Dhimurru Aboriginal Corporation

PO Box 1551 Nhulunbuy N T 0881

ABN: 95 520 121 809
ACN: 1558

Ph: (08) 8987 3992
Fx: (08) 8987 3224

Web: www.dhimurru.com.au
E-mail: nhamirri@dhimurru.com.au

RESEARCH ON THE IMPACT OF MARINE DEBRIS ON MARINE TURTLE SURVIVAL AND BEHAVIOUR: NORTH EAST ARNHEM LAND, NORTHERN TERRITORY, AUSTRALIA

Report to:

Rio Tinto Alcan Gove Pty Limited
World Wide Fund for Nature (Australia)
Northern Land Council and the Aboriginal Benefits Account
North Australian Indigenous Land and Sea Management Alliance
Commonwealth Dept of Environment, Water, Heritage, and the Arts
NT Dept of Natural Resources, Environment, the Arts, and Sports

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Authors: Vanessa Drysdale, Patrick (PJ) White, Phil Wise, Steve Roeger

April 2009
Dhimurru Turtle Entanglement Report
Dhimurru Turtle Tracking Report

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Cover Image: PJ Ganbilpil White releasing *"Troy"* a tagged muduthu (olive ridley) turtle. Cape Arnhem, April 2008.

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1. Abstract

Marine debris consists of any man made material that ends up in our oceans. Over 70 percent of this biohazard is made up of derelict fishing nets termed "ghost nets" that have been accidently lost, deliberately discarded or simply abandoned at sea (Department of Natural Resources Environment and the Arts 2008). Other items such as rope, plastic, glass bottles, footwear, thongs and timber are among the next highest most discarded items (Department of Natural Resources Environment and the Arts 2008) and also pose a significant risk to wildlife.

Marine debris, and in particular ghost net, is an extremely dangerous phenomenon for marine animals. Marine turtles appear to suffer a great number of entanglements resulting in the injury and death of these key iconic and often endangered species. In the period of this report 4 marine turtles were recovered none released alive in 2007 and 4 released alive in 2008.

The second part to this report is concerned with the satellite tracking project undertaken by Dhimurru in conjunction with the partners identified in the preceding pages. Satellite tracking is a technique developed aimed at following the movements of individual turtles over long distances over several months. A specially designed instrument plots the animal's location, depth, direction of travel and length of time spent underwater. It then transmits this information to the researcher's computer via a satellite (NAILSMA 2006). These devices are glued to the turtle shell and can be expected to transmit data for up to 3 years (Hayes, G 2008). Three transmitters were deployed. One relayed very little information, one transmitting for several weeks and one transmitting for over three months and is continuing to present data.

2. Introduction

Dhimurru Aboriginal Corporation is an indigenous community based resource management agency established in 1992 by the traditional Yolŋu (Aboriginal) owners of local land and sea estates. The Corporation undertakes a range of activities designed to promote the sustainable use of natural and cultural resources within and adjacent to the Dhimurru Indigenous Protected Area (IPA). The Dhimurru IPA comprises approximately 92,000ha of land and 9,000ha of adjacent marine areas in relation to which the traditional Yolŋu owners have made a voluntary conservation declaration.

This report provides details of the Turtle Recovery and the Turtle Tracking Projects undertaken primarily in the vicinity of Wanuwuy (Cape Arnhem) and Port Bradshaw, Northeast Arnhem Land, Northern Territory, Australia.

The Dhimurru turtle recovery program is one part of a larger strategy adopted by Dhimurru to address the impact of marine debris. The larger strategy includes

annual marine debris surveys and clean ups, participation and membership in the National Turtle Recovery Group, participation and membership in the Gulf of Carpentaria Ghost Net Programme, and the delivery and development of media and community awareness material.

The Turtle Tracking Project was initiated as a response to concerns raised by Yolŋu land owners in regards to the survival rates of entangled marine turtles which were recovered from marine debris. The turtles often display distressing wounds and are released severely physically compromised as a result of long periods entangled in derelict commercial fishing net. This project was designed to collect data on rates of survival, direction of travel, depth of dive and time spent underwater of recovered muduthu (olive ridley) marine turtles (*Lepidochelys olivacea*). The muduthu is a critically endangered species of marine turtle.

Three satellite transmitters were attached to muduthu turtles however only two appear to have survived to return data on movements. This report incorporates data collected from those deployments.

This turtle recovery work, collection and collation of data and the removal of marine debris from the Dhimurru IPA is making a valuable contribution to the knowledge currently available on the impacts of these phenomena and actual impacts on biota particularly marine turtles. The project is part of the implementation of the *Yolŋu Monuk Gäpu Waŋa Sea Country Plan* (2006) which is a Yolngu vision and plan for Sea Country Management in North-East Arnhem Land, Northern Territory. Dhimurru believes the best method for understanding the health of marine species and their habitats is with reliable monitoring and research over time (*Yolŋu Monuk Gapu Waŋa Sea Country Plan 2006).*

3. Aims and Objectives

The aims and objectives of the Turtle Recovery Program are to:

- Rescue as many stranded marine animals as possible quickly and efficiently so as to minimise trauma to the animals and increase survival rates as much as possible;
- Remove ghost netting from the ecosystem at the time of recovery if possible so as to limit opportunities for further entrapment;
- Record details about the strandings to demonstrate the devastating impact of this phenomena, ie location and net type;
- Record the physical details of animals caught in nets and tag turtles to aid in understanding the animals and their biology as well as the reasons for their entrapment;
- To provide data that can assist in addressing the marine debris/ghost net phenomenon preferably at its source.

Further to this, the turtle tracking project aimed to:

- Increase knowledge of the impact of harmful marine debris on protected marine turtle species and test some possible measures for future impact removal and/or impact minimisation.

- Improve understanding of the impact of marine debris on the survival and health of individual marine turtles. This may guide modification of release techniques if required.
- Improve understanding of which marine turtle stocks are impacted by marine debris in the Gulf of Carpentaria.
- Test protocols for assessing the health and the handling of entangled marine turtles to ensure maximum survival rates post release.
- Provide information to support the assessment of the effectiveness of rescue programs for entangled marine turtles.
- Improve understanding of the home ranges and habitat use of marine turtles
- Enhance Indigenous engagement in turtle conservation and management and understanding of marine turtle biology.

3. Methodology

Survey work commences at the onset of the south easterly trade winds including marine debris monitoring and turtle recovery actions. The onset of SE winds and the survey work routinely commence in April and usually end in July/August of each year. Surveys are undertaken using vehicles on shore, boats offshore, and a helicopter for aerial access when available. Surveillance is focused on targeted areas known to be hot spots for derelict commercial fishing net. Live animals are tagged and released and tissue samples for genetic mapping are taken. Net samples are also collected, recorded and data transferred to the Carpentaria Ghost Net Programme for collation and analysis.

Terrestrial surveys were conducted along the accessible areas of the Dhimurru IPA utilising 4wd vehicles and quad bikes. Terrestrial surveys are very labour intensive but they provide more time for Rangers to undertake a thorough inspection of the beaches. Having a vehicle on the ground during the survey also assists in removal of any derelict net in conjunction with the survey.

Helicopter surveys enable rapid coverage of the survey area and greater coverage as some beaches are not accessible by 4wd or quad. This is offset by the much greater costs associated with helicopter hire.

Boat surveys have very limited effectiveness except as a means to observe quantities of accumulated net on shore. Coastal conditions during the period of surveys are normally severe with strong winds and significant swells preventing effective operation in the intertidal zone where entangled turtles are most likely to be recovered.

After survey and recovery actions have been completed any nets that have been located are dragged above the high tide mark or buried. All nets are marked and tagged with brightly coloured flagging tape. Flagging surveyed net also allows rapid recognition of the nets on subsequent surveys particularly from the helicopter enabling staff to easily see that the net has already been inspected. Nets which were too large to remove immediately are removed at a later date when appropriate resources can be deployed.

During 2007, several helicopter surveys were conducted along the coast outlined in Appendix 8 below. This coastline has been identified by observation as a hot spot for the accumulation marine debris. Limited access to helicopter resources in 2008 resulted in Dhimurru only being able to conduct two flights in this period. This proved to be an enormous hindrance to turtle recovery operations. As a result, during the 2008 stranding period, Dhimurru compensated for lack of aerial surveys by undertaking a greater number of terrestrial surveys than in previous years.

The turtle tracking project was initiated in 2006 as an extension of the routine turtle recovery survey work. The model of transmitter was selected in consultation with CDU researcher Associate Professor Corey Bradshaw and University of Wales' Professor Graeme Hays. Purchasing of transmitters had to be balanced against the cost of satellite data collection. Dhimurru chose to purchase a smaller number of transmitters but ensure a greater scope for data collection. The SDRL Series 9000-X V1.6 2005/05 (http://www.smru.st-and.ac.uk) model of transmitter was selected. The number of transmitters that could be purchased was further affected by a poor exchange rate which reduced purchasing capacity and meant that only five, rather than the planned six, transmitters were finally acquired. Late delivery of the tracking units effectively prevented Dhimurru from deploying any transmitters in 2007.

The life of the transmitter, once attached to the animal, is potentially three years. This is highly variable and can depend on circumstances as diverse as: battery life, condition of animal on release, likelihood of predation, death through exhaustion and other environmental hazards. Also, barnacles can affect performance and it is for this reason anti foul is recommended to cover the unit prior to release.

The data collected includes depth of dive, length of time spent underwater, water temperature, surface intervals and direction of travel.

The transmitters were attached to the turtles using a procedure introduced to the Dhimurru Rangers by Dr Corey Bradshaw in 2007. Dr Bradshaw traveled to Gove where he trained the Sea Country Rangers in the appropriate methodology for attaching the satellite trackers in a one day workshop. The training was video taped to transfer this knowledge to future rangers and facilitators or those who were unable to be present at the workshop. The methodology of the attachment of the tracker is outlined below.

- The turtle recovered from ghost net was taken to a cool, shaded area and allowed to rest for a short period.
- Turtle stranding data sheets are filled out as per attachments 3 and 6. Skin samples were taken, GPS position of the animals capture location and measurements were recorded.
- Information was collected on the animals health using the Turtle Health Assessment Protocol. See attachments 4 and 7. The development and function of these protocols will be discussed later in this report.
- When the animal was assessed as being strong enough to endure the satellite attachment process, the procedure was commenced.

- The shell was cleaned using light sandpaper and acetone. The removal of loose material and any marine growth was essential to ensure an adequate bond was created between the satellite tracker and the shell.
- An epoxy glue was mixed on a hard surface and applied thickly, but topically on the cleaned area of shell.
- The satellite tracker was then gently applied to the thick layer of glue and gently pressed into place. The glue was then manipulated around the tracker to create a continuous bond with the shell. Care was taken to avoid the two anterior and the single lateral sensors on the tracker. These could not be covered with glue as the unit would be unable to collect or transmit data.
- It took approximately 40 minutes for the glue to adequately dry during which time the animal was doused in sea water to prevent dehydration and to cool the glue as it cured.
- The turtle was then released as close to stranding site as possible and the scientists involved in the project were contacted with GPS positions so that tracking could commence.

5. Results: Summary of Recovery Effort

Unfortunately, the data sheets for the turtle recovery effort were misplaced after the 2007 season and it is believed the information was inadvertently discarded prior to it being inputted into the database. As a result, the only information Dhimurru have on the 2007 recovery effort was from the field notes of Parks and Wildlife Senior Ranger Phil Wise. As can be seen below in the results in table 1 the only definitive information that could be collated was on the recovery of 4 turtles during this time.

TABLE 1 Turtle Strandings 2007

	Date	Location	Species	Found by	Method
1	11.05.07	Dhimurru IPA	Unknown	Dead	Helicopter
2	26.05.07	Dhimurru IPA	Flat Back	Dead	Helicopter
3			Muduthu/olive ridley	Dead	Helicopter
4	15.06.07	Dhimurru IPA	Unknown	Dead	Helicopter

Results for the 2008 recovery effort are outlined in Table 2 below and include the details of 17 turtles recovered.

TABLE 2: Turtle strandings 2008

	Date	Location	Species	Width	Length	Condition	Found by	Comments
1	1/04/2008	Yirrkala Beach	Hawksbill	12	13.5	Alive	Kids fishing at Yirrkala	
2	30/04/2008	Jirrkawul 12.43594S, 136.85860E	Muduthu/ olive ridley	58	42	Alive	Phil, PJ, Dhuru, Ness	Turtle satellite Tagged
3	30/04/2008	Jirrkawul 12.43594S, 136.85860E	Muduthu/ olive ridley	61	59	Alive	Phil, PJ, Dhuru, Ness	Turtle satellite Tagged
4	30/04/2008	Ganynada 12 23.615 S 136 53.929 E	Flat back	58.5	64.5	Alive	Phil, PJ, Dhuru, Ness	Very healthy, found in net in surf.
5	30/04/2008	Yukuwarra	Muduthu/ olive ridley	63	63	Decomposed	Phil and Ness	Same net as next entry.
6	30/04/2008	Yukuwarra	Unknown	Not taken		Decomposed	Phil and Ness	Badly decomposed. No measurements taken. Same net as above.
7	31/04/2008	Lurrupugurru	Muduthu/ olive ridley	56	59	Dead	Ness, Larrpan, Arian	net 10m x 5m
8	3/05/2008	Ritjala	Muduthu/ olive ridley	69	54.5	Decomposed	PJ, Banula, Ness	net 10m x 5m
9	3/05/2008	Wanuwuy	Green	35	38	Dead fresh	PJ, Banula, Ness	net 10m x 15m
10	13/05/2008	Djerrirrwuy	Muduthu/ olive ridley	53.5	53.5	Dead fresh	PJ	net 2m x 1m
11	15/05/2008	Twin Eagles	Hawksbill	68	79	Dead	Daryl, Arian, Ness	No net. Dead on beach.
12	20/05/2008	Wanuwuy	Green	Not taken		Dead bones	PJ	Bones only. No measurements taken
13	20/05/2008	Lurrpukurru	Muduthu/ olive ridley	<30		Dead bones	PJ	net 1m x .5m
14	14/06/2008	Jirrkawul	Unknown	Not taken		Dead bones	Danny Barrow	net
15	25/06/2008	Ritjala	Green	46	Not taken	Dead bones	PJ	net 3m x 2m
16	25/06/2008	Ritjala	Green	57	Not taken	Dead bones	PJ	net 1.5m x 1m
17	26/06/2007	Wanuwuy	Muduthu/	67	71	Decomposed	Djawalu,	

	Date	Location	Species	Width	Length	Condition	Found by	Comments
		Nth 12 22.172S, 136 57.692 E	olive ridley				Phil, Daryl	

Table 4 – Results by species and condition for 2007

Species	Dead	Alive	Total
Hawksbill	0	0	**0**
Muduthu/olive ridley	1	0	**1**
Flatback	1	0	**1**
Green	0	0	**0**
Unconfirmed	2	0	**2**
Total	**4**	**0**	**4**

Table 5 – Results by species and condition for 2008

Species	Dead	Alive	Total
Hawksbill	1	1	**2**
Muduthu/olive ridley	6	2	**8**
Flatback	0	1	**1**
Green	4	0	**4**
Unconfirmed	2	0	**2**
Total	**13**	**4**	**17**

Table 6 – Results by species, condition, and year since project commencement in 1996.

	Hawksbill Dead	Hawksbill Alive	Muduthu/olive ridley Dead	Muduthu/olive ridley Alive	Flatback Dead	Flatback Alive	Dead	Alive	Unconfirmed Dead	Unconfirmed Alive	**Total**
1996	12	9	0	1	3	3	0	4	9	14	**55**
1997	5	5	0	0	3	1	1	0	10	13	**38**
1998	2	0	3	1	0	3	2	2	1	4	**18**
1999	0	1	1	1	0	1	5	2	0	0	**11**
2000	2	2	2	6	2	0	1	5	3	5	**28**
2001	3	7	2	7	2	0	4	6	2	1	**34**
2002	1	0	0	1	0	1	0	2	0	0	**5**
2003	4	0	0	0	0	0	0	0	1	0	**5**
2004	8	4	7	9	0	1	2	2	1	0	**34**

	Hawksbill Dead	Hawksbill Alive	Muduthu/olive ridley Dead	Muduthu/olive ridley Alive	Flatback Dead	Flatback Alive	Dead	Alive	Unconfirmed Dead	Unconfirmed Alive	**Total**
2005	18	25	10	14	3	1	3	3	1	1	**79**
2006	8	4	0	0	1	0	3	0	0	0	**16**
2007	0	0	1	0	1	0	0	0	2	0	**4**
2008	1	1	6	2	0	1	4	0	2	0	**17**
Total	**64**	**58**	**32**	**42**	**15**	**12**	**25**	**26**	**32**	**38**	**344**

6. Results: Turtle Tracking Project.

Two muduthu (olive ridley) turtles were successfully recovered and had transmitters attached in the Dhimurru IPA. Both animals were discovered entangled in net during the same patrol. One turtle bore an old wound which had resulted in the loss of approximately one fifth of its shell. This wound was completely healed and was considered by the rangers to be possibly a predator attack early in life. As a result, this turtle was named "Troy" (Appendix 3, 4 and 5: T1/2008) for its heroic survivorship. The other turtle was named "Aŋgi" (Appendix 6,7 and 8: T2/2008) which roughly translates to '*weak one'* in Yolŋu matha. She bore some significant wounds on her flippers but none the less seemed strong and alert and responded well once released from the net. Both turtles were allowed to have several waves wash over them as 'salt water therapy' and rehydrate prior to attaching the transmitters.

A datasheet for each turtle were completed which is standard Dhimurru operating procedure for the recording of stranded turtles. This information is fed back into a database for future reference. Also completed were "Turtle Health Assessment Protocol" sheets for each turtle. These were developed in conjunction with local Vet Susan Samuelsson. These protocols were developed as a field assessment of a turtles' condition prior to the attachment of a tracker. The animal was given a rated score on a number of physiological parameters and an over-all rating was concluded. This rating was intended to indicate the overall health of the stranded animal. The purpose of the tracking project was to monitor the movements and likelihood of survival of stranded marine turtles which had become entangled in marine debris. However, an animal which is deemed highly physically compromised could not be considered a likely candidate for this project. The turtle must appear to be healthy and strong enough to endure the satellite attachment process as well as carry with it the additional weight and drag of the satellite unit itself. This can be physically onerous for an animal which is already comparatively weakened by the entanglement. As can be seen in Appendixes 4 and 7 both turtles recovered by Dhimurru rangers early in 2008 scored well on the Assessment Protocol test sheets and were considered likely candidates to take part in the project.

Skin samples were also taken of the first two turtles. These samples have been passed onto Nancy Fitzsimmons of University of Canberra for DNA assessment. Results have not been returned to Dhimurru at time of printing this report. Results, however will be included in a future study.

Troy was released first and he swam strongly. As can be seen by the results in Appendix 5, the turtle spent some time in the vicinity of Cape Arnhem then headed north past Marchinbar Island. After 67.4 days, the signal from Troy suddenly ceased. It is not completely clear as to why this occurred but it is likely that the turtle perished.

Aŋgi on the other hand weakened significantly during the final stages of the satellite attachment process and failed to send any significant data. Even though the turtle was assessed as strong at the time of release from the ghost net, it was presumed to have perished almost immediately on release.

A third turtle was fitted with a transmitter in Queensland. This turtle was named "Princess" (Appendix 9 and 10: tu42-B-06) and was recovered from a ghost net at Pennefather Beach, Weipa in January 2008. Princess was rehabilitated at Cairns Turtle Rehabilitation Centre prior to tagging and release. She had been cared for by centre owner Jennie Gilbert for almost 4 months and had gained a respectable 10kg during that time. Her wounds were allowed to almost completely heal and she was in peak condition when released. It can be noted that the Turtle Stranding Datasheet is slightly different for this turtle (see appendix 9). This is due to a slightly different datasheet preferred by the Queensland ranger groups. Also, a Turtle Health Assessment Protocol sheet was not required for this animal as it had been rehabilitated and was deemed by Veterinarians in Cairns to be in peak physical condition. The transmitter on Princess is continuing to transmit information as can be seen from the attachment in appendix 10.

From this information we can see that the turtle which has been allowed to rehabilitate in a sheltered environment had the greatest longevity. The two turtles tagged and released in the Dhimurru IPA had only a 50 percent survival rate and only for a period of months (Sea Mammal Research Unit 2008). To prove this conclusively however, we need to continue this project and gather much more information over a broader geographic area and over a much longer time-frame.

Unfortunately we are unable to conclusively analyse the data to determine home range and long range behaviour of the turtles as the data returned on the three individuals has been very limited. The time frame of the project was also very constricting and any future tracking projects will need to consider the longer term goals of such an undertaking and ensure to consider these elements in any future projects of this nature.

7. Conclusion

The Turtle Tracking Project faced many challenges, many of which were outside of Dhimurru's control. But despite these challenges, Dhimurru's achievements were many. Three satellite transmitters were successfully deployed on muduthu (olive ridley) turtles and valuable data collected on these key animals. Data from one of these individuals continues to be collected at present and it is hoped this will continue for some time. Further, Dhimurru rangers and staff released many other stranded individuals who would otherwise have perished as a result of entanglement.

The success of the turtle stranding work that Dhimurru undertakes every dry season is imperative to the wellbeing of these key marine species, and it is vital that this work continues into the future. Not only does Dhimurru save individual animals, but it continues to collate data on stranding numbers and now has records which date back to 1996. Once again, it is only with long term collection of this data that we can begin to understand trends and attempt to put in place effective and long term management practices for marine turtles.

On top of the obvious benefits to the turtles themselves, these projects instill pride in the Yolngu rangers. They are continuing to work on traditional country, they are constantly learning new skills and are being equipped in a very practical way to continue to manage their country. The term for Dhimurru's work vision is "both ways" management of the land, and the turtle tracking project is a perfect example of the melding of traditional knowledge with mainstream natural resource management practices.

The major challenges facing the Dhimurru marine turtle recovery program and the turtle tracking project for 2007 and 2008 included:

- The almost complete lack helicopter availability during 2008, this is despite a reasonable budget being allocated for that purpose. The only helicopter available to Dhimurru was the Telstra service aircraft. The priority of this machine is to service the telecommunication requirements of the outstations and island communities around the Gove Peninsular and it was rarely available for use by Dhimurru.

- The targeted species of muduthu (olive ridley) turtles did not present in as many numbers in 2007 or 2008 as they had in previous years. At the peak of stranding in 2005, 14 live and 10 dead muduthu (olive ridley) turtles were found entangled in nets whereas only 2 live and 7 dead were found in the entire 2007/08 seasons. It is probably important to note here that the only two live muduthu (olive ridley) turtles that were found by Dhimurru in the period of the turtle tracking project were successfully released with transmitters.

- Surveys could have been conducted more frequently in an attempt to reduce the actual mortality rates resulting from entanglement in net during the peak season (April to June). Bi-weekly surveys during this period would be ideal. At present Dhimurru is limited by staff numbers, vehicle availability and other resources which limit the number of surveys that can be undertaken.

- There was also a marked decline in the number of nets encountered this season which may indicate fewer nets being dumped at sea, or could also be due to the removal of net from beaches. This is consistent with high variability between years. A thorough analysis of the data would be needed to ascertain whether a trend is developing.

8. Future Priorities

Turtle recovery in the Dhimurru IPA has been a priority and an annual event since 1996, and will continue for as long as turtles are washing ashore in drift net and Dhimurru continues to operate. As with any project, there is always room for improvement. Some of these improvements include:

1. Streamlined methods of collection and storage of data. Up until now, the main collection of turtle stranding data has been facilitated by the use of turtle stranding data sheets (see appendix 7). In the field these sheets are cumbersome, prone to damage and, as can be seen by the event of 2007, they can be misplaced. Recently Dhimurru has been supplied with a cybertracker (http://www.cybertracker.co.za/). This equipment was sponsored by NAILSMA (North Australia Indigenous Land and Sea Management Alliance). The Cyber Tracker unit collects data in a pre-set format and also collects GPS waypoints whilst the rangers are on patrol. This information is then downloaded from the unit onto a computer, stored and can then be transferred into reports. Dhimurrus' staff require ongoing support and training in the use of this equipment to further streamline collection and collation of data.

2. Variability across the years means that the recovery project is a long term commitment and needs to continue. Dhimurru will look into continuing sources of funding to enable this project and in the short term aid in the ongoing collection of data from the satellite transmitters still in circulation.

3. Resources also need to be secured to begin analyzing data that has already been collected.

4. The tracking project itself should be extended to cover a much larger geographic area so as to guarantee deployment with suitable candidates in a reasonable time frame.

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Appendix 1 Western Cape Bulletin Article September 2008

Turtle Tracking Partnership spans the gulf.

On the 30th of July, 2008 an Olive Ridley Turtle was released from Pennefarther beach north of Weipa, Queensland. The turtle 'Princess' was found in a ghost net that washed up on the beach at the end of February, 2008. Princess had excellent initial care at Pennyfather beach with Angela and Peter Harper, but she was found to have had 'floaters disease' this meant she had air trapped under her shell and could not dive down under the water to be able to feed. This condition was probably caused by her being tumbled around caught in ghost nets then washed up on shore. Princess did not improve over time so Angela and Peter decided while Jennie Gilbert from Cairns Turtle Rehabilitation Centre was at Pennyfather she should be transferred to Cairns where she could be treated by Marlin Coast Vet clinic and monitored daily by Jennie, Paul and Damian. She spent approximately 4 months in rehabilitation and made a very successful recovery. Princess was then flown back to Weipa 'first class' by Qantas-link on tuesday the 29th July.

She was returned to Pennyfather beach where she was found, but not before Princess became a true princess when she was crowned with a very special piece of equipment. In a complex collaboration which spans the world, Princess was fitted with a satellite tracker.

Dhimurru Aboriginal Land Management staff members Patrick White (Sea Ranger) and Vanessa Walsh (Sea Country Facilitator) flew to Weipa to oversee the attachement of the tracker and were warmly hosted by Gary Luchi (Carpentaria Ghost nets Project) and Jennie Gilbert (Cairns Turtle Recovery Centre). Dhimurru is located in Nhulunbuy, East Arnhem Land, and has undertaken a project for the last three years attaching satellite tracker to Olive Ridley Turtles found entangled in Ghost Nets and washed ashore. The purpose of the project is to gain data on the survival rates of these turtles when released from nets, where they travel, the speed of their travel, depth of dives and the amount of time they spend underwater. This project involves close partnerships between NT Parks and Wildlife Service, Swansea University in Wales, Charles Darwin University, The Northern Australian Indigenous Land and Sea Alliance (NAILSMA), Govets and the Carpentaria Ghost Nets Project.

This turtle is slightly different to the turtles previously tracked by Dhimurru as this individual has had the opportunity to recover in a sheltered environment. She was released 10kg heavier than she was found and she was in an extremely healthy and energetic state. The majority of turtles released from ghost nets have suffered injuries of varying degrees, are almost certainly dehydrated and suffering from malnutrition and exhaustion. It will be very interesting to follow princess' progress and compare her travels to those of previously tagged Olive Ridley Turtles. In Australia these animals are classified as endangered so the information becomes invaluable to help these species of turtles.

If you are interested in following Princess' progress, you can access the data she is transmitting on the website: www.cturtle.org/tracking/
Once there scroll down to 'Australian turtle tracking' and you should find her data transcribed onto a map.

Appendix 2 Arafura Times Article

Turtles v's Marine Debris.

With the commencement of the dry season winds, the population of East Arnhem land breaths a collective sigh of relief. The coolness of the evenings and the end of the wet seasons humidity is appreciated by most.

But the end of the wet season also signals a very busy time for Dhimurru's Sea Country Team. The dry season south easterly winds routinely blow discarded fishing nets, commonly known as 'ghost nets', towards our exposed beaches. These unattended nets indiscriminately collect marine life on their deadly journey around our coastline before washing ashore.

One of the most susceptible marine creatures to entanglements is marine turtles. Of the 7 species of marine turtle found in the world, 6 routinely call the Arnhem Land coast home and they travel vast distances between feeding grounds and nesting sites. Some turtles take up to 15 years to reach maturity and they usually return to coastal waters near where they hatched to reproduce. We are fortunate to host many marine turtles during their nesting season around the Arnhem Land coast, but this is also when they are most susceptible to entanglement.

Dhimurru has been managing marine turtle entanglement for over 10 years and with assistance from Parks and Wildlife NT, NAILSMA (North Australia Indigenous Land and Sea Management Alliance) and the Carpentaria Ghost Nets Program, are continuing this work today. This year already rangers have released 6 live marine turtles from ghost nets in the Cape Arnhem (Wanuwuy) region and are conducting weekly patrols to monitor the arrival of any new net. If members of the public come across a ghost net washed up onto the beach, you can check the net for marine turtles which may be entangled. If you do find any, carefully release them and photograph both the turtle and net it was caught in. When convenient, please contact Dhimurru with and provide details of the area in which the net was found and forward photographs for their records.

Dhimurru is also conducting a project which involves the attachment of satellite trackers to Olive Ridley turtles that are found and released from ghost nets. The purpose of this project is to assess the likely survival rates of turtles that have been entangled and track their movements once released.

Along with ghost net surveys, Dhimurru also organises marine debris cleanups targeting specific beaches throughout the year. The next cleanup is planned for Yirrkala Wed 4th June, 2008.

For further information or any queries, please contact Dhimurru on 8987 3992 or check our website www.dhimurru.com.au

Appendix 3: Turtle Stranding Datasheet: *"Troy"* T1/2008

IEET

LOCATION DETAILS:

Recorder/s: Phil, Dhurrut Ness Survey date: 20/4 Net Number: T1 /2008

Location: JIRRKAWUL

Latitude: 12.493594 S Longitude: 136.858606 E

CAUSE OF STRANDING:

Marine debris [✓]

Sample taken [None] ~~GR24~~.

Net ID: GR24

Net length: 5 (m) Net depth: 10 (m)

Necropsy performed [ ]

Turtle condition:

Alive [✓] Dead [ ] Euthanised [ ]

Fresh [ ] Decomposed [ ] Bones only [ ]

Other [ ]

Turtle condition: Alive [ ] Euthanised [ ]

Dead [ ]

Fresh [ ] Decomposed [ ] Bones only [ ]

Necropsy performed [ ]

Necropsy results: ______

TURTLE ID

Olive ridley [✓]

Hawksbill [ ]

Green [ ]

Flatback [ ]

Loggerhead [ ]

Leatherback [ ]

Unknown [ ]

Other animals [ ]

Please list:

______ size ______ cm

______ size ______ cm

______ size ______ cm

______ size ______ cm

______ size ______ cm

______ size ______ cm

Head width at widest point 10 cm

Prefrontal scale pairs # 2

Genetic sample taken

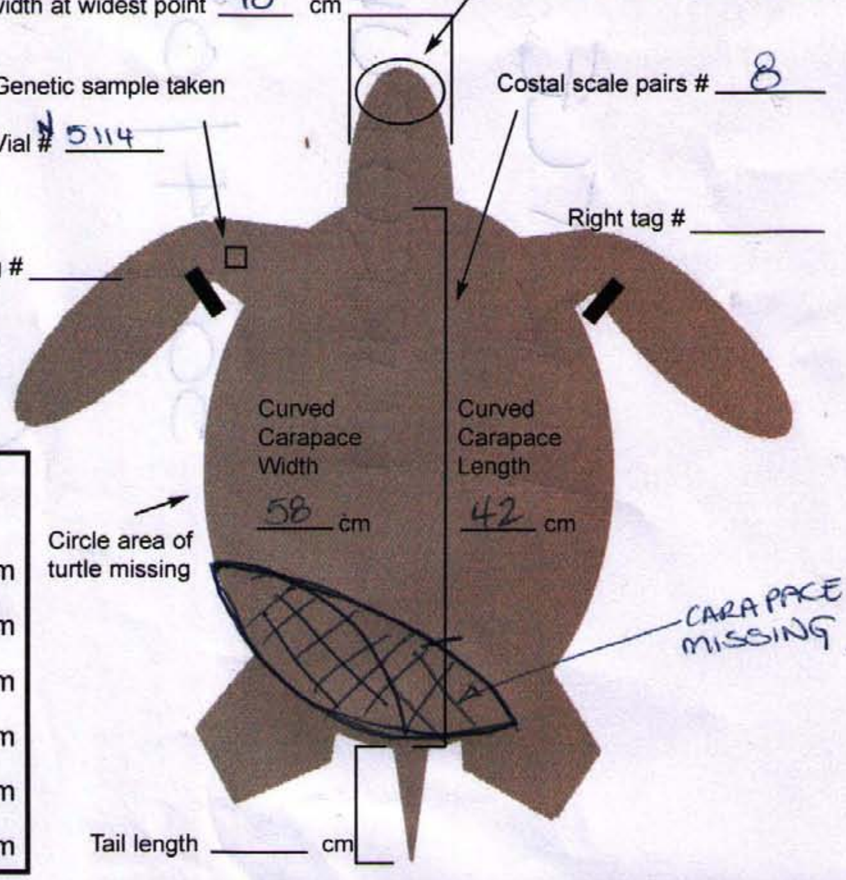
Vial # 5114

Costal scale pairs # 8

Right tag # ______

Left tag # ______

Circle area of turtle missing



Tail length ______ cm

Photo taken [✓]

Comments: Even with partial carapace missing very strong and deep flipper wound

Appendix 4: Turtle Health Assessment Protocol: *"Troy"* T1/2008

Turtle Health Assessment Protocol

Mentation

T(1) 2008.

How alert is the turtle?	1	2	(3)
	Turtle is despondent. There is minimal effort to resist and head legs and tail do not retract in to carapace.	Movements are slow though resists handling. Attempts to retract head legs and tail in to carapace but is easily removed	Moves quickly when approached and handled. Retracts head, legs and tail in to carapace when handled and strongly resists removal
Can it swim?	1	2	(3)
	Minimal effort is made to swim but floats passively on release and head does not lift to breathe	Turtle can swim but with out vigor or may swim in circles	Turtle can swim well and on an even keel and lift its head to breathe
Is there a corneal reflex?	1	2	(3)
	The eye ball does not retract when cornea is touched	The corneal reflex is present but slow	The eyeball retracts immediately when cornea is touched
Head & limb carriage	1	2	(3)
	The turtle can not lift its head. Legs hang limply when turtle is lifted	The head sometimes is raised above horizontal. There is reduced tone in legs when turtle is lifted	The head is raised above horizontal. Legs held with even tone when turtle is lifted

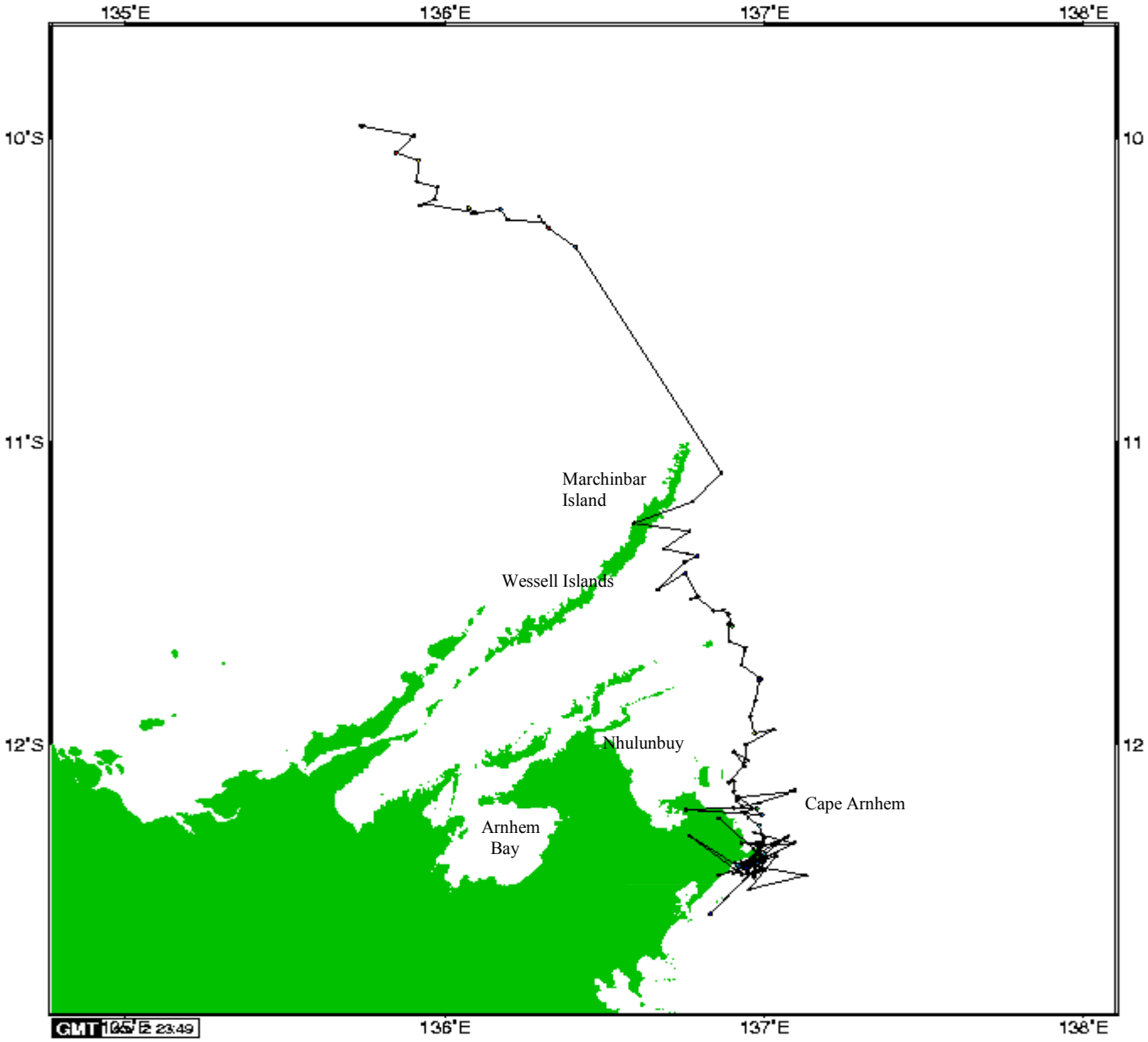
Body Condition

Is the turtle dehydrated?	1	2	(3)
	The skin stands up in multiple folds and appears to stick. Eyes are sunken.	When pinched the skin stands up and sticks but very slowly retracts again. Eyes are minimally sunken.	The skin retracts back to original position when pinched and eyes are not sunken
Is there muscle wastage?	1	(2)	3
	The supraoccipital process at back of head is very prominent. The plastron is concave with prominent bone structure and there appears to be minimal muscle at the front of flippers. Neck is sunken in.	The supraoccipital process has reduced muscle coverage. The plastron is possibly slightly concave but bone structure is not obvious. There is some muscle over front flippers but the muscle is not well rounded. Neck is mildly sunken in.	The supraoccipital process at the back of the head is well covered though still palpable. The plastron is flat to convex. The front of flippers and neck are well rounded with muscle .

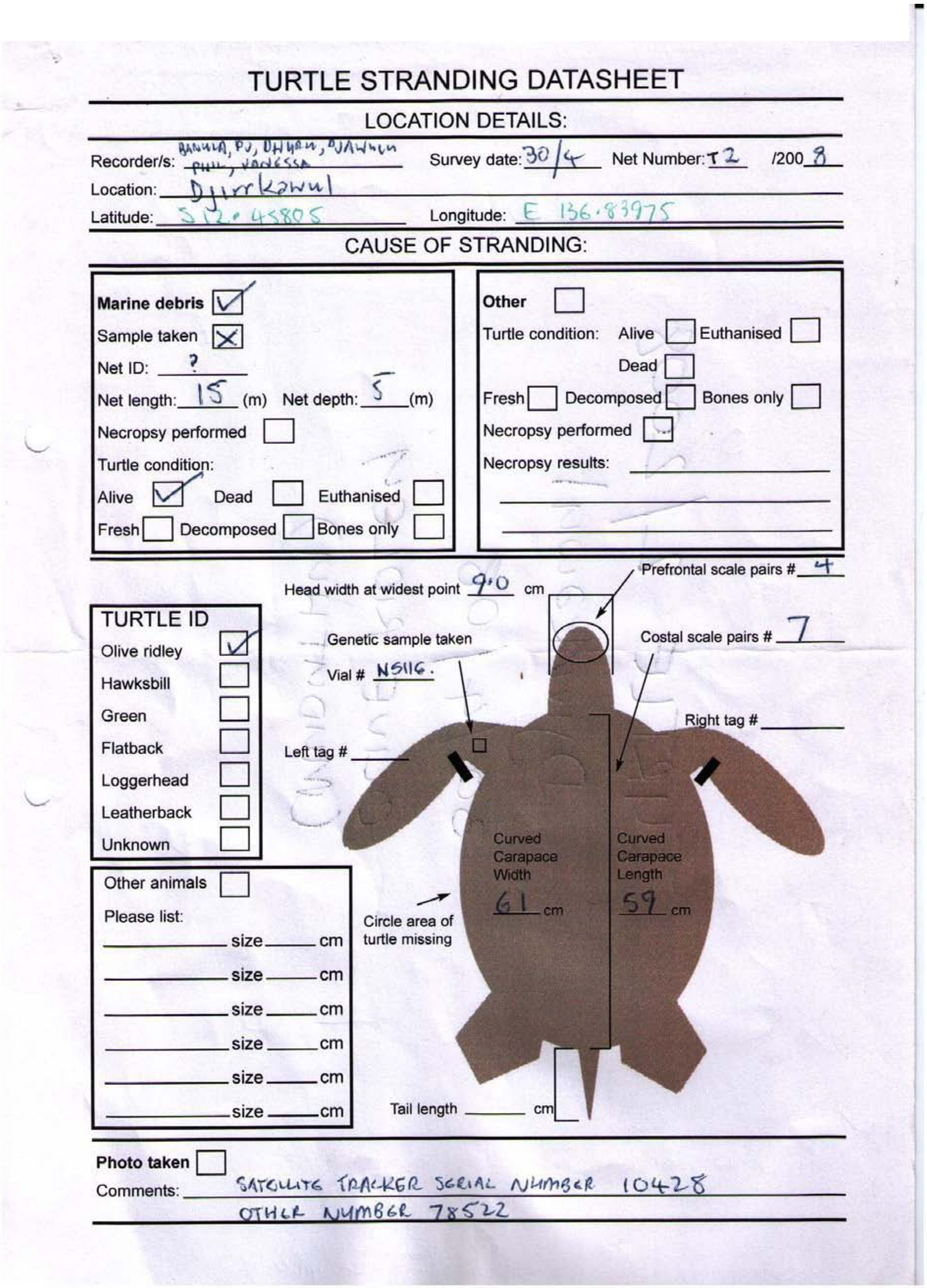
External Appearance

Signs of external trauma?	OLD DAMAGE TO CARAPACE - WELL HEALED -Damage recent to flippers - deep cuts. (1) (circled)	2	3
	Multiple cuts and abrasions over flippers and/or head or lesions present are large, deep and severe	Several small cuts and abrasions over body noted but appear to be superficial	No external cuts or abrasions noted over body
Fibropapillomatosis lesions noted?	1	2	3
	More than 2 lesions found or lesion found >1cm or with the potential to restrict function	Suspicious lesion(s) on turtle noted but either very few in number or very small	No lesions detected
Any external parasites? **Eg copepods, algae, barnacles**	1	Evidence of algal growth below water line. (2) (circled)	3
	The carapace has a water line where parasites are attached below this or parasites are numerous over whole body. There are numerous barnacles attached.	A couple of barnacles may be attached, minimal evidence of other parasites	There is no evidence of external parasites.
Body Temperature	1	2	3
	>35 degrees	25 – 35 degrees	12 – 25 degrees

Appendix 5: Data returned turtle tu42-2190-08 *"Troy" T1/2008*



Appendix 6: Turtle Stranding Datasheet: *"Troy"* T1/2008



TURTLE STRANDING DATASHEET

LOCATION DETAILS:

Recorder/s: BANULA, PJ, DHUAN, DJAWULU PHIL, VANESSA   Survey date: 30/4   Net Number: T2   /2008

Location: Djirrkawul

Latitude: S 12.45805   Longitude: E 136.83975

CAUSE OF STRANDING:

Marine debris [✓]
Sample taken [x]
Net ID: ?
Net length: 15 (m)   Net depth: 5 (m)
Necropsy performed [ ]
Turtle condition:
Alive [✓]   Dead [ ]   Euthanised [ ]
Fresh [ ]   Decomposed [ ]   Bones only [ ]

Other [ ]
Turtle condition: Alive [ ]   Euthanised [ ]   Dead [ ]
Fresh [ ]   Decomposed [ ]   Bones only [ ]
Necropsy performed [ ]
Necropsy results:

TURTLE ID
Olive ridley [✓]
Hawksbill [ ]
Green [ ]
Flatback [ ]
Loggerhead [ ]
Leatherback [ ]
Unknown [ ]

Head width at widest point 9.0 cm
Prefrontal scale pairs # 4
Genetic sample taken
Vial # N5116.
Costal scale pairs # 7
Left tag # ____
Right tag # ____
Curved Carapace Width 61 cm
Curved Carapace Length 59 cm
Circle area of turtle missing
Tail length ____ cm

Other animals [ ]
Please list:
____ size ____ cm
____ size ____ cm
____ size ____ cm
____ size ____ cm
____ size ____ cm
____ size ____ cm

Photo taken [ ]
Comments: SATELLITE TRACKER SERIAL NUMBER 10428
OTHER NUMBER 78522

Appendix 7: Turtle Health Assessment Protocol: *"Anggi"* T2/2008

Turtle Health Assessment Protocol

T 2/2008

Mentation

How alert is the turtle?	1	(2)	3
	Turtle is despondent. There is minimal effort to resist and head legs and tail do not retract in to carapace.	Movements are slow though resists handling. Attempts to retract head legs and tail in to carapace but is easily removed	Moves quickly when approached and handled. Retracts head, legs and tail in to carapace when handled and strongly resists removal
Can it swim?	1	(2)	3
	Minimal effort is made to swim but floats passively on release and head does not lift to breathe	Turtle can swim but with out vigor or may swim in circles	Turtle can swim well and on an even keel and lift its head to breathe
Is there a corneal reflex?	1	2	(3)
	The eye ball does not retract when cornea is touched	The corneal reflex is present but slow	The eyeball retracts immediately when cornea is touched
Head & limb carriage	1	(2)	3
	The turtle can not lift its head. Legs hang limply when turtle is lifted	The head sometimes is raised above horizontal. There is reduced tone in legs when turtle is lifted	The head is raised above horizontal. Legs held with even tone when turtle is lifted

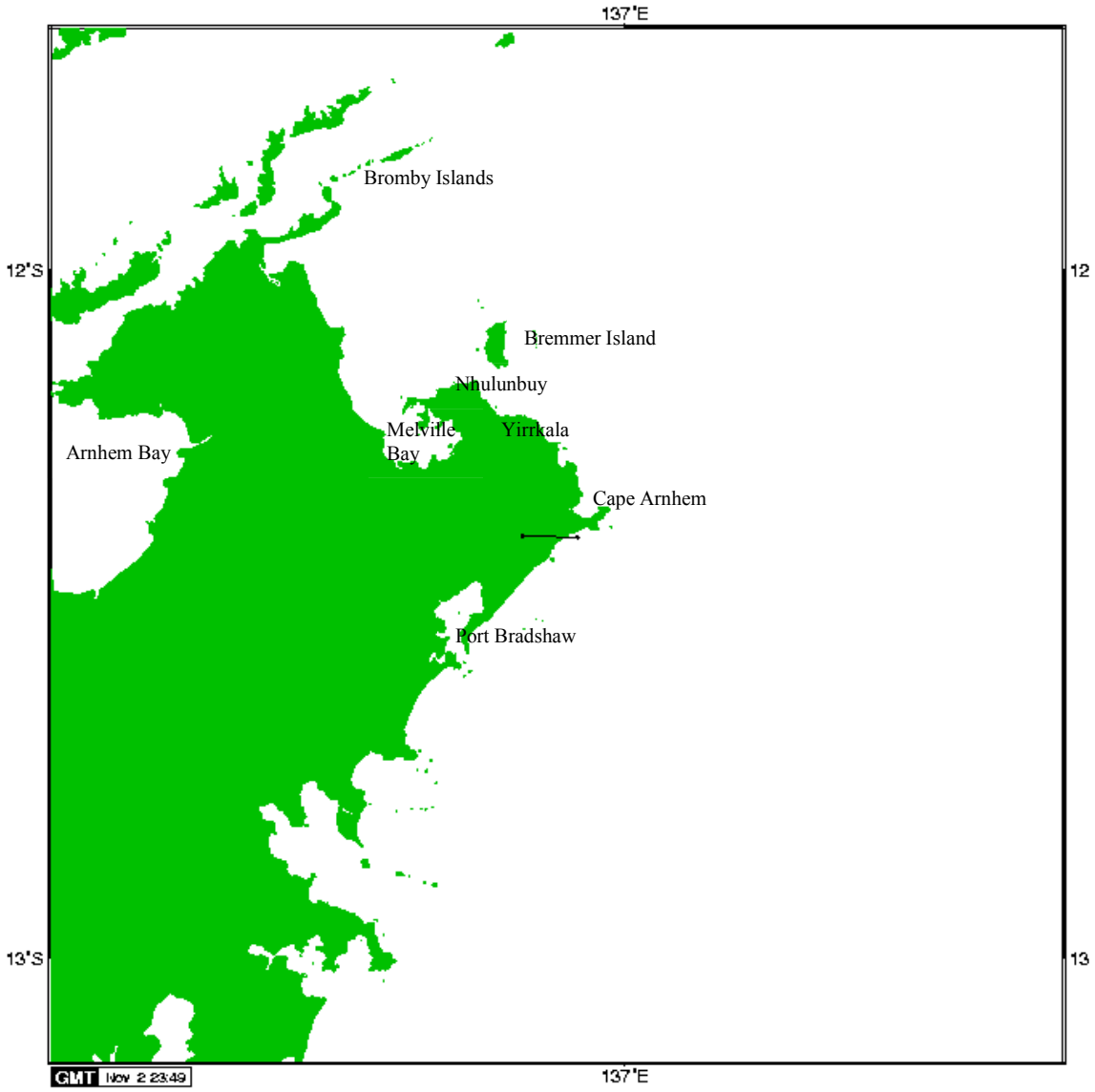
Body Condition

Is the turtle dehydrated?	1	(2)	3
	The skin stands up in multiple folds and appears to stick. Eyes are sunken.	When pinched the skin stands up and sticks but very slowly retracts again. Eyes are minimally sunken.	The skin retracts back to original position when pinched and eyes are not sunken
Is there muscle wastage?	1	(2)	3
	The supraoccipital process at back of head is very prominent. The plastron is concave with prominent bone structure and there appears to be minimal muscle at the front of flippers. Neck is sunken in.	The supraoccipital process has reduced muscle coverage. The plastron is possibly slightly concave but bone structure is not obvious. There is some muscle over front flippers but the muscle is not well rounded. Neck is mildly sunken in.	The supraoccipital process at the back of the head is well covered though still palpable. The plastron is flat to convex. The front of flippers and neck are well rounded with muscle .

External Appearance

Signs of external trauma?	1	2	3
	Multiple cuts and abrasions over flippers and/or head or lesions present are large, deep and severe	Several small cuts and abrasions over body noted but appear to be superficial	No external cuts or abrasions noted over body
Fibropapillomatosis lesions noted?	**1**	**2**	**3**
	More than 2 lesions found or lesion found >1cm or with the potential to restrict function	Suspicious lesion(s) on turtle noted but either very few in number or very small	No lesions detected
Any external parasites? **Eg copepods, algae, barnacles**	**1**	**2**	**3**
	The carapace has a water line where parasites are attached below this or parasites are numerous over whole body. There are numerous barnacles attached.	A couple of barnacles may be attached, minimal evidence of other parasites	There is no evidence of external parasites.
Body Temperature	**1**	**2**	**3**
	>35 degrees	25 – 35 degrees	12 – 25 degrees

Appendix 8: Data returned turtle tu42-29358-08 “Anngi” T2/2008



10424

Tracker no 7852 1.

MARINE WILDLIFE STRANDING AND MORTALITY REPORT

DOLPHINS, WHALES, DUGONG, TURTLES, SEA BIRDS, SEASNAKES

631(8).

DATE 9/4/08 TIME: _____

"Princess" data-sheet

SPECIES

Turtle		Mammal		Other species	
green	☐	dugong	☐	seasnake	_____
loggerhead	☐	dolphin	☐	seabird	_____
hawksbill	☐	species	_____		
flatback	☐	whale	☐	other	_____
ridley	☒	species	_____		
leatherback	☐	unidentified	☐		
unidentified	☐				

TAG NUMBER: K94409 R3
K94406 L3

SEX

female ☐ male ☐ unknown ☐

MATURITY

immature ☐ adult ☐ unknown ☐

LATITUDE ____° ____'S

LONGITUDE ____° ____'E

Dugong Protection Area ☐

LOCATION: exact description required _____

ALIVE ☐
DEAD ☐

Condition/behaviour: _____

The following coding can be used to code beach washed carcasses

1 Live but subsequently died ☐
2 Carcass in good condition (fresh/edible) ☐
3 Carcass fair (decomposed but organs intact) ☐
4 Carcass poor (advanced decomposition) ☐
5 Mummified carcass (skin holding bones) ☐
6 Disarticulated bones (no soft tissue remaining) ☐

NOTES: Transfered from Wiepa to Cairns Sea Turtle Rehab via Qantas Link

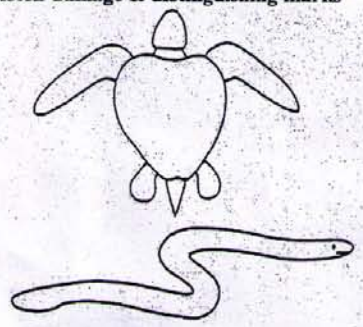
SECURITY/DISPOSAL of animal : _____

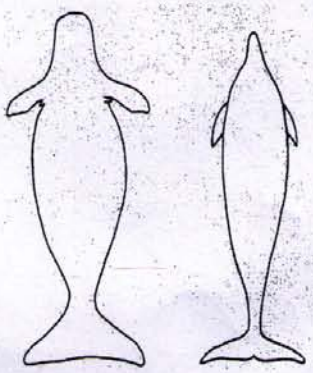
EXPERT ASSESSORS : _____

MEASUREMENT :

Turtle	carapace 54 cm	Tail 9 cm	Head width 9.2 cm	CCW 58 cm	
Mammal	body length ____ cm				
Seasnake	body length ____ cm				

Sketch damage & distinguishing marks





Sent Back to Wiepa for release on 29/7/08 via Qantas Link.

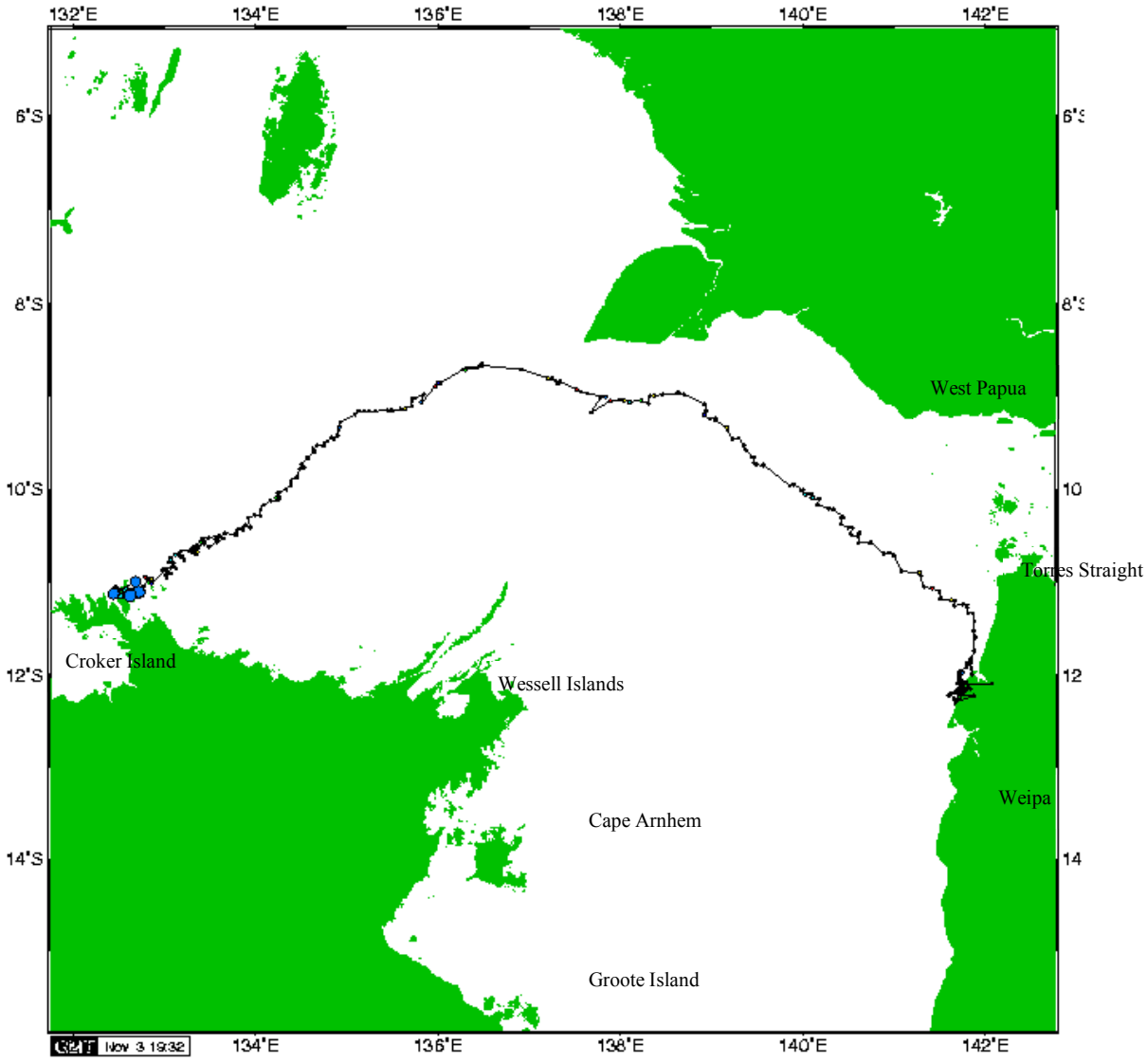
Contact : Name _____ Phone _____

Address _____

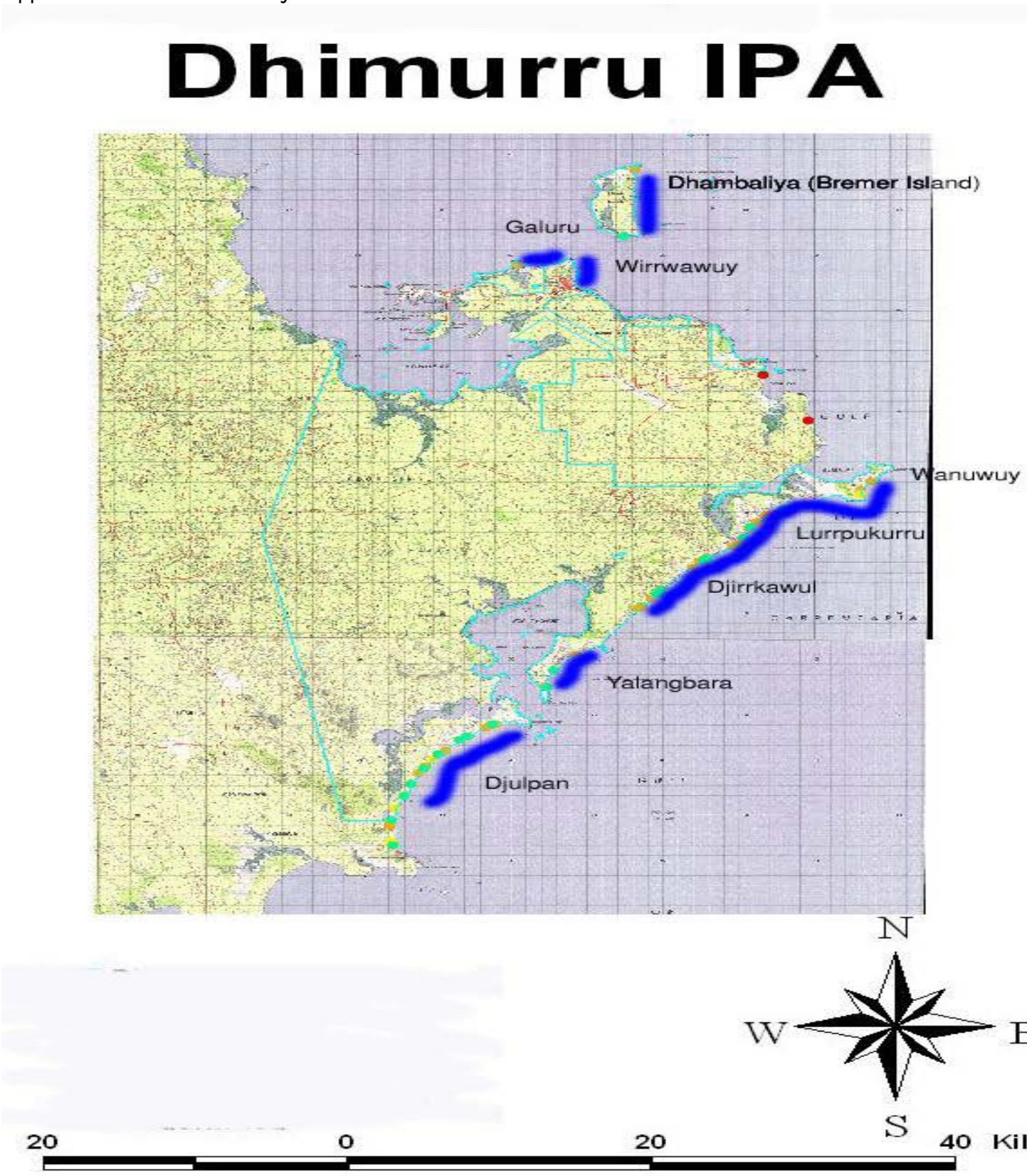
Distribution Check List

☐ Faxed immediately to: QPWS Planning and Research Division, Fax: 3247 5966
☐ Original sent to District Manager (Hinchinbrook): PO Box 5391 Townsville MC Q 4810
☐ Details distributed to "Stranding Internal" group via e-mail
☐ Details recorded on District data base and stranding file

Appendix10: Turtle tracking data: tu42-B-06 *"Princess"*



Appendix 11 Turtle Recovery Area



April 2009
Dhimurru Turtle Entanglement Report
Dhimurru Turtle Tracking Report

Dead turtle found at Cape Arnhem during a survey in 2008

Sea Country Ranger, PJ Ganbilpil White, filling out turtle stranding data sheet Cape Arnhem 2008

Keeping turtle cool as resin dries on transmitter. Cape Arnhem late April 2008

Typical injuries inflicted on flippers whilst animal entangled in net. This turtle was one of the muduthu (olive ridley) turtles to which a transmitter was attached. Cape Arnhem 2008

Princess. Muduthu (olive ridley) turtle rescued from Penne Father beach, Weipa Qld and rehabilitated at the Cairns Turtle Recovery facility. Penne Farther beach July 2008

Napranam ranger Angela and Dhimurru ranger PJ White preparing to release Princess. Penne Farther Beach July 2008.