

Appendix C

Technical Report Sea Turtles, Dugongs and Seagrasses in the Region of the Blacktip Project prepared by Dr Michael Guinea, Charles Darwin University



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Technical Report
Sea Turtles, Dugongs, and Seagrasses
In the region of the Black Tip Project

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Summary:

A preliminary survey for sea turtle and dugong habitat was conducted along the coastline to the north and south of the proposed pipeline landfall site at Yelcher Beach. The survey consisted of an aerial survey of the beaches and a survey of the intertidal zone seaward of the shoreline on 4 June 2004. Informal interviews were conducted with three traditional owners and their family groups. The Traditional Owners of the country that was surveyed participated in the aerial survey and subsequent land-based survey of the beaches. Sea turtles nesting density was compared with that of Bare Sand Island where flatback sea turtle nesting has been monitored for nine years.

Flatback Sea Turtles nest on Yelcher Beach, the site of the proposed pipeline landfall. Annually it is expected that on this beach there would be some tens of nests, laid by possibly less than 20 individuals. Larger nesting populations of flatback sea turtles occur to the north at Dorcherty Island and to the south at Pearce Point. In each of these two regions it is anticipated that some tens to hundreds of flatback sea turtles nest each year. Olive ridley sea turtles nest along the beaches as well. Although no nests of olive ridley sea turtles were found on Yelcher Beach it is anticipated that they would nest there as well. An olive ridley nest was collected from the neighbouring beach some days prior to this survey.

Dugongs were reported by the traditional owners to frequent the rock flats at Cape Hay on Dorcherty Island, the mouth of the Moyle River and the southern regions of Joseph Bonaparte Gulf. In the region of the pipeline a dugong was shot from a boat some years ago.

Seagrasses were reported from the western side of Dorcherty Island. In addition, in the region seaward of Yelcher Beach, I was told that during the lowest tides of the year the locals have walked to the low tide mark and found long seagrasses about the width of a belt (cf. *Enhalus acoroides*). In amongst these seagrasses are dugong-feeding trails.

The people of the area do not hunt sea turtles or dugongs. They do not kill turtles on the beach. There was no sign of hearths or skeletal material of sea turtles or dugongs at any of the sites surveyed. The traditional owners do not have turtle spears or harpoons and appear to have little experience in capturing turtles. This is in contrast to areas further north in Joseph Bonaparte Gulf.

As sea turtles nest on the beach where the pipeline is due to cross there will need to be special attention to restoration of the beach, its profile and strand vegetation. The beach should retain its functionality as a turtle nesting site. The Sea Rangers of Wadeye appear to be the best choice for conducting the risk abatement and monitoring of sea turtles on Yelcher Beach and neighbouring beaches.

Introduction

Few records exist of sightings of sea turtles and dugongs in the southern regions of the Joseph Bonaparte Gulf. Captain Phillip Parker King sent one of his crew (Mr Roe) ashore on Lacrosse Island on September 16, 1819 to collect sea turtles. King (1827) described the turtle as “one of the hawksbill species that contained fifty eggs”. A clutch size of 50 eggs is more characteristic of a flatback sea turtle than a hawksbill that normally lay more than twice that number of eggs. This journal entry also indicated that the turtle season included September. John Lort Stokes (1846) in 1839 reported a scene of devastation in which hundreds of sea turtles were stranded on the mud flats of Turtle Point, presumably after some catastrophic event. More recently, it has been estimated that up to 1000 flatback turtles nest each year at Cape Dommett (Prince, 1994, IOSEA data base). Nesting track densities have been estimated at more than 100 tracks per km but the species was unidentified and thought to be either flatback or green sea turtle (Chatto, 1998). It is the purpose of this survey to identify the species of sea turtles nesting in the area and the densities of nests in the region of the export pipeline. This is an initial reconnaissance survey which could be the catalyst for future community based programs should this survey identify any nesting sites for sea turtles.

Little is known of the numbers of dugongs and their habitat preferences in the southern regions of the Joseph Bonaparte Gulf. The Port Keats area was excluded by the aerial surveys for marine fauna (Bayliss, 1986). Observations by Whiting (2002) revealed that dugongs fed on macro algae on rocky reefs in tropical Australia. These observations expanded the number of habitats utilised by dugongs. Satellite tracking of dugongs in the Darwin region revealed the some dugongs travel substantial distances. A male travelled from the Vernon Islands north of Darwin into the Joseph Bonaparte Gulf visiting each patch of rocky reef before losing the transmitter at Cape Scott (Whiting 2004). As part of this preliminary survey, all observations on dugongs were to be documented and possible negative interactions recorded.

Methods

Three methods were employed in this preliminary survey of the sea turtles, dugongs and seagrasses of the proposed project area.

1. A regional or large scale survey involved the use of an aerial survey at low altitude in the IMCRA bioregion of Anson and Beagle (No 18). The aerial survey was conducted in the morning of 4 June 2004. The high tide at Fish Reef in the northern part of the survey was 7 metres above datum at 6.26 am and was 8.0 metres at 7.32am at Port Keats in the southern part of the survey area. These survey conditions meant that the beach had been swept clean by the tide the morning of the survey and only tracks from the morning tide were visible during a low altitude aerial survey. The aerial survey in the Port Keats region was conducted during the period of low tide from 11.57 to 13.13 when the tide reached it minimum of 2.7 metres at 13.48. This enabled maximum viewing of the intertidal region for seagrasses. An ideal tide for sighting

dugongs would have been during the rising tide when dugongs could gain access to the intertidal foraging areas.

2. Discussions were held with Traditional Owners of the coastal regions likely to incur an impact by the proposed pipeline. The discussions were facilitated by over 100 photographs of sea turtle related topics. The photographs were based on almost ten years of sea turtle research on Bare Sand Island and include sequences of catching sea turtles from boats and the usual research techniques of measuring, tagging, counting eggs and identification of the various species. Life-sized diagrams of turtle eggs were useful in identifying the species of sea turtles that were present.
3. Beach surveys by foot and vehicle were used in areas where sea turtles had been reported nesting. All nests were identified to species responsible by the tracks of the nesting turtle, the size of the eggs, numbers of the eggs and the morphology of the nest. The location of each nest was recorded with Global Positioning Satellite (GPS) receiver. All foot and vehicle surveys were conducted in the presence of the Traditional Owners.

Results

The aerial survey of the northern areas of the Anson Beagle Bioregion revealed that five sea turtles had nested in the previous evening on Bare Sand Island. This island supports about 500 flatback sea turtle nests each year. Each turtle lays on average three times per season and deposits approximately 50 eggs on each occasion. Using proportions, it is estimated that one track visible from the air at the time of the survey was indicative of approximately 100 turtle nests annually. This is meant as a guide only as the errors associated with this kind of survey and the assumptions about proportionality make the estimates “ball park” figures only and necessitate follow up surveys by either foot or vehicle of the beaches surveyed. Estimates therefore are presented as orders of magnitude such as tens, hundreds etc.

The aerial survey consisted of flying south over Whale Flats and north along the coast line to just north of Cape Dombey. The aircraft then turned southwards and flew approximately 1 km seaward of the shoreline to Fossil Head and then onto Wadeye Airdrome (Figure 1). Only two turtle tracks were seen from the air in the southern Anson Beagle Bioregion. Both were on the western side of Dorcherty Island. Following the above guidelines it is assumed that some hundreds, possibly two hundred flatback turtle nests are laid on Dorcherty Island each year.

Discussions with the Traditional Owners always involved several people including personnel from the Northern Land Council (NLC). The photographs were large enough for several people to view the images at once and this initiated discussions amongst the Traditional Owners in their own language and usually a response in English. Although several people of each group had seen live turtles some were unsure of the identity of the turtles that lay on their beaches until they saw the images of sea turtle eggs. Few had difficulty in identifying the large eggs of the Flatback Sea Turtle (*Natator depressus*) that is known as the Greenback to the Traditional Owners. Some people were familiar with the numerous but small eggs of the Olive Ridley sea turtle (*Lepidochelys olivacea*). All were familiar with turtle tracks and the shape of the sea turtle nests. Few were familiar with the sub-adult green and hawksbill turtles

because few people hunted turtles. Each of the three family groups involved in the survey were eager to share their knowledge of the sea turtles and the localities where they nested.

A total of 23 sea turtle nests were seen during the survey including the two nests seen on Dorcherty Island (Table 1). Two Flatback Sea Turtle nests were on Yelcher Beach in Angus's country, the site of the pipeline landfall. Two nests by the same species were 12.5 km north in Anthony's country on the beach near the old mission. Another two Flatback Sea Turtle nests were located 14.5 km to the south in Cyril's country at Ditchi and another 14 nests were 18.7 km south of the pipeline landfall near Nangu. A single nest belonging to an Olive Ridley Sea Turtle was reported during the survey period 6 km north of the pipeline landfall.

From the discussions there appeared to be little in the way of sea turtle and dugong hunting in the area. This was not because of the lack of animals but rather the skills of hunting had in part been either unused or lost. There was no evidence of fireplaces or hearths where sea turtles had been eaten in the dune country through which the survey passed. The Traditional Owners knew of the dugongs but had not taken part in a hunt for many years.

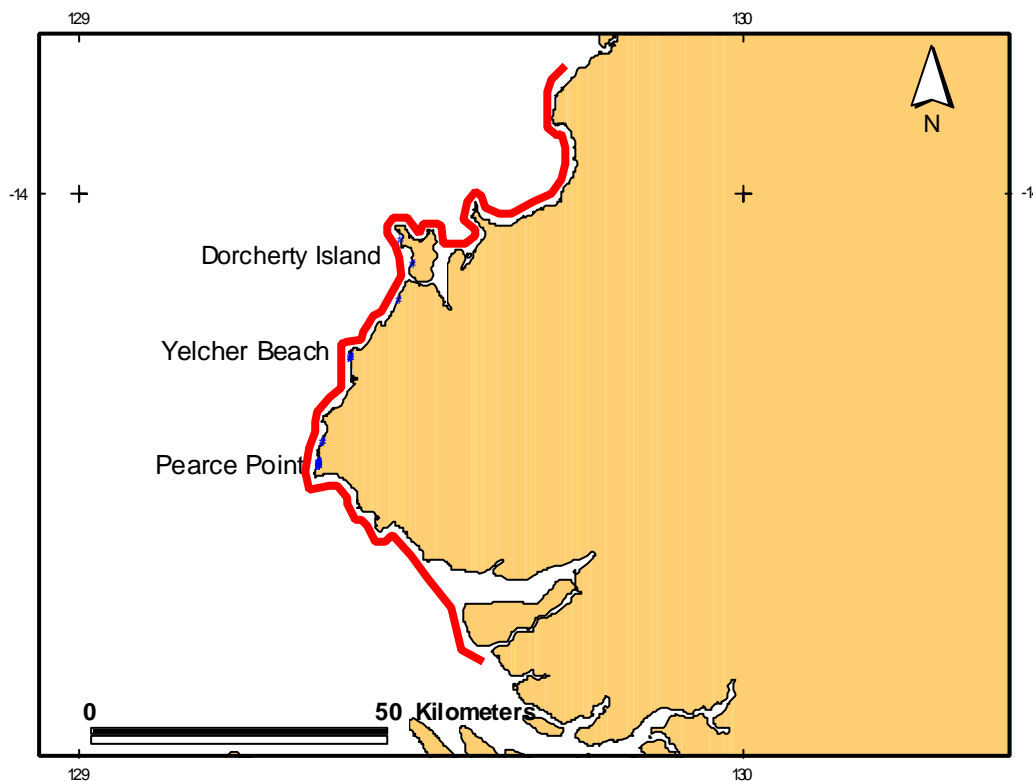


Figure 1 Nest locations along the coastline of Port Keats. Blue circles represent nest location. Red line indicates the path of the aerial survey.

Table 1 Localities of sea turtle nests seen on the preliminary survey of sea turtle resources near the Black Tip Project.

Nest Number	Latitude	Longitude
1	14° 24.262'S	129° 21.641'E
2	14° 24.306'S	129° 21.627'E
3	14° 24.313'S	129° 21.622'E
4	14° 24.327'S	129° 21.618'E
5	14° 24.327'S	129° 21.618'E
6	14° 24.327'S	129° 21.618'E
7	14° 24.37'S	129° 21.642'E
8	14° 24.38'S	129° 21.597'E
9	14° 24.395'S	129° 21.591'E
10	14° 24.438'S	129° 21.576'E
11	14° 24.438'S	129° 21.576'E
12	14° 24.238'S	129° 21.65'E
13	14° 24.236'S	129° 21.652'E
14	14° 24.229'S	129° 21.654'E
15	14° 9.601'S	129° 28.828'E
16	14° 22.244'S	129° 22.069'E
17	14° 22.298'S	129° 22.031'E
18	14° 14.743'S	129° 24.626'E
19	14° 14.728'S	129° 24.639'E
20	14° 14.477'S	129° 24.716'E
21	14° 14.779'S	129° 24.607'E
22	14° 6.2665'S	129° 30.1178'E
23	14° 4.109'S	129° 29.1781'E

Discussion

The six species of marine turtle occurring in Australian waters are listed marine species under Environmental Protection Biodiversity Conservation Act 1999 (EPBC) (Table 2). Internationally, the nesting species, Flatback and olive Ridley are considered Vulnerable and Endangered respectively. Their respective status is repeated at the National level. However, both species are listed as Data Deficient in the Northern Territory. The proposed pipeline project will contribute to rectifying the local lack of information about the nesting species of sea turtles through community involvement in the monitoring of any impacts resulting from the project.

Table 2. Conservation status at the International, National and Territory levels of the six species of sea turtles inhabiting Australian waters.

Common	Names Scientific	Conservation Status		
		International Red List 2000	National EPBC 1999	Northern Territory Threatened Species 2002
Flatback	<i>Natator depressus</i>	Vulnerable	Vulnerable	Data Deficient
Green	<i>Chelonia mydas</i>	Endangered	Vulnerable	Least Concern
Hawksbill	<i>Eretmochelys imbricata</i>	Critically Endangered	Vulnerable	Data Deficient
Leatherback	<i>Dermochelys olivacea</i>	Critically Endangered	Vulnerable	Vulnerable
Loggerhead	<i>Caretta caretta</i>	Endangered	Endangered	Endangered
Olive Ridley	<i>Lepidochelys olivacea</i>	Endangered	Endangered	Data Deficient

Pipeline Landfall

The pipeline project is going to cross the coast at the site of a sea turtle nesting beach that could support some tens of nests laid per year. There was no indication of other species such as Green sea turtles nesting on the beaches in the project area. This species causes a great deal of disturbance in the sand and the resulting depressions persist for some months. There is no local knowledge of species other than Flatback and Olive Ridley Sea turtles nesting in the area. The nesting season for these species in the Anson Beagle Bioregion starts in March and finishes in October each year. The peak of nesting activity is usually in July and August. Any risk of disturbance to the nesting beach associated with the pipeline landfall would be mitigated by the operations being conducted between October and March. The October to March construction period would have a low likelihood of impact. The March to October operation would have medium likelihood of impact, in that the disturbance would be over a medium scale and over several months.

Risk reduction measures should be viewed as an optimum given the time constraints of the pipeline installation being scheduled for the dry season, the need for operations to continue on a 24 hour basis, the need for the construction to be illuminated at night for safety reasons and the subsequent possibility of the light spill covering the entire beach. With the pipeline scheduled to cross Yelcher Beach in the dry season (March

to October), the risk of a negative impact on the nesting turtles increases from a low to medium level. Bearing in mind that there are an estimated 20 nests laid on Yelcher Beach each season and within the Anson Beagle Bioregion there is an estimated 2000 Flatback nests laid annually, approximately one percent of the nests risk direct negative impact. It is unlikely that a negative impact of this magnitude could be detected at a population level. However the impact would be detectable at the local level. This can be ameliorated by installing further safeguards.

As the pipeline landfall is towards the northern end to Yelcher Beach, it is recommended that the major source of illumination be from the southern side of the construction so that the spill of light onto the beach is reduced. The spill of light should be further reduced by placing shades on the southern (beach) sides of lights. This should place most of the beach in the shadow from the shades.

Female turtles will either nest on Yelcher Beach or move to a neighbouring beach to nest during the construction phase. Yelcher Beach and the neighbouring beaches to the north and south need to be monitored for sea turtle nesting activity to determine if turtles have been displaced by the construction activities. This monitoring should be conducted each morning from the start of the nesting season in March and continue for the entire season. Records should be kept on the number of turtle tracks and turtle nests on each of the beaches.

Even with the noise and lights of construction there is a high probability that turtles will nest on Yelcher Beach. On their return to the sea, the turtles will be attracted to the lights of construction. The equipment on the beach and the pit in which the pipe will be laid need to have a barrier in place to deflect the turtle down the beach towards the water. There needs to be a trained sea turtle handler on call from Wadeye during high tides, to coax nesting females away from construction lights and similarly to remove any hatchlings that may have emerged from nests that were missed by the beach monitors.

All nests laid on Yelcher Beach should be removed and transported with appropriate precautions to a hatchery on Kentjiptharra Beach at about 14° 15.276S 129° 24.641E or at another suitable location in the area. The removal and relocation of the nests should be completed by sunrise of the morning following laying. Precautions should be taken against vibrations and rotations. This removal of eggs should include all the nests for the season because eggs laid up to eight weeks prior to the construction will be affected by the vibrations. The embryos of sea turtles are particularly sensitive to vibrations and rotations during their development. For this reason during the construction of the pipeline landfall the nests should be collected by suitably trained community groups and removed to a hatchery on a neighbouring beach. Kentjiptharra Beach to the south would be a suitable location because the area has limited access to groups other than the traditional owners. The beach is of a suitable profile and aspect to support successful incubation of sea turtle eggs. The area can be monitored relatively easily. After incubation hatchlings should be collected in suitable corrals, held until darkness and released onto the beach to facilitate their imprinting to the area and its environmental and geomagnetic cues.

Hatching success of transplanted nests in the hatchery should be compared with hatching success from the control nests laid on the beaches to the north and south of Yelcher Beach. A complete report should be written on the number of turtles that

nested on Yelcher Beach during construction of the pipeline landfall, the numbers of eggs relocated to the hatchery, the hatching success of nests from within the hatchery and those nests left to hatch on the neighbouring beaches. From such a report the impact of the pipeline construction could be ascertained.

Lights

Beach Lighting

Sea turtles are sensitive to lights in the visible spectrum. There is no evidence that they can perceive light in the infrared or ultra violet wavelengths. Adult female sea turtles are photonegative as they approach the beach to nest. They can perceive and detect diffuse dark objects even in starlight. Having said that, they are subject to habituation and having nested in an area previously will return to the area even in the presence of light. Flatback sea turtles are extremely faithful in their nesting beaches and will return to the same island or beach having nested successfully there in previous years (Limpus *et al.* 1984). First time nesters are not so forgiving and are more sensitive to disturbance whilst on the nesting beach. Having finished nesting female turtles become photopositive and will move towards a lighted area that is at the lowest horizon. They are capable of detecting all wavelengths of visible light but respond less to red light.

Hatchling sea turtles are photopositive once they leave the nest. They move towards brighter regions and away from high beach silhouettes. The combination of light and low horizon usually leads the hatchlings to the open ocean (Limpus 1971, Bartol and Musick 2003). Unlike adults, hatchlings will climb uphill to a white light. Red light has a less effect but the hatchlings still respond to these wavelengths if sufficiently bright. Light of sufficient intensity can attract hatchlings from out of the water and entice them to climb the beach towards the light. This results in wasted energy and places the hatchlings in an illuminated area with greater risk of predation. Hatchlings are attracted to the deck lights of boats at anchor and towards the “all round” white lights of yachts while anchored in the vicinity of nesting beaches. The best turtle friendly types of lights near nesting beaches include those light that emit a colour that has minimal effects on sea turtle adults and hatchlings. Luminaries that emit light in the shorter wavelengths of red and yellow have less attraction to hatchlings and adults than do other sources. Low pressure sodium vapour lamps are high in yellow wavelengths and are less disruptive near sea turtle nesting beaches (Witherington and Martin 1996).

Excess Gas and Flare

The flare system is designed to provide a safe means of disposing of pressurised gas in the event of an emergency and for proper maintenance of the plant. The frequency of accidental triggering of the flare system is expected to decrease after the commissioning phase and become an infrequent event. In emergencies, the flames may be up to 60 metres in height but with durations as short as 15 to 20 minutes. Given that the gas plant is approximately two kilometres from the shoreline, such an infrequent, short-lived flame is unlikely to have any impact on nesting sea turtles even if it occurred during their peak nesting period on a high tide at night during the dry season. The flame produced prior to scheduled maintenance is much smaller in size but may have a longer duration. The maintenance flares are scheduled at four times per year and may well occur during daylight hours. The pilot flame is of insufficient

size to impact on nesting turtles or their hatchlings. Should any impact from the flares be detectable then it would be classified as a minor and temporary disruption to a small portion of the population of nesting sea turtles and have no impact on critical habitat of activity.

Vibrations

Although lacking external ears sea turtles can hear by vibrations passing down the ear canals through a layer of fat. They respond mostly to low frequency sounds (Bartol and Musick 2003). Green turtles respond to sounds between 200 to 700Hz with best detection in the region of 400Hz (Bartol and Musick 2003). Pacific islanders noticed this behaviour and have a folk lore of the sound of the waves on the beach calling the nesting turtles. The sound of the waves crashing on the beach at high tide may be an important cue for nesting Flatback Sea Turtles to come ashore. Sea turtle embryos are particularly sensitive to vibrations. During the early phase of development vibrations and movement may dislodge the embryo from the egg membranes leading to the death of the embryo. In the later phases of development vibrations may cause the hatchlings to hatch prematurely leading to non-synchronous emergence from the nest and an increase in late development mortality (Andrea Koch, Personal Communication). As vibrations have the potential to cause negative impacts over several stages of embryonic development it is prudent to remove nests from the beach at the pipeline landfall where there is excessive noise and vibration to a safer hatchery area. This would provide a safeguard for the hatchlings during the construction phase of the pipeline.

Produced Water

Sea turtles are air breathers and are therefore less susceptible to substances dissolved in the water than are fish. This is an area that has had little research and needs further literature searches particularly of the grey literature from the USA. It is noteworthy that having examined several thousand sea turtles in the northern regions of Joseph Bonaparte Gulf, there has not been a single case of fibropapillomatosis a debilitating condition of sea turtles that has been reported from more industrialised areas.

Community Involvement

This preliminary survey of the sea turtles in the region of the Black Tip Project was to pave the way for follow up monitoring by a community group. The Wadeye community had started a Sea Ranger program which aims to be a marine counterpart to the "Caring for Country" initiative. This group appears to be an excellent organisation to conduct the ongoing monitoring of the sea turtles resources during the construction phase and after.

At the time of the survey the Sea Rangers had been in existence for at least twelve months and because they did not include members from all of the family groups, I detected an air of uncertainty regarding their role in my conversations with the Traditional Owners. I would encourage the Sea Rangers to get to know the coastal groups in whose land the sea turtles nest. This acceptance of the Sea Rangers is important in facilitating of ongoing monitoring. The monitoring should be inclusive of

the Traditional Owners, their understanding of what is going on and the benefits which can come from having a sea ranger program.

For the Sea Rangers to participate in the monitoring of the sea turtles and shifting nests to a safe hatchery, I recommend initiating a number of training sessions. This should include the Traditional Owners to provide the cultural aspects and consultants to provide the scientific and procedural aspects of the monitoring. In addition I support the sea Rangers at Wadeye forming links with Sea Rangers in other localities in the Northern Territory such as Borroloola and the Tiwi Islands to further facilitate the capacity building that grows from community conservation groups.

Training programs should be developed for:

1. Reading turtle tracks on nesting beaches.
2. Hatchery design and site location.
3. Hatchery management.
4. Safe methods of egg collection, transport and burial.
5. Detection of nests about to hatch.
6. Hatchling collection, care and release.
7. Record keeping, data collection and report writing.

The Sea Rangers under the guidance of Mr Scott McIntyre were an enthusiastic group who with appropriate training would make a positive contribution to monitoring the impacts of the Black Tip Project.

Acknowledgements

I thank Ms Una Phelan (SKM) and Ceri Morgan (Woodside) for the opportunity to participate in the project. Andrea Koch provided valuable photographs during the aerial survey. I thank the Traditional Owners Anthony, Cyril and Angus and their families for their guidance through their country and for the openness with which they participated in the discussions. I thank the Northern Land Council personnel for their attention to detail and for facilitating meetings with the Traditional Owners. I thank Scott McIntyre and the Sea Rangers of Wadeye for their hospitality and participation in the aerial surveys.

In addition to this report a full list of photographs and their captions will be presented in digital and hard copy form to SKM. Prints and captions will be presented to NLC, and the Traditional Owners.

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Diary of Events:

4 June 2004

Arrived at Pearl Aviation with CDU student Andrea Koch, for weigh in at 0830 and met Katie Tschia and Una Phelan and Scott McIntyre. Leon the Traditional Owner did not make it to the air port hence there may be a problem with Andrea leaving the aerodrome at Wadeye.

The aircraft was a Beachcraft Kingair seating 9 passengers and two pilots

Following the introductory video I spoke with the pilots about what we were looking for and enquired as to the best way for flying to provide a good coverage of the survey area.

Take off at 09.26 for a short flight to Bare Sand Island. Andrea and I were seated behind the wing so that from either side of the plane we had an unobstructed view of the survey. Survey height was 500 ft and air speed in excess of 140 knots (280 km/hr).

On Bare Sand Island there were 5 fresh turtle tracks from last night. This island supports up to about 500 nesting flatback sea turtles each year. This equates to about 1500 nests and 75,000 eggs. In addition there are about ten or so olive ridley sea turtles nesting on the island, but their tracks because of their small size are difficult to see from the air.

South of Dum in Mirrie Island, on the mainland there was one fresh sea turtle track on the most northern beach at Dundee Beach. This area supports some tens of nesting flatback sea turtles each year.

The aircraft kept a low altitude along the coast to the vicinity of Channel Point near the Perron Islands. There were no further sea turtle tracks on any of the beaches in the intervening 80 km.

From Channel Point the plane climbed to 2,000 ft to conserve fuel and to provide a more comfortable ride for those on board. We flew south over Cape Scott and Cape Hay on the way to Wadeye.

We landed at Wadeye and Scott McIntyre collected the Sea Rangers together, David Greg and Vincent were to accompany us on the aerial survey of the Port Keats Area. The traditional owners Anthony, Angus and Cyril also flew the survey as the plane was flying over their country.

As Andrea and Katie could not be accommodated under the existing permits they also joined the aerial survey.

Aerial Survey:4 June 2004

Take off at 11.57 and flew to the south over Whale Flat as one of the sea rangers indicated that at times locals collected turtle eggs from that area. The survey height was again about 500 ft and 200 m seaward of the shoreline and a speed of 140 knots.

The plane turned north-west after crossing Whale Flat (14°42.00'S 129° 37.00'E) and flew towards Fossil Head and Pearce Point and then turned north to follow the coast. The coastline was highly scenic with rocky laterite cliffs and protected beaches in between. In several places shoreline consisted of long sand beaches with well formed sand dunes and coastal swamps further inland. Almost the entire coastline was photographed for later ground surveys. The survey continued north to 13° 52.00'S and 129°43E where a road joins the beach north of Cape Dombey. At 12.47 the plane turned south and flew parallel to the coast about 1000m seaward of the shoreline to Pearce Point before heading north to Wadey Aerodrome and landing at 13.13.

During the survey only two turtle tracks were seen and these were on the sandy dunes on the western side of Dorcherty Island. No other evidence of turtle nesting was seen. One green sea turtle was seen in the water off Pearce Point. There was no evidence of seagrass in the intertidal zone. No dugongs were seen. The speed and height of the survey was adequate to see large marine life in the water as evidenced by the single sea turtle and on the return southern leg of the trip a large salt water crocodile was seen in Treachery Bay to the south of Pearce Point.

Visit to Anthony's Country.

After the aerial survey I travelled with the NLC party to Anthony's outstation (14° 07.768S 129°29.866E) just south of Dorcherty Island. I opened my folder of sea turtle pictures and other information and conducted an informal interview that was mainly constructed around the interests of the traditional owners. Anthony and John Daly were eager to provide information about the types of sea turtle and the presence of dugongs in the area. The main nesting sea turtle was identified as the Greenback. Anthony identified a flatback (*Natator depressus*) from the photographs and particularly the diagrams of the turtle eggs. Anthony gave the name for the turtle in his language and indicated that this meant the turtle that lays eggs. This name may have referred to the activity as well as the species. The main nesting beaches in Anthony's country were on the western side of Dorcherty Island. Sea turtle nests were common on Dorcherty Island and fresh nests were found throughout the dry season. Goannas were common on the island. They raided many turtle nests and ate many of the turtle eggs.

Dugongs also occur along the coastline at Dorcherty Island. They inhabit the shallow reef to the north of Dorcherty Island and the vicinity of Cape Hay. Near Cape Hay there is a flat patch of reef and dugongs are commonly found on this patch. Melissa Byass (NLC) asked if seagrasses were found in this area near Cape Hay to which Anthony answered, "Yes" but did not elaborate and I was unsure if he understood the difference between seagrass and seaweed or his affirmative reply was out of courtesy. The region of Dorcherty Island and the surrounding reefs appears to be an important sea turtle nesting and dugong-feeding habitat.

John Daly indicated that he had seen large dugongs at the southern regions of the Joseph Bonaparte Gulf but did not give an exact locality. He did recall a large dugong surfacing beside his crabbing boat at the mouth of the Moyle River. This dugong had surfaced repeatedly beside the boat and had rubbed its back on the boat. The local people at Wadeye do not hunt the dugongs. Many people do not have boats and are therefore not in a position to engage in a hunt. Anthony indicated that he had taken a dugong some years ago but he did not hunt regularly. John Daly indicated that few people went turtle hunting as no body had turtle spears or harpoons and there were few boats and in large part the hunting skills had been lost by the people.

Few turtles nested on Anthony's front beach. Anthony indicated that whenever he went along the front beach there was sometimes one nest or maybe two nests but not any more. This was taken as a low level of sea turtle nesting. An inspection of the beach by 4wd vehicle revealed only two nests from within the last two weeks in approximately 2 km. One nest was located at 14° 09.601S 129° 28.828E. It was that of a Flatback (Greenback to the locals). It had not been raided by goannas as there were few goannas on this coastline. Anthony was not interested in collecting the eggs either. On the beach there were dead shells of the auger shell mollusc (*Turritella terebra*) which indicate that there was a mud bank offshore that could be a feeding ground for loggerhead and olive ridley turtles as were found further north in Fog Bay.

Visit to Cyril's Country

Saturday 5 June 2004. I accompanied Anna and the NLC team to Wadeye and picked up Cyril and his family and headed south to the Pearce Point region. We arrived at the outstation and went onto the beach to find a Flatback turtle nest (14° 24.262S 129° 21.641 E) from last night. Cyril's family identified the turtle nest was that of a Greenback (Flatback *Natator depressus*). They located the eggs by probing for the soft eggs with pointed sticks. The identification was supported by there being 53 eggs in the nest. This is a typical clutch size for Flatback sea turtles. A table of the nests and their locations on this beach are presented in Table 3.

We had lunch at the outstation (14° 24.269S 129° 21.694E) and spoke about sea turtles. Cyril's family do not hunt turtles and have no harpoons. They collect some eggs at times. Similarly they do not hunt dugongs. They are familiar with dugongs and know they are in the area but seem to pass through rather than stay in a particular area.

After lunch Cyril took the party to the Sun Rock and the ochre cliffs. This was a sacred site and I was privileged to have been taken there.

We then went to another outstation and sacred site with Cyril. This site had been seen from the air and consisted of sand dunes that backed the beach at 14° 22.205S 129° 22.069E. We approached the dunes through the paperbark swamp and climbed the back of the dune that was about 30 m in height. Seaward of the dune that was a Python Dreaming Site, was a flatback nest (14° 22.244S 129° 22.069E) from which the group collected the eggs. Another nest (14° 22.298S 129° 22.031E) had been raided by goannas. We walked southwards along the beach past a women's dreaming

site in which men were not permitted, to a rocky headland from which freshwater seeped from the rocks. Around the corner Cyril and Francis (Cyril's cousin) showed us the cave through which the sea turtles and the fresh water turtles changed over. The sea turtles found they were too large to live in the freshwater pools and the longneck turtles found they were too small to live in the sea. It was through this cave (14° 22.715S 129°21.782E) where the fresh water seeps into the sea that they changed places.

We walked back to the vehicle and left the area at 1525 to go to another beach. The ladies in the party were too tired to walk further so having got to the site we abandoned our plans and tried to contact the camp indicating we were dropping the group off in Wadeye before returning to the camp.

Table 3 Positions and fate of nests found on the beach at the out-station.

Number	Position	Comments
1	14° 24.262S 129° 21.641E	53 eggs collected as above
2	14° 24.306S 129° 21.627E	Raided by goannas
3	14° 24.313S 129° 21.622E	Raided by goannas
4	14° 24.327S 129° 21.618E	Raided by goannas
5	14° 24.327S 129° 21.618E	Raided by goannas
6	14° 24.327S 129° 21.618E	Raided by goannas
7	14° 24.370S 129° 21.642E	Raided by goannas
8	14° 24.380S 129° 21.597E	Eggs collected
9	14° 24.395S 129° 21.591E	Raided by goannas
10	14° 24.438S 129° 21.576E	Nest from last night there fore not present for aerial surveys. Eggs collected
11	14° 24.438S 129° 21.576E	Old (several weeks) nest opened by goannas
12	14° 24.238S 129° 21.650E	Left intact
13	14° 24.236S 129° 21.652E	Raided by goannas
14	14° 24.229S 129° 21.654E	Left intact

Visit to Angus's Country

Sunday 6 June 2004. We left the camp at 0830 to go to Yelcher Beach. Today's party consisted of Angus the Traditional Owner, Colin his brother-in-law, Anna, Melissa, David and others from NLC and other relatives and children. We reached Yelcher Beach (according to the locals) and the site of the pipeline landfall at 08.47.

A Flatback turtle had nested last night at 14° 14.743S 129°24.626E. The eggs were collected.

Last Wednesday (2 June 2004), this family group had collected the eggs from another Flatback nest on this beach. The nest was located at 14° 14.728S 129°24.639E. Further north along the beach another Flatback had come ashore last night at 14° 14.637S 129°24.679E but did not nest. The beach was inspected from the south to 14° 14.477S 129°24.716E for signs of nesting sea turtle activity. There was an old Flatback sea turtle nest at 14°14.779S 129° 24.607E.

We left the beach at 0925 and headed south to the neighbouring beach called Yelcher Beach on the maps but which the locals called Kentjiptharra Beach. The survey started at 14° 15.201S 129° 24.628E and continued to the point at 14° 15.517S 129° 24.548E. A stop was made at 14° 15.276S 129° 24.641E to photograph the beach. There was no sign of turtle nesting on this beach although Angus indicated that turtles nested further south around the point.

The party then proceeded to the beach north of the pipeline landfall. We drove along the beach to 14°12.935S 129° 26.400E. There was one old turtle nest that had been collected by a group in a four wheel drive some days before. We walked to the creek mouth and I photographed the hinterland and coastline from atop the dune at 14°12.815S 129°28.506. The beach continued on the northern side of the creek. It was on this northern part of the beach that the group collected the characteristically small eggs of the Olive Ridley Sea Turtle (*Lepidochelys olivacea*) last week.

We returned to the camp and packed for the drive to Darwin. Over lunch I spoke with Colin who said that there were dugongs in the area, but the people do not hunt them. Some years ago a fellow shot one and they cut it up and they ate it. They know the dugongs are in the area because on the lowest tides of the year he has walked out to the low tide mark and found seagrasses that were long and flat like a belt and also found the depressions in between clumps of this seagrass where dugongs had been feeding. The seagrass from its description is *Enhalus acoroides* that is relatively common in intertidal regions but to my knowledge is not a species of seagrass favoured by dugongs.

I left the camp at 13.05 with Melissa Byass (NLC) and drove to Darwin. We made the sat phone schedule calls as we crossed the Daly River and refuelled at Daly River and continued on to Darwin.

List of Photographs taken during this survey:

Photographs listed are the low resolution reference numbers.

Film Number	Caption
AA_0_001	Anthony's beach
AA_0_002	Anthony's beach
AA_0_003	Anthony's outstation
AA_0_004	Turtle tracks on Dorcherty Island
AA_0_005	Turtle tracks on Dorcherty Island
AA_0_006	Tree Point to Cape Dombey
AA_0_007	Tree Point to Cape Dombey
AA_0_008	Tree Point to Cape Dombey
AA_0_009	Melissa (NLC) with Anthony on Anthony's beach
AA_0_010	turtle nest at Anthony's beach 14deg 09.601minS: 129deg 28.828minE
AA_0_011	Anthony and Melissa (NLC) at turtle nest 14deg 09.601minS: 129deg 28.828minE
AA_0_012	General view of the low profile beach at Anthony's outstation
AA_0_013	General view of the low profile beach at Anthony's outstation
AA_0_014	Cyril and Francis with the ladies on Cyril's outstation beach14deg 24.262minS: 129deg 21.641minE
AA_0_015	Cyril and Francis with the ladies on Cyril's outstation beach14deg 24.262minS: 129deg 21.641minE
AA_0_016	Cyril and Francis with the ladies on Cyril's outstation beach14deg 24.262minS: 129deg 21.641minE
AA_0_017	Cyril and Francis with the ladies on Cyril's outstation beach14deg 24.262minS: 129deg 21.641minE
AA_0_018	Cyril and Francis with the ladies on Cyril's outstation beach14deg 24.262minS: 129deg 21.641minE
AA_0_019	Cyril and Francis with the ladies on Cyril's outstation beach14deg 24.262minS: 129deg 21.641minE
AA_0_020	Cyril and Francis with the ladies on Cyril's outstation beach14deg 24.262minS: 129deg 21.641minE
AA_0_021	Cyril and Francis with the ladies on Cyril's outstation beach14deg 24.262minS: 129deg 21.641minE
AA_0_022	Cyril and Francis with the ladies on Cyril's outstation beach14deg 24.262minS: 129deg 21.641minE
AA_0_023	Cyril and Francis with the ladies on Cyril's outstation beach14deg 24.262minS: 129deg 21.641minE
AA_0_024	Cyril and Francis with the ladies on Cyril's outstation beach14deg 24.262minS: 129deg 21.641minE
AA_0_025	Cyril and Francis with the ladies on Cyril's outstation beach14deg 24.262minS: 129deg 21.641minE
AB_0_001	Yelcher Beach (map) 14deg 15.201minS: 129deg 24.628E
AB_0_002	Proposed pipeline landfall
AB_0_003	Camp site on the headland at the site of the old nunnery
AB_0_004	Cyril, Francis and group entering the python dreaming site
AB_0_005	Python dreaming site
AB_0_006	Python dreaming site
AB_0_007	Cyril's group on top of the dune overlooking the wetlands
AB_0_008	David (NLC) on beach nort of camp 14deg 12.935min S: 129deg26.400min E
AB_0_009	Soft sand and nearly bogged troop carrier at 14deg 12.935min S: 129deg26.400min E
AB_0_010	Mellissa Byass (NLC) returning to Darwin by road
AB_0_011	Mellissa Byass (NLC) returning to Darwin by road
AC_0_001	Start of Aerial Survey. Departing Darwin Camera check on Darwin harbour Development
AC_0_002	Flight check, heading north over Darwin Harbour
AC_0_003	Approaching Bare Sand Island and Quail Island
AC_0_004	Bare Sand Island
AC_0_005	Bare Sand Island
AC_0_006	Bare Sand Island
AC_0_007	Bare Sand Island
AC_0_008	Bare Sand Island
AC_0_009	Dum in Mirrie Island
AC_0_010	Dum in Mirrie Island
AC_0_011	Bare Sand Island
AC_0_012	Bare Sand Island
AC_0_013	Bare Sand Island
AC_0_014	Bare Sand Island
AC_0_015	Bare Sand Island
AC_0_016	Bare Sand Island
AC_0_017	Bare Sand Island

AC_0_018	Dum in Mirrie Island
AC_0_019	Dum in Mirrie Island
AC_0_020	Dum in Mirrie Island
AC_0_021	Dum in Mirrie Island
AC_0_022	Dum in Mirrie Island
AD_0_001	Quail Island
AD_0_002	Quail Island
AD_0_003	North Perron Island
AD_0_004	North Perron Island
AD_0_005	Wetlands at New Moon Inlet
AD_0_006	Wetlands at New Moon Inlet
AD_0_007	Whale Flat
AD_0_008	Whale Flat
AD_0_009	Whale Flat
AD_0_010	Whale Flat
AD_0_011	Whale Flat
AD_0_012	Whale Flat
AD_0_013	Whale Flat
AD_0_014	Whale Flat
AD_0_015	Pearce Point
AD_0_016	Pearce Point
AD_0_017	Pearce Point
AD_0_018	Sand dunes at the Python Dreaming Beach
AD_0_019	headland to the south of the Turtle Sacred site
AD_0_020	Cyril's Python dreaming beach
AD_0_021	Cyril's Python dreaming beach
AD_0_022	Creek on Yelcher Beach on Cyril's beach with python Dreaming
AD_0_023	Creek on Yelcher Beach
AD_0_024	Yelcher Beach looking north
AD_0_025	Channel Island on the return flight to Darwin
AE_0_001	turtle nest opened by goannas at Cyril's outstation 14deg 24.262minS: 129deg 21.641minE
AE_0_002	turtle nest opened by goannas at Cyril's outstation 14deg 24.262minS: 129deg 21.641minE
AE_0_003	Cyril's beach at outstation
AE_0_004	Beach facing north at Cyril's outstation
AE_0_005	Anna (NLC) and children of the back of the dune at the Python dreaming site
AE_0_006	Beach facing south at Python dreaming site
AE_0_007	Beach facing north at Python dreaming site
AE_0_008	Francis and friend collecting eggs from the python dreaming site
AE_0_009	Cyril and Francis at the turtle sacred site 14deg 22.715minS:129deg 21.782minE
AE_0_010	Angus, Colin and group with turtle nest at pipeline landfall beach 14deg 14.743minS: 129deg 24.626minE
AE_0_011	Angus, Colin and group with turtle nest at pipeline landfall beach 14deg 14.743minS: 129deg 24.626minE
AE_0_012	Angus, Colin and group with turtle nest at pipeline landfall beach 14deg 14.743minS: 129deg 24.626minE
AE_0_013	Angus, Colin and group with turtle nest at pipeline landfall beach 14deg 14.743minS: 129deg 24.626minE
AE_0_014	Angus, Colin and group with turtle nest at pipeline landfall beach 14deg 14.743minS: 129deg 24.626minE
AE_0_015	Angus, Colin and group with turtle nest at pipeline landfall beach 14deg 14.743minS: 129deg 24.626minE
AE_0_016	Flatback Turtle track at pipeline landfall beach 14deg 14.637minS: 129deg 24.679minE
AE_0_017	Pipeline Landfall Beach (Yelcher beach to locals) 14deg 14.477minS: 129deg 24.716minE
AE_0_018	Kentjiptharra Beach south of Pipeline landfall Beach facing south at 14deg 15.276minS: 129deg 24.641minE
AE_0_019	Kentjiptharra Beach south of Pipeline landfall Beach facing north at 14deg 15.276minS: 129deg 24.641minE
AE_0_020	Kentjiptharra Beach south of Pipeline landfall Beach facing south at 14deg 15.517minS: 129deg 24.648minE
AE_0_021	Children playing with cuttlefish boats
AE_0_022	Beach north of Camp view southwest from 14deg 12.815minS:129deg 28.506minE
AE_0_023	Beach north of Camp view east from 14deg 12.815minS:129deg 28.506minE
AE_0_024	Beach north of Camp view north from 14deg 12.815minS:129deg 28.506minE
AE_0_025	David(NLC) and others at the creek north of the camp
AE_0_026	David (NLC) Anna (NLC) and Melissa (NLC)and Colin at northern end of beach before returning to camp.

AF_0_001	Cape Scott
AF_0_002	Dashwood Plains
AF_0_003	Dorcherty Island from East
AF_0_004	Port Keats
AF_0_005	Upstream of Port Keats
AF_0_006	Wetlands at New Moon Inlet
AF_0_007	Wetlands at New Moon Inlet
AF_0_008	Whale Flat
AF_0_009	Whale Flat
AF_0_010	Whale Flat
AF_0_011	Fossil Head
AF_0_012	Fossil Head
AF_0_013	Fossil Head
AF_0_014	Fossil Head
AF_0_015	Pearce Point
AF_0_016	Pearce Point
AF_0_017	Pearce Point
AF_0_018	Pearce Point
AF_0_019	Pearce Point
AF_0_020	Pearce Point
AF_0_021	Pearce Point
AF_0_022	Cyril's outstation 14deg 24.262min S: 129deg 21.641min E
AF_0_023	Cyril's coast
AF_0_024	Cyril's coast showing th python dreaming site being the sand dunes14deg 22.205minS: 129deg 22.069minE
AF_0_025	Cyril's coast
AF_0_026	Cyril's coast