

Sea-turtle Rookeries in North-western Torres Strait

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Abstract

Deliverance Island, Kerr Islet and Turu Cay in north-western Torres Strait support a major nesting population and the most northerly recorded rookery of the flatback turtle, *Natator depressa*. Nesting occurs there year round, with a peak in the early months of the year. The islands are insignificant nesting sites for the green turtle, *Chelonia mydas*, and the hawksbill turtle, *Eretmochelys imbricata*. The *N. depressa* turtles that nest in western Torres Strait-north-eastern Gulf of Carpentaria are smaller and lay smaller eggs on average than the *N. depressa* turtles that breed in the southern Great Barrier Reef. On Deliverance Island, the inhabitants of nearby Queensland islands and Papua New Guinea coastal villages infrequently harvest *N. depressa* eggs as well as the green turtles that feed over the surrounding reef flats.

Introduction

The annual harvest of green turtles by the island and coastal people of northern Australia and neighbouring countries is one of the largest in the world (C. J. Limpus, unpublished data). Conservation management of this resource has been hampered by a paucity of knowledge not only about the population dynamics of the green turtle but also about the distributions and sizes of the breeding aggregations and the associated harvests. Within northern Australia, the sea-turtle populations of north-western Torres Strait are among the most poorly documented. Meek (1913) reported that Tara (=Turu) Cay was 'one great nest of turtles', and he recorded capturing several green turtles nesting there in May 1910. During aerial surveys of turtle nesting in Torres Strait in the 1975/76 breeding season, Kowarsky (1978) recorded small numbers of tracks on the three north-western islands of Turu Cay, Deliverance Island and Kerr Islet on 9 December 1975. The nesting aggregations on these islands were the largest for Torres Strait at the time. Using track characteristics, Kowarsky identified the species involved as *Chelonia mydas* (green turtle). However, he could not differentiate between the tracks of *C. mydas* and those of *Natator depressa* (flatback turtle) (Limpus *et al.* 1983). The inhabitants of other islands in Torres Strait have verbally reported to us at various times that they hunt for turtles and their eggs on all three islands, where both green and flatback turtles were plentiful. On the basis of their conflicting information, Limpus and Parmenter (1986) rated the status of the north-western Torres Strait turtle-nesting area as undetermined. The first opportunity to document turtle breeding in the three islands came in 1987, and the results are reported here.

Study Area

Deliverance Island, Kerr Islet and Turu Cay are uninhabited sand cays composed of white carbonate sands and surrounded by intertidal sand flats. They lie in north-western Torres Strait approximately 34–72 km south of Papua New Guinea (PNG), 68–103 km south-west of Boigu Island and 81–85 km north-west of Mabuig Island (Fig. 1). The islands are Australian territory within the State of Queensland. Deliverance Island and Kerr Islet were declared 'Reserves for Departmental and Official Purposes' (R224 and R226 respectively) under the trusteeship of the Corporation of the Director of Aboriginal and Islander Advancement on 5 August 1978. Turu Cay is vacant crown land. Under the terms of the Torres Strait Treaty (Anonymous 1978), inhabitants of coastal PNG villages as well as Torres Strait Islanders may fish and hunt in the waters surrounding the three islands.

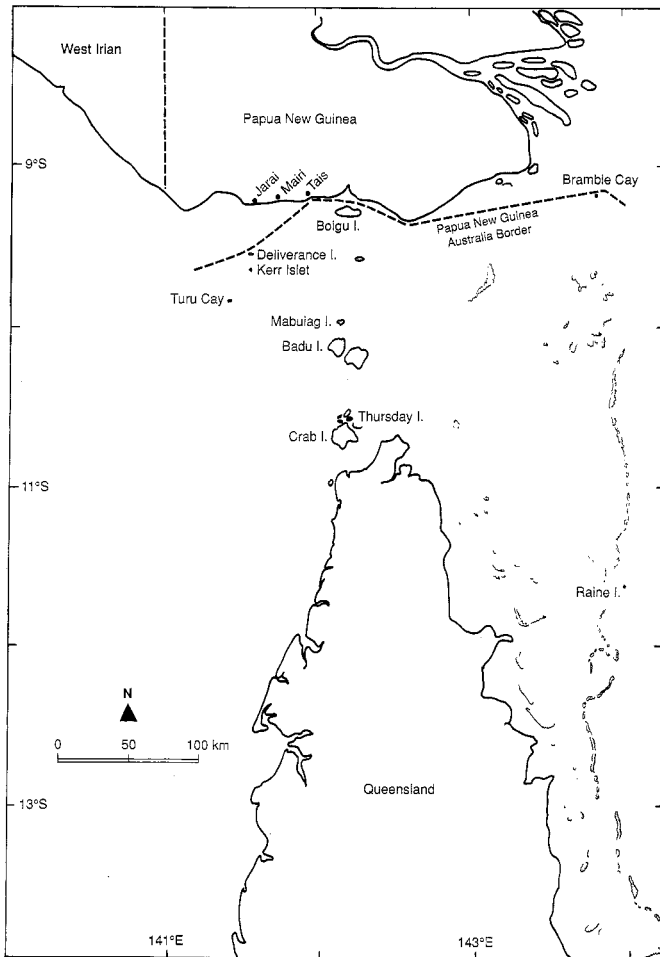


Fig. 1. Locality map of Deliverance Island, Kerr Islet and Turu Cay in north-western Torres Strait.

Deliverance Island ($09^{\circ}32'S$, $141^{\circ}31'E$.; also known as Warul Kawa) was surrounded by a shallow reef platform measuring approximately 9×5 km, with the long axes of both the reef and the island lying N.E.–S.W. At low tide, exposed sandbanks extended approximately 2–3 km off the S.W. corner of the island. The island was approximately 1.5 km long and 0.5 km at its widest, and it had an area of approximately 38.6 ha. The vegetation ranged from vine- and grass-covered strands to a dense closed forest up to 20 m high on the north-western side of the island.

Kerr Islet ($09^{\circ}37'S$, $141^{\circ}34'E$.; also known as Kiss Islet) was a low sand island of approximately 1.8 ha with a forest rising to 14 m. The vegetation was sparser than on Deliverance

Island. The long axis of the island, which measures approximately 0.8×0.1 km, lay N.E.-S.W.

Turu Cay ($09^{\circ}49'S$, $141^{\circ}25'E$.) was a small unvegetated sandbank measuring approximately 0.9×0.1 km and rising to 0.9 m above the mean spring high tide level. The long axis lay E.-W. About 75% of the cay was awash during spring high tides.

Methods

Deliverance Island was visited on 19–20 February 1987 and counts of nesting turtles were made. Turu Cay and Deliverance Island were visited on 27–28 September and from 28 September to 15 October 1987 respectively. The crew of our boat visited Kerr Islet while the turtle research team was camped on Deliverance Island. Turtles were tagged through the axillary tagging scale on the trailing edge of each front flipper with a 4.1-g titanium tag (after Limpus and Reed 1985). Measurements of the turtles and their eggs and nests follow the standard methodology used in the Queensland Turtle Research Project (Limpus *et al.* 1983). Turtles swimming near the island were caught by 'beach jumping', i.e. leaping on them with a running dive from the beach. Flight reports from Australian Government Coastwatch flights past Deliverance Island were examined for the period January 1987 to May 1988 inclusive. Members of several Islander communities in western Torres Strait were interviewed to assess the frequency with which fishing parties visited the three islands.

Results

Deliverance Island (February 1987)

On 19 February, 18 nesting *N. depressa* had come ashore in the afternoon prior to sunset, and 46 had beached by 2200; a total of 52 fresh sets of tracks were counted the next morning. On 20 February, 69 nesting *N. depressa* were counted. No nesting *C. mydas* were recorded. Numerous adult-sized *N. depressa* were seen swimming over the surrounding intertidal flats each time the party went ashore. Two Torres Strait Islanders, who had hunted unsuccessfully for dugong on the surrounding reef, landed on the island and took away as food eight clutches of *N. depressa* eggs (filling five 10-L buckets) and four megapode (*Megapodius reinwardt*) eggs. There were about eight megapode mounds on the island. The islanders said that they did not want to take any flatback turtles, adding that they would eat them if there was nothing else but that they preferred green turtles.

Deliverance Island (September–October 1987)

On arrival, the study team found vast numbers of old turtle body pits around the island. About 20 sets of tracks from the previous few nights were still visible. All nesting turtles observed over the next 16 nights ($n=19$) were *N. depressa*. When ashore, this species crawls by pushing with all four flippers simultaneously, and the hind flippers obliterate most of the marks from the front flippers (Limpus *et al.* 1988). All tracks from nesting turtles were made by this species. A total of 48 tracks were observed over 16 days (mean = 3.0 per day, s.d. = 2.96, range = 0–10). While most of the tracks were nocturnal, three (6%) were diurnal. There was a high proportion of unsuccessful nesting attempts, with only 44% ($n=21$) of the total attempts resulting in oviposition. With seven of the successful attempts, the female dug more than one egg chamber before laying her eggs. The mean number of egg chambers per successful attempt was 1.6 (s.d. = 0.92, $n=21$, range = 1–4). Multiple egg chambers also featured in most of the unsuccessful attempts (mean = 1.6, s.d. = 1.8, $n=27$, range = 0–4). All three diurnal attempts were successful. The primary reason for abandoning an egg chamber before oviposition appeared to be the collapse of the walls of the egg chamber because of the dryness and looseness of the coralline sand. No nest preparation occurred during four of the unsuccessful nesting attempts. For these, the disturbance appeared to result from one female crawling into a pile of sticks, two females (or possibly the same one) crawling among the dense low branches of a shrub, and a fourth female moving into an area of high-velocity wind-blown sand.

The nesting females that were tagged had a mean midline curved carapace length of 88.74 cm (s.d. = 2.962, $n=19$, range = 81.5–94.0). Three clutches were counted at laying time (62, 55 and 43 eggs). None included multi-yoked or yolkless eggs. The mean egg

diameter was 5.08 cm (s.d. = 0.141, $n=30$ eggs in three clutches, range = 4.79–5.34). The depth to the bottom of the eggs in these nests was 62, 70 and 64 cm respectively.

Freshly emerged clutches of *N. depressa* ($n=13$) and *Eretmochelys imbricata* (hawksbill turtle) ($n=1$) were identified. The mean nightly rate of hatchling emergence of *N. depressa* clutches was 0.8 (s.d. = 0.98, $n=16$, range = 0–3). As there was no evidence of erosion of the nesting area during the preceding few months, this is also a minimum estimate of turtle nesting numbers from approximately two months earlier. Nine *N. depressa* nests were excavated within 24 h after hatchling emergence. Their pooled incubation success was as follows: 386 eggs produced hatchlings that emerged to the surface, 2 eggs produced hatchlings that were live in the nest among the hatched shells, 20 eggs produced hatchlings that died in the nest, 16 eggs died with obvious embryos, and 22 eggs contained no obvious embryos (=undeveloped). The mean measurements from the nine emerged clutches were: clutch count = 51.4 eggs (s.d. = 14.86, range = 38–87) and nest depth to bottom of eggs = 75 cm (s.d. = 11.3, range = 56–92). One clutch contained one yolkless egg and none had multi-yolked eggs. While the pooled hatching success of the 463 eggs was 88.1%, the hatching success from individual clutches ranged from 72 to 100%. The pooled emergence success of these eggs (to produce hatchlings at the beach surface) was 83.4%. The mean *N. depressa* hatchling midline straight carapace length was 5.70 cm (s.d. = 0.166, $n=69$ in nine clutches at 3–10 hatchlings per clutch, range = 5.11–5.97). Mean *E. imbricata* hatchling midline straight carapace length was 3.82 cm (s.d. = 0.060, $n=10$ in one clutch, range = 3.67–3.89). An *N. depressa* hatchling and an *E. imbricata* hatchling collected during this visit were lodged with the Queensland Museum (specimen numbers J48285 and J48284 respectively). Sand temperatures measured on 2–4 October (at 50 cm below the surface within the nesting habitat) ranged from 28.4 to 31.3°C (mean = 29.4, s.d. = 0.95, $n=7$).

One female *N. depressa* observed nesting had recently been mauled by a shark and had lost almost its entire left front flipper; the flesh of the stump was beginning to heal. Ghost crabs, *Ocypode ceratophthalmus*, were recorded as preying on *N. depressa* hatchlings crossing the beach. Other potential hatchling predators that were recorded at the island (but not as actually preying on the hatchlings) included numerous terrestrial hermit crabs, *Coenobita* spp., tens of silver gulls, *Larus novaehollandiae*, flocks of about 20 Australian pelicans, *Pelecanus conspicillatus*, and two white-bellied sea eagles, *Haliaeetus leucogaster*. No evidence of varanid lizards or (non-human) mammalian predators of turtle eggs or hatchlings was found on the island. The skeletal remains of a medium-sized crocodile (probably *Crocodylus porosus*, a potential predator of adults and hatchlings) were found in the vegetation of the island.

Turtles were commonly seen swimming over the intertidal flats. They included adult-sized *N. depressa* and small immature to adult-sized *C. mydas*. Small *C. mydas* were regularly seen swimming in the shallows adjacent to the island, and three (curved carapace lengths = 42.0, 42.5 and 44.0 cm) were caught by beach jumping. On arrival at the island, the study team found the charred remains of an adult-sized turtle, apparently cooked on an open fire. During the study period, a party of Torres Strait Islanders came for a day visit. After unsuccessfully digging for eggs at several old turtle nests, they turned a daylight nesting *N. depressa* on her back while she was digging a body pit, cut her inguinal pouch open, and removed the eggs from one oviduct for eating. She was left on her back in the sun, and she died later that day. No further use was made of her. The Islanders caught five small *C. mydas* by beach jumping (these turtles were similar in size to those caught by the study team). One of the turtles was cooked and eaten at the island. Another was speared several times following its capture, apparently for spear-throwing practice, and the carcass was discarded at the water's edge. The remainder was taken away.

Turu Cay (September 1987)

On arrival, the study team saw about 20 old turtle body pits. However, recent spring high tides had washed over the island and would have obliterated others. On 27 September, one *E. imbricata* nested (as identified from the wide track displaying an alternating gait) and one clutch of *N. depressa* hatchlings emerged (as identified from tracks and egg

remains). One large immature *C. mydas* was seen over the intertidal flat, and one mounted pair of *C. mydas* drifted past the anchored boat just outside the reef.

Kerr Islet (October 1987)

The nightly density of turtle nesting on Kerr Islet was similar to that on Deliverance Island, but no precise track counts were made. The island also supported a pelican rookery with chicks and eggs in the nests.

Turtle and Egg Harvests

Informal interviews with some of the 400 inhabitants of Boigu Island (November 1983–February 1987 by W.M.) indicate the Boigu Islanders visit Deliverance Island (68 km to the south-west) in small open aluminium boats about four times a year and usually during periods of calm seas, e.g. December–March, when there are light N.W. winds. The interviewees estimated that only 6–8 green turtles a year were captured in the shallows adjacent to Deliverance Island. They stated that it was easier to bring turtles (presumably adult-sized ones) back to Boigu from the Red Sandbanks to the west of Boigu and the reef flats to the south. A major reason for visiting Deliverance Island was to collect turtle eggs. The number of eggs collected on each trip was estimated to be 4–6 10-L buckets. If 5 buckets hold 8 clutches, then four trips a year yield approximately 32 clutches (20 buckets) of *N. depressa* eggs to the Boigu community.

No data were gathered on turtle and egg harvests at Deliverance Island by inhabitants of the nearby PNG villages of Mairi (9°10'S., 141°44'E.), Tais and Jarai. The Boigu Islanders were of the opinion that Mairi villagers visited Deliverance Island once or twice a year, usually during December–January. The number of turtles and eggs harvested by PNG nationals during a visit to the island may be higher than that during a visit by Boigu Islanders, for the larger sailing canoes of the PNG villagers can carry greater loads than the aluminium dinghies of the Boigu Islanders. Discussions with inhabitants of Badu Island indicate that members of other Torres Strait Islander communities also infrequently harvest turtles and eggs from the three study islands.

Coastwatch aircraft flew past Deliverance Island on 39 days during 1987 (2–5 flights a month). On only two of these flights were visitors recorded on the island: 28 March—'six 4 m dinghies anchored offshore, several Islanders on beach, possibly digging for turtle eggs', and 10 October—'three dinghies beached, seven people (locals) under trees + two Caucasians on beach'. On the latter occasion, one of the dinghies and the two Caucasians were from the study team. If these Coastwatch sightings represent a random sample of all visits for the year, then an estimated 19 parties of natives visited the island during 1987. On these 1987 flights, no records were made of turtles at Deliverance Island. During 1988, however, turtles were recorded adjacent to the island as follows: 17 April—20+ turtles, 28 April—50+ turtles, 1 May—60+ turtles, 4 May—50+ turtles, 14 May—60+ turtles, 26 May—one turtle on dry land stranded by the tide.

Discussion

The breeding season for individual sea turtles spans several months. For each turtle, courtship occurs in the vicinity of the rookery and nesting begins about a month later. The female visits the nesting beach every two weeks to lay successive clutches, usually 3–6 clutches a season. The arrival of females at a rookery for their first nesting is asynchronous, with the arrivals of different females spanning several months. The emergence of hatchlings from a nest occurs about two months after oviposition. Thus, the absence of recorded *C. mydas* nesting on Deliverance Island and adjacent islands in mid-February and from late July to mid-August (as indicated by the lack of hatchling emergence two months later) and from late September to mid-October, as well as the sparseness of courtship sightings in the surrounding waters in February and October, indicate that the three study islands are not a significant *C. mydas* nesting area. The breeding observations of '*C. mydas*' at these islands by Kowarsky (1978) and Meek (1913) most likely refer to misidentified *N. depressa*.

The limited observations of turtle nesting at the three study islands (Table 1) indicate that *N. depressa* breeds year round in north-western Torres Strait, with the peak nesting density occurring in the early part of the year. Year-round nesting with a peak nesting density in April–May is characteristic of *N. depressa* in the Northern Territory (Cogger and Lindner 1969). The low-density nesting in August at Deliverance Island (as indicated by the low-density emergence of hatchlings in October) contrasts with the August peak in nesting density on Crab Island on the south-western border of Torres Strait (Limpus *et al.* 1983). The November–December peak nesting density along the east coast of Queensland (Limpus 1971; Limpus *et al.* 1981) also contrasts with the early to mid-year peak nesting density at Deliverance Island.

Table 1. Calendar of marine turtle nesting records from Deliverance Island, Kerr Island and Turu Cay

Date	Observations	Reference
February 1984	Deliverance: 40 tracks Kerr: 12 tracks	S. Garnett (<i>in litt.</i>); aerial survey
February 1987	Deliverance: 52 <i>Natator depressa</i> tracks Deliverance: 69 <i>N. depressa</i> turtles	Present study
May 1910	Turu: 'one great nest of turtles'	Meek (1913)
July–August 1987	Deliverance: low-density <i>N. depressa</i> nesting Turu: low-density <i>N. depressa</i> nesting Deliverance: sporadic <i>Eretmochelys imbricata</i> nesting	Present study, extrapolated from hatchling emergence in September–October
September–October 1987	Deliverance: 0–10 <i>N. depressa</i> nesting each night Kerr: low-density <i>N. depressa</i> nesting Turu: 1 nesting <i>E. imbricata</i>	Present study
December 1975	Deliverance: 11 tracks of unknown age, identified as <i>Chelonia mydas</i> and <i>E. imbricata</i> Kerr: 1 track of unknown age, identified as <i>C. mydas</i> Turu: 7 tracks of unknown age, identified as ' <i>C. mydas</i> '	Kowarsky (1978); aerial survey

Although the absolute size of the nesting population has not been measured, the occurrence of 60 nesting *N. depressa* in one night during the peak nesting period plus low-density nesting at other times of the year at Deliverance Island, with additional nesting on Turu Cay and Kerr Islet, is sufficient to identify these islands as a major rookery region for this species. It is at least as significant as the Peak Island rookery in central Queensland (Limpus *et al.* 1981), which is the second largest nesting aggregation recorded for the species. As is typical of other islands in western Torres Strait, Deliverance Island, Kerr Islet and Turu Cay support only low-density *E. imbricata* nesting.

N. depressa have been recorded as breeding only in Australian territory, and Deliverance Island is now the most northerly recorded breeding site of the species. Given the extensive records of turtles that have been accumulating over recent years from the northern areas of central and eastern Torres Strait and the southern PNG coast to the east of Torres Strait, the absence of recorded *N. depressa* nesting in those areas probably reflects a real absence. In contrast, there is a dearth of information on sea turtles from the southern PNG coast to the west of Torres Strait. Given the size of the Deliverance Island nesting population and its proximity to the PNG coast, *N. depressa* nesting may also occur on islands further west along the southern coast of Irian Jaya.

In eastern Australia, *N. depressa* breeds over a north-to-south range from approximately 9°32'S. at Deliverance Island to 24°47'S. at Mon Repos. Within this approximately 1700 km range, most of the nesting activity is concentrated in two regions: the southern Great Barrier Reef at Peak, Wild Duck and Avoid Islands, and western Torres Strait to north-eastern Gulf of Carpentaria at Crab and Deliverance Islands. A comparison of the sizes of female *N. depressa* from Queensland rookeries located along the range (Table 2) demonstrates

Table 2. Comparison of the sizes and clutch counts of adult female *Natator depressa* from a series of Queensland rookeries

Rookery	Curved carapace length (cm)		n	Clutch count		Reference			
	Mean	s.d.		Range	n				
Southern Great Barrier Reef Province									
Mon Repos and south Queensland	92.3	—	88.0-96.0	14	50.2	10.7	7-73	87	Limpus 1971
Curtis Island	93.9	2.67	87.0-99.0	42					Limpus, unpublished data
Peak Island	93.7	2.87	84.0-100.0	212	54.5	10.0	34-76	44	Limpus <i>et al.</i> 1981
Wild Duck Island	92.4	2.91	85.0-96.5	18					Limpus, unpublished data
North-eastern Gulf of Carpentaria									
Crab Island	89.3	2.66	80.5-97.0	326	56.2	9.6	22-76	76	Limpus <i>et al.</i> 1983
North-western Torres Strait									
Deliverance Island	88.8	2.96	81.5-94.0	18	52.0	14.0	36-87	12	Present study

Table 3. Comparison of *Natator depressa* egg diameters and hatching sizes from a series of Queensland rookeries

Rookery	Egg diameter (cm)		n	Straight carapace length (cm)		Reference			
	Mean	s.d.		Range	n				
Southern Great Barrier Reef Province									
Mon Repos	5.21	—	—	250	6.12	—	—	190	Limpus 1971
Curtis Island	5.14	0.14	4.63-5.40	159	6.21	0.19	5.51-6.42	36	Limpus, unpublished data
Wild Duck Island	5.19	0.12	4.93-5.49	50					Limpus, unpublished data
North-eastern Gulf of Carpentaria									
Crab Island	5.06	0.14	4.66-5.40	310	5.79	0.19	5.39-6.65	211	Limpus <i>et al.</i> 1983
North-western Torres Strait									
Deliverance Island	5.08	0.14	4.79-5.34	30	5.70	0.16	5.11-5.97	69	Present study

that the turtles nesting in western Torres Strait to north-eastern Gulf of Carpentaria are smaller than those nesting in the southern Great Barrier Reef (one-way ANOV: $F=131$, d.f. = 3, 594, $P \ll 0.001$, Crab and Deliverance Islands vs. Curtis and Peak Islands). A similar comparison of egg diameters from the same rookeries (Table 3) indicates that the flatback turtles at Crab and Deliverance Islands lay smaller eggs than those from the southern Great Barrier Reef (one-way ANOV: $F=20.19$, d.f. = 3, 545, $P \ll 0.001$). The data on hatchling sizes (Table 3) are inadequate to allow a reliable statistical analysis, but they are consistent with hatchlings being smaller at Crab and Deliverance Islands. No similar north-to-south difference is evident for clutch counts (Table 2). Whether these differences are nutritionally or genetically based cannot be determined at present.

Although the Deliverance Island *N. depressa* are the smallest recorded nesting females, their nests appear to be much deeper than those recorded elsewhere. This should mostly be the result of Deliverance Island turtles nesting in loose sand, which required a turtle to dig a deeper body pit in order to reach sand that is stable enough to support the steep walls of an egg chamber. The looseness of the sand and the deeper nests on Deliverance Island do not appear to reduce hatchling emergence success from undisturbed *N. depressa* nests compared with the siliceous sand beaches in south Queensland (Limpus 1971) and Crab Island (Limpus *et al.* 1983). During the dry season, the loose sand on Deliverance Island also resulted in a low nightly nesting success that was half the value recorded for *N. depressa* nesting on the firmer siliceous sand beach at Mon Repos (Limpus *et al.* 1984). The greater number of beachings per clutch laid at Deliverance Island will need to be taken into account when extrapolating from track counts to numbers of turtles using the beach.

The number of visits to Deliverance Island each year by small parties of Torres Strait Islanders and/or PNG nationals, as estimated from the Coastwatch observations, was of the same order of magnitude as the number of visits reported verbally by the Boigu and Badu Islanders. For the Islanders, at least, the emphasis has been on harvesting *N. depressa* eggs from the island and non-breeding green turtles from the adjacent reef flats, and only small catches are made during any one visit. Taken together, these data indicate that at present the utilisation of sea turtles and their eggs at the three study islands is low. This, however, is no justification for the wasteful practices of killing female turtles just to obtain their eggs and not eating turtles that are caught and later killed. Such practices should be discouraged by community leaders who have interest in the continued availability of the turtle resources of the three islands.

N. depressa is normally found in turbid waters, and this is applicable to the area around Deliverance Island during much of the year. During the dry season, however, this rookery offers a unique opportunity to study the poorly documented underwater life of this species. Deliverance Island is the only *N. depressa* rookery that is recorded to have water clear enough and shallow enough to enable observation of the species at sea.

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