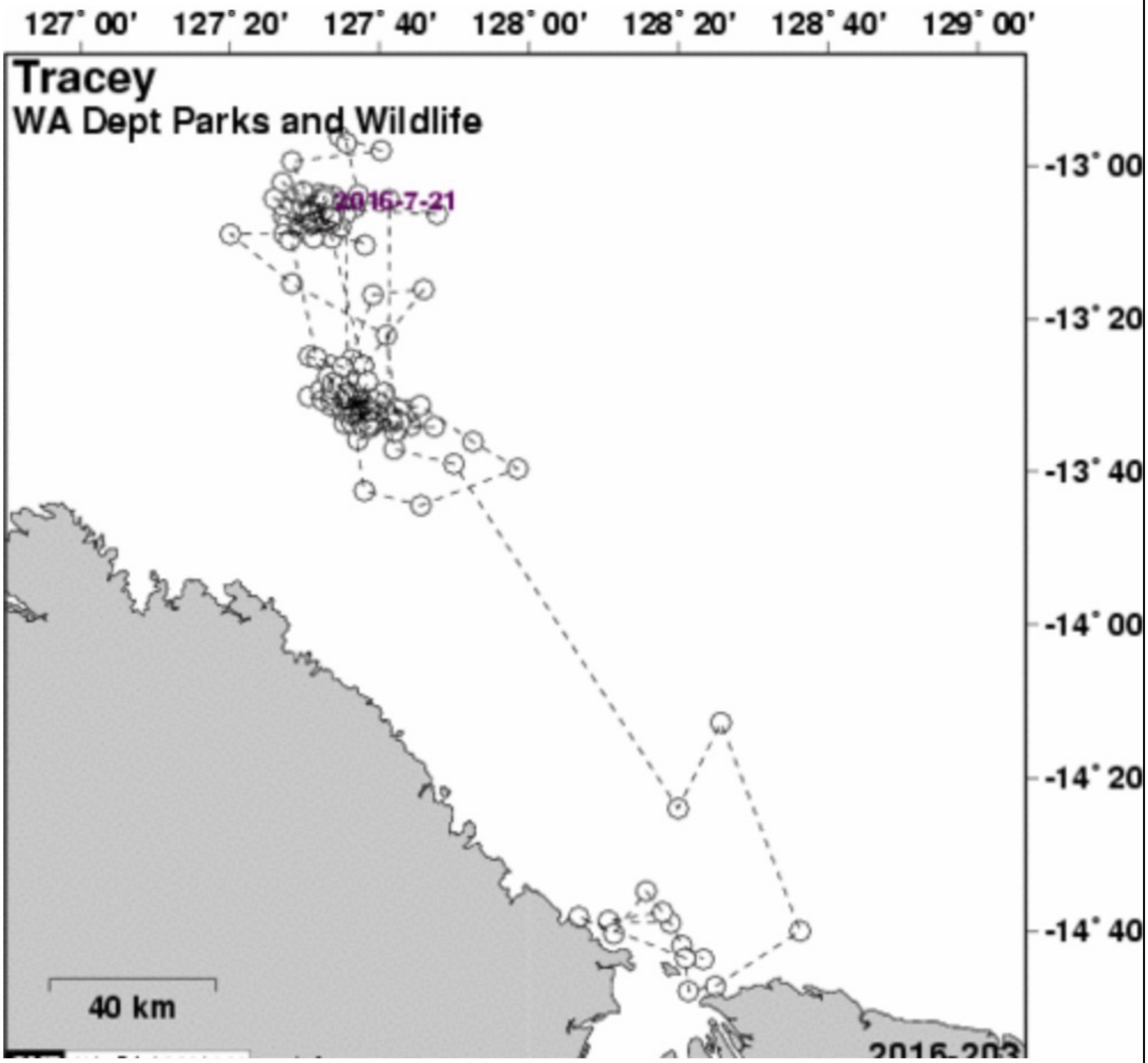
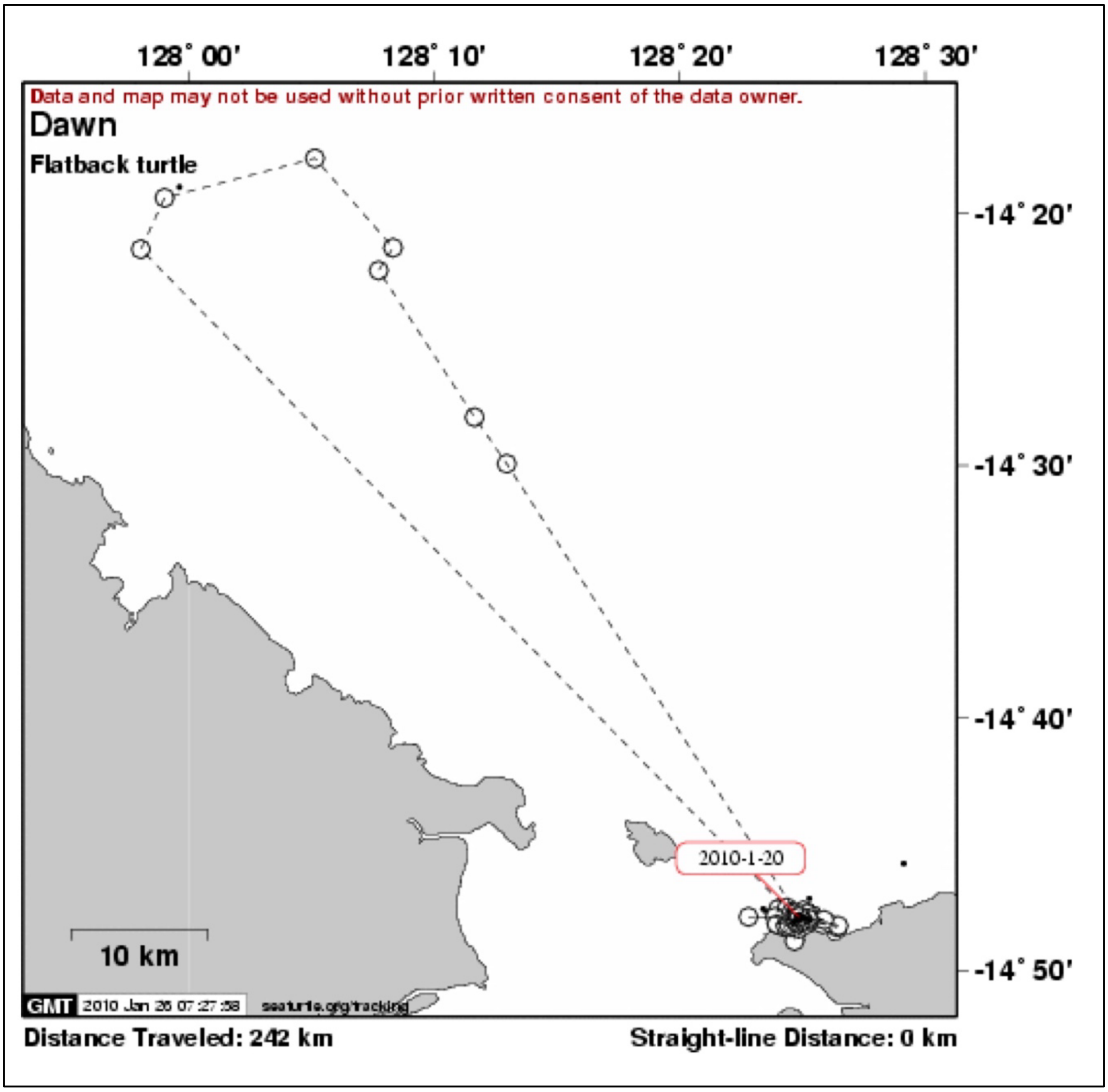
Last 14 Days



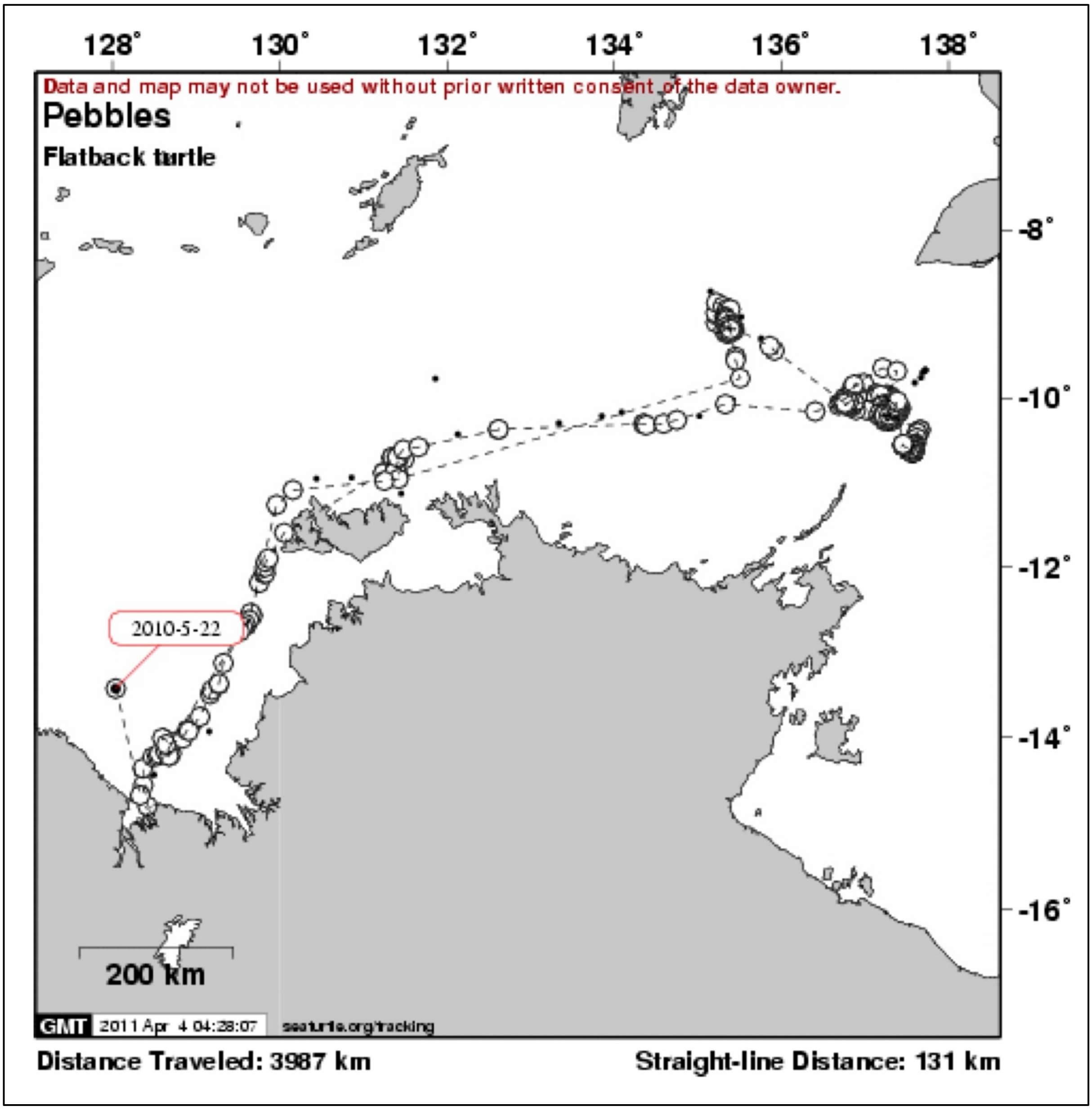
Dawn

Released 24 June 2009. Did not enter CG.



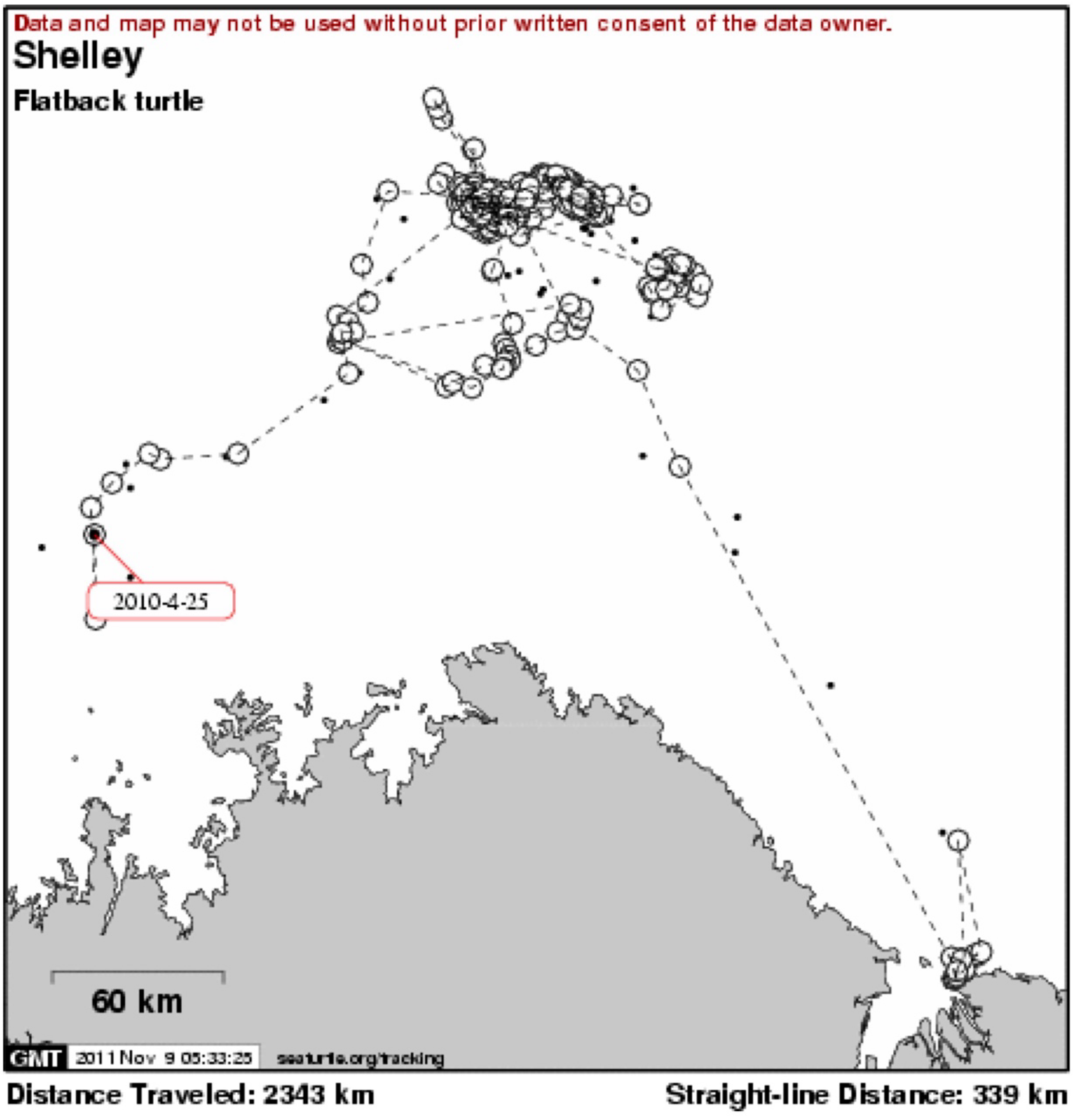
Pebbles

Released 24 June 2009. Did not enter CG.



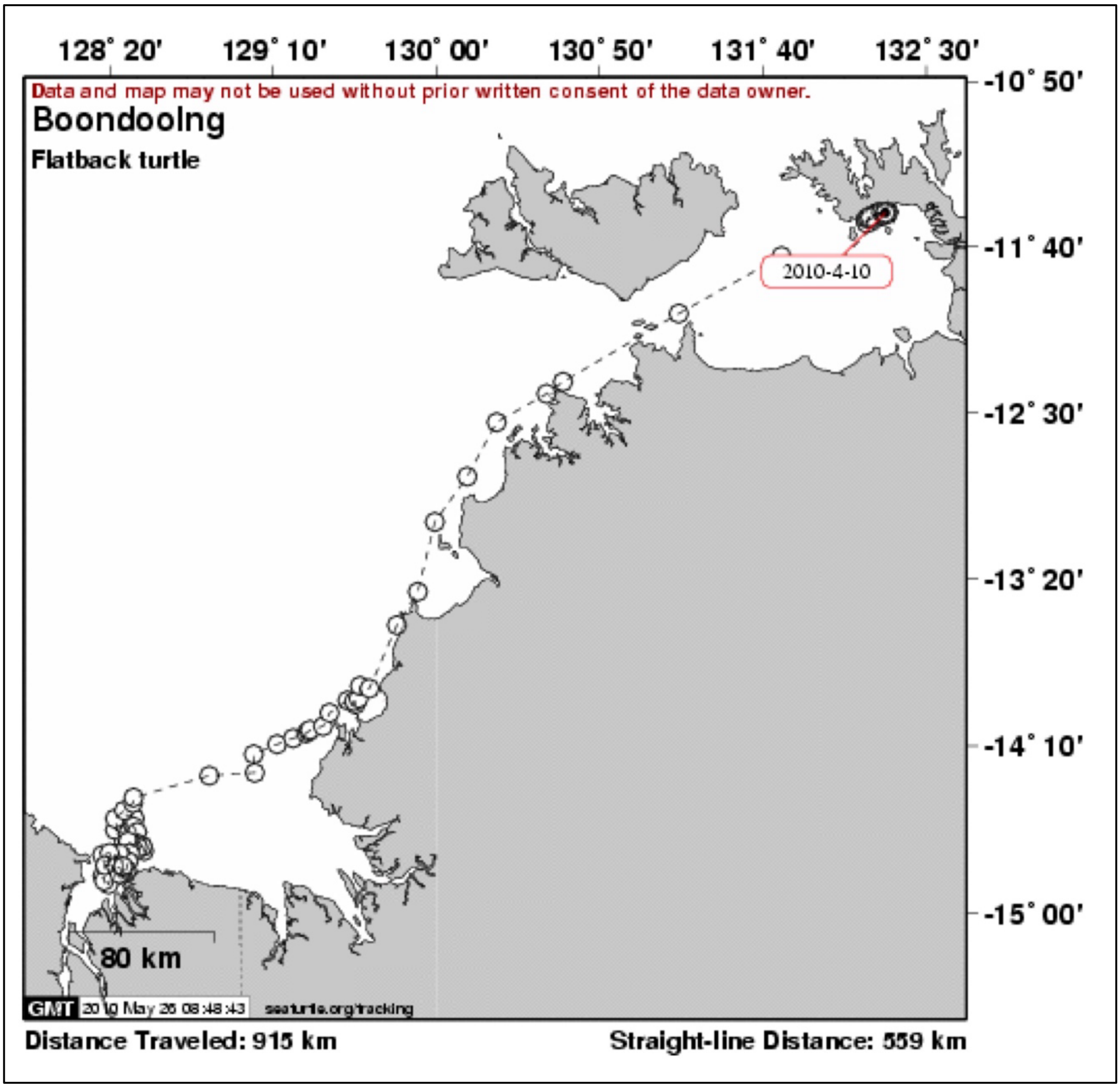
Shelley

Released 24 June 2009. Did not enter CG.



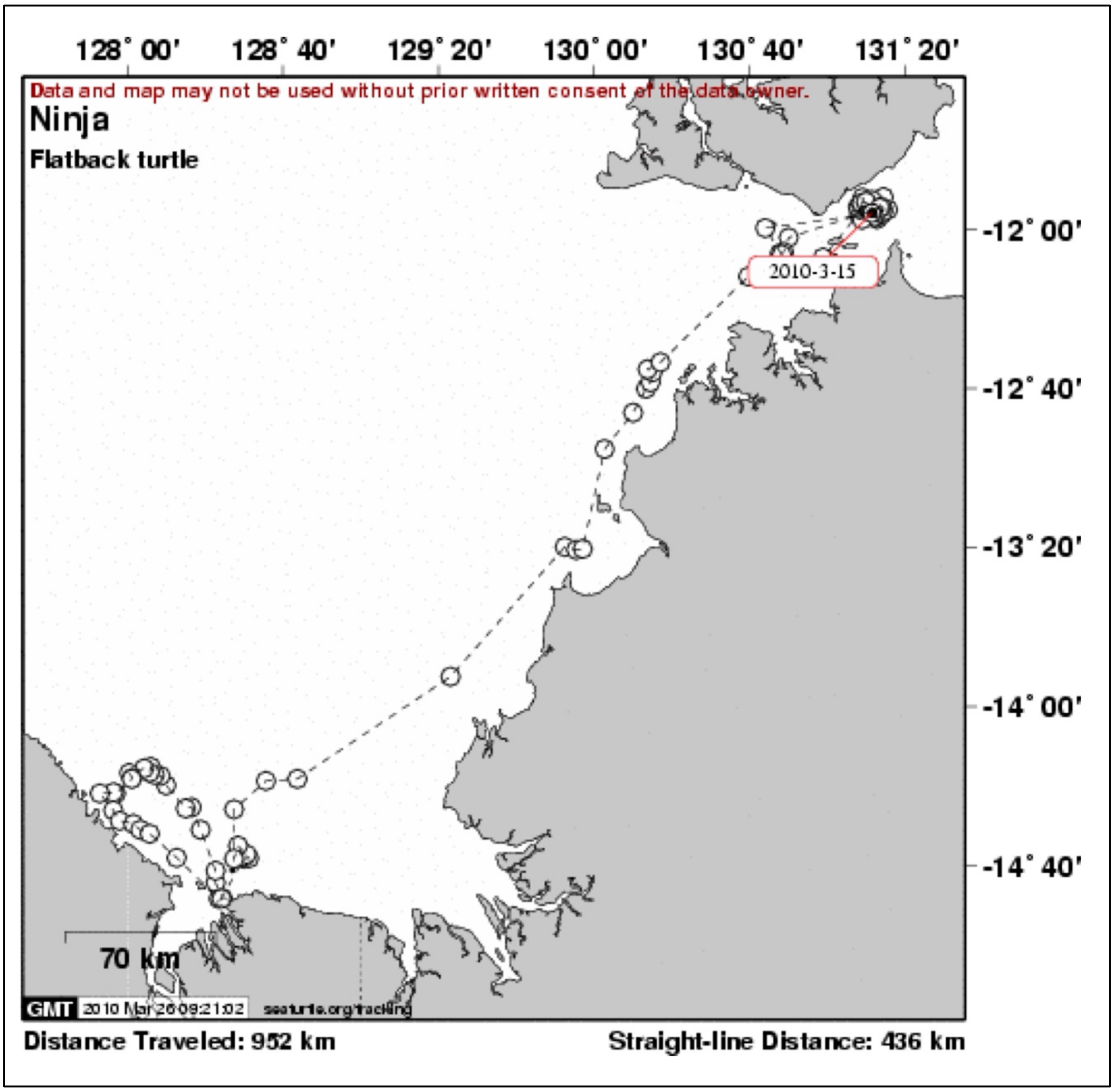
Boondoolng

Released 23 June 2009. May have 'possibly' entered CG - north-east side only (map not clear).



Ninja

Released 23 June 2009. Did not enter CG.

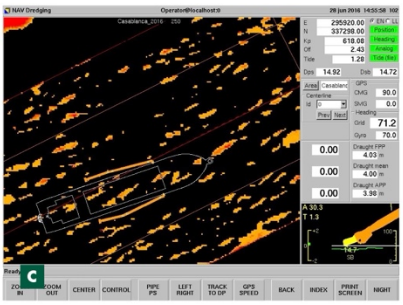


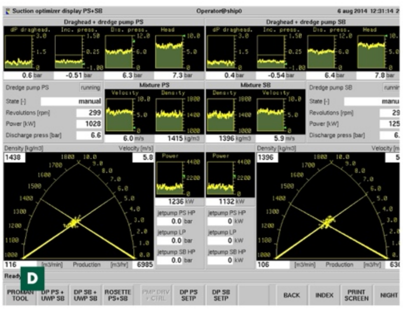
4. BOSKALIS CAPABILITY SHEET - DV HOPPER DREDGER

Boskalis
Dredging & Marine Experts

CAPABILITY SHEET

DV HOPPER DREDGER
TRAILING SUCTION HOPPER DREDGER POSITIONING AND PRODUCTION MODULE





INTEGRATE PRECISE 3D POSITIONING

DV Hopper Dredger is the integrated positioning and dredging production module and is custom-tuned to each Boskalis Trailing Suction Hopper Dredger.

The module integrates precise 3D positioning and project- specific design information, survey results, and dredger production- and status information. Various displays and calculations are available to assist the operator in optimizing the dredge process.

All information can be viewed on independent graphical displays at any display station on board. These real-time displays enable dredging operators to accurately dredge to the required design. During dredging, on-screen bathymetry data are updated in real-time to show project progress between hydrographic surveys.

All process and position parameters are logged at a selected time interval in ASCII format and automatically transferred to shore daily. These parameters include draghead and vessel position (XYZ), and dredge production data. Reports are generated automatically on a production cycle basis.

Boskalis operators are trained to use DV Hopper Dredger in a training simulator at Boskalis head office in the Netherlands.

A DV Hopper Dredger training simulation at the Boskalis premises in the Netherlands
B DV Hopper Dredger suction tube position display
C DV Hopper Dredger Navigation Display
D DV Hopper Dredger dredging process optimizer

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