
Evidence of Marine Turtle nesting near the proposed James Price Point Gas Hub



Survey and report prepared for the Goolarabooloo and Broome Community No Gas Campaign

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Executive Summary

Introduction

- A volunteer community survey was conducted in collaboration with the traditional custodians, the Goolarabooloo, and the Broome Community No Gas Campaign to investigate marine turtle nesting along the coastline near the proposed Browse Liquefied Natural Gas (LNG) Precinct as it was perceived that the surveys conducted for the environmental impact assessment were inadequate.
- There are six species of marine turtle that occur in WA, all are listed as rare or likely to become extinct (WA Wildlife Conservation Act 1950), as vulnerable or endangered nationally (EPBC Act 1999) and as endangered or critically endangered internationally (IUCN red list).),
- Little is known about turtle populations or important nesting habitat in the Kimberley due to a lack of surveys.

Results

- 14 nests and 38 false crawls were found from Flatback, Hawksbill and Green turtles, with all nests and most false crawls occurring in a 6 km strip between Walmadan and the Gully. This stretch of coastline was exactly where Goolarabooloo elders forecast that all nesting would occur.
- Exhumations showed that nest egg numbers and success rates varied greatly, however, 6 out of 8 nests had over 42 % of hatchlings successfully exit.
- Photographs of one laying mother were sent away to confirm the species as being Hawksbill. Three turtle experts agreed that the markings suggest it is a hybrid Hawksbill, potentially with an Olive Ridley. DNA samples have been sent away for genetic analysis.

Discussion

- Density of nests in the 6 km nesting area are lower than the average nest density from two monitored beaches near Broome, however, the study area is unique for occurrence of Hawksbill nests, a species thought to rarely nest in the Kimberley.
- The 14 nests and 38 false crawls greatly differs from the 1 nest and 3 false crawls previously found in the same area by RPS (2010a, 2011) as part of the environmental impact assessment for the Browse LNG Precinct.
- The confirmation of nesting hawksbill/hybrid turtles is important as it is rare for them to nest in the Kimberley. If the species is a hybrid, it will represent the first recorded Hawksbill hybrid in Australia.
- The difference in results is most probably due to variations in study design:
- The RPS study only surveyed areas assessed by the scientists as ‘potential nesting beaches’, thus restricting their spatial sampling greatly and overlooking the 6 km stretch where all nesting activity was found in this study. In comparison, this study surveyed all non-rocky coastline, letting the turtles define what was appropriate nesting habitat.
- The RPS study sampled for a week in the middle of each month. This infrequent temporal replication is problematic as if the turtle nesting behaviour is linked to the spring-neap tidal cycle as has been observed elsewhere, then the nesting behaviour estimate would be biased. In comparison this study sampled most transects roughly every second day, with the less frequent transect sampled weekly.

- The differences in results is not due to inter-annual variation in nesting behaviour as if our dataset is restricted to similar spatial and temporal sampling as the RPS study, then similar results are found for the 2010/2011 nesting season compared to the 2009/2010 season examined by RPS
- It can therefore be concluded that the study design of the RPS surveys conducted for the impact assessment were vastly inadequate in describing the importance of the area to marine turtle nesting.
- The proposed LNG precinct will significantly impact the 12km stretch of coastline adjacent to the precinct and pipelines due to the building and maintenance of the marine facilities and the excavation and laying of the pipelines.
- Unfortunately, this high impact area coincides directly with the prime nesting habitat, meaning that much of the nesting habitat will be removed or seriously altered.
- Those turtles nesting on beaches not directly impacted by the marine facility or pipelines, will be exposed to increased ship movement, dredging, light pollution and noise pollution, all shown to decrease nesting behaviour and survival.
- Although some of these impacts can be managed, the close proximity, cumulative stressors and loss of nesting habitat will most likely cause a significant impact to local nesting behaviour and individual survivorship.
- Due to the impact of cumulative stressors and the species' extensive migrations, all nesting populations within Western Australia are considered significant because of their contribution to the conservation of the species (EPA 2010).
- The nesting population of James Price Point is all the more significant in the region due to the inclusion of nesting Hawksbill turtles or a hybrid thereof.
- The likely and significant impacts from the Browse LNG Precinct on this significant population must be considered seriously as the Kimberley's marine turtle population is recognised as being of global significance (EPA 2010).

Recommendations

- Due to the inadequacies of the nesting surveys conducted for the environmental impact assessment of the Browse LNG Precinct, all marine turtle studies informing the Strategic Assessment Report (SAR) should be peer reviewed by independent experts.

Introduction

Project Background

The West Australian Department of State Development is currently seeking environmental approval for the Browse Liquefied Natural Gas (LNG) Precinct to be constructed at James Price Point, traditionally known as Walmadan, 50 km north of Broome on the Dampier Peninsula in the Kimberley. The Browse LNG Development is the first project proposed for the precinct and is a joint venture between Woodside, Shell, Chevron, BP and BHP Billiton. The Browse LNG Precinct is a multi-user hub for processing oil and gas piped from the Browse Basin. Additionally, the West Australian Premier, Colin Barnett, has expressed interest in placing two other projects at the 35 km² LNG precinct (Taylor & Perpetch 2011). These additional projects are not covered by the current environmental impact assessment. Consequently, the accumulative impact of the proposed Browse LNG Precinct and additional projects will be much larger in the long term than is currently identified.

Walmadan and the broader Dampier Peninsula has important natural, cultural and social values, including ancient and contemporary indigenous heritage, palaeontology sites of significance, high ecological diversity and importance to the local Broome community. As part of the environmental impact assessment process, the WA state government and lead joint venture partner Woodside, commissioned fauna studies to assess the ecological values of the area and the degree of impact that would result from the proposed development. Two commissioned studies have specifically examined the area's value for marine turtles (RPS 2010a; RPS 2011), whilst two broader focused studies recorded opportunistic sightings (Biota 2009; RPS 2010b). These studies concluded very little turtle nesting occurs in the area, a conclusion that is in contradiction to local indigenous knowledge. As a result, the traditional custodians, the Goolarabooloo, and the Broome Community No Gas Campaign felt that these surveys were vastly inadequate. Consequently, a community survey was conducted in collaboration with these communities to investigate the nesting activities of marine turtles near the proposed Browse LNG Precinct. This project was largely unfunded and all participants contributed their time voluntarily.

Marine Turtles

There are six species of marine turtle that occur in northern Western Australia: the Green sea turtle (*Chelonia mydas*), Flatback (*Natator depressus*), Hawksbill (*Eretmochelys imbricata*), Loggerhead (*Caretta caretta*), Leatherback (*Dermochelys coriacea*) and Olive Ridley (*Lepidochelys olivacea*) (DEWHA, 2011). All these species are listed as rare or likely to become extinct (WA Wildlife Conservation Act 1950). Nationally these species are migratory and listed as vulnerable under the *Environmental Protection of Biodiversity and Conservation (EPBC) Act 1999*, with the exceptions of the Loggerhead and Olive Ridley which are listed as Endangered. Of these six species, only Green and Flatback turtles have been recorded to nest in significant numbers in the Kimberley region (DEWHA 2011; Prince 1994). However, there have been few surveys in the region to accurately quantify the actual distribution and abundance of turtles. Furthermore there are no known long term studies on populations and few dedicated ecological studies of habitat use (RPS 2010a). Given the paucity of information on marine turtle ecology in the Kimberley and the threatened nature of all the species, it is vital that thorough and adequate surveys document the level of importance of the

James Price Point area and the magnitude of the impacts that would occur from the proposed LNG precinct before it is given environmental approval.

This study aims to describe nesting behaviour of marine turtles along the coastline adjacent to the proposed Browse LNG Precinct utilising frequent and extensive transects, and nest exhumations to estimate hatching success rate. The results will be compared to surveys carried out on behalf of the proponents of the proposed LNG precinct to assess their adequacy. The survey will involve and be informed by two senior Goolarabooloo elders (Phillip Roe and Richard Hunter) who have a very intimate cultural and ecological knowledge of the area and the target species.

Methods

Transects

James Price Point is located 50 km north of Broome on the Dampier Peninsula, Western Australia. Transects were conducted from the 7th of October 2011 to the 11th of Jan 2012 to the north and south of James Price Point, encompassing the coastline adjacent to the Browse LNG Precinct (Figure 1). The northern section comprised 2 transect lengths: A 6 km short transect from Walmadan to the Gully (Figure 1: NTS) was sampled every second day, whilst the longer 12 km transect between Walmadan and Flat Rock (NTL) was sampled once a week. The southern section was split into 2 transects: 4.5 km from Walmadan to Kundundu (ST1) and 2 km from Murdudun to Quondong point (ST2), both sampled every second day. The time taken to patrol transects varied due to the numbers of turtle activity encountered and length of transect. Although both Phillip Roe and Richard Hunter advised us that the vast majority of nesting would occur between Walmadan and the Gully (NTS) and that it was a waste of time searching the other transects, all transects were sampled to get extensive coverage. The surveys recorded nest and false crawl activity, GPS location, track pattern and width. Species identification was done using a photographic guide showing species specific track patterns and track widths. Photos were taken of tracks and nests, and where sighted, of the nesting animal itself (Appendix A). Photos of the animals were passed onto experts to get a positive identification. Turtle behaviour recorded outside the transects or sampling period were recorded separately.

Nest Exhumations

Exhumations of nests were carried out at least 65 days after a nest was identified to ensure all hatching had occurred as Flatbacks average 53 days in development (Limpus 2007) and Hawksbills average 58 days (Limpus 2009). Previously recorded sites were located by GPS position, whilst new unrecorded nests were impressively identified by Phillip Roe during ghte exhumation excursion using his traditional knowledge. Egg size, egg condition, nest depth and the number of hatched eggs, unhatched eggs and dead hatchlings were recorded. The percentage of hatchlings to have successfully exited the nest was calculated as the number of hatched eggs minus the number of dead hatchlings found. Some dead hatchlings and eggs were collected and sent for DNA analysis to determine species. Exhumations were requested by Bob Prince (DEC), and lead by Goolarabooloo elder Phillip Roe. DEC turtle watching code of conduct was strictly adhered to throughout the entire survey. When flash photography was used to record an animal it was used with a long lens from a significant distance and only during low disturbance periods of nesting.

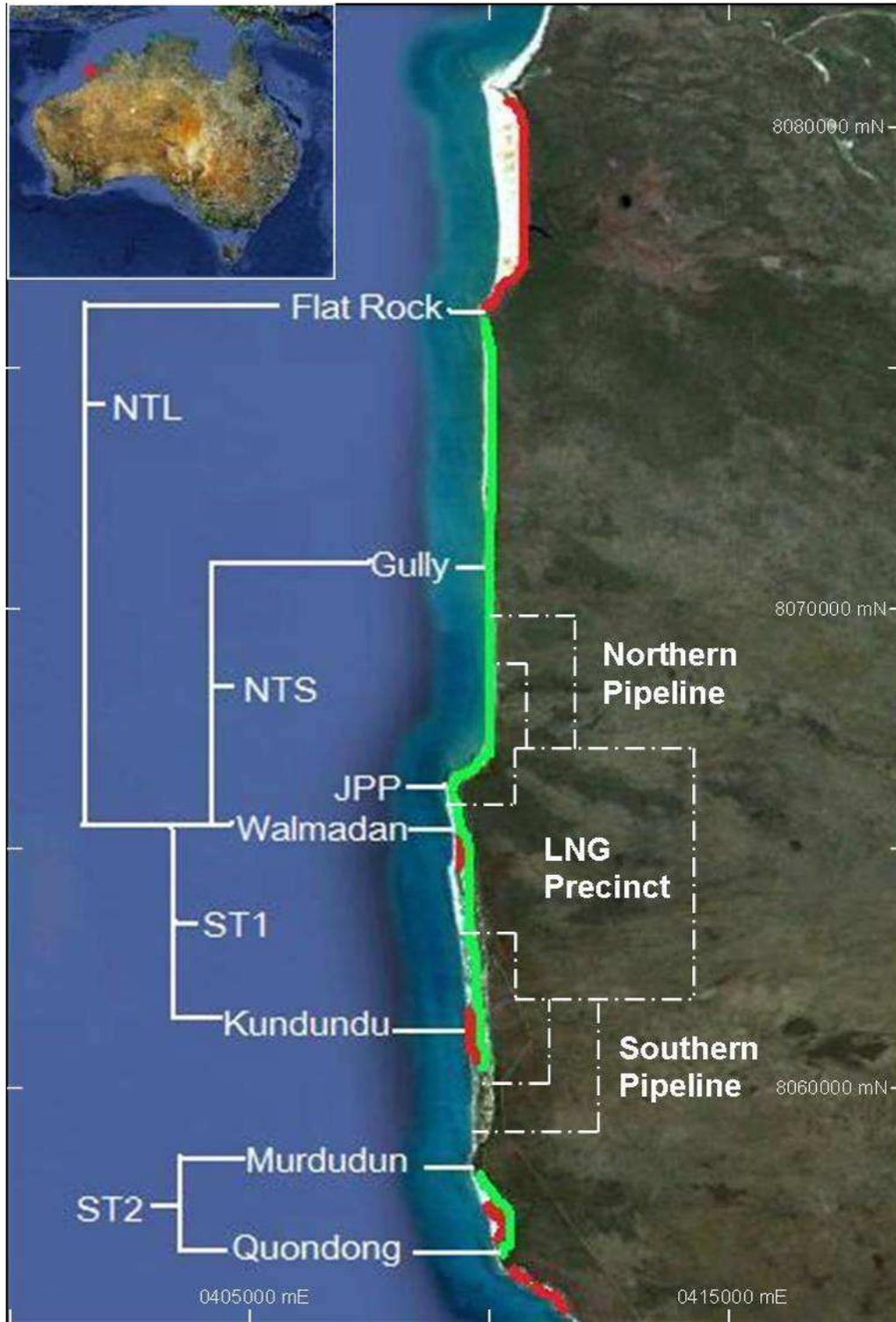


Figure 1. Site map and location names of the James Price Point (JPP) area. Coloured sections of coastline indicate sections surveyed for turtle nesting during this study (green) and those by RPS (red: 2010a; 2011). This study divided the area into four different transects: NTL North Transect Long, NTS North Transect Short, ST1 South Transect 1 and ST2 South Transect 2. Overlaid on the land is the proposed site of the Browse LNG Precinct and pipelines (DSD 2010). Grid lines represent UTM 51K and image is sourced from Google Earth.

Results

A total of 14 nests were found during the study: 11 during the transects and a further 3 nests found by Phillip Roe during the exhumation excursions (Table 1). Of the 14 nests, 5 were believed to be from Hawksbill, 6 from Flatback and a further 3 were unidentified.

Additionally, 38 false crawls were observed, 18 by Hawksbill turtles, 16 by Flatback, 3 by Green and 1 from an unidentified species.

Over the total 16.5 km surveyed, nests occurred at a density of 0.9 per km and false crawls at 2.3 per km. However, all the nests and the majority of false crawls occurred between Walmadan and the Gully (Figure 2) where Phillip Roe and Richard Hunter proposed they would occur. Therefore, in this 6 km stretch of coastline nests occurred at a density of 2.6 per km and false crawls at a density of 7.4 per km.

A total of 8 nests were exhumed, 5 identified during the transects and 3 during the exhumation excursions (Table 1). Egg number varied greatly between 8 and 146 per nest, with 1.4 % to 100 % of hatchlings having successfully exited the nest. However, 6 out of 8 nests had over 42 % of hatchlings successfully exit the nest.

At nest NN11, a suspected Hawksbill turtle was observed and photographed while laying her eggs. These photographs were sent to experts to confirm the species, as it is rare to see Hawksbill's nesting in the Kimberley. Three experts (Dr. Bob Prince WA DEC; Dr. Col Limpus QLD DERM; Teri Shore TIRN) agree that the markings suggest a hybrid species of a Hawksbill and potentially Olive Ridley turtle (Appendix A). To confirm this hypothesis, tissue samples from nest NN11 and NN12 have been sent away for DNA testing with the results pending.

Table 1. Nests found during Transects (07/10/11 - 12/11/11) and Exhumation process (08/01/12 - 11/01/12). Species: HB = Hawksbill, FB = Flatback.

Nest #	Date – Found	Easting (m 51K)	Northing (m 51K)	Track Width (cm)	Species	Date - Exhumed	# Eggs	Hatched Eggs	Unhatched Eggs	Dead Hatchlings	% Exited
NN11	7/10/2011	409904	8067330	-	HB	8/01/2012	144	2	142	0	1.4
NN1	13/10/2011	409891	8067314	80	FB	-	-	-	-	-	-
NN2	21/10/2011	409150	8065366	72	HB	11/01/2012	13	13	0	0	100
NN3	23/10/2011	409881	8070409	104	FB	-	-	-	-	-	-
NN4	25/10/2011	409981	8068492	69	FB	-	-	-	-	-	-
NN5	29/10/2011	409361	8066504	82	FB	8/01/2012	112	47	65	0	42
NN6	29/10/2011	409105	8065637	75	HB	11/01/2012	8	8	0	0	100
NN7	2/11/2011	409920	8067534	77	HB	-	-	-	-	-	-
NN8	3/11/2011	409118	8065561	62	HB	11/01/2012	14	14	0	0	100
NN9	6/11/2011	409958	8069682	105	FB	-	-	-	-	-	-
NN10	12/11/2011	409969	8069309	90	FB	-	-	-	-	-	-
NN12	8/01/2012	409884	8067294	-	Unid.	8/01/2012	146	91	55	15	52.1
NN13	11/01/2012	409096	8065670	-	Unid.	11/01/2012	74	0	74	0	0
NN14	11/02/2012	409106	8065639	-	Unid.	11/01/2012	106	94	12	0	89

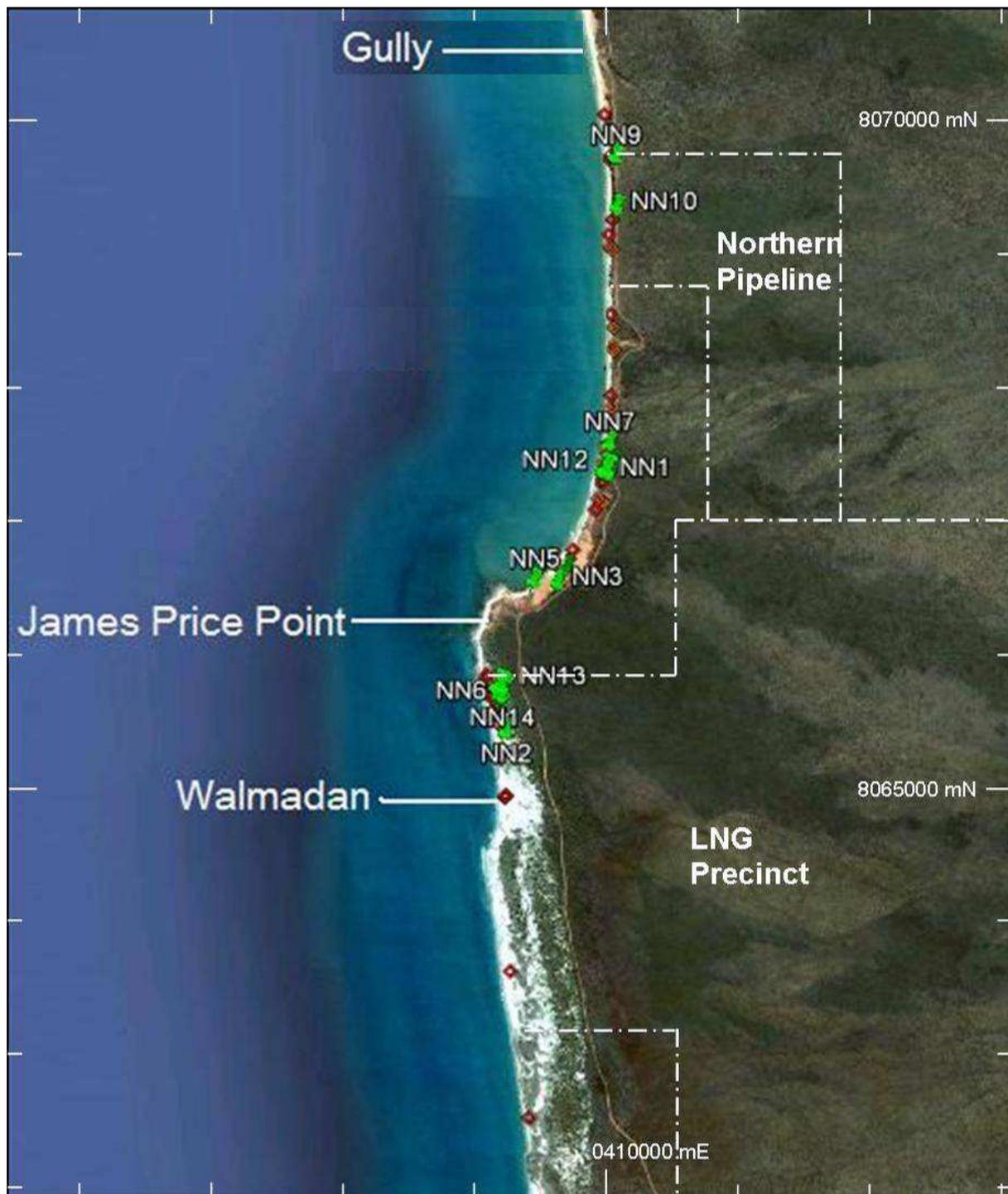


Figure 2. Locations of all the 14 nests (green pin) and 38 false crawls (red diamond) observed near the James Price Point LNG Precinct. Nest labels correspond to information in Table 1, note that some labels are obscured by others. Overlaid on the land is the proposed site of the Browse LNG Precinct and Northern Pipeline (DSD 2010). Grid lines represent 1km (UTM 51K) and image is sourced from Google Earth.

Discussion

Comparison with other studies

The 14 nests and 38 false crawls observed in this study near James Price Point over the 2011/2012 nesting season are much higher in number than the previously recorded 1 nest and 3 false crawls found during the year long (2009/2010) marine turtle survey conducted by RPS in the same area (2010a; 2011). The Walmadan to Gully section of nesting beach had a nest density of 2.6 per km, lower than the average 6.17 per km density at Cable beach near Broome (RPS 2010a) and the average 5.8 per km at Eco Beach to the south of Broome (McFarlane 2010). However, the nesting beach near James Price Point is unique in comprising nesting behaviour of Flatback, Green and Hawksbill/hybrid turtles, a diversity not identified in the past studies from the area (RPS 2010a; 2011). The Hawksbill turtle had not been expected to nest along any of the beaches on the Dampier Peninsula or the Kimberley (Limpus 2009), however, this may be due more to a lack of thorough surveys than actual distribution. Given the Hawksbill turtle is listed as critically endangered internationally (IUCN), any areas that support nesting of the Hawksbill are of great significance. Hybridisation of Hawksbill turtles has been observed internationally (Lara-Ruiz *et al.* 2006), however this represents the first record from Australia. Hybridisation may occur due to populations being under pressure from anthropogenic stressors or may occur naturally with resultant sterility or, as in this case, the successful hatching of eggs (Lara-Ruiz *et al.* 2006).

The differences in the results of our study and RPS (2010a; 2011) for the James Price Point region is most likely due to differences in study design, such as the extent of coastline that was surveyed. RPS (2010a) perceived much of the coastline to be unsuitable due to inundation and limited their survey to 6 areas deemed 'potential nesting beaches' (Figure 1) based on cursory observations of nesting activity, dune topography, beach slope, evidence of tidal inundation and barriers to beach approach (RPS 2010a). Strangely, one of these human defined 'potential nesting beaches' did not extend to incorporate a site where nesting behaviour had been previously observed in a terrestrial fauna survey (Biota 2009). In contrast, our survey focused on all non-rocky parts of the coastline, letting the turtles define what is appropriate nesting habitat. As a consequence of these different approaches, RPS surveyed a total of 29 % (8.7 km) of the 30 km study coastline, with a lesser 21% (6.4 km) more frequently surveyed (RPS 2010a; 2011). In contrast, our more comprehensive study covered 61.3 % (18.4 km), with 41.7 % (12 km) surveyed more frequently. More worrying is the extent of surveys conducted along the 12 km of coastline directly adjacent to the proposed LNG precinct and pipelines (Figure 1) which are at high risk of heavy impact from the marine facilities and pipeline excavation process. RPS surveyed only 14 % (1.6 km) of this high risk coastline in contrast to 83 % (9.96 km) surveyed in our study. With such differences in spatial coverage it is not surprising that our results differ greatly from those of RPS.

The most striking difference in spatial coverage is that the surveys conducted by RPS did not cover the important nesting habitat identified between Walmadan and the Gully. This area was correctly forecast by two traditional elders as the main area of turtle nesting, highlighting the importance and accuracy of traditional ecological knowledge. This stretch of coastline comprises moderately sized beaches of white sand, black sand and pebbly beach habitat, sandwiched between offshore reef patches and large pindan cliffs. This is not considered ideal nesting beach habitat by humans (see Appendix A), yet the turtles regularly choose this area to nest over more idealised wide sandy beaches nearby (e.g. north of Flat Rock). It would be presumed that egg survivorship along this stretch of coastline will be low due to

inundation, yet the percentage of hatchlings that successfully exited the nests was above 42 % in 6 out of the 8 nests exhumed. This suggests that great care should be taken when restricting sampling areas based on human presumptions.

The second major difference in study design between our study and that of RPS is the extent of temporal replication. RPS surveyed 'potential nesting beaches' for 1 to 7 successive days depending on the site, in the middle of every month (13th-23rd) throughout the year (2010a; 2011). This concentrated monthly sampling is problematic as turtle nesting behaviour has been shown to vary with spring-neap tidal oscillations (Islam 2002; Girondot *et al.* 2006). If this tidally linked behaviour is occurring at James Price Point, then nesting behaviour will be varying fortnightly. As monthly surveys are at roughly twice the period of the spring-neap tidal oscillation, each sample will be taken at a similar point in the oscillation of nesting behaviour giving a biased estimate. Similarly, according to local traditional knowledge, turtles prefer to nest on cloudy days (Phillip Roe and Richard Hunter), providing another source of potential bias to an infrequently sampled study. Our samples were taken every two days (except NTL which was sampled every week), providing a much better sampling frequency of potential fortnightly oscillations in behaviour, cloud cover, or for that matter, any other low frequency periodicity in behaviour.

Although differences occur in spatial and temporal replication between the two studies, the different results could be in part due to inter-annual variation in nesting behaviour. If our results are merely due to a good 2011/2012 nesting season, theoretically, the RPS study design replicated during this period would have also recorded higher nesting behaviour. This can be tested by restricting our data set to match the spatial and temporal scales of the RPS study. If our sampling was restricted to the RPS transects (ignoring the northern and southern most RPS transects (Figure 1) for which we did not sample and RPS found no activity) but maintaining our more frequent temporal sampling, then only 3 false crawls would have been observed. If our sampling was restricted to only the 13th-22nd of every month from which RPS sampled during the nesting season, but maintaining all our spatial transects, we would have only observed 3 nests and 12 false crawls. If we were restricted to both RPS' transects and sampling timing we would have only found 2 false crawls, a result very similar to that found by RPS in 2010/2011 (RPS 2010a; 2011). Although not a formal test of inter-annual variability, this demonstrates that the low nesting behaviour observed by RPS in 2010/2011 was most likely due to poor and inadequate spatial and temporal replication and therefore failed to accurately describe the importance of the area to marine turtle nesting.

Potential impact from the proposed LNG precinct

The proposed LNG precinct will have a large impact on local nesting habitat. Along the 12 km of coastline directly adjacent to the precinct and pipelines (Figure 1) the nesting beach habitat will be changed dramatically through the construction and maintenance of the port facilities (*i.e.* shipping channel, jetty, loading berths, breakwater, causeway etc.) and the excavation and laying of the two pipelines. Unfortunately, this high impact area encompasses the majority of the high use nesting habitat observed in our study. Consequently, a large portion of the nesting habitat will be removed or severely altered making it unattractive to nesting females. Those turtles nesting on the beach area that will not be directly impacted by the port facilities and pipelines will be exposed to higher ship traffic, dredging, noise pollution and light pollution, stressors that have all been shown to impact nesting behaviour, hatchling survivorship and adult survivorship (Lutcavage *et al.* 1996; Salmon 2003; Pendoley 2005). These impacts will decrease with distance from the precinct and port facility, however,

the preferred nesting habitat is within 3 km of the precinct and therefore at high risk of being impacted. Some of these impacts can be managed to decrease their influence (e.g. light pollution: EPA 2009) while for others it is more difficult due to the nature of the stressor (e.g. ship traffic). Within this close proximity to the impact sources, the cumulative stressors and loss of nesting habitat will most likely cause a significant impact to local nesting behaviour and individual survivorship. As genetic studies have shown a high fidelity of mothers nesting on the beach in which they were laid (Limpus, 2009), the impacted nesting behaviour will reduce the reproductive output of the local Flatback and Hawksbill populations to some degree.

Turtles are a highly threatened group of animals worldwide due to their old age, late sexual maturity, low reproductive output, nesting site fidelity and susceptibility to anthropogenic stressors, earning them international listings as endangered or critically endangered and national listings as vulnerable or endangered. Due to the impact of cumulative stressors and the species' extensive migrations, all nesting populations within Western Australia are considered significant because of their contribution to the conservation of the species (EPA 2010). The nesting population of James Price Point is all the more significant in the region due to the inclusion of Hawksbill turtles. The likely and significant impacts from the Browse LNG Precinct on this significant population must be considered seriously as Kimberley's marine turtle population is recognised as being of global significance (EPA 2010).

Recommendations

Due to the inadequacies of the nesting surveys conducted for the proponents of the Browse LNG Precinct, all marine turtle studies informing the environmental impact assessment and Strategic Assessment Report (SAR) should be peer reviewed by independent experts for their adequacy.

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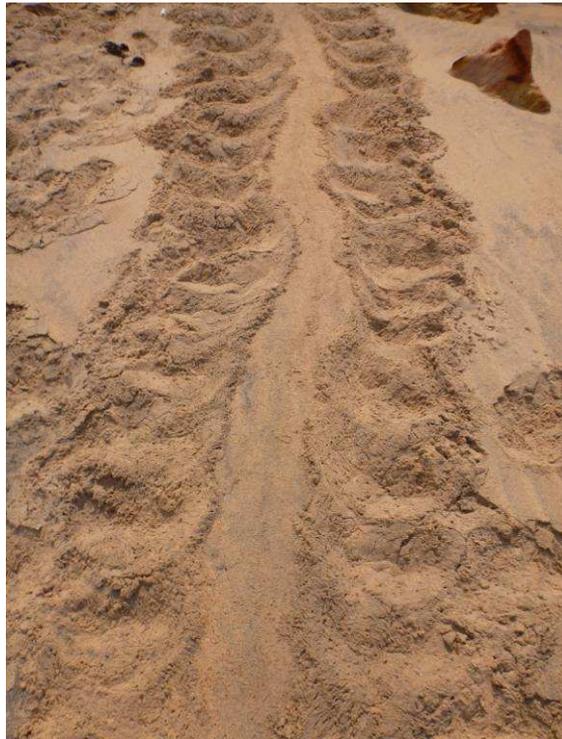
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Appendix A



Hawksbill track. 25/10/11



Flatback track. 19/10/11



The suspected Hawksbill hybrid entering the water after laying at nest NN11. 07/10/2011



The tracks and NN11 nest built up the rubble slope of the pindan cliff. 08/10/2011