Final NHT Report

Australian Government

Department of the Environment and Water Resources

Sea Turtle Conservation and Education on the Tiwi Islands

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WWF

TIWI LAND COUNCIL

COASTCARE

Australian Government
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Natural Heritage Trust
Helping Communities Helping Australia
An Australian Government Initiative

1.0 Introduction

Several key components led to the development of sea turtle conservation work and the development of this Natural Heritage Trust project on the Tiwi Islands; 1) a large population of endangered olive ridley turtles in an accessible location, 2) a successful marine ranger program already established on the Tiwi Islands, 3) a successful satellite tracking study conducted in 2004, 4) a desire and interest of Tiwi Traditional Owners to manage their own sea turtle stocks and 5) a lack of sea turtle educational material and resources on the Tiwi Islands.

The Tiwi Islands are located approximately 80 km to the north of Darwin in the Northern Territory (NT), Australia (Figures 2 and 3). Two islands, Bathurst and Melville, make up the Tiwi Islands, with Melville the second largest island in Australia, after Tasmania. The Tiwi Islands was proclaimed an Aboriginal Reserve in 1912. Tiwi is the main language spoken on the islands. The population of the islands is approximately 2,700. The four settlements are Nguiu and Wurankuwu on Bathurst Island and Pirlangimpi (Garden Point) and Milikapiti (Snake Bay) on Melville Island.

Previous work in 2004 (Chatto 2004; Whiting *et al*. 2005) confirmed previous reports by Chatto (1997) that olive ridley (*Lepidochelys olivacea*) turtles nest in relatively high densities at Cape Van Diemen on the Tiwi Islands. Little is known about the biology of olive ridley sea turtles in Australia with key nesting areas still largely unknown and for those that are known there has been little detailed investigation conducted. There are currently no long term studies on the nesting or feeding biology of this species in Australia.

The Tiwi Land Council Marine Ranger Program (Figure 1) was the first Indigenous Marine Ranger Programme in the NT. It commenced in 2001 in response to the desires of Traditional Owners to take a more active role in sea country management. The Tiwi program was so successful that it became the model for other Marine Ranger Programs around the Top End of the NT. The program directly employs two full time rangers, and two trainees through the Community Employment Development Programme. From January 2006 the two trainee rangers will go on to unsubsidised trainee salaries. Both ranger teams are based on Melville Island, at Pirlangimpi and the other at Milikapiti. The program is supported by NT Fisheries and the Tiwi Land Council. The program is involved with many projects which include: sea turtle research, weed control, feral animal control (dogs, pigs and cane toads), mitigation of coastal erosion and coastal surveillance. This program has been very successful and won the Northern Territory Coastcare Award in 2004.

Figure 1. Marine Ranger Vessel Pirlangimpi

The Tiwi Islanders continue to exercise their rights to customary harvest of sea turtles and dugongs. Anecdotal evidence and some scientific reports indicate that green turtles are the main turtles harvested in the water while eggs of any species of turtles are taken periodically. Dugongs are also taken periodically. To manage any population of animals it is important to understand the dynamics of the population by gathering as much information as possible. One of the most important is to understand mortality which includes both natural and human induced. There are no locations in Australia which currently have a good understanding of the harvest rates of the turtles, turtle eggs and dugongs. The Tiwi Traditional Owners have been a driving force behind learning more about this mortality.

There are few sea turtle educational resources available that are specific to Australia and much fewer that are developed specifically for Aboriginal Communities. The Tiwi Land Council, Pularumpi School, Munipi Art Centre and Coastcare NT saw a need for this to be developed specifically for the Tiwi Islands with a variety of educational activities.

The Natural Heritage Trust funds awarded to WWF-Australia and the Tiwi Land Council were to address the following services related to sea turtle conservation and education under the following four broad topics.

1) On-ground Monitoring of Turtles Nesting at Melville Island.
2) Satellite Tracking Olive Ridley Turtles.
3) Indigenous Harvest of Dugong and Marine Turtles.
4) Community Participation and Engagement in Turtle Conservation.

2.0 Methods

Study Site

Most of the sea turtle research was conducted on Cape Van Diemen (Figures 2, 3 and 4), which is the most northerly point of the Tiwi Islands and is located approximately 30 km from the nearest community of Garden Point (Pirlangimpi). The beach was accessed by the Tiwi Land Council boat and Marine Ranger Jack Long as the driver.

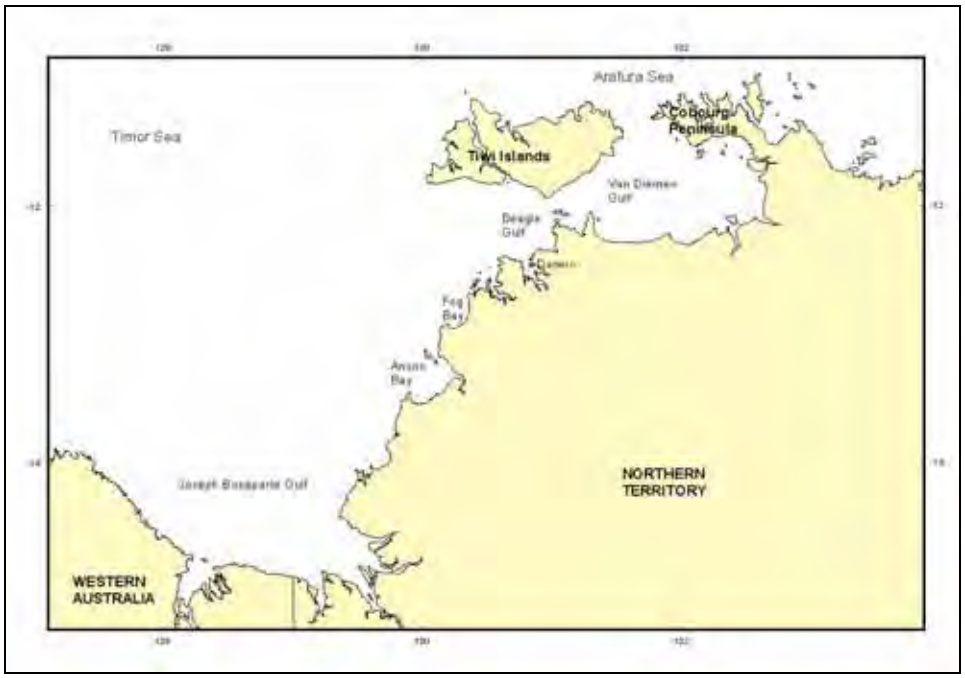

Figure 2. Location of Tiwi Islands in the Northern Territory

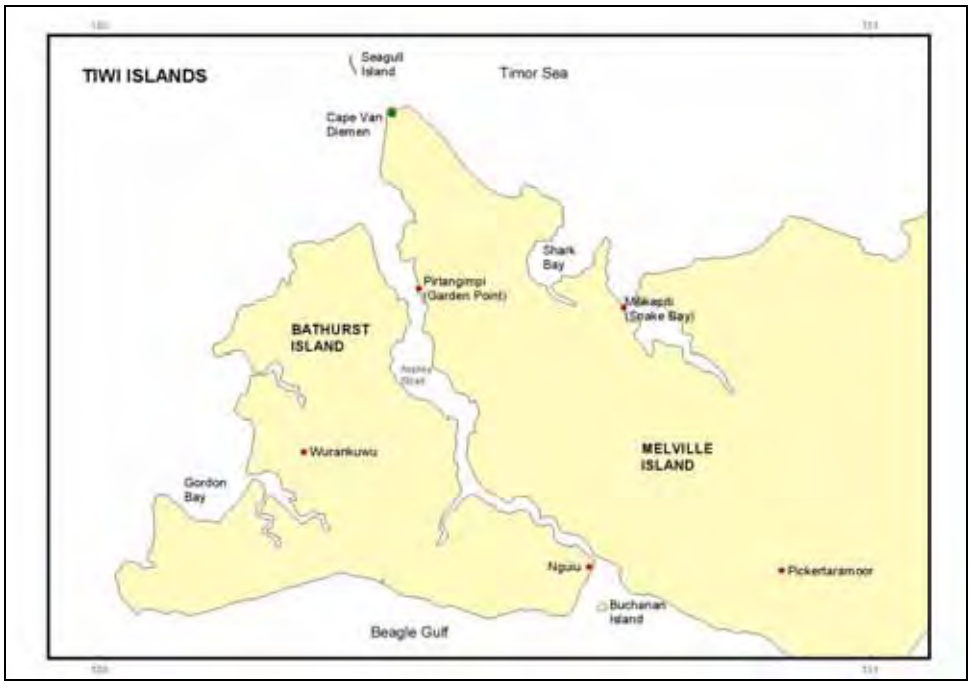

Figure 3. Location of Cape Van Diemen on Melville Island, Tiwi Islands

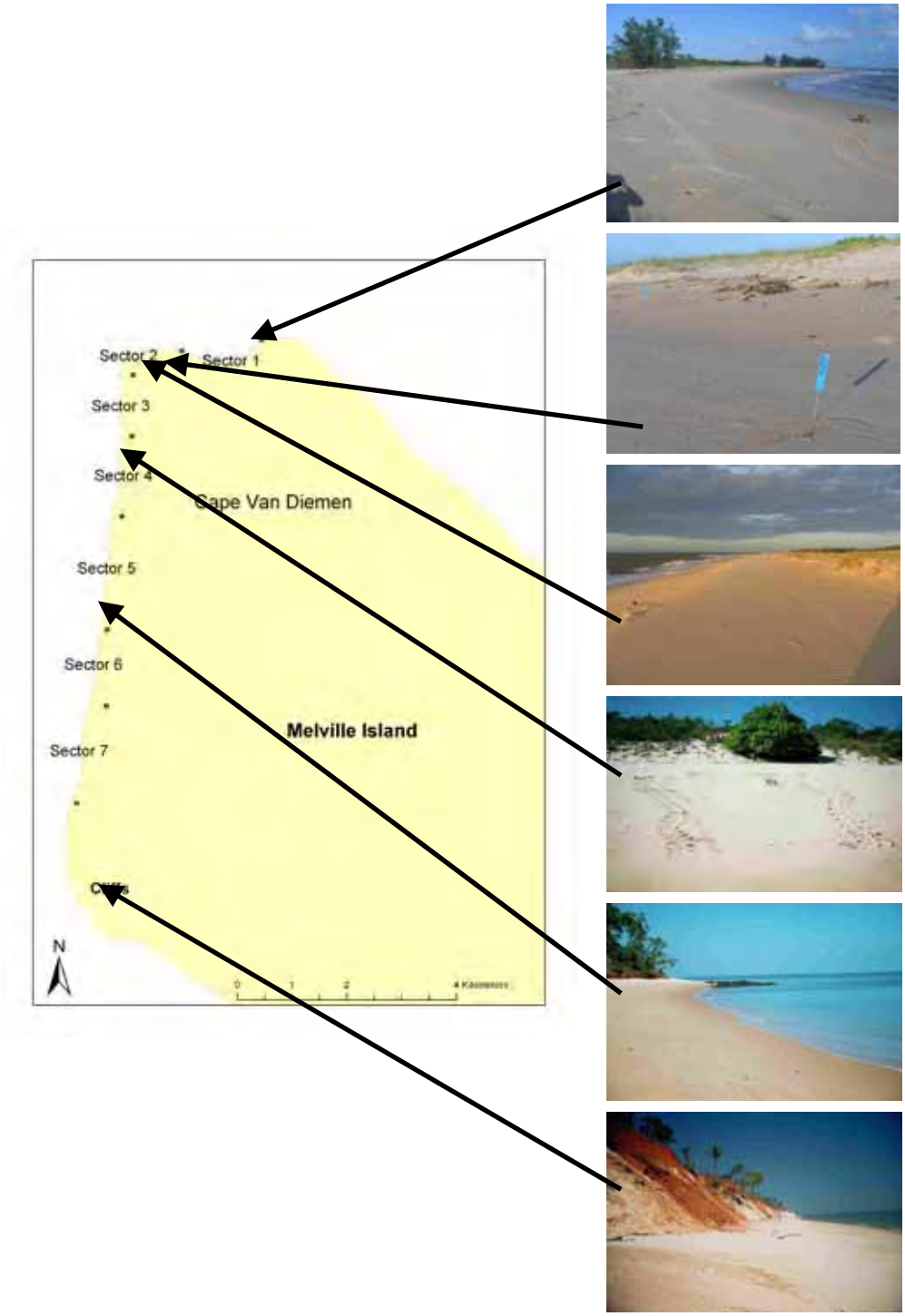

Figure 4. Map of study area at Cape Van Diemen. Sector 2 is the location of the densest sea turtle nesting and this was the focus of the intensive study. This map shows some of the coastline found in this area.

2.1 On-ground Monitoring of Turtles Nesting

Track Counts

Track counts made every fortnight in 2004 and periodically in 2005 were used to determine the species composition of nesting turtles and the length of the nesting season and to identify any peak nesting period in the season (Figures 5 and 6). Track counts were conducted with Marine Ranger Jack Long, Andy Lauder (Coastcare) and Kate Hadden (TLC). Tracks were categorised as being fresh (last night) or old (older than one night).

Figure 5. Olive ridley track

Figure 6. Olive ridley track with predation by feral dogs

Biological Data Collection

Adult nesting turtles were tagged on each of the front flippers with individually numbered titanium tags (Limpus 1992), the curved carapace length (ccl) and width measured (+/- 0.5 cm) measured (Limpus *et al.* 1983 and 1984) and weighed using a 100 kg (+/-0.5 kg) hanging balance. Extra measurements were made on a sample of 11 turtles to gather a standard set of measurements to allow comparisons to other populations in Australia and overseas at a later date. These measurements included straight carapace length (scl), straight carapace width (scw), head length (hl), head width (hw), plastron length (pl), tail length (carapace to tip), tail length (plastron to tip), tail length (vent to tip). Scale counts were also conducted using the nomenclature of Marquez (1990).

Clutch counts were made by excavating the nest after oviposition. The eggs were placed in rows of ten (Figure 7) and 10 eggs were randomly chosen to be measured and weighed. The sand from each of these eggs was removed (Figure 8) from the eggs using a soft brush. Eggs were measured using vernier callipers (+/-0.01) (Miller 1999) (Figure 9) and weighed using a Pesola spring balance (+/-0.5g). All procedures were conducted under Animal Ethics Approval from Charles Darwin University and under a Permit to interfere with wildlife from Parks and Wildlife NT.

Marine Ranger Jack Long as well as Kate Hadden (TLC) and Andy Lauder (Coastcare) were trained in tagging and collecting biological data from nesting beaches.

Nest success was determined using categories proposed by Miller (1999) (Table 1).

Table 1. Categories and definitions proposed by Miller (1999)

E = Emerged	Hatchlings leaving or departed from nest
S = Shells	Number of empty shells counted (>50% complete)
L = Live in nest	Live hatchlings left among shells (not those in neck of nest)
D = Dead in nest	Dead hatchlings that have left their shells
UD = Undeveloped	Unhatched eggs with no obvious embryo
UH = Unhatched	Unhatched eggs with obvious embryo (excluding UHT)
UHT	Unhatched apparently full term embryo in egg shell or pipped (with a small amount of external yolk material)
P = Depredated	Open, nearly complete shells containing egg residue

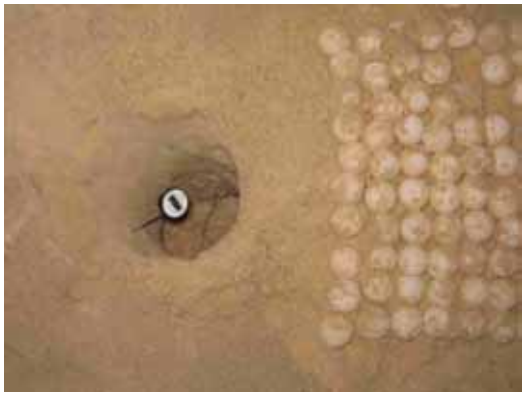

Figure 7. Clutch count and nest temperatures

Figure 8. Cleaning the sand from an egg to allow measurement

Figure 9. Measuring an olive ridley turtle egg

2.2 Satellite tracking of Olive Ridley Turtles

A new attachment system was made based on the existing epoxy method. The new transmitters are smaller (Figure 10) that the previous version used and for this reason

a large base for the transmitter was needed for greater adhesion (Figure 11). This was designed based on a mould from an olive ridley turtle from the NT Museum.

Figure 10. New satellite transmitters from Wildlife Computers, USA

Figure 11. New trial attachment plate designed for olive ridley turtles

The deployment of the transmitters was delayed by several weeks from the proposed schedule because of several reasons: 1) the shipment of transmitters was delayed through Australian Customs and then with shipment to Darwin from Melbourne, 2) the new shape of the transmitter meant that more time has been spent on modifying the existing attachment method to ensure longer attachment and 3) errors were discovered in the Argos data processing while test trials were conducted.

Between June and July 2005, satellite transmitters (Platform Terminal Transmitters – PTT, KiwiSat 1.0W by SirTrack, New Zealand) were applied to three olive ridley turtles at the completion of their nesting activity at Cape Van Diemen, on Melville Island. The transmitters included a duty cycle to save battery power, to facilitate a longer tracking period and maximise the number of locations when the turtle was making its post-nesting migration. A saltwater switch saved battery power by turning the transmitter off when the turtle was underwater. Data was collected via a French satellite system called ARGOS which includes seven polar orbiting satellites (Anon. 1996). ARGOS calculates each location and classes their accuracy based on the number of signals the satellites receive from the transmitter in a single pass. The accuracy of each of the location classes are LC3 (150 m), LC 2 (350 m), LC 1 (1000 m) and LC 0 (>1000 m) LC A (unknown) and LC B (unknown) (Anon. 1996). Only LC 3, LC 2 and LC 1 location classes were used to plot locations and calculate speeds and distances. LC 0 location classes were used in addition to the other classes to determine the length of time that a turtle stayed in the foraging area when data was lacking.

Two types of transmitters were used. The first was a Kiwi Sat from SirTrack in New Zealand (the same as those used in 2004 -Whiting *et al.* 2005) while the second type was a Cricket Tag from Wildlife Computers in the USA. The first transmitter was attached using Powerfast® epoxy (Mitchell 1998) while the other two were attached using a polycarbonate base and using Powerfast® epoxy to attach the unit to the turtle. The carapace of each turtle was scrubbed using a brush and scourer and wiped with acetone to provide a clean surface for the epoxy. The carapace and the moulded base of the transmitters were roughened to increase the adhesion properties of both surfaces. Using the first method, the transmitter was turned upside down and Knead-It (repair putty) was used to form a bead around the base of the transmitter and the

epoxy was applied to the base of the transmitter on the inside of the bead. This bead ensured that when the transmitter was turned over and placed on the carapace that the epoxy did not run out the sides and form an uneven base for the transmitter. All turtles that had transmitters attached with epoxy were kept on the beach for 60 minutes.

The tracking information was automatically downloaded from ARGOS via a non-profit organisation called “Seaturtle.org” that used their own computer program to sort the ARGOS data into fields. Data was then downloaded from Seaturtle.org for analysis. Swim speeds and distances travelled were calculated for different periods. The renesting interval was determined as the number of days between a successfully laid clutch and the next nesting attempt.

Maps were produced using Maptool (online GIS, www.seaturtle.org) and ArcView 9.1 Software (ESRI, Calfornia, USA). Preliminary homerange analysis was conducted using Biotas software (Ecological Solutions). Minimum Convex Polygon and Harmonic Mean Analysis were used to describe home ranges.

Marine Ranger Jack Long (TLC), Kate Hadden (TLC) and Andy Lauder (Coastcare) assisted in the attachment of transmitters. It was initially proposed that a trainee ranger would also assist with this component of the project. However, a suitable candidate was not found during this period which resulted in a variation of contract and the GIS component substituted. Therefore, a trainee ranger did not help with this component of the project.

All procedures were conducted under Animal Ethics Approval from Charles Darwin University and under a Permit to interfere with wildlife from Parks and Wildlife NT.

2.3 Indigenous Harvest

Discussions and meetings were held both informally and formally throughout the study period. There were three main types of discussions: 1) Initial discussions between Kate Hadden, Scott Whiting and Andy Lauder with Cyril Kalippa (hunter and Traditional Owner), 2) visits to communities by Kate Hadden to talk to the hunters and Traditional Owners and 3) ongoing discussions by Kate Hadden with Traditional Owners and between Traditional Owners at TLC meetings (including two formal sessions attended by 32 Tiwi Island leaders). Each is discussed below in the results.

The gathering of Traditional harvest data progressed through a series of stages. Cyril Kalippa was employed as the interim Tiwi Liaison Officer for Indigenous harvest monitoring and developed initial protocols for the engagement of members of the Tiwi Community. Initial discussions were held with four senior members from each of the eight Traditional Owner groups, representing all clan estates, communities and outstations. Discissions and outcomes included perceptions of hunting activity and impact, identification of key hunting areas, general support for the collection of data, and a willingness to use the data for management discussions. Advice was also received about the proposed methods of data collection.

Three key people were initially selected to regularly fill out harvest data forms. Sample sheets were trialled, and simplified a number of times in consultation with the

collectors. The forms were eventually dismissed because they may have biased the surveys by having a lower number of reports filled out, and anecdotal evidence indicated that a lot of data was not being collected. Subsequently, Kate Hadden and Cyril Kalippa visited each of the communities to discuss the issues of Traditional Hunting and the lack of information.

A suitable methodology was finally determined on advice from the communities, data collectors and hunting groups. It was clear that verbal interview's with hunters/ hunting groups was the best method of gathering information. There were several reasons for this:

1. they were not biased on the level of literacy of the hunters,
2. hunters were comfortable talking about their hunting with someone they knew and trusted, but were suspicious about forms being filled out,
3. reports could be easily crossed referenced with other hunters to check validity and accuracy (often concurrently),
4. they could be obtained easily and were not depended on hunters handing in reports,
5. further information and general observations about areas visited were volunteered at every interview, and
6. there is a limited number of hunters in each community, and each hunting group is widely known.

Small cash payments were made to the hunters for each interview. This was essential for a number of reasons:

- Hunters are all Traditional Owners and Traditional Owner consultation is a remunerable activity,
- Payment reinforces the importance placed on the information by the Land Council, and encourages accuracy,
- Payment ensures that all hunters are included,
- Payment encourages hunters to volunteer information, rather than respond to a request, and
- Other community members comment on the accuracy of the information because payment is involved.

Geographic Information System – altered Harvest component

The development of a Geographic Information System (GIS) was not in the original proposal for this project. The decision to set up a GIS was only made in December 2005 as a result of the Indigenous Harvest component of the contract being undertaken differently, resulting in some unspent funds. An approval to amend the existing contract was received.

Work on implementing a Geographic Information System (GIS) started in December 2005. A review of the existing GIS datasets was undertaken and new installation CD's were obtained from ESRI Australia.

The Tiwi Land Council already had a substantial amount of GIS data but is currently not using it due to the previous laptop being stolen with the data and software on it, lack of skills, time and staff.

This component of the project undertook two main objectives:

- Setting up an easy to use and maintain GIS, and
- Incorporating the Indigenous Harvest data and hunting records into the GIS.

GIS Set up

The GIS set up and training was conducted on the Tiwi Islands in March 2006. Software was installed on two computers and further licences will be looked into once additional sea rangers are employed. GIS training was delivered to the Tiwi Land Council Rangers and staff.

A training manual was drafted and this formed the basis of the training. This will also act as a ready reference for questions and queries as the GIS is being maintained.

GecOz, Geospatial and Environmental Consultants Australia have agreed to assist with the training and implementation of the GIS.

Incorporating Scientific and Indigenous Harvest data

The Tiwi's used a standard form for collecting Indigenous Harvest data; this form was used as the basis for developing an appropriate data capturing tool that would work in conjunction with the GIS.

The information targeted for the GIS is the location of hunting activities, number of each species caught and the age class of these species (juvenile, adult, calf or egg). This information will be able to be easily displayed on the GIS and built upon should the Traditional Owners want further analysis performed.

The rangers were given training in transferring this information from the form to the GIS.

2.4 Community Involvement and Education

Community involvement and education is a major component of any community project.

Initially it was proposed to do a full year of activities but the Traditional Owners, the Munipi Artists, school staff, Tiwi Land Council and Coastcare agreed that a more concentrated effort was needed which would culminate in an educational camping trip to a turtle beach.

Pularumpi school activities

The Pularumpi School and Coastcare planned curriculum activities for the whole of Terms 1 and 2 based around a sea turtle theme with emphasis on threats and conservation.

The school activities included:

- Art and craft in combination with the Munupi Art Centre,
- Story writing,

- Research and fact finding about turtles,
- Developing a Pantomime about the life cycle of sea turtles, including all of the challenges that they face during their life, and
- Organising and participating in a school camp that's main role was promoting sea turtle awareness and conservation.

A meeting was held at Garden Point (Pirlangimpi) on Melville Island on 9 December 2004 to discuss the future activities of this project. In attendance were Kate Hadden (Tiwi Land Council), Manyi Rioli (President, Pirlangimpi Community Management Board), Diana Stewart (Munipi Art), Andy Launder (CoastCare) and Anthony Kleidon (Principal of Pularumpi School).

Community Camp - Sea Turtle Dreaming Camp

The camp was planned through numerous meetings organised by Kate Hadden of the Tiwi Land Council

The plan for the camp was to base it around the school students of the Pularumpi School, their families and for hunters and artists in the community. The camp was planned to cater for around 70 students and 70 other members of the community. The intent was to centre the camp around student activities involving turtle conservation including:

- Traditional dances
- Songs
- Painting and other artwork
- PowerPoint presentations

Participating personnel organisations included:

Cyril Rioli	Trustee, Munupi Landowning Group
Jack Long	Senior Marine Ranger, Tiwi Land Council
Andrew Tipungwuti	Marine Ranger, Tiwi Land Council
Andy Lauder	NT Coastcare Coordinator
	NT Department of Natural Resources, Environment & the Arts
Anthony Kleidon	Principal, Pularumpi School
Manyi Rioli	President, Pirlangimpi Community Management Board
Patricia Brogan	Community Services Officer, Pirlangimpi CMB
Joseph Bourke	CDEP Coordinator, Pirlangimpi CMB
Kerry Benton	Pirlangimpi Progress Association
Sibby Rioli	NT Department of Health
Anthony Castro	NT Department of Health
Diana Stewart	Coordinator, Munupi Arts
Zoe Cozens	Federal Department of Environment & Heritage

3.0 Results and Discussion

3.1 On-ground Monitoring of Turtles Nesting

Track Counts

Track counts continued but were interrupted by Cyclone Ingrid and the clean up afterwards. Track counts in 2005 indicate that dogs were still a primary predator of eggs. A survey of 1.3 km of beach on Cape Van Diemen on 11 April 2005 found that 17 nests had been dug up by dogs. These would have only included nests that were laid after Cyclone Ingrid on 14 March. 2005.

Surveys post Cyclone Ingrid showed that the beach was eroded substantially causing loss of nests already laid for the season (short-term impact) but no large scale change to nesting conditions for future nesters. Almost all nests laid eights weeks prior to Cyclone Ingrid would have been destroyed (Figures 30 - 33).

Intensive Biological Data Collection

An intensive field trip was conducted between 20 April and 4 May 2005 (Figure 12). Preliminary data indicate that Cape Van Diemen is an important nesting beach for olive ridley turtles.

During the 14 day field trip, 218 olive ridley nests were laid from 221 attempts (98.6%) while only two flatback turtles successfully nested. For olive ridley and flatback turtles this is an average of 15.6 and 0.1 turtles per night respectively. Species composition of nests laid was 99.1 % olive ridley and 0.9% flatback turtles. It is interesting to note the variation in nightly nesting for olive ridley turtles on this beach of between 1 and 37. It is also interesting to note that during periods of strong winds tracks stayed on the beach for several days on Sectors 3 to 7 but only lasted less than 30 minutes for Sectors 1 and 2. This was the case for a period of 10 days during this field trip. This has significant implications for track counts of beaches from the air or at fortnightly or monthly intervals.

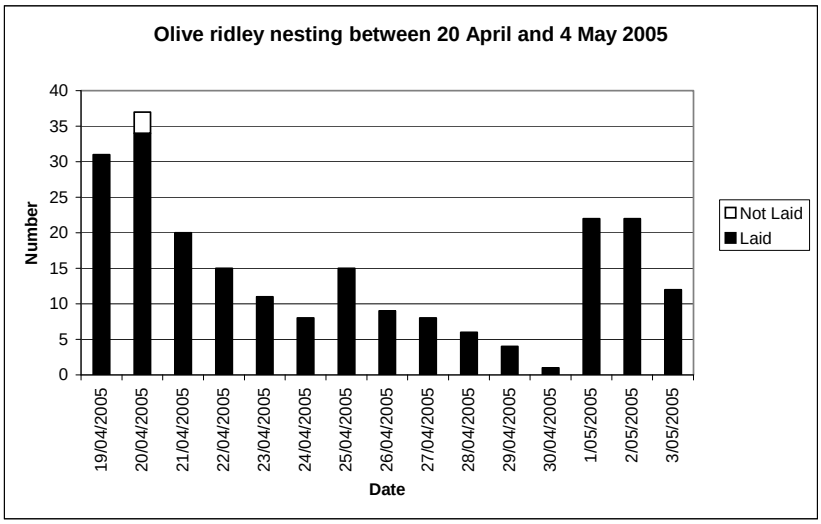

Figure 12. Nightly track count for Cape Van Diemen

A total of 76 turtles were tagged and measured. This included 74 olive ridley turtles and two flatback turtles. Genetic samples were obtained from 71 of the olive ridley turtles and both of the flatback turtles. A sample of 11 turtles was used to obtain a complete set of records and measurements for olive ridley turtles.

The number of hatched nests was extremely low with only five hatched nests recorded over the 14 day period. All hatched nests were located on the highest dunes. By looking at the storm surge zone it is likely that Cyclone Ingrid eroded or flooded most nests that were laid in the eights weeks prior to 14 March 2005. This would mean there was an almost 100% mortality rate of eggs laid in the six to eight weeks prior to Cyclone.

Adult Turtles

The mean curved carapace length of adult nesting turtles on Cape Van Diemen was 69.5 cm (ranged 65.0-75.0, sd=2.87, n=79). No other substantial data sets containing measurements of nesting olive ridley turtles exists in Australia to enable comparisons. The size distribution was normal (Fig 13). Correlations for each morphometric are listed in Table 2 and also show in Figures 14, 15 and 16.

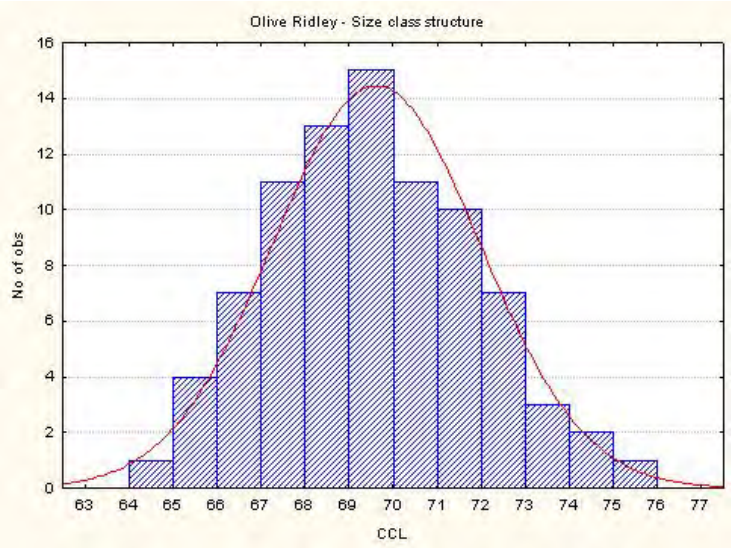

Figure 13. Size class structure of olive ridley turtles measured during project

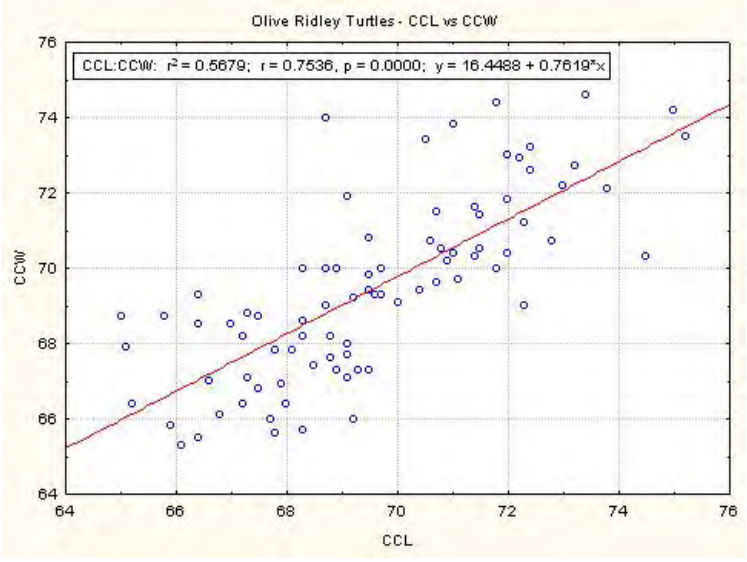

Figure 14.Curved Carapace Length vs Curved Carapace Width

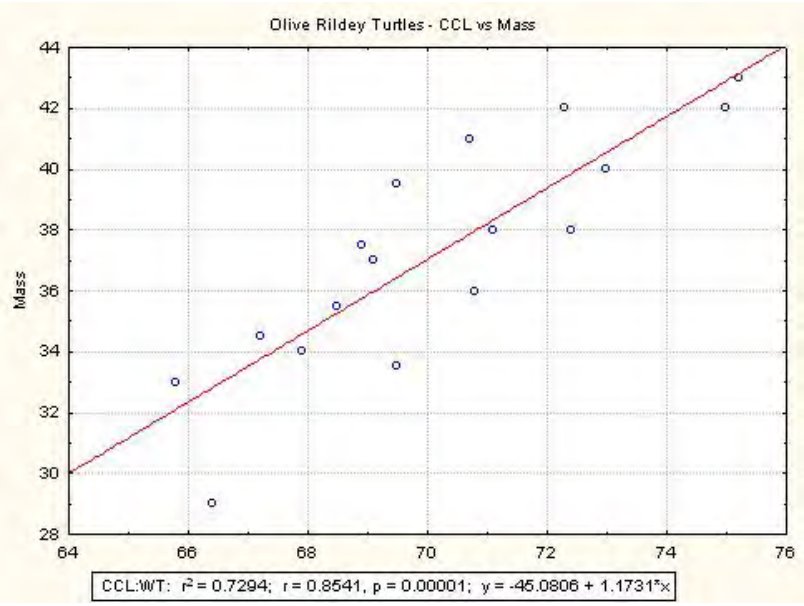

Figure 15.Curved Carapace Length vs Mass

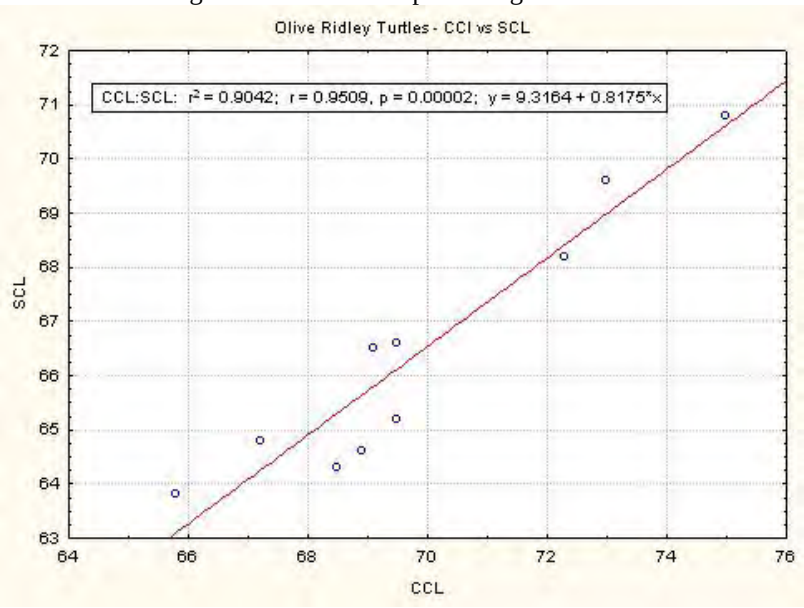

Figure 16. Curved Carapace Length vs Straight Carapace length

Nests and Eggs

The egg and nest parameters for 2006 are shown in Table 3. Correlations of egg mass and egg diameter are show in Figure 17. No hatchling (Figure 18 and 19) measurements were taken in 2006 because of the low numbers of hatched nests in April. A mini weather station (Figure 20) was installed on the nesting beach in 2004 but was lost during cyclone Ingrid.

Table 3. Egg and nest parameters for 2006

	Mean	SD	Min	Max	N
Clutch Size	112.9	24.3	53	149	12
Egg Diameter	3.82	0.06	3.73	3.92	12
Egg Mass	31.9	1.5	29	34	12

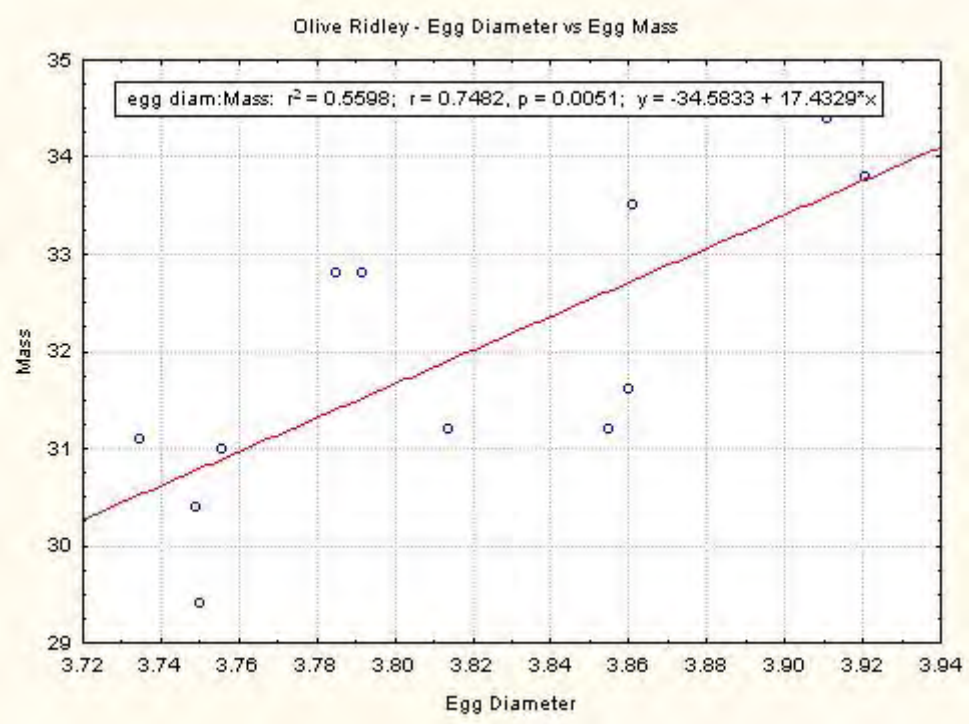

Figure 17. relationship between egg diameter and egg mass egg mass

Figure 18. Olive ridley hatchings

Figure 19. Olive ridley hatchling

Figure 20. Mini weather station

Mortality

The types of mortality affecting each life stage of olive ridley turtles associated with Cape Van Diemen are listed in Table 4. Further details are provided below:

Table 4. Mortality sources for Olive Ridley turtles

Type of Mortality	Life Stage of Turtle	Mortality Estimate	Notes
Dogs/Dingoes	Eggs	3-7 clutches per week	Based on Two week field trip and notes from track counts in 2004
Human	Eggs	0.3 clutches per week	Based on Two week field trip
Cyclone Ingrid	Eggs	75 clutches for season	Based on 1.5 nests laid per night for 8 weeks prior to Ingrid
Dogs/Dingoes	Hatchlings	unknown	Not observed directly but presumed
Ghost Crabs	Hatchlings	unknown	Observed on several nights in 2005
Crocodile	Adult Female	1-2 per fortnight	Based on observations from 2004 and 2005

Dog Predation

There was a minimum of five dogs that lived behind the dunes on Cape Van Diemen and patrolled the beach every day (Figures 21 - 26). The dogs would patrol all seven Sectors (11 km) every night. Dogs were regularly seen in Sector 2 in packs of between two and five dogs. Only one goanna track was observed on the beach during this time. Parks and Wildlife NT are considering continuing their baiting program, and the Tiwi Land Council has requested formal training so that the Marine Rangers can continue this activity over the long term. This will reduce egg mortality and increase hatchling production. Removal of a predator is not always simple. Once dogs were removed in 2004, the predation by goannas and bandicoots increased.

Figure 21. Dog predation of olive ridley nest

Figure 22. Olive ridley nests initially predated by dogs and the washed over by the tide

Figure 23. Pin markers were used to record predation on individual nests. Dogs chewed most markers even though they did not necessarily dig up the marked nest

Figure 24. A fresh nest laid during the previous night was predated within hours of being laid

Figure 25. Shows fresh olive ridley tracks, successful nest, fresh dog tracks and freshly predated nest

Figure 26. Dog Faeces. This shows egg shells (yellow arrow) and carapace of a hatchling (orange arrow). The hatchling carapace indicates that older nests with developing embryos are also taken along with fresh nests.

Cyclone Ingrid

The number of hatched nests was extremely low with only 5 hatched nests over the 14 day period. All hatched nests were located on the highest dunes. By looking at the storm surge zone it is likely that Cyclone Ingrid eroded or flooding most nests that were laid before 14 March 2005 (Figures 27 – 30). This would mean that almost 100% of nests laid in the 6 to 8 weeks prior to Cyclone Ingrid would have been destroyed.

Figure 27. First dune at Cape Van Diemen.

Figure 28. First and second dune at Cape Van Diemen. Most nests located below seaward of the second dune were lost during cyclone Ingrid

Figure 29.Erosion of steep dune in Sector 3. Only nests laid above the dune hatched during the two week field trip.

Figure 30. A combination of erosion from cyclone Ingrid and dog predation has impacted on this nest.

Crocodile Mortality

Crocodile live in the waters around Cape Van Diemen and regularly use the beach for basking and to take adult turtles for food (Figures 31 and 32). On the night of 30 April 2005 the largest crocodile in the area (greater than 4 m) took one adult flatback turtle and one olive ridley turtle. The flatback turtle may have escaped but had potentially fatal wounds while the olive ridley turtle was consumed in full view of researchers. It is estimated that one turtle is taken at least every fortnight from this beach.

Figure 31. Crocodile track in the sand

Figure 32. A human footprint beside that of a crocodile left in the sand

3.2 Satellite tracking of Olive Ridley Turtles

The three sea turtles tracked were Imalu, Munupi and Purrapuntirri.

Analysis is all but final on the tracking data. Detailed data is sent monthly by ARGOS in France and includes depth information. Specialised software "SPLASH" was installed and used in the analysis.

Imalu - Tracked Turtle No. 1

Tags - K58386/K58385
Transmitter No. - 16180
Curved Carapace Length – 71.0 cm
Date Attached – 1 June 2005

Imalu's transmitter was attached during the "Turtle Dreaming Camp" in June (Figure 33). Her transmitter remained active for two months. She re-nested before making her migration journey which took her 26 days. She then spent 52 days in a feeding area which corresponds closely with two tracked turtles from 2004. Further investigation will take place on the proximity of this area to trawling, defence activities and mine leases, all of which are known to occur in the southern Joseph Bonaparte Gulf. See Figure 34. The proportion of each location class is show in Figure 35.

Figure 33. Imalu's transmitter being attached

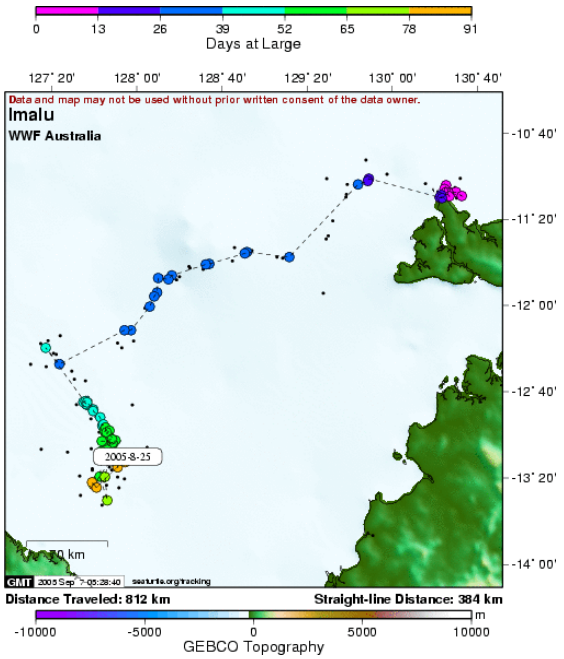

Figure 34. Migration path of Imalu

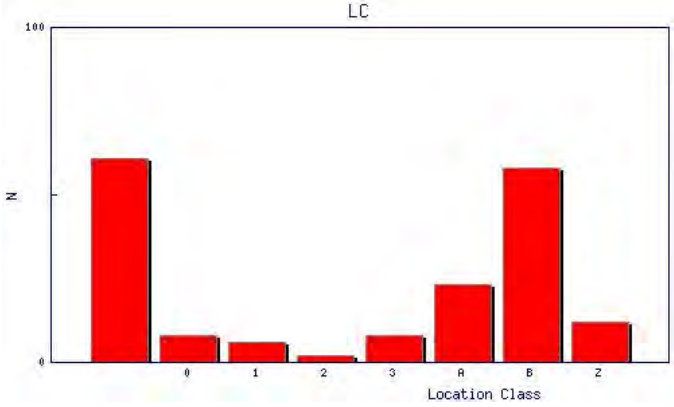

Figure 35. Number of each locations allocated in each error category. class from Imalu's transmitter. Only categories 1,2 and 3 were used for plotting the position of each turtle. Categories 0, A and B have unknown error and were not used. Tracking of marine animals creates a large percentage of 0, A and B locations because the animal is not at the surface long enough to reduce the location error.

Munupi - Tracked Turtle No. 2

Tags - K58387/K58388
Transmitter No. - 55690
Curved Carapace Length – 71.8 cm
Date Attached – 19 July 2005

Munupi (Figure 36) has been travelling for 8 weeks and does not seem to have settled in a feeding area. She travelled directly out to the slope of the continental shelf and turned around and headed south-east. In her seventh week she changed directional again and head north-east (Figure 37). The proportion of each location class is shown in Figure 38. The proportion of days that Munupi spent inside and outside of Australian waters (based on seaturtle.org maps) is shown if Figure 39.

Figure 36. Munupi returning to the ocean

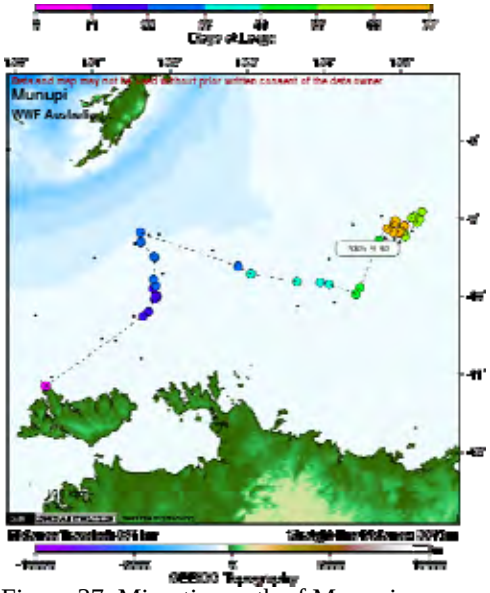

Figure 37. Migration path of Munupi

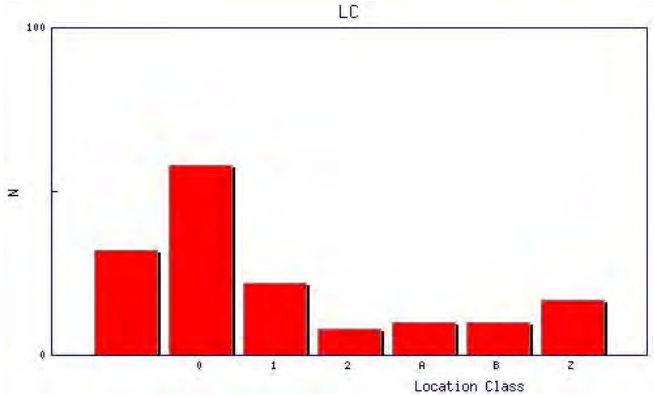

Figure 38. Proportion of each location class for Munupi's transmitter. Only categories 1,2 and 3 were used for plotting the position of each turtle. Categories 0, A and B have unknown error and were not used. Tracking of marine animals creates a large percentage of 0, A and B locations because the animal is not at the surface long enough to reduce the location error.

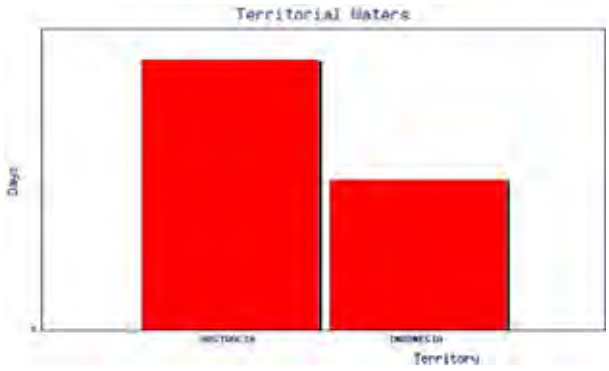

Figure 39. The proportion of days that Munupi has spent inside and outside of Australian waters (baseline data source – seaturtle.org)

Purrapuntirri - Tracked Turtle No. 3

Tags - K58389/K58390
Transmitter No. - 55689
Curved Carapace Length – 67.2 cm
Date Attached – 21 July 2005

Purrapuntirri (Figure 40) took only nine days to travel to Cobourg Peninsula where she then spent another 11 days before the loss of transmission. Concentrated locations suggest she was feeding in this area. It is difficult to tell if this was her permanent feeding area (Figure 41). See Figure 42 for further information.

Figure 40. Purrapuntirri returning to the water

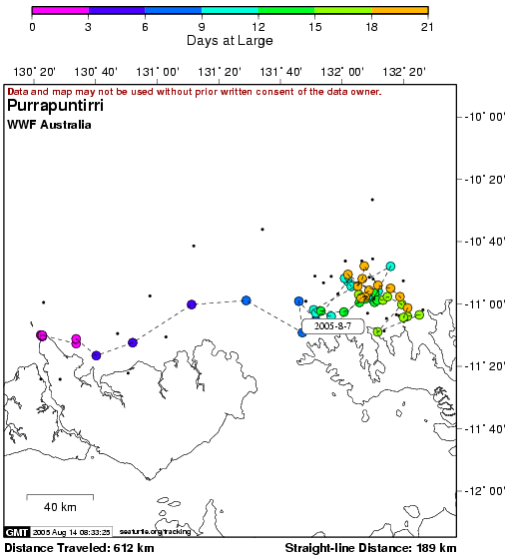

Figure 41. Migration path of Purrapuntirri

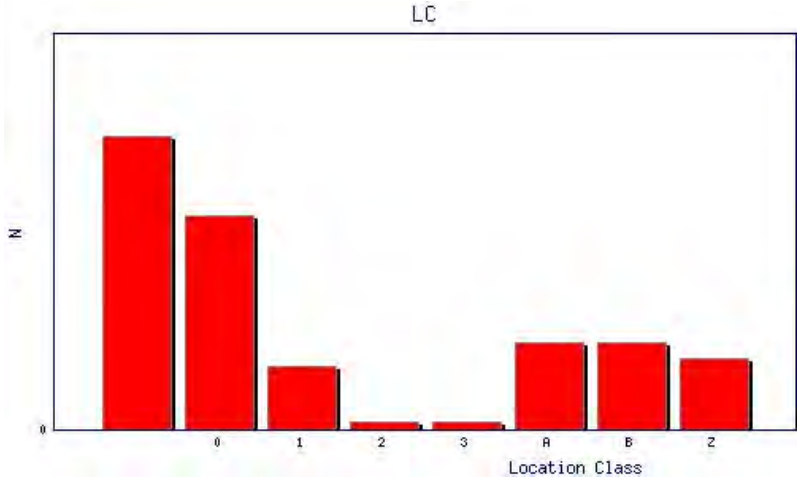

Figure 42. Proportion of location classes for Purrapuntirri. Only categories 1,2 and 3 were used for plotting the position of each turtle. Categories 0, A and B have unknown error and were not used. Tracking of marine animals creates a large percentage of 0, A and B locations because the animal is not at the surface long enough to reduce the

location error.

The three turtles tracked during this project were combined with previous data from a 2003 NHT project. Together these data were used to create a combined map of all eight olive turtle tracked over the two year period across northern Australia (Figure 42b).

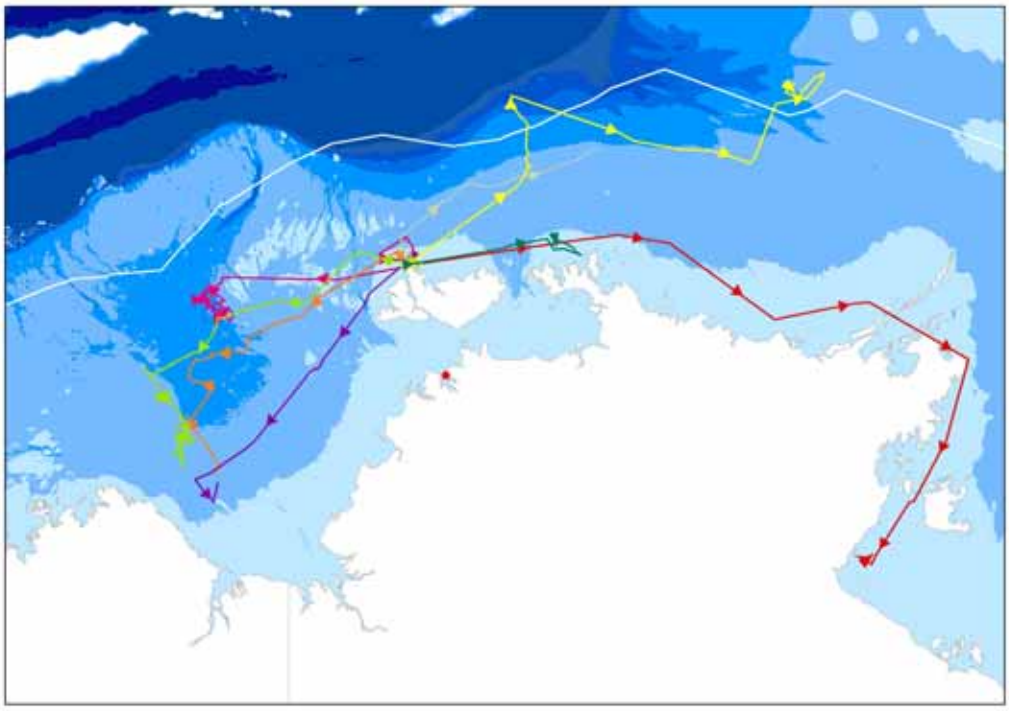

Fig. 42b Tracks of all eight tracked olive ridley turtles from two NHT projects

3.3 Indigenous Harvest

Initial discussions with Traditional Owners

Meetings with Traditional Owner and hunter Cyril Kalippa showed that the sustainability of natural resources is extremely important to the Tiwi people. Cyril has been a prominent figure in the community promoting the sustainable use of resources for the past 15 years and has appeared on television and in the NT News. Several issues were discussed on 9 December 2004 including:

- ensuring the turtles and dugongs are not wasted
- ensuring that hunts are conducted with the appropriate equipment to ensure that there are no potentially fatally injured dugongs from failed hunts
- ensuring people only take what they need

Visits to communities

In 2005, a number of discussions were held at each of the communities and outstations on the Tiwi Islands, and a cross section of each community was canvassed about the issue of indigenous harvest of turtles and dugong. These discussion were initiated by Kate Hadden (TLC) and were attended by prominent Traditional Owners in each community. This activity was ongoing throughout the life of the project, so an excellent cross-section was canvassed. Conservation outcomes included raised awareness across a wide audience of the need to quantify and manage harvest as well as broad scale support for the project and ongoing quantification of Indigenous harvest under the proviso that the information is managed by the Tiwi Land Council. A map was presented at each of the visits and the perceptions of past and present abundance was marked. Additional detail was also provided, for example, areas where the average size of turtles caught had changed. In addition, valuable historical information was provided on perceptions of abundance in times past (for example, in people's grandfather's time etc). This information will be added to the Tiwi GIS. Baseline information from past history and present observations that can be used for ongoing comparisons. Identification of areas that are subject to heavier harvest levels, and may need closer monitoring.

Ongoing discussions with Traditional Owners and community leaders on the issue of Indigenous harvest

In 2005, discussion with Traditional Owners and community leaders was ongoing throughout the year in both formal and informal settings. These included informal ad hoc meetings as well as formal meetings such Tiwi Land Council meetings. In addition, two intensive sessions information sessions were held with Traditional Owners and community leaders. The sessions were attended by the 32 identified Tiwi Leaders, representing all clan estates, communities and outstations. Discussions and outcomes included:

- Recording the perceptions of Tiwi Leaders about the abundance of turtle and dugong, and perceived changes over time (including current perceptions about the health of populations).
- Discussions about the perception of whether current harvest levels are sustainable (including egg harvest).
- Identification of areas of concern/no concern for Landowners with regard to Indigenous harvest (these areas have been marked on maps, and will be transferred to the Tiwi Geographic Information System).
- General support for the collection of Indigenous harvest data, on the condition that it remains the property of the Tiwi Land Council, and can only be used with Tiwi Land Council consent.
- General understanding of and willingness to use Indigenous harvest data for management discussions.
- Advice that one liaison officer will not be effective in gathering harvest information for the whole of the Tiwi Islands.

As a result of the discussions, a modified Indigenous harvest collection program was developed and trialled. Initially three key people were selected to collect the data. It was designed that these people would collect 95% of the harvest information and the other 5% would be collected from the small community on Bathurst Island, and

possibly (but not likely) from outstations by the Tiwi Land Council through weekly or fortnightly phone calls and normal regular contact. This system was revised and it was decided that a verbal interview system would produce more reliable and unbiased data.

To date information has been gathered on:

- Numbers of turtle and dugong harvested;
- Species of turtles harvested;
- Age class of animals harvested;
- Area hunted; and
- Relative abundance of turtle and dugong.

A bonus outcome of the harvest monitoring is that a range of information about turtle and dugong is now being volunteered. This information includes general observations whenever an area is visited – be it for hunting or not, and by hunters and others. An interesting outcome is that perceptions on turtle abundance vary, depending on the relative success of the hunters.

While the Tiwi Land Council holds the raw data, trends to date indicate that the predominant turtle hunted is the green turtle; adults only are hunted; most are large males; and dugong is not heavily hunted. This supports the current knowledge that dugong around the Tiwi Islands mostly congregate off-shore.

Further work needs to be done on the collection of turtle eggs and it will require a different approach. This activity is carried out by many members of the community, is not reliant on a boat, and is often carried out as part of other activities. Since it is not seen as an activity in its own right, it is difficult to gather the information (it is likened to Europeans telling someone every time they go to a shop).

The Tiwi Land Council has spent much time and energy on developing a larger and longer term framework that will establish a more extensive Tiwi Ranger Program into the next decade. This programme will have the capacity to develop methodologies for the collection of egg harvest information. In the meantime, this current project has laid a solid foundation for ongoing harvest monitoring.

Geographic Information System – altered Harvest component

Work on implementing a Geographic Information System (GIS) started in December 2005. A review of the existing GIS datasets was undertaken and new installation CD's were obtained from ESRI Australia.

The Tiwi Land Council already had a substantial amount of GIS .

This component of the project undertook two main objectives:

- Setting up an easy to use and maintain GIS, and
- Incorporating the Indigenous Harvest data and hunting records into the GIS.

GIS Set up

The GIS set up and training was conducted on the Tiwi Islands in March 2006. Software was installed on two computers and further licences will be looked into once

additional sea rangers are employed. GIS training was delivered to the Tiwi Land Council Rangers and staff.

Karen Cook (WWF) and Josh Forner (GecOz) developed a training manual to assist in the training of the Traditional Owners, rangers and TLC staff.. Training occurred over a five day period in March 2006. This manual will also serve as an ongoing reference.

The first two days was spent organising, updating and structuring the data that the Tiwi Land Council already owned. Software needed to be loaded and meetings were held to discuss expectations and needs of this new resource. The last three days were spent traveling to each community to set up their new computers and provide training. None of the TO's had really had much to do with computers so the training in most instances started with how to turn on the computer, general familiarisation, some basics in MS Word and MS Excel and them some basic instruction for Arc Explorer. It was decided in the first two days that Arc Explorer was a better option at this stage for each of the TO's. Kate Hadden at TLC is running the full version of ArcGIS and will initially be responsible for data entry. A full Arc Explorer project was set up on each computer giving the TO's the ability to turn layers off and on and look at different overlays as well as zooming in and out for a better look at the layers. They are also able to take note of discrepancies and advise Kate so she can amend and alter the ArcGIS layers.

After the existing data was examined a new GIS data structure was compiled as well as a new 'general use' GIS project (Figure 42c) that allowed easy access to almost all the data the Tiwi Land Council will need for planning and monitoring.

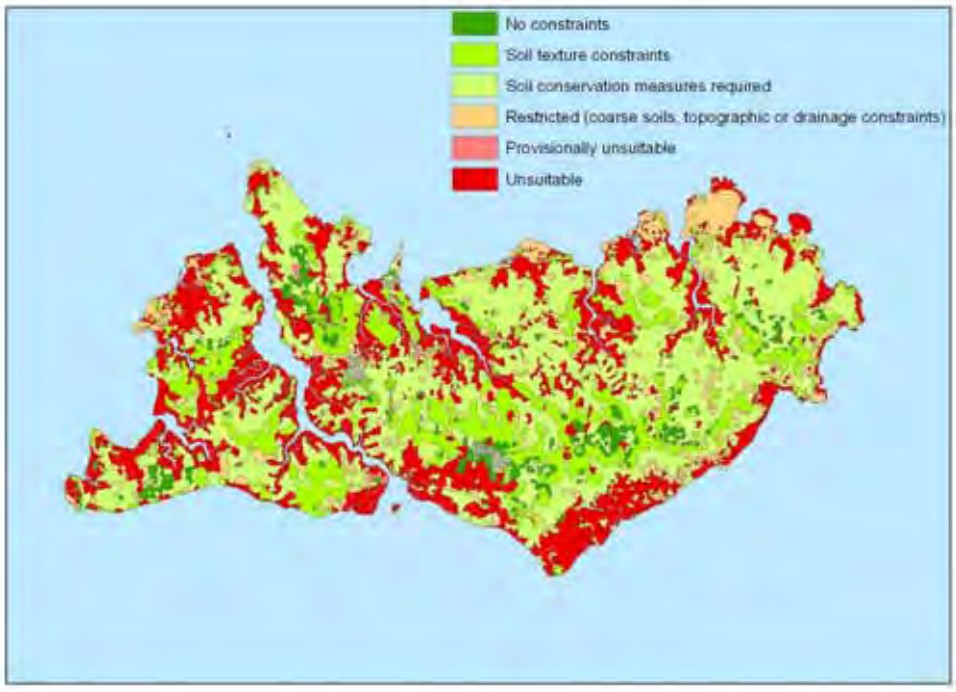

Figure 42c: A map exported from the Tiwi Land Council GIS

All of the data was set up on four computers and will be set up on a fifth at a later date. ArcGIS 8.3 was installed onto a laptop along with all the newly organised datasets. ArcExplorer was installed on the other three computers, one computer in

each of the Tiwi Land Council offices, and the major GIS project replicated. Most of the people using these computers had never used a computer before and ArcExplorer was a better way of them being able to view projects than having to learn ArcGIS. Data had been previously sourced from a number of places, datasets now available to the Tiwi Land Council include:

Table 5 Data sources, organised or added to the Tiwi Islands GIS

Data	**Details**
Air photos of Tiwi Island communities	Black and white air photos of the entire Tiwi Islands.
Airstrips	Point, line and polygons of all the airstrips on the Tiwi Islands
Aquaculture	• Existing fish and sea cage sites • Depth suitability
Basemaps	• Coastline • Custodian areas • Tiwi Islands polygon
Coastal	• Beach ridges • Coastal land cover • Intertidal reefs and flats • Mangroves • Saltflats • Offshore reefs
Community	• Barge and boat landings • Buildings (for each community) • Residences • Roads
Contours	
Cultural	• Ceremonial sites • Culture contact sites • Custodian data • Grave sites • Hunting campsites • Residential sites • Significant sites
Fauna	• All tiwi waterbird observations • Crocodile egg collections and sales • Dugong breeding areas • Dugong observations • Red goshawk nests • All fauna records • Seagrass beds • Turtle observations
Ferals	• Horse and buffalo sightings • Cane toad sign locations
Forestry	• Conservation zones • Old forestry sites • New leases • Plantation lines • Sylvatech leases
Geology	
Groundwater	• Bores • Brackish areas • Deep aquifer lines • Shallow aquifer lines
Hunting	New tools for recording Traditional Harvest records
Land	• Tiwi Island polygon • Land cover

	• Land units
Land capability	Land capability for: • Bananas • Building and construction • Excavation • Forestry • Irrigation • Landfill • Peanuts • Ponds • Roads • Septic • Sewerage • Drainage • Erosion risk
Land units	Old and new land units
Olive ridley tracking	Migration paths for all eight tracked turtles
Other	• Recreational fishing camp sites • Sea
Photos	Air photos of each community
Place names	
Roads	
Soils	
Topo 50 and 100K	
Vegetation	• Dense vegetation • Fire frequency • General vegetation • Rare plants • Sparse vegetation • Landcover
Water	• Bores • Catchments • Guaging data • Inundation • Rivers • Springs • Swamps
Weeds	• Gamba grass • General weed observations • Pennesetum

In addition to this, a conversion spreadsheet was also provided to allow all data recorded in degrees/minutes/seconds or degrees decimal minutes to be easily converted to decimal degrees for use in the GIS.

Training Manual

The second objective of this trip was to provide a basic GIS and computer training manual. A training manual was developed and given out; this will be used if further training is decided upon. The training manual also covers setting up their GPS's – which hadn't arrived before training commenced. Overall the training was well received by the TO's and they really enjoyed looking at the maps that were produced, it also gave them a new tool for future planning activities. Quite a bit of time was also spent training Kate Hadden (Secretary Natural Resources). We covered off the basics of bringing in data layers, layouts, symbology, etc and then moved on the clipping layers and working out areas of polygons. The Tiwi Land Council members to be trained were Tiwi people with varying degrees of literacy, numeracy and computer

skills. The training manual needed to be designed in a way that someone with poor computer skills and literacy could easily understand and perform basic GIS functions.

The manual consists of mainly screen shots and diagrams to illustrate the processes involved, with text kept to a minimum.

Training

Training was delivered over a five-day period and consisted of two days spent setting up the computers, downloading data and installing software, the remaining three days were spent travelling to the communities on the Tiwi Islands to deliver the training.

The training for the Tiwi Land Council Managers and rangers covered:

- Basic computer, mouse and keyboard operation;
- Setting up a GPS (ensuring correct datum and position format ie. UTM, decimal degrees, etc);
- A general overview on information protocols and the use of a GIS for planning, presentations, funding submissions, etc.;
- General Microsoft Word and Excel functions
- Navigation of ArcExplorer

The training package developed for the Tiwi Land Council Natural Resource Manager included:

- A re-introduction to the GIS environment
- Performing area calculation, intersects and select by location and attributes functions
- General editing tasks in the Edit environment
- Layout and exporting maps (and associated file formats)
- Symbolising

Incorporating Scientific and Indigenous Harvest data

The Tiwi's used a standard form for collecting Indigenous Harvest data; this form was used as the basis for developing an appropriate data capturing tool that would work in conjunction with the GIS.

The information targeted for the GIS is the location of hunting activities, number of each species caught and the age class of these species (juvenile, adult, calf or egg). This information will be able to be easily displayed on the GIS and built upon should the Traditional Owners want further analysis performed.

The rangers were given training in transferring this information from the form to the GIS.

Traditional Harvest was addressed in the new GIS and a new tool for accurately recording Traditional Harvest information was designed. Due to various levels of computer literacy, two tools were developed. The first is a simple Microsoft Excel spreadsheet that is designed for people with low computer literacy skills. It was designed with a series of drop down (or list boxes) to ensure the information is easy to access, accurate and can be periodically sent to the Natural Resource Manager for inclusion in the GIS. The second tool is a shapefile that mimics the spreadsheet

mentioned above in relation to the drop down boxes. However, it works with spatial data and is simply used by clicking on a spot on the map and selecting all the relevant information from the drop down boxes.

The type of Traditional Harvest data that will be collected will include species, age, sex, number caught, hunter, community and any additional notes.

All other scientific data was entered into the GIS including the olive ridley tracking data.

Outcomes

The training and GIS compilation took place on 20 – 24 March 2006. All objectives were attained and by the end of the week the Tiwi Land Council Natural Resource Manager could perform the functions she required, and the Tiwi Land Council Managers and rangers could perform tasks covered in the training (listed above).

Excellent feedback was received from all involved and the Natural Resource Manager was very happy to have the GIS function available to her again.

The re-compilation of the GIS was a major achievement after the weeks of development and design, resulting in a professional, functional GIS that will be a great asset not only to the Tiwi Land Council, but to the entire community.

Recommendations

The technology involved in GIS is not always simple to use and can be problematic. I would recommend that regular contact is made with the Natural Resource Manager to help with troubleshooting, general maintenance of the GIS and to provide further training.

A Land Management Unit Mentor has just commenced with the Tiwi Land Council but was unavailable for the training. I would also recommend that he be contacted in the near future to ensure he has access to the software and relevant datasets.

3.4 Community Involvement and Education

The Tiwi artists from the Munupi Art Centre ran workshops in the local school at Garden Point. The entire school took on the theme of Sea Turtle Conservation for the whole school term. The Principle of the Pularumpi School, Anthony Kleidon, was excited about this project and said “it was the first time that all classes and ages have combined to work on one theme for one whole term”.

The Turtle Dreaming Camp was the main event that pulled together a term of sea turtle education within the school and brought the community together for a large camp with a sea turtle conservation message. The camp was held between 30 May and 3 June 2005. Jack Long (TLC Marine Ranger) was also involved with organising and setting up the camp.

School activities

Many activities were conducted at the Pularumpi School which were directly related to sea turtle. These included: sessions on sea turtle biology, sea turtle status as threatened species and sea turtle conservation. These activities were conducted through the following disciplnes:

- Cooking – items were cooked in the shape of turtles and eggs;
- Art & craft – coastal and marine themes covered all class interiors, including a huge mural that showed the life-cycle of turtles and threats to their survival. Students also made replicas of coastal and marine animals;
- Maths – problems solving using nest and egg numbers, survival rates, measurements and weights;
- English – spelling, poetry and sentence construction using coastal terminology and issues;
- Social science/geography – the range and habitats of different species of turtles, and relationships with other cultures around the world;
- Visual studies – photography of coastal subjects.

Some of the products are displayed below in Figure 43, Figure 44 and Figure 45)

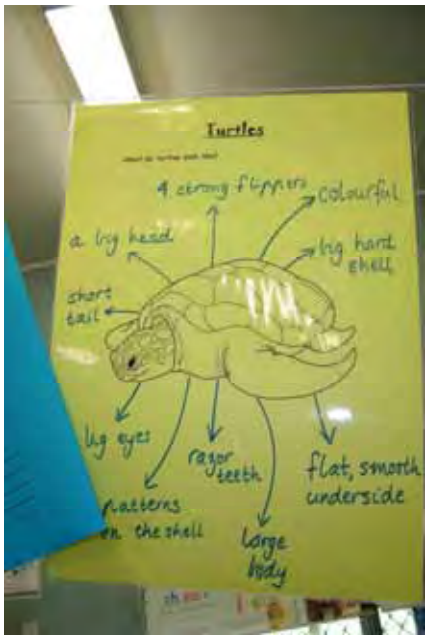

Figure 43. Classroom work at Pularumpi School

Figure 44. Classroom work at Pularumpi School

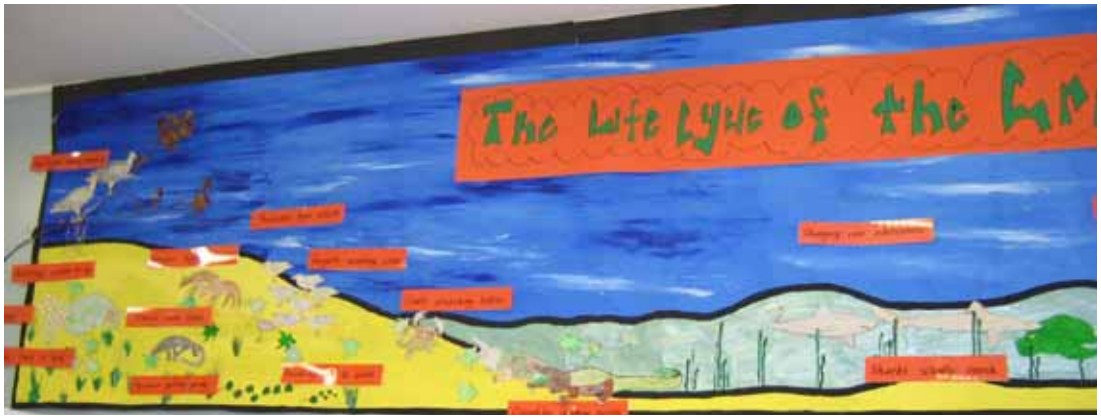

Figure 45. Classroom work at Pularumpi School

The web tracking was set up and operated through Seaturtle.org is the USA. This allowed the general public and the schools to monitor the progress of the turtles.

Turtle Dreaming Camp

In June 2005, the "Turtle Dreaming Camp" was held on the Tiwi Islands to help promote sea turtle education and conservation. The camp was conducted by a combination of groups including the Tiwi Land Council, Pularumpi School, Coastcare, Munupi Arts, NT Dept. Health & Community Services and the Pirlangimpi Progress Association. The Pularumpi School won the NT Coastcare award for various activities, one of which was the "Turtle Dreaming Camp".

While the camp was the highlight of the school's activities, a number of other initiatives were generated which were beyond the original scope of this project. Details of these can be found in the attached copy of the submission for the NT Landcare Awards.

4.0 Summary Consultancy Services

Table 5 A list of the proposed individual components of this NHT project and the final outcomes.

Sub components	Result	Details of Results	Conservation Outcome
1. On Ground Monitoring of Turtles at Melville Island			
Monitor all species to determine species composition	Completed	Completed for Cape Van Diemen. Species composition was	Increased base biological knowledge
Assess mortality of eggs on beaches	Completed	Completed for Cape Van Diemen. Eggs in 2004 were subjected to severe dog predation estimated at between 30-60%.Baiting reduced this in 2005. Cyclone Ingrid caused destruction of an estimated 75 nests (all nests laid 6 weeks before Date)	Knowledge to allow management action to be taken
Assess mortality to adult turtles on nesting beach	Completed	Completed for Cape Van Diemen. Crocodile were the make source of mortality with an estimated 1 turtle per fortnight taken	Increased base biological knowledge
Nesting density estimated by tracks counts once per fortnight	Completed	Completed but requires method change for future. This work was also conducted in 2003. However, the south easterly winds blow soft sand over the tracks in Sectors 1 and 2 which causes errors to the counts. It is suggested that actual counts during the nights are more accurate for this area.	
Estimate the nesting density by conducting regular track counts at Cape Van Diemen	Completed	Track counts were conducted throughout the year.	Knowledge about the spatial and temporal nesting distribution for Cape Van Diemen
Expand nesting monitoring to the east Coast of Melville as project progresses	Not Completed	It was decided that the project would benefit from consolidating the work around Cape Van Diemen instead of gaining less data over a wider area	
Collect biological data on the size and weight of nesting adult turtles, eggs, and emerging hatchlings.	Completed	Detailed measurements collected	First data for Australia
Take genetic skin samples from nesting adult olive ridley turtles using standard methods approved by the Charles Darwin University Animal Ethics Committee and under permit from the Northern Territory Parks and Wildlife Service.	Completed	Over 70 samples collected and sent to the University of Canberra for analysis.	First major collection on nesting olive ridley turtles in Australia
Engage Indigenous Marine Rangers and trainees in all of the on-ground monitoring activities outlined above.	Completed	Marine ranger was trained in all aspects of the project	Knowledge and skills remains with the local community
2. Satellite Tracking of Olive Ridley Turtles			
Platform Terminal Transmitters (PTT's) attached to three	Completed	Transmitters were attached to three olive ridley turtles. Results	First tracking of olive ridley turtles in

olive ridley turtles nesting on Melville Island		were added to five previously tracked olive rildey turtles	Australia
Transmitters will operate on the ARGOS satellite	Completed		
The tracking information will be automatically down-loaded from ARGOS via a non-profit organisation called "seaturtle.org" who use their own computer software to sort the ARGOS data into fields. Data will then be down-loaded from seaturtle.org for analysis.	Completed	Seaturtle.org was used to sort, analyse and display the tracking data so that it could be viewed by the public on an interactive web-based interface.	Education
Swim speeds and distances travelled will be calculated for different periods.	Completed	Locations of foraging grounds identified	First collected for Australia
The inter nesting interval will be determined by tracking individual turtles that return to the beach	Completed	One internesting interval was identified from this study. Combined with the work form the previous year	First detailed information on habitat used during this period
Migration routes and foraging grounds will be determined from location data.	Completed	Migration routes were determine using tracked turtles. This data was combined to the previous years data	First links from nesting beaches to foraging grounds
The components of satellite tracking include; the transmitters, the attachment equipment, data retrieval, data processing, data	Completed	All components were completed	
Home range analysis of turtle feeding grounds will be calculated using Biotas software. Home ranges will determine what habitat is important to each turtle when it reaches its foraging area.	Completed/ altered	Detailed home ranges were not completed as proposed because the turtles did not remain in their final location for a long enough period before the transmitters failed. However, foraging areas were indicated by the data.	Foraging area indicated by the data indicate that they do not display oceanic wandering like turtles in studies outside Australia
Engage Indigenous Marine Ranger in fitting of the satellite transmitters and in distributing the results of the satellite tracking to Tiwi Island communities.	Completed	The Tiwi Land Council Marine Ranger was involved in all aspects of the project. Education material was disseminated through www.seaturtle.org, Coastcare NT and through the Pularumpi School.	Education /Training
Indigenous Harvest of Dugong and Marine Turtles including GIS component			
Visit each community and outstation in the Tiwi Islands and hold discussions with cross-sections of Traditional Owners and community leaders on Indigenous harvest of dugong and marine turtles.	Completed	A number of discussions were held at each of the communities and outstations on the Tiwi Islands, and a cross section of each community was canvassed about the issue of indigenous harvest of turtles and dugong. This activity was ongoing throughout the life of the project, so an excellent cross-section was canvassed.	Raised awareness across a wide audience of the need to quantify and manage harvest. Broad scale support for the project and ongoing quantification of indigenous harvest under the proviso that the information is managed by the Tiwi Land Council.
Determine Traditional Owner's and community leader's perceptions of past and present abundance of dugongs,	Completed	A map was presented at each of the visits, above, and the perceptions of past and present abundance was marked.	Baseline information from past history and present observations that

marine turtles and marine turtle eggs.		Additional detail was also provided, for example, areas where the average size of turtles caught had changed. In addition, valuable historical information was provided on perceptions of abundance in times past (for example, in people's grandfather's time etc). This information will be added to the Tiwi GIS.	can be used for ongoing comparisons. Identification of areas that are subject to heavier harvest levels, and may need closer monitoring.
Develop a culturally appropriate process for obtaining quantitative data on the level of Indigenous harvest of dugong and marine turtles.	Completed	A culturally appropriate process was developed by the Tiwi Land Council but could not be used because it was outside the terms of the NHT contract	First harvest data collected for Tiwi Islands
Employ a Tiwi Island person to work with others in the project to set a data collection framework and catch reporting system. The primary role of the Tiwi Islander employed will be to implement the framework developed.	Not Completed NEW AGREED TERMS		
Indigenous Marine Rangers (Jack Long and Andrew Tipungwuti) will also liase with hunters and will collect data in the water and on beaches where available.	Completed	Data was collected by the Tiwi Council Marine Rangers and passed on the Natural Resource Manager	Harvest data collected
The Tiwi Land Council will manage data collection and analysis and the results will be entered onto the Tiwi Geographic Information System.	Ongoing	GIS support and training was supplied to Tiwi Land Council and rangers. Existing	Management options have been discuss and informal protection has been implemented eg informal protection of Imalu Beach
Management actions for harvest will be assessed on the basis of the results of the analysis of data collected and include the ongoing involvement of Traditional Owners. Management options will be discussed with Traditional Owners and trials will be attempted.	Ongoing but successful	This project engaged the community at all levels and ages. The Imalu Beach (focus of study) has been given informal status as a research and education beach not to be used for harvesting	Nesting beach protected from egg collecting
The Community Participation and Engagement in Turtle Conservation component of the project (described below) will be conducted in tandem with the Indigenous Harvest component of the project to ensure communities understand the threats facing marine turtles and dugong and the impact of excessive harvest.	Completed	The major component of this was the three day community camping trip with school students and their families. This included a school pantomime on sea turtle conservation issues.	Education, awareness of issues, community involvement and participation
Alteration to initial contract – GIS Component			Increased ability to manage natural resources by the Tiwi Land Council. Analysis of harvest data.
Planning of initial stages of GIS and database development	Completed	Planning and development of the GIS and database system by Karen Cook from WWF	

Obtain all free available layers and data to compliment existing data	Completed	Free data and information, satellite images and map layers to assist in developing a GIS were obtained to allow harvest data to be incorporated into a complete management package	
Purchase non-profit version of Arc View	Completed		
Meetings with Traditional Owners	Completed	The needs of the Traditional Owners were combined with the sea turtle, harvest and natural resource management needs to develop a useful GIS system for the area.	
Consultant to develop the database	Completed	Josh Forna from GecOz was contracted for this work. He set-up Completed the technical aspects of the GIS system to allow easy data entry.	
Training for a Tiwi Island Ranger in data entry		Andrew Tippungwuti a marine ranger for the Tiwi Land Council (Snake Bay) and lives within one of the hunting communities was trained in the process of data collection and trained in the use of the GIS system .	
Community Participation and Engagement in Turtle Conservation			
Involve the students and teachers from the Pularumpi School (Garden Point) in beach monitoring activities; including monitoring turtle tracks, hatched nests and causes of egg mortality.	Incomplete But awareness successful	All monitoring was conducted by WWF, Tiwi Land Council Marine Rangers and Coastcare NT. The school put all of the efforts into raising conservation awareness and education about sea turtle biology.	Community awareness of monitoring
Develop a partnership with the Munipi Art Centre (Melville Island) and the “Green Turtle Dreaming” project to hold workshops in the schools involving traditional stories, paintings and dances to convey a message of turtle conservation.	Completed	The was a major success resulting in a camp near the turtle beach which was attended by over 120 people including students and the families, Traditional Owners of the nesting beaches and Land Council employees	Education and Awareness

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Appendix 1

NATIONAL LANDCARE AWARDS
NORTHERN TERRITORY

Natural Heritage Trust Coastcare Community Award – Pularumpi School
Melville Island NT

SUMMARY

Pularumpi School is located at Pirlangimpi (Garden Point) on Melville Island, the largest of the Tiwi Islands. There are approximately 70 primary school children, and a staff of both Tiwi and non-Tiwi teachers.

In 2004 WWF Australia developed a NHT funded partnership project with the Tiwi Land Council for an integrated marine turtle conservation project. The project focuses on significant turtle nesting beaches which are in close proximity to Pirlangimpi community. In conjunction with Coastcare NT, the project partners invited input from Pularumpi School.

Pularumpi School subsequently developed a wide-ranging activity plan that not only engaged the school, but attracted the excitement of the community as a whole. The plan encompassed all aspects of the school curriculum, and included activities that required the involvement of students, parents and the entire community. The plan also covered all aspects of coastal and marine management.

Implementation of the plan was taken up with enthusiasm by community residents. The variety of activities and level of communication meant that the efforts of the school had far reaching impacts – from Tiwi Traditional Owners to community organisations and external organisations. Outcomes from the many activities over a three month period included:

- community members taking on ownership and responsibility for coastal condition;
- a broadened community understanding of the cause and effect relationships in environmental management;
- generation of community confidence that ‘we can change things’;
- support for, and implementation of, more sustainable use of coastal resources;
- setting aside areas specifically for conservation and ongoing study;
- developing new and strengthening existing partnerships in coastal and marine management.

The efforts of the staff and students of Pularumpi School over the 10 week term deserve recognition, as all indications are that there has been a fundamental shift in coastal management among all residents of Pirlangimpi, with implications reaching throughout all Tiwi Island communities.

Consequently, this application has been made under the Coastcare Community Award rather than the Landcare Education Award.

KEY CRITERIA

1. Creates a plan for coastal activity and awareness raising

In late 2004, Pularumpi School was invited to become involved in the WWF Australia/Tiwi Land Council turtle project, funded through NHT. The level of involvement was entirely up to the school. Principal Anthony Kleidon became very excited about the whole project and started developing an activity plan. Staff (both Tiwi and non-Tiwi), parents and students of Pularumpi School developed a plan that not only provided involvement in the original project, but expanded into a whole community plan for coastal activity and awareness raising.

The plan included participation from the whole of Pirlangimpi community, and revolved around intense activity throughout Term 2 (April to June 2005). As a result of the original plan, coastal activities and awareness raising have now been embedded within the community, and will be an ongoing focus for coastal issues. In addition, suitable activities will now be exported to the other communities throughout the Tiwi Islands.

Specific activities within in the plan included:

- Standard curriculum activities based around turtle biology;
    - Cooking – items were cooked in the shape of turtles and eggs;
    - Art & craft – coastal and marine themes covered all class interiors, including a huge mural that showed the life-cycle of turtles and threats to their survival. Students also made replicas of coastal and marine animals;
    - Maths – problems solving using nest and egg numbers, survival rates, measurements and weights;
    - English – spelling, poetry and sentence construction using coastal terminology and issues;
    - Social science/geography – the range and habitats of different species of turtles, and relationships with other cultures around the world;
    - Visual studies – photography of coastal subjects.

- Expert speakers;
    - WWF Australia scientists giving talks to the school, and parents and community members were also invited;
    - Coastcare conducting classes on turtles and carrying out field trips to the local beach.

- A pantomime about the green turtle life cycle to be performed for the community, and to be taken to other communities throughout the Tiwi Islands. Pantomime also to be translated into Tiwi language. The pantomime was seen by a representative from DEH in Canberra, who was so impressed that she is currently looking at ways to take the production to Canberra.

- A community camp for all members of the community. The theme of the camp was the coastal environment, with an emphasis on marine turtles. Camp included science walks, art, observation of nesting turtles, attaching tags and attaching satellite transmitters.

- Artists from Munupi Art Centre working with the community on coastal issues through art.

- Ongoing beach monitoring for turtle nesting and hatchling success.

2. Contributes to improved sustainability of their coastal area

Through Pularumpi School, students and extended families are now involved in regular beach monitoring. Reports fed back to Coastcare, the Tiwi Land Council and WWF Australia include details on marine debris, nesting numbers, incidence of predators taking turtle eggs and general information on coastal health and issues. In addition, information is now being gathered for the Tiwi Land Council on indigenous harvest levels.

Residents are now more aware and active within the coastal environment in terms of rubbish, access, development and resource usage.

As a direct result of the community camp, a particular beach at Cape van Diemen that is significant for the endangered olive ridley turtle has now been declared a 'No Hunting Zone' by the Tiwi Traditional Owners. This came from the children talking to elders when watching the turtles lay, who in turn over the few days of the camp had learned a great deal about sustainability and their turtle resource. Turtles and nests will no longer be taken from this area.

The beach is also now being set up as a designated study beach for ongoing educational activities, which may not be restricted to just Tiwi people.

3. Fosters a sense of stewardship by the community

As a result of the plan developed by Pularumpi School, the whole community has now had direct contact with and experience in contemporary coastal management activities. Community members are now taking responsibility for observing and reporting change, and also taking responsibility for actions to manage change.

This is evidenced through the decision to set aside a beach for turtle conservation and ongoing education and awareness, and providing feedback on observed changes. It is also evidenced through direct action, including the collection of harvest data and discussions about harvest levels. In addition, the community is now directly involved in monitoring coastal condition and providing feedback on issues that arise.

4. Targets the causes rather than the symptoms of environmental problems

A lot of the causes of marine environmental issues are out of the control of the residents of Pirlangimpi. However, due to the huge success of the education and public awareness activities, the whole community now has sound information about the causes of a wide variety of coastal environmental problems. This knowledge has generated lively and ongoing discussion and exploration of areas where the community can assist.

More directly, community members are now aware of areas where their actions can contribute to the cause of coastal environmental problems, and are responding. Examples include:

- At the behest of Traditional Owners, and initiation from students at Pularumpi School, residents have stopped harvesting turtle eggs along the local beach that is significant for olive ridley nesting.
- All organisations have made a commitment to support the ongoing use of the beach as a study beach to continue to with awareness, public education and on-ground activities, especially with school age children.
- Residents are providing harvest data to the Tiwi Land Council in order to develop turtle and dugong management plans.
- Responding to students from Pularumpi School, family members are treating the coast with more respect in terms of litter and rubbish.
- Community members are providing ongoing feedback to management agencies about changes and concerns with the coastal environment.

5. Contributes to the development and application of best practice

Best practice management is far more likely to be achieved as a direct result of the activities initiated by Pularumpi School. In addition, the fact that some of the activities are being exported throughout the Tiwi Islands (and possibly interstate) provides widespread contribution to best practice management. As well as outcomes mentioned elsewhere, elements that contribute to best practice include:

- Involvement at the community level;
- Enhanced community ownership and responsibility of the condition of the coastal environment;
- Confidence to report observations to management agencies;
- Increased knowledge of, and exposure to, contemporary resource management actions;
- Willingness to accept and take part in contemporary resource management techniques and processes;
- Development of pathways and relationships between community residents and external agencies.

6. Helps develop partnerships for Coastcare activity

The implementation of the Pularumpi activity plan has far outstripped original expectations. All of the organisations represented in the Pirlangimpi community contributed and took part in some way. An extraordinary (and unexpected) outcome is that all organisations are now working in partnership around a central theme of coastal management. These organisations include:

- Pularumpi School
- Pirlangimpi Community Management Board
- Munupi Arts & Crafts
- Tiwi Islands Local Government
- Pirlangimpi Progress Association
- Tiwi Land Council
- NT Health Department
- NT Police

- NT Department of Community Development, Sport and Cultural Affairs

In addition, valuable and ongoing partnerships have also been developed and strengthened with external agencies such as Coastcare, WWF Australia and the Federal Department of Environment and Heritage.

Although Coastcare has had a high profile elsewhere on the Tiwi Islands, it is now expected that it will provide an ongoing educational resource within Pularumpi School and Pirlangimpi community. Field trips, class sessions, discussion groups and school based research are all now on the agenda.

Tiwi Traditional Owners will also contribute as full partners in what now is being seen as an expanded coastal environmental management awareness programme.