# Torres Strait Marine Turtle Resources

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## Abstract

*Three of the six species of marine turtles that occur in the Torres Strait are represented by both nesting and foraging groups. Genetic uniqueness has been demonstrated for the regional green turtle nesting group but not for any of the other species. The number of nesting green turtles is correlated with an index on the Southern Oscillation. Pesticides and heavy metals do accumulate in the bones, soft tissues and eggs of marine turtles but the impact cannot be evaluated. International cooperation will be necessary for a regional conservation efforts to be successful.*

## Introduction

The marine turtle resource of Torres Strait was last reviewed in 1985 (Limpus & Parmenter, 1986). Six species of marine turtles occur in the Torres Strait region (Table 1). Two of these, the leatherback and the olive ridley, are only known from occasional sightings. The remaining four species are resident in foraging areas throughout the region. Only three species of marine turtles breed in Torres Strait and for two of these, flatback and hawksbill turtles, the rookeries are of international significance.

Table 1. Sea turtle species of Torres Strait.

| | |
|---|---|
| FAMILY: CHELONIIDAE | |
| *Eretmochelys imbricata* | Hawksbill turtle |
| *Natator depressa* | Flatback turtle |
| *Caretta caretta* | Loggerhead turtle |
| *Chelonia mydas* | Green turtle |
| *Lepidochelys olivacea* | Olive Ridley turtle |
| FAMILY: DERMOCHELIDAE | |
| *Dermochelys coriacea* | Leatherback turtle |

## Key Breeding Sites

### *Eretmochelys imbricata*

The rookeries were last surveyed in 1978 (Table 2). At that time significant nesting aggregations were recorded in central and eastern Torres Strait: Long, Aukane, Mimi and Kabbikane (Limpus, 1980a; Limpus *et al.* 1983a). Other rookeries identified since 1986 as being potentially important include Johnson Island, Bet Island and western Albany Island. This Torres Strait hawksbill nesting and that of the adjacent northern Great Barrier Reef constitutes one of the few remaining large nesting populations for the species worldwide. Although the size of this nesting population has never been accurately assessed, it is estimated that over three thousand females may nest annually throughout the region. Limpus and Parmenter (1986) expressed concern over the potentially excessive harvest of hawksbill eggs on some of the islands. This harvest remains unquantified.

### *Natator depressa*

The rookeries of western Torres Strait (including Crab, Deliverance, Turu Cay and Kerr Islands) support the largest known nesting population of the Australian endemic flatback turtle (Limpus *et al.* 1983b, Limpus *et al.* 1989), with an annual nesting population of several thousand females. The size of the annual nesting population at these rookeries has never been accurately quantified. Crab Island has supported an annual egg harvest by residents of the Bamaga community (Limpus *et al.* 1983b). The regional impact of this egg harvest and that on the other islands has not been quantified.

### *Chelonia mydas*

Bramble Cay supports the largest green turtle rookery in Torres Strait with an annual nesting population of several hundred nesting females (Parmenter, 1977, 1978).

Table 2. Sea turtle nesting populations in north-eastern Australia.

Based on Limpus 1979. Species: G = green turtle, H = hawksbill turtle, F = flatback turtle, R = Olive ridley turtle. Abundance: a = 0-10, b = 10-20, c = 20-30, d = 30-50, e = 50-100, f = 100-500, g = 500-1000, h = 1000+. Rookery Description Code: VSC = Vegetated Sand Cay, VSC-T = Vegetated Sand Cay - Trees, SSB = Submerging Sand Bank, MI = Mangrove Island, SC-M = Sand Cay - Mangroves, CSD = Coastal Sand Dune, SB-M = Sand Bank - Mangroves, CI = Continental Island.

| LOCATION | BREEDING SEASON SURVEY | | | | ROOKERY DESCRIPTION CODE |
|---|---|---|---|---|---|
| | 75/76 | 76/77 | 77/78 | 78/79 | |
| OUTER BARRIER ISLANDS | | | | | |
| Bramble Cay | | Gd/e | Gc | Gd Ha | VSC |
| Anchor Cay | | | | Gb | VSC |
| East Cay | | | | Nil | SSB |
| Don Cay | | | | Gc | VSC |
| Underdown Cay | | | Gb/c | | VSC |
| Dower Is. | | | Nil | Gb | CI |
| Maer Is. | | | Nil | Nil | CI |
| Wyer Is. | | | Nil | Nil | CI |
| Maclennan Cay | | | | Gc | VSC |
| Pandora Cay | | Gg | Gc/d | | VSC |
| Raine Is. | Gf | Gh | Gf | Gg | VSC |
| INNER SHELF CAYS | | | | | |
| Sinclair Is. | | Gb,Hb | | | VSC-T |
| Milman Is. | | Hc/d, Gb | | Hc, Gb | VSC-T |
| Aplin Is. | | | | Nil | MI |
| Wallace Is. | | Hb, Gb | | | VSC-T |
| Little Boydong Is. | | Hb | | | VSC-T |
| Boydong Is. | | Hc, Gb | | | VSC-T |
| Bird Is. | | Hc, Gb | | | VSC-T |
| Fife Is. | | Hb/c | | | VSC-T |
| Hannah Is. | | Nil | | | SC-M |
| Pelican Us. | | Hb | | | VSC-T |
| EASTERN CAPE YORK PENINSULA COAST | | | | | |
| False Orford Ness to Ussher Point | | Gb, Hb | | | CSD |
| TORRES STRAIT ISLANDS | | | | | |
| Stephens Is. | | | Nil | Nil | CI |
| Darnley Is. | | | Nil | | CI |
| Campbell Is. | | | | Hc,Gb | VSC-T |
| Keats Is. | | | | Hb,Gb | VSC-T |

Table 2 continued over

Table 2 continued

| LOCATION | BREEDING SEASON SURVEY | | | | ROOKERY DESCRIPTION CODE |
|---|---|---|---|---|---|
| | 75/76 | 76/77 | 77/78 | 78/79 | |
| TORRES STRAIT ISLANDS/continued | | | | | |
| Yorke Is. | | | Ha | Nil | VSC-T |
| Kabikane Is. | | | | Hc,Gc | VSC-T |
| Aukane Is. | | | | Hc,Gc | VSC-T |
| Mimi Is. | | | | Hc,Gb | VSC-T |
| Rennel Is. | | | | Hb | VSC-T |
| Long Is. | | | | Hd/e | SB-M |
| Coconut Is. | | | Ha/b | | VSC-T |
| Sue Is. | | | Ha/Hb | | VSC-T |
| Little Adolphus Is. | | | | Hb/c | CI |
| Lacey Is. | | | | Hc | CI |
| Salter Is. | | | | Hb | CI |
| Mt. Adolphis Is. | | | | Hc,Gb | CI |
| Thursday Is. | | | | Nil | CI |
| NORTHEASTERN GULF OF CARPENTARIA | | | | | |
| Crab Is. | | Fd,Hb | | Fd/e, Hb,Ra | VSC-T |

Almost all the green turtle nesting of Torres Strait occurs in the eastern islands. Although regionally important, none of these green turtle rookeries of eastern Torres Strait are of international significance (Table 2). An undetermined number of nesting females and eggs are harvested annually from Bramble Cay, Dowar and other islands.

## Identification of Turtle Stocks

The green turtle nesting population of eastern Torres Strait has been demonstrated to be part of the northern Great Barrier Reef (GBR) breeding unit, centered on Raine Island, using mitochondrial DNA analysis (Norman *et al.* in press) and inter-island movement of tagged nesting females. The northern GBR breeding unit has been demonstrated to be a separate breeding unit from that of the southern GBR breeding unit with both GBR breeding units completely isolated genetically from the Western Australian breeding unit (Norman *et al.* in press). The genetic relationships of the Wellesley Group green turtle nesting population and that of the Aru Island nesting population have yet to be determined.

Limpus *et al.* (1989) demonstrated a difference in size of nesting females and their eggs between the flatback turtles nesting in western Torres Strait including Crab Island and those nesting in the southern Great Barrier Reef. While this suggests that these rookery regions are separate breeding units it has not been confirmed through genetic analysis.

There has been no determination of the limits of breeding units for hawksbill turtles in the Torres Strait/northern GBR region.

## Foraging Area & Migration

The geographical distribution of adult female marine turtles recaptured in Torres Strait following their migration from rookeries in eastern Australia (Limpus *et al.* in press) is summarised in Table 3. Green turtles captured in Torres Strait nest at rookeries in eastern Torres Strait (Bramble Cay, Campbell Island), the northern GBR (Raine Island, Moulter Cay, No. 7 and No. 8 Sandbanks) and islands of the Capricorn-Bunker Groups of the southern GBR. Most of the tags recovered in Torres Strait have been from turtles tagged in the northern GBR breeding unit (97%), in particular at Raine Island and Moulter Cay and recaptured as resident feeding turtles or as migrating courting turtles. Torres Strait acts as a corridor through which turtles must migrate from feeding grounds in eastern Indonesia, the Arafura Sea region and the Gulf of Carpentaria en route to the rookeries of eastern Torres Strait and the northern GBR (Limpus and Parmenter, 1986). It is assumed that most of the green turtle courtship recorded in Torres Strait is by turtles migrating to rookeries of the northern GBR breeding unit.

Table 3. The geographical distribution of post-nesting tag recoveries of green and loggerhead turtles that were originally tagged while nesting at Queensland rookeries (from Limpus *et al.* In Press). Numbers in brackets refer to turtles captured by rodeo in selected foraging areas of the Great Barrier Reef (GBR).

| | *Chelonia mydas* (n=273) | | | *Caretta caretta* (n=118) | |
|---|---|---|---|---|---|
| Rookery / Recapture Location | Eastern Torres Strait | Raine Island | Capricorn Bunker Islands | Mainland | Capricorn Bunker Islands |
| Indonesia | 2 | 9 | 0 | 1 | 0 |
| Gulf of Carpentaria & Arnhen Land | 0 | 18 | 2 | 5 | 4 |
| Torres Strait (PNG side) | 10 | 69 | 1 | 2 | 1 |
| (Australia) | 4 | 50 | 3 | 1 | 1 |
| PNG & Solomon Islands | 3 | 7 | 1 | 3 | 7 |
| Vanuatu & New Caledonia | 0 | 2 | 12 | 0 | 2 |
| Northern GBR (<17 S) | 0 | 7 (+2) | 12 (+2) | 3 | 3 |
| Southern GBR (17 S - 24 30 S) | 0 | 1 | 22 (+25) | 5 (+16) | 3 (+2) |
| South of GBR (>24 30 S) | 0 | 0 | 9 | 45 | 15 |
| TOTAL | 19 | 163 (+2) | 62 (+27) | 34 (+16) | 66 (+2) |
| % International Recaptures | 79 | 53 | 16 | 12 | 15 |

Substantial numbers of tagged turtles from the northern GBR green turtle breeding unit are captured outside of Torres Strait in Northern Territory, Indonesia, southeastern and northeastern Papua New Guinea, Vanuatu and New Caledonia (Figure 1; Table 3). Tag recoveries of loggerhead turtles captured while feeding on reefs and inter-reefal habitats of Torres Strait demonstrate that these turtles are part of the southern GBR loggerhead breeding unit (Limpus *et al.* in press). Loggerhead turtles that migrate from the Gulf of Carpentaria also pass through Torres Strait en route to the southern GBR rookeries.

One of the few hawksbill turtles tagged while feeding on reefs in eastern Torres Strait has been recaptured nesting in the Solomon Islands (Parmenter, 1983). The foraging region utilised by the hawksbill turtles that nest within Torres Strait is unknown.

There has been one tag recovery in Torres Strait of a flatback turtle tagged while nesting at a central Queensland rookery (C. J. Parmenter, pers. comm.). Although over 500 nesting flatback turtles have been tagged at Crab Island and Deliverance Island, none have been recovered. The foraging distribution of the western Torres Strait nesting flatbacks remains unknown.

## ENSO Regulation of Green Turtle Breeding Density

Nesting numbers vary dramatically from year to year at green turtle rookeries within eastern Australia (Limpus, 1989) (Figure 2), with the fluctuations at all rookeries being in synchrony. A significant correlation exists between an index of the El Nino Southern Oscillation (ENSO) measured two years before the commencement of the nesting season and the annual green turtle nesting numbers at both Heron Island and Raine Island (Limpus and Nichols, 1988, in press) (Figure 3). The two year time lag is the result of adult female marine turtles typically taking in excess of a year to prepare for a breeding season. The annual fluctuations in nesting numbers are primarily the result of different proportions of the available adult females coming into breeding condition in some years and not in others, rather than the result of intrinsic changes in the number of adult females in the population (Limpus and Nichols, in press). Because of these irregular annual fluctuations, it will require a database gathered over some two decades of monitoring of nesting numbers at a rookery before significant changes in the size of the population can be detected. There is no database to assess whether or not the nesting numbers of hawksbill or flatback turtles show similar interseasonal fluctuations.

In high density nesting seasons, which occur two years following big ENSO events, there are also large numbers of mating green turtles seen in Torres Strait, notably in September to November prior to the nesting season. Correspondingly, in nesting seasons that follow two years after small ENSO events very reduced numbers of mating turtles are seen.

## Impact of Pollution on Turtles

As immature and adult animals, marine turtles utilize the shallow waters of the continental shelf, including the Great Barrier Reef, Torres Strait and the Gulf of Carpentaria, as foraging areas. Because of the environments which they inhabit and their position in the food chain, marine turtles are likely to be exposed to wastes that are dumped into the marine environment.

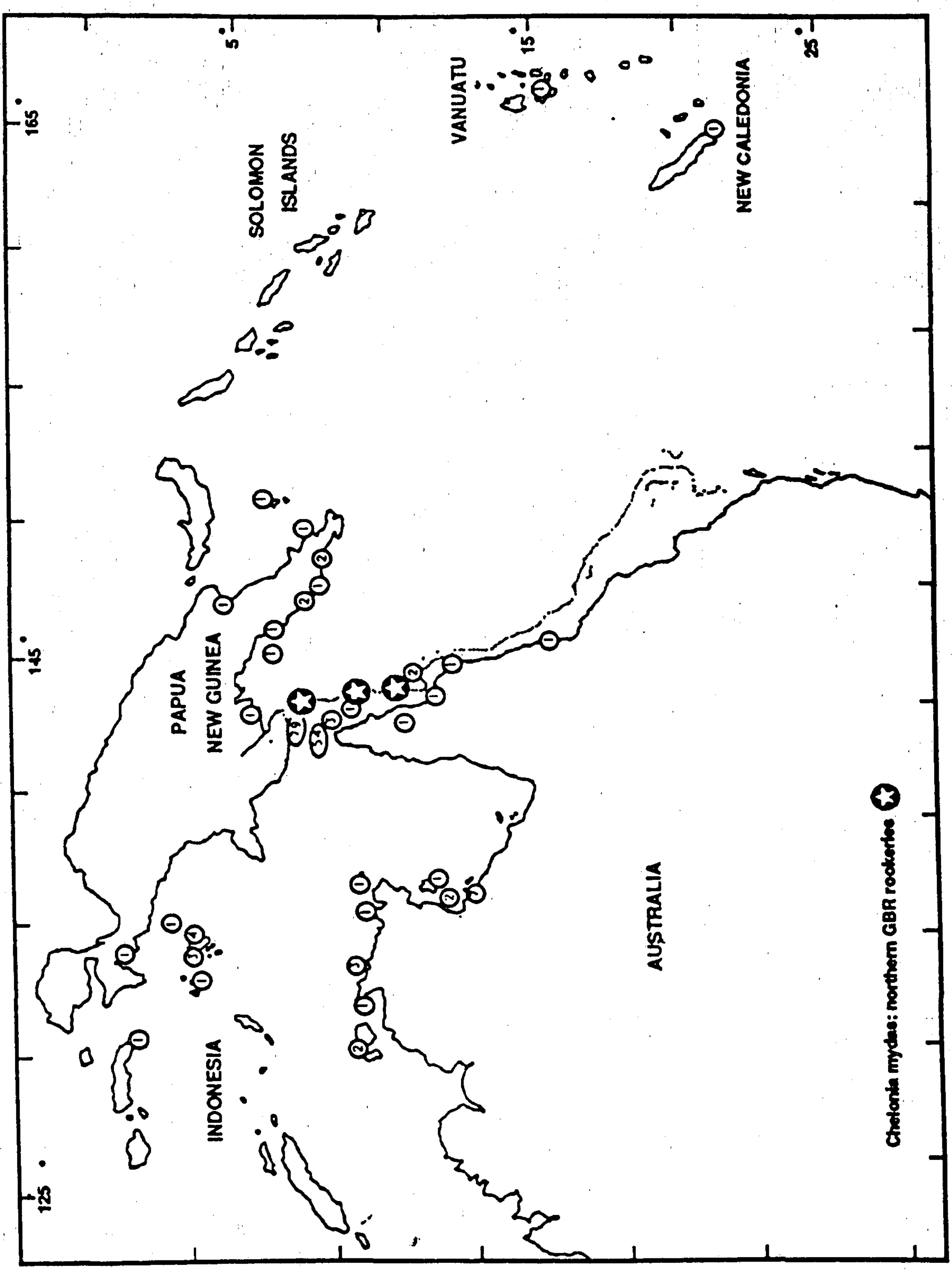


Figure 1. Pattern of recaptures of turtles tagged at the northern Great Barrier Reef green turtle breeding unit. Stars indicate nesting/tagging locations. Circled numbers indicate location and number of recaptures.

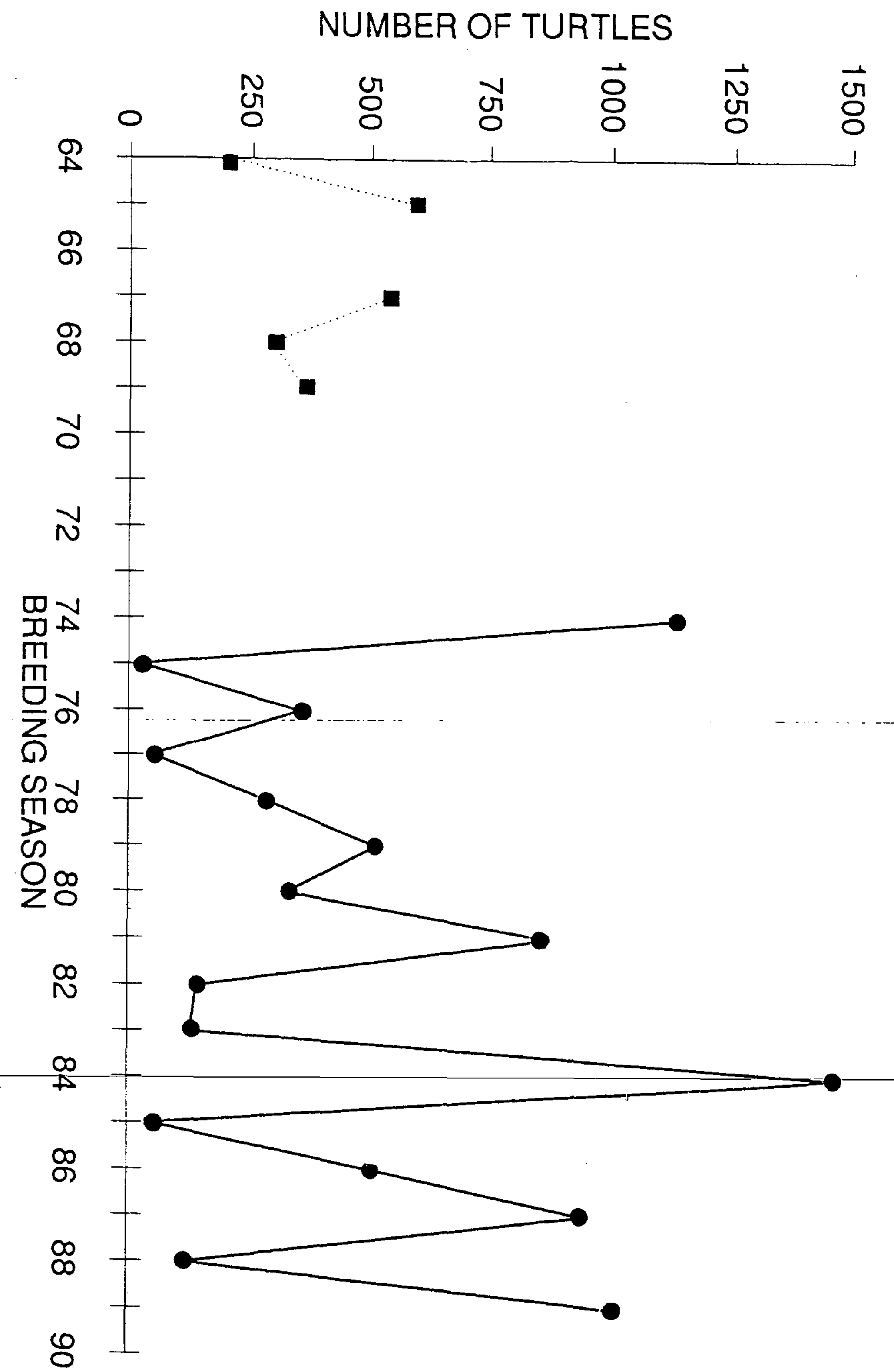


Figure 2. Fluctuations in the number of green turtles nesting at Heron Island. Squares represent approximate values obtained from various publications by Dr. H.R. Bustard. Circles represent data collected within the QTR project since 1974.

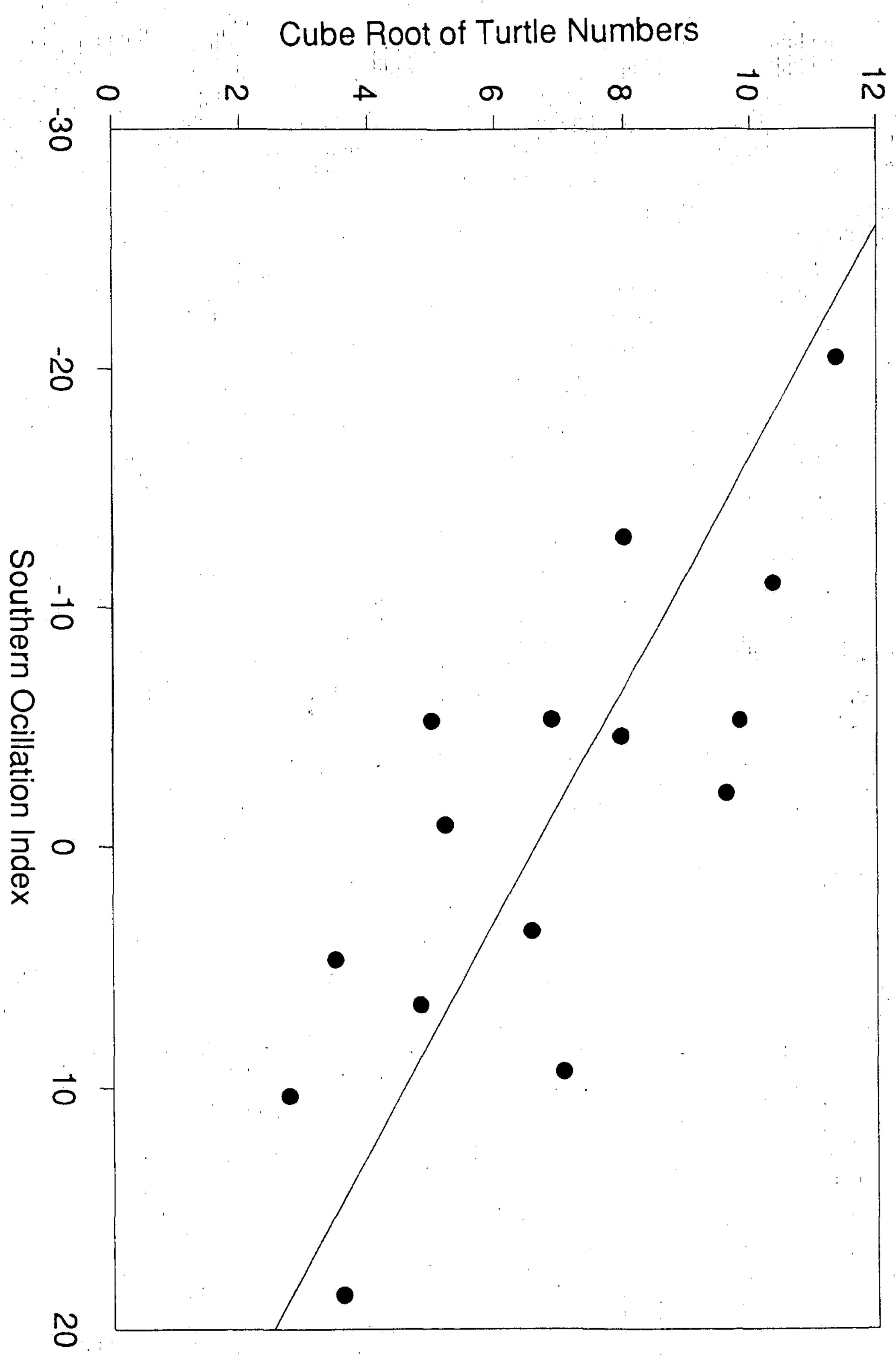


Figure 3. Correlation between the cube root of the number of nesting turtles and an index of the Southern Oscillation measured two years before. (See Limpus & Nichols, *in Press*, for details).

Plastic and other debris which are undigestible are, at least occasionally, eaten by turtles and when this happens the turtle eventually starves to death when its gut becomes clogged (Frazier, 1980).

Oil slicks may cause fouling of skin and obstruct breathing and feeding of turtles in the water. There are a few experimental data which describe the impact of petroleum on developing embryos (Fritts & McGehee, 1989). The minimum lethal tolerance levels, as well as LD50, teratogenic effects have not been determined for any of the known contaminants.

Table 4. Trace metals and pesticides found in marine turtle parts. Single values are MEANS; hyphenated values are RANGES. Codes are T = trace; Y = yolk; A = Albumen. Sources: A = Hillestad *et al*, 1974; B = Stoneburner *et al*, 1980; C = Witkowski & Frazier, 1982.

| SOURCE | A | B | C |
|---|---|---|---|
| MEASURE | ppm | ug/g | ug/g |
| MATERIAL | yolk & albumen | yolk only | bone only |
| SUBSTANCE | | | |
| TOTAL DDT | 0.06 - 0.31 | | |
| DIELDRIN | T - 0.056 | | |
| Al | | 3.56 - 6.01 | |
| Ba | | 2.08 - 6.86 | |
| Cd | 0.17 Y<br>0.56 A | 0.02 - 0.19 | |
| Co | | 0 - 0.07 | |
| Cr | | 1.04 - 1.71 | |
| Cu | 2.08 Y<br>6.0 A | 4.96 - 6.6 | 9.1<br>8.6<br>8.9 |
| Fe | | 71.2 - 74.6 | 78.5<br>198.3<br>309.0 |
| Hg | 0.02 - 0.09 Y<br>0.01 - 0.03 A | 0.41 - 1.39 | |
| Mn | | | 8.4<br>35.6<br>33.5 |
| Mo | | 2.66 - 17.9 | |
| Ni | | 0 - 2.27 | |
| Pb | 2.87 Y<br>12.0 A | 1.13 - 2.18 | 41.5<br>86.6<br>97.2 |
| Sr | | 66.1 - 74.0 | |
| Zn | 32.2 Y<br>26.0 A | 73.5 - 80.5 | |

Only a few opportunistic studies have considered the accumulation of contaminates such as heavy metals by sea turtles (Table 4). For the most part these few studies have reported concentrations but have been unable to put their work into a meaningful context (Hillestad *et al*, 1974; Stoneburner *et al*, 1980; Witkowski & Frazier, 1982; Davenport *et al*, 1990). As a result the general physiological impacts of heavy metals, pesticides and other pollutants in marine turtles are unknown; the tolerance of sea turtles to burdens of these contaminants is also unknown.

Hillestad *et al*, (1974) reported a set of baseline results obtained from egg yolks and albumen and found significant differences in the contained levels for Cd, Cu, and Pb but could not interpret the results. The concentrations of 13 heavy metals were determined in eggs of 40 loggerhead turtles (Stoneburner *et al*, 1980). Barium, cobalt, chromium, mercury, molybdenum, and nickel exhibited significant variation among the samples; however, aluminum, copper, iron, strontium, and zinc did not. The meaning of these results could not be determined. Witkowsky & Frazier (1982) reported the results from analysis of unidentified marine turtle bones. Again they had no context into which they could place their findings. Recently Davenport *et al*, (1990) reported on heavy metal analysis from a leatherback turtle. The liver contained the highest concentrations of Hg, Cd, Zn, and Ni; concentrations of Cu, Pb, and Se were higher in pectoral muscle tissue or blubber (As). None of the values reported were elevated above levels reported for other organisms (see Bryan, 1984, for review).

Other workers have had the same problem interpreting levels of pesticide accumulation. In each report the question of 'What does it mean if levels of DDE found are low (loggerhead turtles :0.091 ppm, Witkowski & Frazier, 1982; 0.05 ppm, Clark & Krynitsky, 1980, 1985; 0.003 ppm, Thompson *et al*, 1974; 0.034 ppm Fretemeyer 1980; 0.002 ppm in green turtles, Clark & Krynitsky, 1980)?' remains unanswered.

Because turtles migrate from several foraging areas to nest at specific locations, the concentration of heavy metals in eggs can serve as an indicator of variation among foraging areas. However, unless specific turtles can be traced to specific foraging areas, the only direction for the research to take is to examine the impact of various concentrations on development. This has intrinsic scientific and some practical value; however, this should not be emphasized over the determination of concentrations in specific foraging areas. Because the foraging areas provide the energy for vitellogenesis, the concentration of heavy metals found in eggs reflects the accumulation of elements from the foraging areas.

The presence of heavy metals in eggs and bone demonstrates that females can and do accumulate such contaminants in a manner that is at least superficially similar to that of other marine animals. Whether their exposure is indirect, from the environment, or more directly via food, has not been investigated.

Not enough is known to evaluate the impact of heavy metals and pesticides on marine turtles during any life stage. The information available provides some background levels for future comparison; however, they do not have direct application on the situation in Torres Strait. Because turtles are a part of the diet of the people in Torres Strait, regionally-based detailed studies need to be conducted to determine the background levels in the turtles being harvested and to monitor for any changes.

## Population Dynamics Constraints on Turtle Utilization

Almost all of the marine turtles harvested for food within the Torres Strait region are green turtles. Additionally, the catch is strongly biased to large female turtles (Parmenter, 1980; Kwan, 1989). Although some estimates of the size of the annual harvest have been attempted with varying precision (Limpus, 1980b; Parmenter, 1980; Kaowarsky, 1982; Johannes and MacFarlane, in prep; Kwan, 1989), no study has been made which links the harvest to the turtle population(s) being harvested. There is no database against which to judge whether the turtle populations (resident and migratory) in Torres Strait are being depleted by the harvest.

Additionally, the data required for understanding green turtle population dynamics (and those of other species) are incomplete. In particular, reliable estimates of recruitment to and survivorship of turtles of the various size classes are unavailable. Size classes of marine turtles are used to describe marine turtles because age cohorts can not presently be recognised.

Tag recoveries have demonstrated that the Torres Strait inhabitants are not the only people harvesting substantial numbers of turtles from the northern GBR green turtle breeding unit. If the people of Torres Strait wish to maintain turtles for their descendants to hunt, more emphasis should be placed on gathering data relevant to maintaining the turtle population within the context of sustained harvesting. Because of the international migration of turtles from the northern GBR green turtle breeding unit and the position of Torres Strait as a migratory corridor for many of these turtles, cooperative assessment and management of this turtle resource by Australian, Papua New Guinean and Indonesian Governmental agencies is to be encouraged.

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