Status of leatherback turtles in United Arab Emirates

By Nicolas Pilcher

1. Introduction
The United Arab Emirates, situated at the extreme eastern coast of the Arabian Peninsula, is bounded by Oman and Saudi Arabia. The United Arab Emirates terrain consists mostly of desert with little or no vegetation; some wooded steppes occur between the desert and the Hajar Mountains in the east on the border with Oman. There are patchy coastal mangrove forests distributed in limited areas along 450 km of the Arabian Gulf coast and 100 km of the Gulf of Oman (Kahn 1982; Ramadan-Jaradi 1985; Satchell 1978). Numerous offshore islands and banks are favourable for sea-grass beds and coral reef development (Carp 1976; UNEP/IUCN 1988). Traditional forms of nature conservation have had a long history in the Arabian Peninsula, in the form of range reserves or *hema* (hima or ahmia). Numerous offshore islands and banks are favourable for sea-grass beds and coral reef development.

2. The legal protection status for leatherback turtles
2.1 Overview
The UAE acceded to CITES on 1 July 1975 but withdrew from the Convention in 1988. It receded on 12 May 1990. The UAE is a signatory to CITES and is a member of ROMPE, the regional organisation concerned with the protection and development of the marine environment and the coastal areas along with Bahrain, Iran, Iraq, Kuwait, Oman, Qatar, Saudi Arabia and United Arab Emirates.

Legislation for nature reserves and national parks does not exist in the technical sense. Individual sites are established under private initiative of the ruling families or under hunting legislation. Under the Hunting Law seasonal protection is provided to a number of bird colonies, in addition to restrictions applying to at least one turtle beach and the Jebel Hafit Tahr Reserve area. Khor Dubai Wildlife Sanctuary was established in 1985 (Carp, 1976; Richardson, 1990). In addition, the Dubai government has designated a single national park, a combination of natural woodland and recreational area (Richardson, 1990). The only other forms of protection include Al Ayn Wildlife Enclosure and Zoological Garden and a municipal nursery in Ra's al-Khaymah (Richardson, 1990).

2.2 Management agencies responsible for marine turtle conservation
The federal Environmental Agency (FEA) has primary responsibility for drafting environmental laws and regulations and serves as the point of contact for international environmental conventions. A comprehensive Federal Environmental Law in 1999 stipulated that all new construction projects implemented in the UAE must complete environmental impact assessments, and these assessments must be reviewed and certified by emirate-level enforcement authorities. In addition to the FEA, other federal ministries have environmental responsibilities in specific areas. The Ministry of Agriculture and Fisheries promulgates laws relating to agriculture, pesticides and marine resources. The Ministry is also obliged to manage and protect the various hunting areas, bird sanctuaries and turtle beaches. Khor Dubai Flamingo Colony has 24-hour police protection (Richardson 1990). The Fisheries Section of the Department of Agriculture undertakes research on the marine environment, although as far as is known there are no marine conservation areas (Carp 1976).

Each of the emirates is responsible for enforcing environmental laws through its own local environmental regulatory authority. The emirate of Abu Dhabi established the Environmental Research and Wildlife Development Agency (ERWDA), which is the largest and most proactive of the local authorities in the UAE. Abu Dhabi designated ERWDA as the “competent authority” for environmental and wildlife issues in the Emirate of Abu Dhabi in 2000, as well as the scientific authority for UAE for the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES).

Other main state bodies with interests in protected areas are the Permanent Committee for Conservation and Ecology at the Presidential Court of Abu Dhabi and the Higher Environmental Committee (HEC) of the Ministry of Health. The HEC is concerned with aquatic life in coastal and marine areas and the impact

of water pollution, as well as environmental threats posed by oil and gas development. In addition, both bodies undertake monitoring of marine pollution (Montague and Bruun, 1987). The Dubai Wildlife Research Centre, established by the son of the ruler of Dubai, is a semi-governmental organisation. Its sphere of interests include; fauna and flora surveys, habitat studies including wetlands and shorebird areas and the establishment and development of wildlife preserves and zoos. It has been closely involved in identifying important nature conservation areas of Dubai (DSP 1987; Montague and Bruun 1987).

3. Nesting populations

There is no historical or contemporary record of leatherbacks nesting in the United Arab Emirates.

4. Foraging populations

4.1 Overview

The United Arab Emirates historically lists the leatherback as rarely occurring in its waters, and there are no contemporary records of leatherbacks having been seen in UAE's waters. No research has been carried out, or directed conservation action taken, on leatherback turtles in the United Arab Emirates.

4.2 Threats to leatherback turtles

The main environmental problems which would affect leatherback turtles include expansion of cities and residential/commercial areas leading to reclamation of vast tracts of shallow waters and saltmarshes in order to provide more space for building, port installations and industry. During the 1991 Iraq-Kuwait war oil slicks threatened the coastal and marine habitats all along the Arabian coastline. With the exception of a small purse seine industry operating out of Sharjah, the fisheries of the UAE are entirely artisanal in nature. No trawling takes place in the UAE since this has been banned since the 1970s in an effort to protect marine habitat. Although the use of drift nets is also prohibited, their illegal use is common.

4.3 Protection of foraging areas

Marine Protected Areas (MPAs) are an important part of marine management in the UAE and several large MPAs are reported to exist, although only one is reported officially (Ganadah, or Ras Ganadah, lagoon and mangrove Marine Park) particularly in the west of the country. These western areas are primarily concerned with protection of marine habitat and rare and endangered species, such as dugong. Fishing activities in these MPAs are either banned or restricted. In addition, large areas of the UAE's territorial waters are occupied by oil concessions where most activities are either banned or restricted.

4.4. Gaps in capacity and requirements for improved conservation

It is widely regarded that there is a lack of legislation relevant to protected areas. Indeed, in 1982 a recommendation was put forward for a comprehensive forest law for the country as a whole, envisaging a technically trained and suitably constituted forest service to apply and enforce the provisions of the proposed law (Khan, 1982). It was recommended that a study be made of existing forest laws in other parts of the Middle East. It was further suggested that subsequent phases could involve the United Nations Food and Agriculture Organisation to provide suitable consultancy services in drafting the outlines of the proposed forest law (Khan, 1982).

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Status of leatherback turtles in British Indian Ocean Territory (B.I.O.T.)

By Jeanne A. Mortimer

1. The legal protection status for leatherback turtles

1.1. Overview

All marine turtles are protected by law in BIOT. Certain fisheries regulations are particularly pertinent to leatherback turtles.

1.2. Legislation protecting leatherback turtles

Legislation pertinent to marine turtles in general:

The protection and preservation of Wild Life Ordinance 1970 (as amended) empowers the Commissioner to enact legislation to protect wildlife (including turtles), prohibit the purchase, sale or export of wildlife, and prohibit the introduction of wildlife. It also permits the seizure in certain circumstances, of any vessel which brought a suspected offender into the Territory and, if any fine imposed is not paid, the eventual forfeiture of that vessel.

The Wildlife Protection regulations of 1984 makes it an offence to 'intentionally kill or attempt to kill or injure, or to take or be in possession of 'and 'intentionally to destroy, damage or take any birds nest while the nest is in use or being built, or any birds egg or turtles eggs'. The Wild Life Protection (Amendment) Regulations 2000 (2003) extends this list to include possession of a 'dead animal or any part of an animal or of a dead animal

Green Turtles Protection regulations 1968 states that 'no person shall harpoon, kill, destroy or take possession of any turtle for any reason whatsoever (Similar legislation was not passed for Hawksbill turtles at this time because hawksbill turtle flesh was not being hunted for its meat; however all turtles are protected under other legislation)

The Prohibited Imports and Export Order, 1984 prohibits the exportation of 'wild animals, whether alive or dead, (includes turtle eggs)

The Trade in Endangered Species (Control) Ordinance 2001 provides for the application of CITES, appointing the Administrator as the Management Authority and requiring that advice be taken from a scientific authority '… a person or authority as the Commissioner may from time to time appoint. The Joint Nature Conservation Committee is appointed as the Scientific Authority under Section 5 of this Ordinance.

(The introduction of species does not appear to be expressly prohibited other than in Strict Nature Reserves)

Legislation relevant to Leatherbacks:

The use of drift nets is prohibited in BIOT waters by conditions attached to fishing licences and the Fisheries Conservation and Management Ordinance 1998 and this Ordinance makes it an offence to contravene licence conditions.

Note:

Driftnets are known to impact leatherbacks, and it is likely that leatherbacks forage in the territorial waters of BIOT.

1.3. Management agencies responsible for marine turtle conservation

Operational level	Name and type of agency
National level	UK Foreign & Commonwealth Office, BIOT Administration
State level	
Local level	Department of Environment, Diego Garcia

2. Nesting populations

2.1. Overview

Summary

There have been no confirmed reports of leatherback nesting in the Chagos Islands, British Indian Ocean Territory (BIOT)(Mortimer & Day, 1999). But, according to Marcel Moulinie who managed cobra collection in the Chagos in the 1960s and 1970s (pers. comm. to J.A. Mortimer), a single leatherback once nested at Peros Banhos atoll during the early 1970s.

The following turtle surveys have been conducted in BIOT territory during the past three decades:

- Frazier (1977) made a brief visit to several of the islands in 1970 and interviewed a number of local inhabitants. None reported leatherback nesting.
- Dutton (1980) surveyed several of the islands of Peros Banhos atoll in late 1978/early 1979, and found no evidence of leatherback nesting.
- Mortimer surveyed most of the islands of BIOT during a six week period in 1996 and found no evidence of leatherback nesting anywhere (Mortimer & Day, 1999).
- Mortimer surveyed the entire coastline of Diego Garcia atoll in 1999 and found no evidence of leatherback nesting (Mortimer, 2000).

5. Foraging populations

3.1. Details of any leatherback turtle foraging area census of tagging results

No information available

3.2. Seasonality of leatherback turtles in coastal and offshore waters

No information available

3.3. Approximate size range of leatherback turtles

No information available

3.4. Information on the diet of leatherback turtles

No information available

3.5. Other biological studies conducted on leatherback turtles in foraging areas

No information available

3.6. Threats to foraging populations of leatherback turtles

No information available, however, commercial fishing activities, especially long lines & netting activities are a potential threat to leatherbacks in the territory.

3.7. Fisheries bycatch of leatherback turtles and the fisheries involved

No information available

3.8. Other activities being undertaken to improve conservation of leatherback turtles

No information available

6. Concluding Remarks

Leatherbacks can be expected to forage regularly in the territorial waters of BIOT, but no information is available. Collaboration with the fisheries authorities is needed to gather data on this matter and determine what follow up conservation efforts may be called for.

5. References

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Status of leatherback turtles in Vietnam

By Phan Hong Dung

1. The legal protection status for leatherback turtles

1.1 Overview

Leatherback turtles are listed as a threatened species in the Red Data book of Viet Nam

The following legal documents have been issued by the Government of Viet Nam in relation to the fisheries resources protection and development (including leatherback turtles):

- Ordinance dated 25 April 1989 on the protection and development of fisheries resources, which stipulated that:
  - "Prohibit any actions causing harmful affects on resources or habitats of aquatic living resources "(Chapter I, Article 5).
  - "Exploitation and commerce of living aquatic resources of high economic value that are rare, threatened or endangered should be banned" (Chapter II, Article 12).
- Enactment No 195 - HDBT (Council of Ministers) dated 2 June 1990 guiding on execution of the Ordinance dated 25/April/1989.
- Decision No 130-CP dated 20 April 1991 on Establishment of the Fisheries Protection Department under Ministry of Fisheries.
- National Law on Environment Protection issued in 1993 and innovated in 2004.
- Provisions No 415/TTg dated 20 August 1994 of Prime Minister promulgating the statute on the organization and activities of State Inspectors in the field of protection of fisheries resources.

The Ministry of Fisheries of Vietnam has also issued other relevant documents, namely:

- Circular No 04-TS/TT dated 4 August 1990 guiding execution of ordinance on protection and development of fisheries resources.
- Circular No 04-TS/TT dated 21 November 1994 guiding the execution of enactment No 85-CP on administrative punishment in fisheries resources protection.
- Decision 682 TS/QD dated 11 September 1993 enacting the provisions on marine resources exploitation and management in key fishing grounds
- The ordinance dated 25 April 1989 stipulates that " The Government of Vietnam welcomes and is ready to cooperate closely with any regional and international organizations in protecting, conserving fisheries resources, their habitats and other shared aquatic living resources"
- In April 2002, the Government of Vietnam amended Decree 48/CP to include marine turtles. Under this decree the deliberate catch, killing or use of turtles (including leatherback turtle) is illegal.
- Most importantly, Vietnam Law of Fisheries had been signed by H.E President of S.R. Viet Nam on December 10 2003 and it entered enforcement on the July 1 2004: "This law is the great legitimacy to exploit, capture, culture, preserve, protect and manage the marine resources, especially, fisheries resources and other marine wildlife".

The Vietnam Law of Fisheries had been states that: Chapter II: Protection and development of fisheries resources Article 7: Habitat protection

1. Organizations and individuals shall be responsible for the protection of aquatic habitat.
2. Organizations and individuals conducting fisheries activities and other activities that directly affect the aquatic habitat, migration, spawning of fish species shall comply with provisions as set out by this Law and other legislation dealing with environmental protection, water resources and other relevant legislation.
3. Organizations and individuals while setting up, altering or destroying the constructions related to aquatic habitat, migration, spawning of fisheries resources shall conduct environment impact assessment as set out by legislation dealing with environmental protection.
4. Organizations and individuals while fishing by setting barriers, set nets in rivers, lakes, lagoons shall have to spend a corridor areas for the movement of fisheries resources as regulated by local People's Committees.

Article 8: Conservation, protection, rehabilitation and development of fisheries resources

1. The State shall issue policies regarding the conservation and protection of fisheries resources, particularly of the endangered, rare and precious ones and ones that have economic value and scientific importance; shall encourage the scientific research for suitable measures to develop fisheries resources; shall invest in production of fish fry for releasing into their natural habitat and shall create artificial residence places in order to rehabilitate and develop fisheries resources.
2. Organizations and individuals shall be responsible for conservation, protection, rehabilitation and development of fisheries resources as set out by this Law and other relevant legislation.
3. Ministry of Fisheries shall periodically proclaim the followings:
   a. The list of aquatic species which are named in the Red Book of Viet Nam and other species prohibited to be fished; the list of aquatic species which are prohibited to be fished in time-limited manner and the closed time as well.
   b. Fishing methods, types of fishery and fishing gear which are prohibited to be used or are restricted to be used;

1.2 Management agency responsible for marine turtle conservation in Viet Nam

Operational level	Name and type of agency
National level	In 1998 the Ministry of Fisheries appointed the Research Institute for Marine Fisheries (RIMF) as the national institution responsible for research activities and proposing the general framework for management and conservation of marine turtles. The National Department of Fisheries Resource Exploitation and Protection (at MoFI) has prepared and developed the management tools that relate to controlling fisheries resource exploitation and protection in sustainable manners. WWF-Indochina, IUCN Viet Nam, Traffic Viet Nam-ASEAN and FFI all collaborate with Viet Nam Government partnerships involving marine turtles in Viet Nam.
State level	Coastal Provincial Fisheries Departments play an important role to coordinate with the national organization as well as NGO to protect and conserve marine turtles at provincial sites.
Local level	Authority Board of Marine Protected Areas, Marine Park and Natural Preservation Area, such as Hon Mun MPA, Nui Chua and Con Dao NP implement several activities as volunteered and assigned by MoFI and RIMF.

2. Nesting populations

2.1 Overview

Bourret (1941) provided the first descriptions of marine turtles in Viet Nam and reported that Viet Nam's waters five species of marine turtles including leatherback turtles. Bourret (1941) also collected information from local fishers indicating that leatherback turtles nested along the beaches in central Viet Nam. More recently detailed surveys of the distribution and abundance of marine turtles in Viet Nam conducted by Pham Thuoc (2003) and Hamann et al, (2005) indicate that in the 1960s/1970s there was a nesting population in the order of 500 females per year. Nesting beaches were spread throughout the central provinces from Quang Binh south to Binh Thuan. In particular, elderly fishermen interviewed by Hamann et al. (2005) from Quang Ngai (Binh Son district) and Binh Thuan (Bai Xep commune) said that prior to the 1960s (and the war) 10 to 20 leatherback turtles nested per night between June to August. Occasional leatherback nesting was also recorded by Nguyen Khac Huong (1978) in Hai Van- Son Tra during the late 1970s

Vietnamese nesting green turtle surveys began at Con Dao in 1995 and at Nui Chua in 2000. Although leatherback turtles are occasionally seen in the waters around Con Dao National Park and the coast adjacent to Nui Chua, they have not been recorded nesting on any of Con Dao's or Nui Chua's beaches (Pham Thuoc 2000; Nguyen Thi Dao 1999; Le Xuan Ai 2001, 2003; Tran Minh Hien 2002; Hamann et al. 2002, 2005).

Recent sightings of nesting leatherback turtles

Thua Thien Hue Province (2000), and Quang Ngai Coastal Area (2001) (Dinh Hong Thanh Personal Communication)

2.2 Details of leatherback turtle nesting population

There are two turtle tagging programs operating in Viet Nam. The first, and longest running program, occurs on Con Dao Islands and the second program was started in 2000 at the mainland beach of Nui Chua (Ninh Thuan Province). Neither of these programs have recorded leatherback turtle nesting. Two recent surveys of marine turtles have been conducted. Between 1998 and 2002 RIMF investigated marine turtle resources in Viet Nam in 28 coastal provinces by conducting interviews at fishing ports and with staff at marine research institutions. This survey found no evidence of current leatherback turtle nesting (Pham Thuoc 2003). A second survey, involving some of the same research staff, was conducted in 2002. This second survey entailed conducting interviews with a broader section of the community (including artisanal fishers, commercial fishers and Government representatives) (Hamann et al. 2005). Results from Hamann et al. (2005) indicated that fewer than 10 nests are laid per year and these occur along the beaches in each of Quang Ngai and Binh Dinh provinces (Figure 1).

2.3 Seasonality of leatherback nesting

Tonkin Gulf (from Quang Ninh to Quang Tri Province): foraging leatherback turtles are normally seen in March and April and very rare captures (one or two per year, generally released alive) of adult sized leatherback turtles occur each year, coinciding with the jellyfish season. Given that the nesting season in the provinces of Quang Binh, Quang Tri, Hue and Da Nang begins in April (Pham Thuoc 2003; Phan Hung Dung 2003; Hamann et al. 2005), it is likely that leatherback turtles are migrating or courting in the offshore island at Tonkin Gulf. ***Central Viet Nam*** (from Thua Thien Hue to Ninh Thuan Provinces): the nesting season for leatherback turtles is similar as for the other species. It occurs from April until July. ***Southern Viet Nam*** The nesting season for marine turtles, although very few leatherback turtles currently nest in this region, lasts from June till September along the southern coast beaches of Vietnam, such as Con Dao, Phu Quy, Tho Chu and Phu Quoc Island Group.

2.3) Genetic studies

A plan to collect and analyse mtDNA samples for marine turtles in Viet Nam, including leatherback turtles, has been approved by RIMF and MoFI and will be conducted after 2006.

2.4) Biological parametres

There are no published biological data collected from nesting leatherback turtles in Viet Nam. However, from interviews with fishermen, Pham Thuoc (1999, 2003) indicate that; the average size of nesting females is between 120 and 180cm, they lay between 70 to 90 eggs per clutch; eggs are between 41 and 50mm in width and hatchlings are between 40 to 60mm in carapace length (Table 1).

Table 1. Summary of biological data collected from leatherback turtles in Viet Nam

Category of data	Average	References
Size of nesting females	120 - 180	Pham Thuoc (2001)
Number of eggs per clutch	70-90	Pham Thuoc (2001)
Clutches per season	Uncertain	
Re-nesting interval (days)	Uncertain	
Number of years between breeding seasons (years)	Uncertain	
Size of eggs (cm)	41-50mm	Pham Thuoc (2001)
Size of hatchlings (cm)	4-6	Pham Thuoc (2001)
Incubation success (%)	Uncertain	

2.5) Pivotal temperature studies

No studies on pivotal temperature or hatchling sex ratios have been conducted in Viet Nam

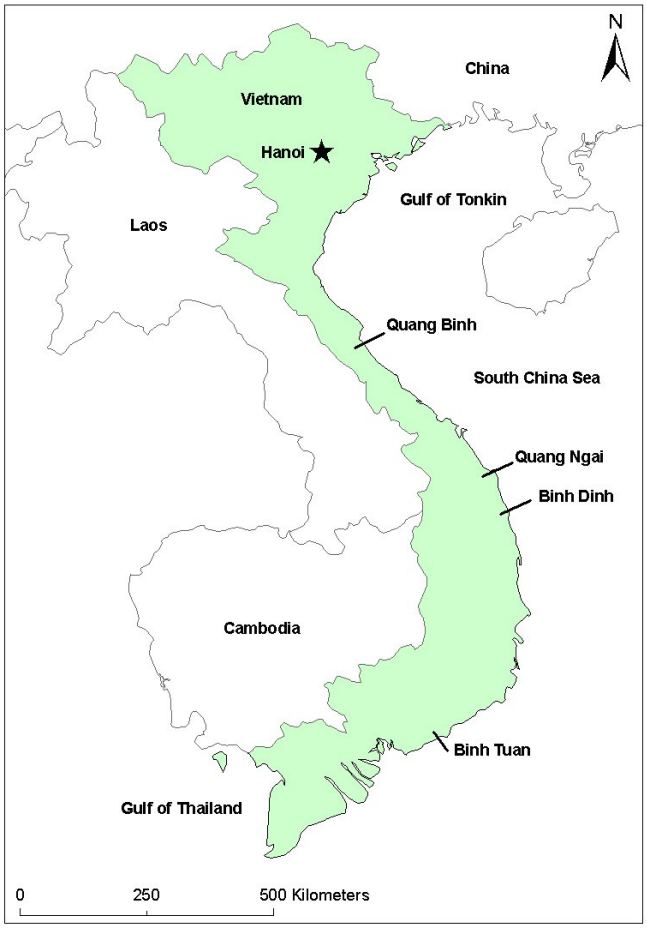

Figure 1. Location of former and current locations for leatherback turtle nesting in Viet Nam

2.6) Migration records

There have been no reports of leatherback turtles being caught in Viet Nam that were carrying tags applied in another country. Only one leatherback turtle has been tagged in Viet Nam. This tagged turtle stranded adjacent Nghia Hung Commune, Nam Dinh Province and was tagged and released.

2.7) Protection of nesting beaches (e.g. national parks)

Name of the beach(s)	Name of the planned National Park
Son Tra Island beaches	Hai Van –Son Tra (Quang Nam)
Nam Yet Island Beaches	Spratly archipelago (although only at sea sightings of leatherback turtles)
Bai Dai Beaches	Phu Quy Island (Ninh Thuan) (although only at sea sightings of leatherback turtles)
Bai cat min	Tho Chu Island (Kien Giang) (although only at sea sightings of leatherback turtles)
Hon Da Lon	Phu Quoc Island (Kien Giang) (although only at sea sightings of leatherback turtles)

2.8) Use of hatcheries used to protect marine turtle nests

Hatcheries are used by staff at Con Dao National Park to protect a small number of green turtle nests. No leatherback clutches have been placed into hatcheries for incubation.

2.9) Threats to nesting marine turtles

The main threats to nesting populations of leatherback turtles in Viet Nam are (1) harvest of eggs and adult turtles from nesting beaches and (2) the incidental capture in fishing gear (Table 2; Pham Thuoc 1999, 2003; Hamann et al. 2002; 2005; Cox 2003).

Table 2. Summary of the threats to leatherback turtles nesting in Viet Nam

Threats at this site/area	Current occurrence			Historical occurrence			
	Low	Med	High	Unknown	Low	Med	High
Exploitation of nesting females	*X*						X
Egg collection	X						X
Agricultural development			X		X		
Tourist development			X		X		
Urban development		X			X		
Industrial development		X			X		
Artificial lighting	X			X			
Coastal erosion			X		X		
Vehicles on the beach		X			X		
Sand mining		X		X			
Unregulated hatchery practices		Not applicable			Not Applicable		
Natural threats/predation			X		X		
Other (please describe):							

2.10) Impacts of coastal development and/or sand mining on leatherback turtle nesting.

Not applicable

2.11) Major existing threats to nesting turtles.

Priority 1 Gill net
Priority 2 Trawling
Priority 3 Longline and purseine vessels
Priority 4 Tourism Development
Priority 5 Egg collection

2.12) Activities underway to improve the conservation nesting populations of marine turtles.

No conservation activities have been planned in Viet Nam to improve the protection of leatherback turtles, their eggs or nesting habitat. However, the Vietnamese Government has prepared a Marine Turtle Action Plan to guide conservation activities for all species until 2010. Within this plan are activities such as environmental education, awareness raising, species identification, beach protection and policy changes. An education package has been released and trailed in some schools, enforcement and legislation awareness training has been provided to local Government staff, police and other enforcement officers.

2.13) Other biological studies conducted on leatherback turtles

None

3. Foraging populations

3.1) Details of leatherback turtle census or tagging results such as tag recovery data.

There are no known tag recoveries. However, the latest stranding recovery of leatherback turtle was found alive and identified by staff from the Department of Marine Conservation Research Sciences and Research Institute for Marine Fisheries (RIMF). Some biological data was collected from this individual.

- Carapace length: 124 cm, Carapace width: 90 cm, Head length: 37 cm, Head width: 23 cm, Front flipper: Length - 74 cm, Width - 24 cm, Rear flipper: Length - 35 cm, Width - 23 cm, Total Body Weight: 170 kg, Tag right flipper: VN(N)0110, Tag left flipper: VN(N)0111, Captured Date: 16th April, 2005, Released Date: 19th April, 2005 at 10am nearby Nghia Hung Commune, Nam Dinh Province. Phan Hong Dung (2005) Unpublished data

3.2) Seasonality of leatherback turtles in coastal and offshore waters
Northern Viet Nam: From March till July
Southern Viet Nam: From June till October
Also see section 2.3 of this assessment

3.3) Approximate size range of leatherback turtles
The carapace length of leatherback turtles caught by fishers, or that have stranded on beaches range from 90-220 cm. In August 2002, an adult female leatherback turtle caught in central Viet Nam contained large yellow ovarian follicles indicating that she was preparing to breed in that year (Hamann et al. 2002). The size of leatherback turtles that have stranded in Viet Nam are supplied in Table 3.

Table 3. Sizes of leatherback turtles that have stranded in Viet Nam (data from Pham Thuoc 2003)

Seawater areas	Rate of occurrence	Min-Max Caught Size (carapace length) (cm)
The Tonkin Gulf	Very rare	90 - 200
The Central	Very rare	120- 220
Southeast	Very rare	120 - 180
Southwest	Very rare	90 - 120

3.4) Information on the diet of leatherback turtles.
There is no known information on diet. However, they are most often caught in the jellyfish season (Phan Hong Dung, Unpublished data).

3.5) Other biological studies conducted on leatherback turtles in foraging areas.
Not applicable

3.6) Threats to foraging populations of leatherback turtles.
The threats to foraging leatherback turtles in Viet Nam are listed in Table 4. Data from Hamann et al. (2005) indicate that current incidental catch rates in trawlers and coastal gill nets is one turtle every two years per province in the six central provinces (Ha Tinh, Quang Tri, Thua Thien Hue, Quang Ngai, Binh Dinh and Khanh Hoa).

Additional threats that have been identified, but not quantified include tuna longline vessels, purseine vessels and drift net operations

3.7) Fisheries bycatch of leatherback turtles and the fisheries involved
In 2005 the number of registered vessels had increased to 85,000. Most of these (73,000) take place in the coastal zone. These registered vessels are using the following different kinds of nets:

- 42.3% are registered as bottom trawler nets
- 12.3% are registered as purse-seining nets
- 19.2% are registered as gill nets
- 7.0% are registered as lift netting gears
- 14.2% are registered as longline nets
- 5.0% are registered as other nets.

The Vietnamese Ministry of Fisheries estimates that gill net, trawlers, and drift nets are having the most substantial impacts on marine turtles (Table 5; Hamann et al. 2002).

Table 4. Summary of threats to leatherback turtles foraging in Viet Nam

Threats at this site/area	Current occurrence			Historical occurrence			
	Low	**Med**	**High**	**Unknown**	**Low**	**Med**	**High**
Directed take of leatherback turtles at sea NA		Not applicable		Not applicable			
Trawl fisheries	X			X			
Gillnet fisheries	X			X			
Longline fisheries		Unknown		X			
Purse Seine	X			X			
Boat strikes		None reported		X			
Plastics and other debris (at sea)		Unknown		X			
Industrial effluent		Unknown		X			
Inshore oil pollution		Unknown		X			
Natural threats/predation		Unknown		X			

Table 5. Relative impacts of various fishing industries on marine turtles in Viet Nam. Data from Phan Hung Dung (RIMF), Hamann et al. (2002), Cox (2003)

Type of fishery	**Months of operation**	**Number of boats**	**Impact –** low, medium, high or unknown	**Reference**
Gill net	Year round	>16,000	High	MoFI inf. Centre
Trawling net	Year round	About 40,000	High	MoFI inf. Centre
Drift net	Year round	About 12,000	High	MoFI inf. Centre

3.8) Other activities being undertaken to improve the conservation of leatherback turtle foraging populations.

- Law of Fisheries of VN
- National Action Plan on Marine Turtle Research, Conservation and Management in VN beyond 2010
- Established National MPA system network
- Marine biodiversity and conservation human capacity building

4. Concluding remarks

Areas of change	Summary including report references
Legislation changes	The State shall issue policies to ensure the sustainable fisheries development; shall encourage and create favourable conditions for organizations and individuals to rationally exploit and use fisheries resources and shall ensure the rehabilitation of fisheries resources and aquaculture development at seas, lagoons and other natural waters.
Action/recovery plans	National Action Plan on Marine Turtle Research, Conservation and Management in VN beyond 2010 (Ministry of Fisheries 2004)
Awareness raising programmes	WWF, IUCN, MoFI & RIMF education and fisheries bycatch awareness raising
Research activities	For green and hawksbill turtles at nesting beaches
Fishery controls	1. The fishing trade shall be registered 2. Fishing vessels shall be registered and inspected. 3. Fishing gear and devices shall have properly modified.
Managed turtle based tourism	There is ecotourism potential at locations such as Con Dao, Ninh Thuan and Phu Quoc whereby turtle-based tourist projects are possible. Such as nesting beach tours, diving tours or turtle sponsoring activities.
Annual nesting beach surveys	Occur at Con Dao National Park and at Nui Chua Beach in Ninh Thuan province with support from WWF and local Government agencies
Managed hatcheries	Only for green turtles at Con Dao – most nests however are left in situ.

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Status of leatherback turtles in Yemen

By Nicolas Pilcher and Mohammed Saad

1. Introduction

The Republic of Yemen lies in the south-western corner of the Arabian Peninsula, and includes the Socotra archipelago. The coastline has a length of about 2200 km, roughly one third of which is in the Red Sea and the remaining two thirds is in the Gulf of Aden. Yemen marine communities are developed in some extreme environments, ranging from high sea temperatures, minimal tidal movement and relatively calm sea conditions in the southern Red Sea, to seasonal cool water up welling and large oceanic waves in parts of the Gulf of Aden and Arabian Sea. Areas exposed to the up welling share a unique mix of tropical and temperate species, and highly productive fisheries.

Along the Red Sea, the climate is dry with an average annual rainfall of 100 - 200 mm and a humidity of about 60 %. No perennial surface streams discharge into the Red Sea. However, flash floods are a wide-spread feature following torrential rains. The Gulf of Aden is dominated by the Indian Ocean monsoon system. The highest annual rainfall occurs after flash floods between January and March (NE monsoon). Between May and September the SW monsoon generates winds in a north-easterly direction (SW Monsoon), and the relatively warm surface water of the Gulf of Aden is blown offshore and replaced by cooler, nutrient-rich water from deeper layers, limiting coral growth. The seasonal influx of waters through the Straits of Bab al-Mandab results in relatively lower surface salinities and higher nutrients levels. About 75 % of the coastline consists of soft sediments and more than half of the shores are covered by sabkhas and salt marshes. The scarcity of hard substrates and the high turbidity along the wide and shallow continental shelf create unfavourable conditions for leatherback turtle nesting.

Along the Gulf of Aden coast, which has a length of about 1400 km and a continental shelf area of 20,225 km², the southern extent is characterised by rocky cliffs that normally terminate in shallow water alternating with stretches of sandy beaches. Coral growth is limited by seasonally low temperatures as a result of the spellings, and large expanses of unfavourable sandy substrate.

The Socotra archipelago has long been isolated from the mainland, surrounded by deep waters, in places exceeding 3,000 m depth. It lies 400 km south of the Arabian Peninsula and is highly exposed to the monsoon climate of the Indian Ocean. Annual rainfall is around 200 mm, mainly falling in June, November and December. Average air temperature ranges from 17 °C in January to 37 °C in July. Most of the coast consists of cliffs or sandy beaches with occasional gravel shorelines. Most of the coastal and marine areas surrounding these islands are still in a pristine state and in 1996, the Government of Yemen declared Socotra a special natural area in need of protection.

Major economic resources are port-related activities; fisheries, maritime traffic,oil and gas exploitation, and coastal and marine tourism play a minor role. Fish production is an important component of the GDP, with bases and landing sites spread along the mainland coastline and from a number of Islands. In the Red Sea, the continental shelf comprises are rich fishing grounds for finfish and prawn trawlers.

2. The legal protection status for leatherback turtles

2.1 Overview

The Republic of Yemen is a party to international conventions, agreements and treaties which have implications on the marine environment. Similarly, a number of national instruments exist at various government levels which directly of indirectly concern marine turtles. Treaties or conventions that were signed by ex-YAR and ex-PDRY Yemen are still in force according to the unification decree. Yemen is party to Convention on Biological Diversity (1996); the Regional Convention for the Conservation of the Red Sea and Gulf of Aden Environment (1982); the United Nations Convention on the Law of the Sea (1987) and the United Nations Framework Convention on Climate Change (1996), among others.

In recent years Yemen has established a number of significant instruments, laws and regulations which address directly or indirectly marine turtles: Prime Ministerial Decree No. 4 (1996) established Socotra as a protected area and developed a High Committee for Development of Socotra headed by the Deputy Prime Minister and Minister of Planning and Development. The Presidential Resolution on Fishing, Exploitation and Protection of Living Aquatic Resources (Law No. 42) enacted in 1991, is the main legal framework for organization, exploitation and protection of fishing and aquatic resources, and under which capture of sea turtles is forbidden. This law deals with the protection of fisheries resources and regulation of fishing activities. The law prohibits the use of destructive fishing methods such as poisons, chemicals, etc. The law also indicates means of limiting and/or dealing with pollution. The Ministerial Decree for Specifications of Fishing Vessels and Gear (No. 101) enacted in 1995 also addresses indirectly turtle issues.

2.2 Management agencies responsible for marine turtle conservation

A number of governmental agencies have responsibility for the coastal and marine areas. There is no authority solely in charge of the management of the coastal zone in Yemen. The Environment Protection Council (EPC) was established in 1990 by Prime Ministerial Decree 94/1990. The Technical Secretariat (TS) co-ordinates and monitors: planning, implementation, environmental protection and natural conservation policy. Implementation at field level is under the responsibility of the line ministries. The EPC is the official government agency in charge of development and implementation of the general national policy planning for environmental protection and control. The EPC is the prime agency responsible for marine turtle conservation. The Ministry of Fish Wealth (MFW) regulates fishing, issues licenses, and supervises processing and marketing of fish and fisheries products for local consumption and export. The MFW, through the department of monitoring and surveillance, is responsible for the enforcement of laws and regulations concerning marine resources, including bycatch of endangered species. The Public Corporation for Maritime Affairs (PCMA) is the main governmental body concerned with maritime safety and marine pollution control, but also plays an important role in developing a legislative framework to protect the marine environment.

In terms of research and monitoring, the Department of Oceanography, University of Sana'a, which was established in the late 1970s, has more than 10 staff members specialized in marine ecology, chemistry, geology and fish biology. Its main responsibilities are teaching, research and advising the government on marine issues. It has a capacity for and is carrying out research and training in the fields of coastal surveys, pollution monitoring and analysis. The University of Aden also has several departments which are involved in research and training in the marine sciences.

The Marine Science and Resources Research Centre (MSRRC) in Aden is the advisory body for the MFW. The centre advises the ministry on aspects of fish stock assessment and management, data on fish landing, fishing seasons, etc. It consists of Fisheries, Oceanography and Benthos departments. The MSRRC operates a 37 m research vessel which is currently in need of maintenance. The centre receives some technical assistance from the Fourth Fisheries Development Project and has collaborated with IV Fisheries to execute a coastal habitat survey of the Gulf of Aden.

3. Nesting populations

Leatherback turtles are reported to occur infrequently along the Yemeni coast, but there is no historical or contemporary data indicating they nest on Yemen’s beaches (Saad 1999).

4. Foraging populations

4.1 Overview

Sightings of leatherback turtles in Yemen’s waters is rare, but one person interviewed during a survey in 2002 recalled seeing a leatherback turtle off Ithmoon-Ras Sharma (down in the southern Hadramaut coast), and another was spotted in the sea near Bir Ali (Saad 2002). No research of any kind has been carried out on leatherback turtles in Yemen, and no concerted conservation efforts have been made which impact them specifically.

4.2 Threats to leatherback turtles

Fishing is likely the greatest threat to leatherback turtles in Yemen, as they may be drowned in trawlers or entangled/drowned in pelagic long lines. Fishermen operate from bases and landing sites spread along the mainland coastline and from a number of islands. Most of the landings come from trawling in the Red Sea and the pelagic fishery in the Gulf of Aden. The trawl grounds of the Red Sea are about 6,200 $km^{2,}$ of which 550 km^2 are shrimp fishery areas (Sanders and Kedidi 1981). The majority of the fishing in the Gulf of Aden targets pelagic species.

Turtles have not ranked highly on the protection agenda in Yemen. Development of urban centres and industry carry a higher priority, and only in recent years has the protection of turtles been addressed. Yemeni waters are major shipping routes. About 16,000 ships pass through the Strait of Bab al-Mandab each year and many call at Yemen's main ports (Table IV; Aden Port Development 1996). Ships are known to dump their wastes and dirty ballast water in the Yemeni waters. Dirty ballast waters result in the formation of tar balls which have been found throughout the coastline of the Gulf of Aden (EC/MFW 1995) and some parts of the Red Sea coast (Rushdi et al. 1991). Additionally, solid waste from ship-based sources may be found on beaches.

4.3 Protection of foraging areas

There is one protected area (Socotra) and six proposed protected areas in Yemen. Establishment of marine protected areas is a relatively new process in Yemen, with funding and technical input from IUCN, the Global Environment Facility and PERSGA. The Socotra Islands archipelago occupies some 362,500 km^2 and is home to diverse terrestrial plant and animal life with a high degree of endemism. Socotra (12°30'N 54°00'E) is the main island, the others being Abd al-Khuri, Samha and Darsa. There are also smaller rock islets, Kal-faraon and Sabouniya. They are all fringed by diverse and largely pristine marine habitats and biota. Funding and logistical support is provided through the GEF-Socotra biodiversity project, which has also included turtle conservation (mostly loggerhead turtles *Caretta caretta*).

Planned protected areas include the Belhaf and Bir Ali Area, a coastal stretch and group of high aspect islands with extensive fringing coral reefs and rich fishing areas (14°00'N 48°10'E). The area is also an important seabird and marine turtle nesting site, and contains a salt water crater with fringing mangroves; Ras Isa / Kamaran Island, located at 15°16'N 42°44'E, the headland / island complex contains coral reefs with diverse associated fauna; Khor Umaira, a semi-enclosed lagoon with mixed seagrass and coral reef habitat, that supports marine turtle feeding (12°40'N 44°10'E); Ras Sharma, an important (regional and possibly global) nesting site for marine turtles (13°00'N 43°40'E); Dhobba, considered as it is a marine turtle nesting site (14°45'N 49°40'E); and Bab al-Mandab and Perim Island, which contain extensive seagrass beds and mangrove stands, and is an important waterway feeding the Red Sea (12°30'N 43°30'E).

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Impact of the December 2004 tsunami on marine turtle nesting beaches in the Indian Ocean – South East Asia Region.

1. December 2004 tsunami; synthesis of impacts to marine turtles and their habitats

Sumatra – Andaman earthquake
On December 26 2004 at 00:58:53UTC an undersea earthquake occurred in the Indian Ocean just north of Simeulue Island in Sumatra (3.16°N, 95.854°E). The earthquake was 9.16 in magnitude making it the second most powerful earthquake ever recorded by a seismograph (Hanson 2005). The earthquake lasted for close to 10 minutes and caused the whole planet to vibrate by a couple of centimeters and triggered earthquakes as far away as Alaska (Hanson 2005; West et al. 2005). The earthquake caused a large tsunami that spread across the Indian Ocean with devastating consequences for people in many nations.

December 2004 tsunami - overview
The tsunami caused by the Sumatra – Andaman earthquake spread across the Indian ocean from Malaysia to South Africa. From the epicenter, the tsunami traveled at between 500 and 1000km/ph over deep waters, taking approximately 16 hours to reach the furthest location in the Indian Ocean - Struisbaai in South Africa (Figure 1). Because the orientation of the fault line was north/south, most of the tsunami's energy was dispersed in an east/west direction. An estimated 275 000 people were killed as the tsunami crossed the coast in 15 of the 21 affected countries; making it one of the deadliest disasters in recorded history. Aside from the loss of lives, the tsunami has, had severe impacts on infrastructure, placed increased pressure on social-economic and health aspects of many coastal peoples and communities, affected tourism, business and fisheries, affected access to drinking water and impacted coastal zone ecology (UNEP 2005). The aim of this synthesis is to provide an overview of the impacts of the December 2004 tsunami marine turtles and their habitats, giving priority to the completion of an assessment of the conservation status of leatherback turtles in the Indian Ocean – South East Asian region.

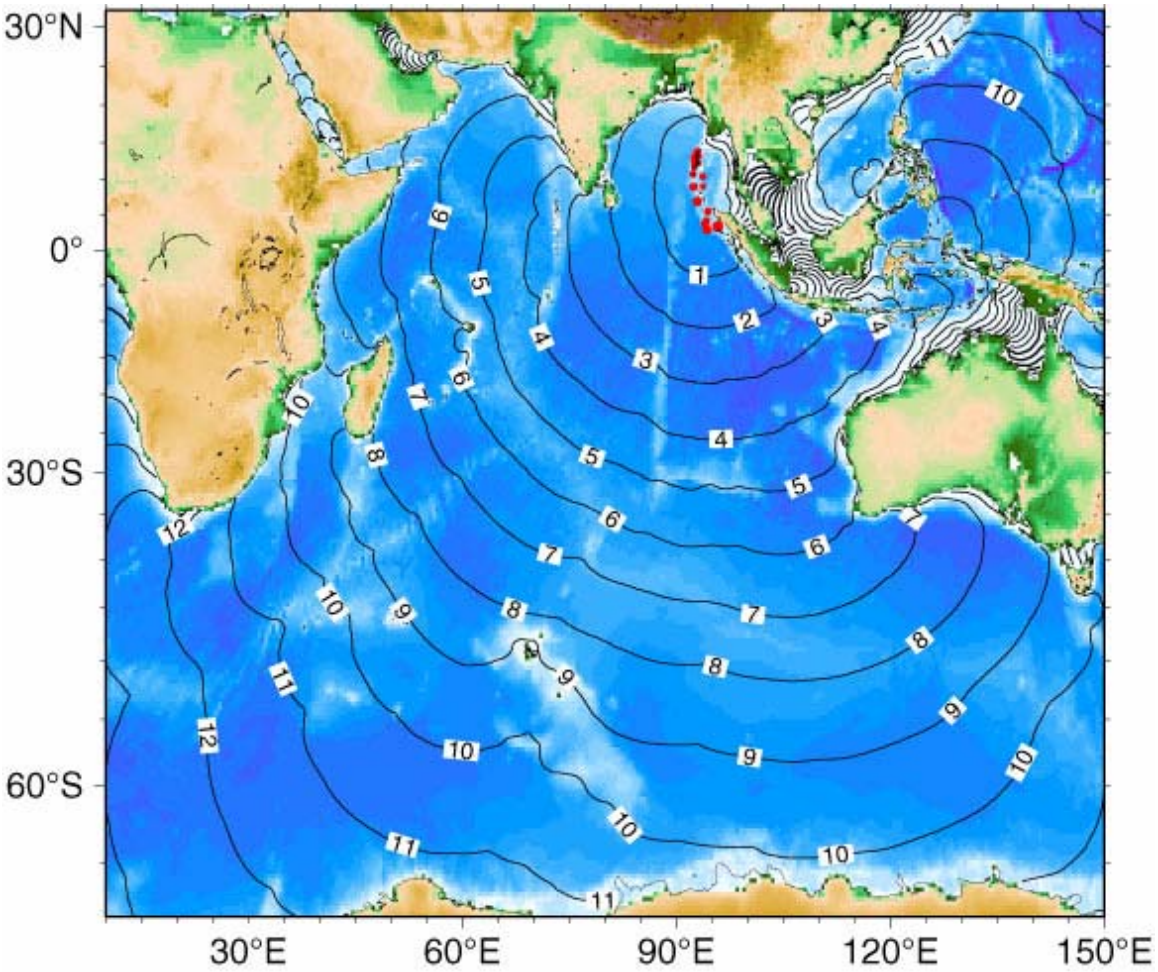

Figure 1. Graphic representation of the time frames involved with the December 2004 tsunami's movement across the Indian Ocean (red dots indicate epicenters of the main earthquake and the aftershocks).

December 2004 tsunami; synthesis of impacts to marine turtles and their habitats
The tsunami reports submitted by the incountry contributors (see section 2 of this chapter) indicate that the tsunami generated by the Sumatra-Andaman earthquake in December 2004 impacted 22 of the 44 nations in the Indian Ocean and Southeast Asian region (Table1). Of these 22 countries the tsunami caused localised damage to marine turtle habitats in 11 countries ranging from minor to severe. While most of the nations affected had minor damage to coastal environments, infrastructure, social well being and marine ecosytems (Table 1), severe impacts occurred to coastal communities of Indonesia, Malaysia, Thailand, India, Sri Lanka and Maldives. The most severe impacts to marine turtle habitats and marine turtle conservation projects were found in Thailand, India and Sri Lanka.

Damage to marine turtle nesting beaches
The countries in which the tsunami had the most severe impact on marine turtle nesting areas are Thailand, Sri Lanka and India (in particular the Andaman and Nicobar Islands). In these countries the tsunami occurred during the nesting season and would have destroyed most clutches incubating at the time, and may have affected the laying and/or incubation of clutches laid later in the season because of increased erosion, beach debris and increased salinity of the sands. Medium term impacts (1-3 years) to the nesting beaches are difficult to assess, because in all locations a complete nesting season following the tsunami has not been completed. It is likely that the tsunami has caused localised alterations to beaches that impact nesting success, nest site choice and sex ratios over the medium term. It is unlikely

that these impacts are severe enough, or on a wide enough scale to impact populations in the longer term. Longer term impacts (10+ years) are more difficult to predict because in the countries that were most affected there are few long term monitoring data on nesting turtles. However, longer term impacts should be considered in light of the species longevity, periodic reproduction and the fact that the Indian Ocean and Southeast Asian region has encountered moderate and large scale tsunamis in the past (e.g. the tsunami generated by Krakatoa in 1883, the Andaman Island earthquake tsunamis of 1881 and 1941 and the Papua New Guinea tsunami of 1998 (Iida et al. 1967; Ewing and Press 1955; George 2003).

- Assuming that the green, hawksbill and leatherback nesting rookeries that exist today in western Java and southern Sumatra (Indonesia) existed in the late 1800s, the tsunami caused by the Krakatoa explosion would almost certainly have caused them significant damage. That there are still marine turtle rookeries in this area, suggests that turtle populations were, at the time, resilient enough to survive any local impacts.
- Although few records are available, the Andman and Nicobar Islands, and the coast of countries within the Bay of Bengal would have been impacted by the earthquake generated tsunamis that occurred in the region in 1881 and 1941.
- In West Sepik region of Papua New Guinea which was hit by a tsunami in 1998, which caused considerable impacts to the coastal zone in an important leatherback turtle nesting area; there are no accounts of any remaining after affects on the nesting leatherback turtle population.

There were minor impacts to nesting beaches of green, hawksbill and olive ridley turtles in Bangladesh, Kenya, Maldives, Comores, Seychelles, and the UK Territories (BIOC). In each case the damage was restricted to particular beaches and only small numbers of clutches were affected. No longer term impacts to marine turtle populations in these nations are suspected. In two of the worst affected countries (Indonesia and Malaysia), in terms of physical damage and loss of lives, the impact to marine turtles was negligible given that the affected areas did not coincide with important marine turtle nesting habitats.

Damage to marine turtle habitats

The tsunami has impacted several offshore and coastal ecosystems in 11 countries. While the “terrestrial” components are relatively easy to survey the “marine” ecosystems have not yet been thoroughly examined. In several countries Rapid Assessments have been done of coral reef and seagrass areas, and the general findings are mixed. Even within a particular nation, the coral reefs and seagrass areas have been impacted to varying degrees. However, even in areas that have had significant damage to coral reefs such as Thailand (13% of coral reefs along the Indian Ocean Coast impacted) it is not certain whether the damage is severe enough to have a local impact on marine turtles. Likewise with the damage to seagrass pastures, in most cases only shallow water areas were monitored, and marine turtle populations have endured localised loss of seagrass in other areas of the world (e.g. Shoalwater Bay – Australia; Limpus et al. 2005). In each of the countries affected there are few data on foraging populations of marine turtles, without this data it is difficult to assess what impacts the tsunami, and the subsequent changes to the marine habitat, had on marine turtle populations. However, it is likely that there would have been short to medium term, localised impacts to foraging marine turtles in Indonesia, Thailand, India, Maldives and Sri Lanka.

Marine turtle conservation projects

Three countries suffered significant damage to their marine turtle conservation projects, including the loss of lives of some of their conservation staff. In India’s Andaman-Nicobar Islands, Sri Lanka and Thailand long term research projects were placed in jeopardy as the tsunami destroyed research infrastructure, research equipment was lost or destroyed and the local communities with which they worked suffered immense social, economic and personal losses.These were communities in which turtle projects had worked side by side for many years to protect sea turtles. Thankfully strong community bonds remain and shared adversity has brought communities and turtle project staff together and may offer new opportunities. In each of the locations impacted turtle project staff have been heavily involved in rebuilding communities and generating financial support to assist in the process. For example in Thailand and Sri Lanka marine turtle NGO groups have played an integral role in kick starting education for children, redevelopment of local business such as fisheries and tourism, and getting projects up and going for the 2005/2006 marine turtle nesting season. It is with the continuation of these extremely important community-based programs that we will learn more about the longer term impacts of the tsunami on coastal habitats, marine turtle populations and on the coastal communities themselves

Table 1. Nations of the Indian Ocean and South East Asian region, and summary of the impacts of the December 2004 tsunami.

Country	Affected	Impact (H/M/L/Nil) to coastal zones, infrastructure and social welfare	Impact to marine turtles & their habitats
Australia	Yes	Nil	Nil
Bangladesh	Yes	Low	Low
Bahrain	No	-	-
Brunei Darussalam	No	-	-
Cambodia	No	-	-
China	No	-	-
Comores	Yes	Low	Nil to Low
Djibouti	No	-	-
Egypt	No	-	-
Eritrea	No	-	-
French Territories	Yes	Nil	Nil
India	Yes	High	High for 2004/05 nesting season & unknown long term impacts
Indonesia	Yes	High	Low – but unknown if any impacts occurred to low density turtle rookeries in north Sumatra.
Iraq	No	-	-
Iran	Yes	Nil	Nil
Japan	No	-	-
Jordon	No	-	-
Kenya	Yes	Medium	Low & long term impacts have not been assessed
Korea	No	-	-
Kuwait	No	-	-
Madagascar	Yes	Low	Nil
Malaysia	Yes	High	Low
Maldives	Yes	High	Low & long term impacts have not been assessed
Mauritius	Yes	Nil	Nil
Mozambique	No	-	-
Myanmar	Yes	Low	Nil
Oman	Yes	Nil	Nil
Pakistan	Yes	Nil	Nil
Papua New Guinea	No	-	-
Philippines	No	-	-
Qatar	No	-	-
Saudi Arabia	No	-	-
Seychelles	Yes	Medium	Few long term impacts suspected
Singapore	No	-	-
Somalia	Yes	Low	Unknown
Sri Lanka	Yes	High	High for 2004/05 nesting season & unknown long term impacts
Sudan	No	-	-
Thailand	Yes	High	High for 2004/05 nesting season & unknown long term impacts
Timor Leste	No	-	-
Tanzania	Yes	Low	Nil
United Arab Emirates	No	-	-
UK Territories	Yes	Medium	Low & short term
Viet Nam	No	-	-
Yemen	Yes	Low	Unknown

2. December 2004 tsunami; country reports

Indonesia

By Mark Hamann

The tsunami had a severe impact on the northern coast of Sumatra (Acheh Province) and some of the smaller islands along the north-west coast of Sumatra. The tsunami had devastating impacts on the city of Banda Acheh; causing substantial loss of lives, buildings, and other coastal infrastructure. Aside from the devastation the tsunami had on built up areas, in Aceh and North Sumatra, a UNEP assessment estimated that 25,000 hectares (ha) of mangroves, some 32,000 ha of previously existing coral reefs, and 120 ha of seegrass beds have been damaged. The economic loss associated with this environmental damage is valued at $118.2 million, $332.4 million and $2.3 million, respectively (UNEP 2005).

The tsunami is believed to have had very little impact on nesting turtles in Indonesia. Although there are several very low density (or unknown density) nesting sites along the southern coast of Sumatra for green, hawksbill, leatherback and olive ridley turtles the tsunami occurred well outside the main nesting season for the area (nesting distribution data from IMAPS http://www.ioseaturtles.org/imaps.php). Long term impacts of the tsunami on nesting marine turtles in Indonesia have not been estimated. Similarly there could be localized impacts to foraging turtles in northern Sumatra, however, there have been no studies looking at marine turtle abundance in the foraging areas in this region.

Malaysia

By Mark Hamann

The tsunami impacted the west coast of Peninsula Malaysia. The northern states and islands were worst affected, such as Kedah (in particular Langkawi), Penang, Perlis, Perak, and Selangor. Impacts included the loss of lives and or livelihoods, destruction of fishing boats, fisheries infrastructure and housing. Although there are nesting areas for green and hawksbill turtles along the western coast of Malaysia there are not believed to have been any short or long term impacts to marine turtles, especially since the tsunami occurred at the opposite time of the year to the turtle nesting season (Kamarruddin Ibrahim Pers. Comm.).

Thailand (Indian Ocean coast)

Prepared by Maitree Duangsawasdi with input from Mark Hamann and Monica Aureggi

The tsunami hit the Indian Ocean coast of Thailand at around 1000 local time on December 24 resulting in widespread destruction of many coastal areas. It caused the high loss of lives in many of the tourist areas, substantial destruction to tourism infrastructure, business, roads, coastal ecosystems and severely affected the social, economic and health of local people. Many of these impacts have been well documented in the general media, popular literature and scientific press.

The United Nations Environment Program's Asian Tsunami Disaster Task Force conducted a rapid assessment of Thailand's marine and coastal environment shortly after the tsunami (UNEP 2005). The taskforce assessed the condition of coral reefs, seagrass pastures, mangroves and marine wildlife. The taskforce's key findings for Thailand were; 13% of the coral reefs (of the 324 reefs within the affected provinces) were significantly impacted, 3.5% (70% of seagrass pastures in Indian Ocean Thailand were assessed) were impacted by siltation and sand sedimentation, with 1.5% suffering total habitat loss and 0.2% of mangroves were impacted and these mangroves were mostly in Phang Nga province which was the hardest hit of the coastal provinces (UNEP 2005).

With regard to the impact of the tsunami on marine turtles, their habitats and conservation infrastructure, the tsunami severely impacted all marine turtle research projects along the Indian Ocean coast. Naucrates, which had established research infrastructure and a successful conservation project at Phra Throng Beach (Phang Nga province) over the last eight years suffered severe damage; the lives of two young research volunteers were lost and the museum, volunteer huts, instruments, turtle tank and other research equipment was all destroyed (see http://www.naucrates.org for more details). At Tap Lamu (Phang Nga province) the Thai Navy's marine turtle conservation centre has suffered severe damage and approximately 2000 turtles that were being headstarted for release escaped. The Phuket Marine and Coastal Resource Development and Research Institute lost research infrastructure and reported the loss of 18 breeding olive ridley turtles. Finally the Marine Turtle Conservation Project in Ranong Province suffered major structural damage and the loss of research equipment.

The tsunami wave crashing ashore on the turtle nesting beach at Pha Throng Island. Photo courtesy Naucrates collection.

Damage to the Naucrates turtle project tanks after the tsunami. Photo by Emma Dilkes

The tsunami occurred in the middle of the nesting season for each of the species of marine turtles that nest along the Indian Ocean Coast. Many of the marine turtle nesting beaches were substantially altered with regard to erosion of the beach and dunes, deposition of debris such as building materials, trees, drift wood and rubbish. Given the more immediate concerns about loss of lives, and the need to re-build social, health, economic and education facilities there were few studies on the short term impacts of the tsunami on marine turtle nesting. However, an unpublished report by Asst. Prof. Kumthorn Thirakhupt of Chulalongkorn University speculates that leatherback turtle eggs that were laid a week after the tsunami at Thai Muang Beach (Phang Nga province) did not hatch because saltwater inundation of the dune system had elevated salinity levels by 12 to 25 times baseline. It is likely that saltwater inundation would have ceased the development of all eggs that had been laid prior to the tsunami occurring. The number of affected clutches is not known, but is likely to be less than a 100 for all species combined. It is interesting to note that while leatherback turtle nests were not found along the Andaman coast for a few years, after the tsunami more nests were laid along the coast, but still in a limited number (less than 15 nests per season). In the area close to Phra Thong Island, according to local fishermen's observations, the number of jellyfish has increased a lot after the tsunami.

Long term impacts on turtle nesting are unlikely because it appears that most of the nesting beaches remain in good condition, and there has not been significant sand loss. Sandy nesting beaches at Phra Thong Island (15 km) changed after the tsunami. It is evident that the beach profile has changed. In particular, the wave action created different lagoon ares (freshwater mixed with sea water) which are now located behind the beaches. In some areas of the beach these have reduced in the available space for turtle nesting. It is not known whether the impacts to coastal vegetation will have any affect on the incubation of turtle nests. Assessment of the longer term impacts will depend in part on the ability of conservation groups to develop the necessary infrastructure and local support. Naucrates staff began

monitoring the turtle beaches in January 2006 and are planning a detailed post tsunami evaluation of the status of the marine turtle nesting and foraging populations in the area. In addition they are coordinating local assessments of mangrove ecosystems and coral reefs. Furthermore Naucrates have coordinated efforts to help rebuild the education facilities that were destroyed, and assist in the socio-economic repatriation of coastal villages (see http://www.naucrates.org for more details).

Myanmar

By Mark Hamann

Reports indicate that while the tsunami did impact the coast of Myanmar, its force was greatly reduced die to coastline topography (along the southern and delta coast) and the presence of numerous rocky islands and headlands. Local scale impacts to communities have been assessed, and significant impacts to the livelihoods of around 5000 to 7000 people have been directly affected. No quantitative assessments of the impacts to the natural environment have been conducted. It is not known whether the tsunami affected marine turtle nesting or foraging populations in Myanmar.

Bangladesh

Prepared by M. Zahirul Islam

The tsunami did not affect the Bangladesh coast like the other countries in the adjacent area. Only some small tidal abnormalities were identified by the people of St. Martin Island. They observed an extreme low tide exposing all sub tidal areas and trapping marine fishes and then the waters returned quite suddenly there after. No coastal zone or infrastructure damage has been reported. There are likely to have been no impact of nesting turtle beaches or foraging areas.

Sri Lanka

Prepared by Thushan Kapurusinghe

Nesting beaches
The tsunami hit the coast of Sri Lanka around 0815 to 0915 local time on December 24 resulting in widespread destruction of many coastal areas. It caused the high loss of lives in many of the tourist areas, substantial destruction to tourism infrastructure, business, roads, coastal ecosystems and severely affected the social, economic and health of local people. Many of these impacts have been well documented in the general media, popular literature and scientific press. The tsunami hit Sri Lanka at low tide in the low season for marine turtle nesting, however there were still incubating nests at most of the nesting beaches, and turtles coming ashore. The short term impacts to the nesting beaches were the inundation of incubating clutches, and the deposition of rubble and other washed up debris, many beaches suffered large scale sand erosion, and destruction of beach vegetation. In the longer term beach width has been reduced in some areas, and this together with the destruction of beach vegetation will increase the beach erosion in future monsoon seasons (due to low resistance). In addition, as beach vegetation is not available for turtle nesting in some areas, there may be an impact on sex ratios as turtles often utilise beach vegetation while nesting.

Foraging areas
With regard to the foraging areas, coral reefs were covered with sand and debris which may have impacts on feeding turtles. However, surveys have shown that mangroves and coral reefs acted as protective barriers prevent more severe coastal damage (Dahdouh-Guebas et al. 2005). Dahdouh-Guebas et al. (2005) assessed the tsunami damage in Sri Lanka and the role that mangrove communities played in forming a barrier to prevent damage. The level of damage to the coastal zone was worse in areas that had mangroves cleared, or where mangrove forests had been infused with non-mangrove species. Similarly, Fernando et al. (2005) have found that the damage caused by the tsunami was more severe, and water traveled further inland in areas with no coral reef protection. Moreover, Fernando et al. (2005) report that

illegal collection of corals for souvenirs or for use in house paint has exacerbated the effect of the tsunami in some locations in western Sri Lanka.

Marine turtle hatcheries
Most of the commercially operated turtle hatcheries suffered severe damage. Marine turtles that were kept in captive by the turtle hatcheries were washed away and some of them were later found dead. Eggs being incubated by the hatcheries were inundated with salt water and as a consequence most probably died. Some of the juvenile turtles and hatchlings that were housed by the facilities were found in inland water bodies such as wells and small tanks and released to the sea. Because the tsunami destroyed most of the illegal turtle hatcheries, it was the best opportunity for the Department of Wildlife Conservation to initiate a mechanism to regulate the activities of these hatcheries. Unfortunately DWC was unable to take an action and therefore the hatchery owners were able to rebuild their hatcheries on a larger scale than they were before the tsunami.

Marine turtle infrastructure and projects
The Turtle Conservation Project (TCP) lost the lives of turtle nest protectors in Kosgoda. In addition, TCP lost the beach hut (beach operations centre), sales outlet with sales items, research equipment, educational materials, office equipment and other items. TCP run turtle hatcheries were destroyed and they lost research and conservation property and equipment. In addition, activities of the Department of Wildlife Conservation were disturbed in Yala and Bundala National Parks; the beach hut used by the Bundala turtle programme was destroyed and research equipment was lost or destroyed. This beach hut has since been re-built for DWC by TCP. One main hurdle to overcome in the re-development is getting permission from the Coast Conservation Department for turtle conservation constructions such as research centers, marine turtle hospitals, as long as they continue to enforce a '100 meter no built zone' rule. A long term impact of the tsunami will be the risk of employing nest protectors, research officers, local and foreign volunteers on the beaches. There is no tsunami warning system available in the country and communication facilities are not at satisfactory level to inform the beach staff for immediate evacuation.

Other implications of the tsunami
Following the tsunami, in which 1000s of lives were lost and people were swept out to sea, there was a growing local paranoia about eating fish that may have fed on humans. The result of this was a reported increase in the number of marine turtles being deliberately caught and sold in the markets as meat (Sri Lanka victims of tsunami – news article 3 Feb 2005, BBC news UK).

<u>India</u>

Prepared by BC Choudhury (Andaman-Nicobar Archipelago) and Mark Hamann (Mainland India)

Mainland coast
The mainland coast of India was impacted by the December tsunami, however, it was not reported to have significant impacts on marine turtle nesting beaches or conservation facilities/projects. The worst affected area was the state of Tamil Nadu, and the States of Pondicherry, Andhra Pradesh and Kerala were affected to a lesser extent. The marine turtle hatchery sites and project facilities along the east coast of mainland India were spared significant damage. The tsunami began hitting around 1645 with waves estimated at between 1.3meters at Kochi and 2.4meters at Vishakapatam (quoted from email Abe, ERI, University of Tokyo posted on tsunami-Japan on January 27, 2005). The impacts of the tsunami on coastal communities on mainland India was large, particularly in the state of Tamil Nadu. In Tamil Nadu there was substantial loss of lives; buildings, infrastructure, fishing boats and ports were destroyed and the social, health, economic and education well being of the people were severely hampered (Yeh 2005). It is likely, similar to other areas that were significantly impacted that coastal fisheries and the fishing industry will suffer large losses that could have economic affects that last for many years. It has been estimated that 2200km^2 (including approximately 11 000ha of cropped lands) of coastal land was affected with saltwater inundation of coastal lands ranging from 300 metres to 3km inland.

Andaman and Nicobar Islands
The Andaman and Nicobar Islands is a significant location for nesting marine turtles especially the leatherback turtle (*Dermochelys coriacea*) in the Indian Ocean. There are currently four nesting beaches known for the Andaman Islands (all on Little Andaman Island); specifically there is high density nesting on the South and West Bay beaches and low density nesting on two beaches on the north west coast (Figure 2; Andrews et al. 2002). There are 17 confirmed nesting locations in the Nicobar group; five along both the west and east coast of Great Nicobar Island, five beaches on the western shore of Little Nicobar Island, west coast of Teressa Island and the west bay of Katchal Island (Figures 3 and 4; Andrews et al. 2002).

Important nesting beaches identified in the Little Nicobar Islands were mainly on the west coast including Pulo Kiyang, Pulo Baha, and beaches on Kiyang and Akupa hamlets (Figure 4). The Great Nicobar Islands contained two important nesting sites, one on the West Coast (beaches at the mouth of Alexandra and Dogma rivers) and other on the South east coast (Galathea bay) (Figure 4). Other Islands where the species has been observed to nest include, Teressa and Katchal (West bay) in the Central Nicobar Islands (Figure 3). In the Nicobar Islands, peak nesting of this species occurs from December to April.

The Nicobar group of islands were among the worst hit in the Indian region. The tsunami created giant waves as high as 12 meters that caused a heavy damage to the coastal habitats in the Andaman and Nicobar Islands. The plate movements have lead to subsidence of land in Nicobar Islands and vertical uplifting in parts of the Andaman Islands (Ramachandran et al. 2005). Over the entire Andaman and Nicobar region estimates of inland seawater intrusion by tsunami waves ranged between 50 and 2000m, depending on the topographic conditions of the individual island (Ramanamurthy et al. 2005). Moreover, Ramachandran et al. (2005) used spatial and aspatial data and estimated that in four islands in the Nicobar group (Camorta, Katchal, Nancowry and Trinkat) that the extent of damage ranged from 51 to 100% for mangrove ecosystems and 41 to 100% for coral reef ecosystems (see Figure 5 for an example from Katchal).

The tsunami caused significant damage to nesting sites in the Andaman and Nicobar Islands. Important nesting beaches in the Great Nicobar and Little Nicobar Islands have been heavily damaged and are currently inundated (Manish Chandy & Ravi Sankaran, *Unpub. Report*). In particular the beaches along the West Coast (Figure 4: http://www.disasterscharter.org/disasters/CALLID_077a_e.html), including submergence at Casuarina Bay (Alexandra and Dogma River mouth area) and the beaches on the Southeast coast such as Galathea Bay (Figure 4; http://www.disasterscharter.org/disasters/CALLID_077a_e.html) were severely impacted and are still at least partially submerged (Manish Chandy & Ravi Sankaran, *Unpub. Report*.). Similar damage to the nesting sites has been reported from the West Coast of Little Nicobar and Little Andaman Island (Andrews, *Pers. Comm*.). Nesting beaches on the West Coast of Katchal Island, although only a low density nesting site, were among the worst affected areas (Figures 4 and 5; http://www.spotimage.fr/html/_167_240_241_781_.php) by the tsunami. Because the tsunami occurred during the peak breeding season of the leatherbacks in the Andaman and Nicobar Islands the impacts to leatherback turtle nests that had already been laid for the season would have been severe; with mortality of those clutches approaching 100%. In addition, in it unknown what affects the tsunami, and its effect on beach elevation, beach submergence and beach debris had on females that attempted to nest for the remainder of the season. A clearer picture of the longer term impacts of the tsunami will emerge over the next few years as nesting leatherback turtle and beach surveys can be completed.

Interestingly, there have been reports of new beach formation in the Islands of Great Nicobar, Katchal and Little Andaman (Manish Chandy, *Unpub. Report*). At certain sites (e.g. Little Andaman), nesting beaches were found to be inaccessible for turtles due to the uplifting of the Coral reef (Andrews, *Pers. Comm.*). Recent attempts to assess the marine turtle populations at some of these new beaches have been impeded due to complete breakdown of logistics in the Islands (Ravi Sankaran, Pers. comm., Vijayakumar & Choudhury, *Unpub. Report.*). There is an urgent need to map these new beaches and monitor the usage of these sites by the leatherbacks in the ensuing leatherback nesting season.

Aftershocks
Following the main shock there were approximately 400 aftershocks which were mostly centered in the Andaman and Nicobar Archipelago. These aftershocks ranged in severity from less than 3 up to 7.5 on the Richter scale, probably adding to localised affects of the tsunami event, by further impacting building structure, uplifting of beaches and stability of the coral reef ecosystems.

Previous tsunamis in the Indian region
Any long term impacts of the 2004 tsunami must be considered in the context that the Andaman-Nicobar Archipelago and the coastlines or India and Sri Lanka have been affected by tsunamis in the past (Ewing 1967; Pararas-Carayannis 2004). Some of those recorded include:

- An 1881 earthquake beneath Car Nicobar caused a 1m tsunami to hit the coast of India adjacent to Chennai.
- In 1883 the explosion of Krakatoa in Indonesia caused 2m tsunamis to hit the coast of Chennai (India).
- In 1941 an 8.1 Richter scale earthquake occurred in the Andaman Islands, this earthquake caused a destructive tsunami that impacted the middle and south Andaman Islands and caused major damage and loss of lives at many coastal villages in the Andaman Islands, Sri Lanka, Bangladesh and India.
- Similarly, another major earthquake in the Andaman-Nicobar Archipelago in 1945 (Richter scale 7.8) caused major damage along the coasts of India, Pakistan, Oman and Sri Lanka.

It is possible that these previous tsunamis have had similar impacts to the coastal zone as the December 2004 tsunami. Hence, marine turtle populations have managed to persist despite these periodic alterations to their nesting environments.

Acknowledgements:
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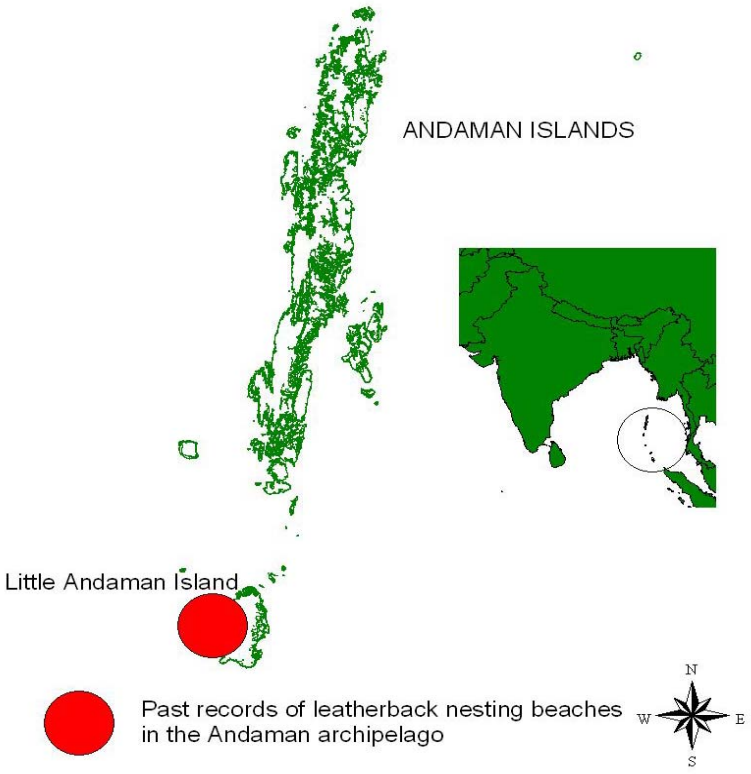

Figure 2. Main nesting areas for leatherback turtles in the Andaman Islands.

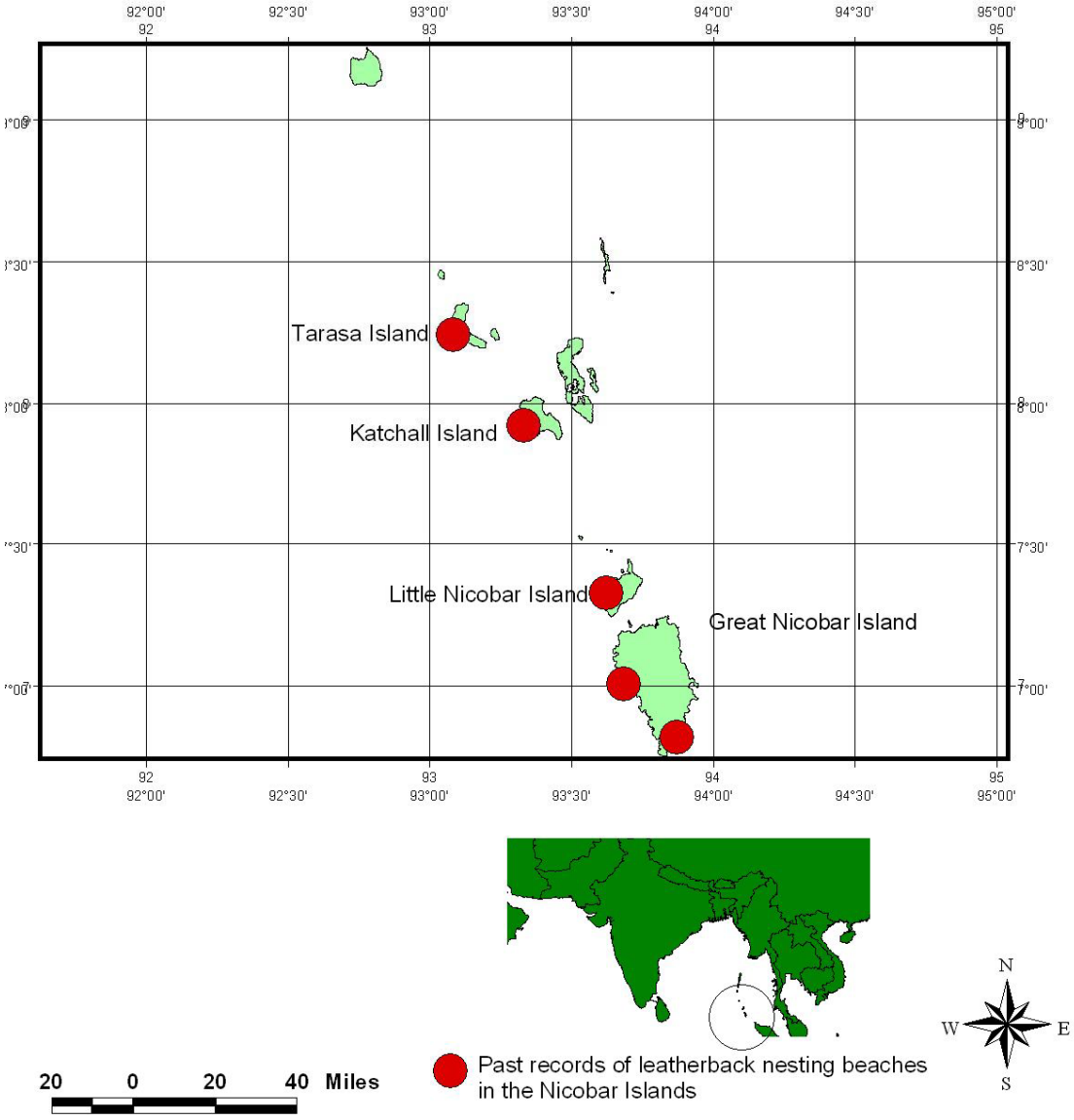

Figure 3. The main islands of the Nicobar Group; showing important nesting locations for leatherback turtles

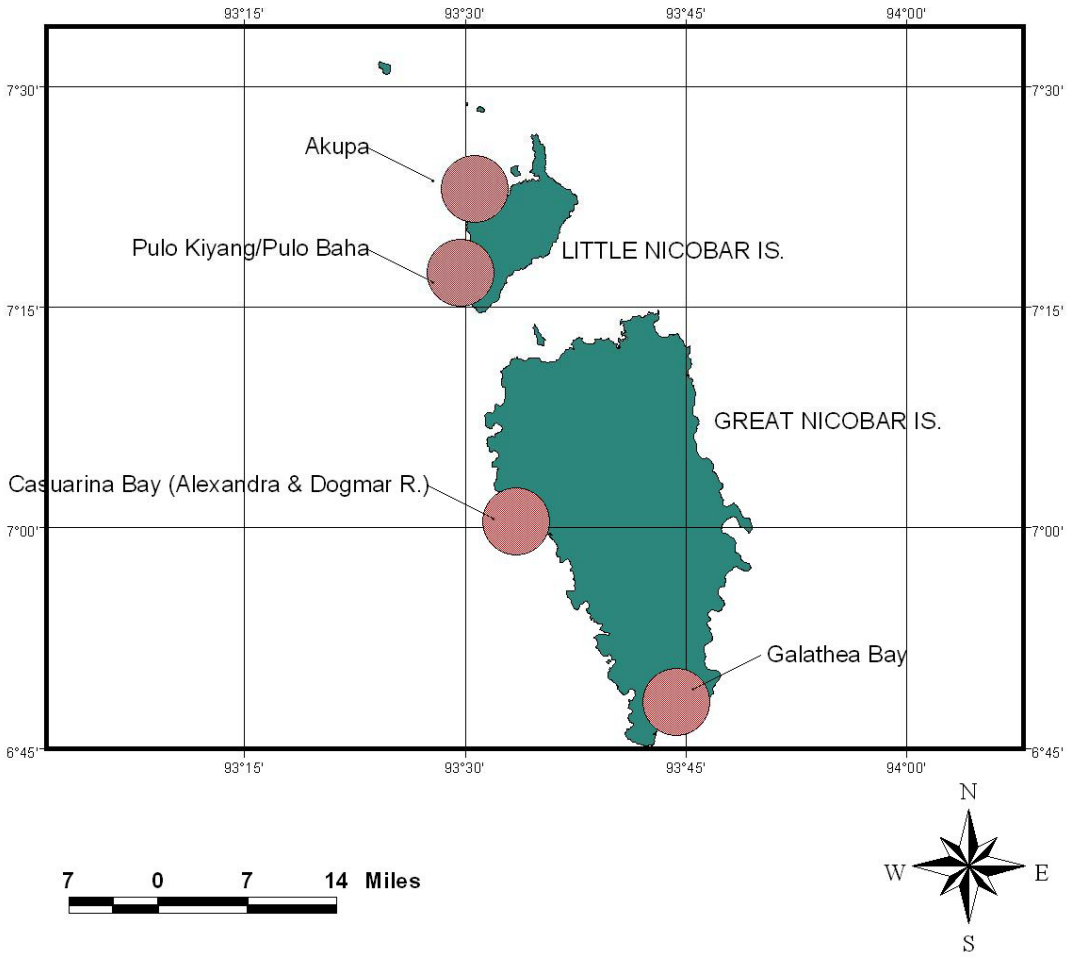

Figure 4. Little Nicobar and Great Nicobar; showing important nesting locations for leatherback turtles

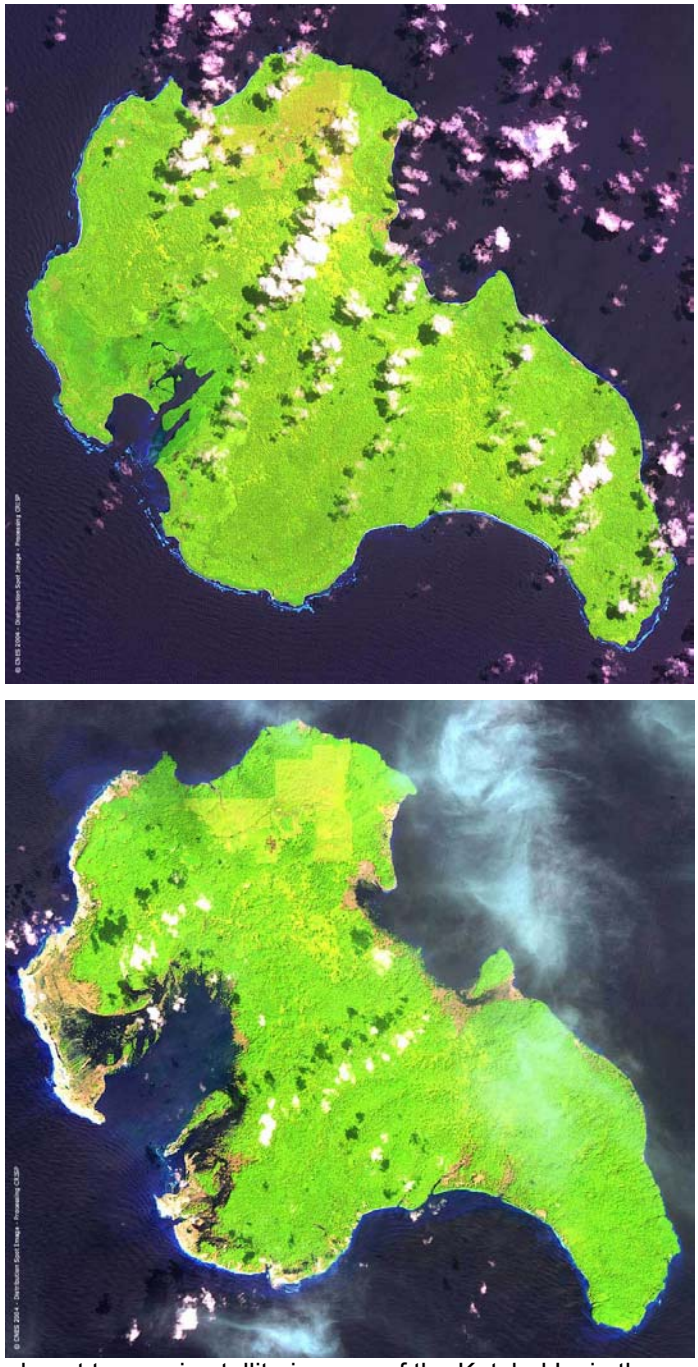

Figure 5. Pre and post tsunami satellite images of the Katchal Is. in the central Nicobar. The West coast where the species have been observed to nest in the past has been largely disturbed by the tsunami waves. But, new beaches appear to have been formed due to uplifting.

Maldives

Prepared by Hussein Zahir

Turtles nest all near around in the Maldives, and December is a good time of the year in some locations. The tsunami hit at approximately 0920 at low tide. There is no specific assessment on the impact of tsunami on the marine turtles in the Maldives. However, because leatherback turtles do not nest in the Maldives it would not have had any impact on leatherback turtles. Some of the good nesting beaches for green turtles were reported to have been temporarily eroded and obviously flooded by the waves, however, it has been reported that nesting has resumed in these beaches. The long term impact of tsunami on marine turtles is unknown.

An assessment of the Damage to Maldivian Coral reefs and baitfish populations from the Indian Ocean Tsunami was carried out using rapid assessment protocols to assess the damage to the reefs. The overall finding was that there is little physical damage to the reefs and the impact from the sedimentation for the tsunami was variable throughout the area assessed. There is little evidence to immediate impact to the baitfish populations and it's too early to say much about the biological and ecological impacts of the tsunami. Overall Maldivian reefs are recovering from 1998 bleaching and the possible effect of sedimentation of the recruitment of corals and recovery of the reefs is a concern (Commonwealth of Australia 2005).

Comores

Prepared by Abdallah Fatouma

Comores was impacted by the Tsunami of December 2004. The tsunami caused a quick retreat of sea water from the coastline, and in certain areas this was followed by strong waves. The tsunami occurred six months after the nesting season of the green turtle (the only nesting species in Comores), hence impacts to nesting turtles was negligible. There was also little damage other than slight beach erosion so longer term impacts on nesting turtles are thought to be low. No impacts were noted to any of the marine turtle foraging areas – such as seagrass habitats or coral reefs, conservation infrastructure or marine turtles (Intergovernmental Oceanographic Commission 2005).

Mauritius

By Mark Hamann

There were no impacts to Mauritius as a result of the tsunami (Mangar Vijay pers. comm.).

Seychelles

Prepared by Jude Bijoux

Seychelles was impacted by the Tsunami of December 2004. The Seychelles are approximately 4500km away from the earthquake epicenter and the tsunami hit the Seychelles approximately 6 hours after the earthquake. The first wave arrived at 1125 and was 1.2 metres above the predicted tide of 0.4 m. The second wave occurred just after 1300 and was 1.7 metres above normal low tide of 0.3 m. The third wave occurred just after 1700 and was 1.2 metres above normal high tide of 1.1 metres. The tsunami occurred at the peak of, and nearing the end of, the hawksbill (*Eretmochelys imbricata)* nesting season. Green turtles nest all year around and leatherback turtles do not nest in the Seychelles hence the tsunami would have had no impact on leatherback turtles in Seychelles.

Impacts to nesting beaches
The short term impacts on marine turtle nesting at both the Inner Granitic Islands and the Outer Coralline Islands are;

- Inner Granitic Islands
  Only 1 nest (probably hawksbill turtle) was reported to have been damaged on the island of Curieuse in the Seychelles inner islands. Apart from that though, there were nesting sites that were eroded to certain degree, but the erosion was not as severe as to damage turtle nests.
- Outer Coralline Islands
  The Seychelles outer coralline islands appear to have been relatively untouched by the tsunami.

The impact of the tsunami on nesting marine turtles in the Seychelles was also assessed by Obura and Abdulla (2005). Aside from the impacts listed above they state that; Bird Island which monitors all their turtle nests reported "large tides" but no apparent damage to any of the nests (Margaret Norah). Aride Island monitors all their nests and reported two nests destroyed by the tsunami (Dylan Evans). Within the Marine Parks, no apparent damage was reported on the beaches of Ste. Anne Island (Jude Bijoux), but at Curieuse nests were lost in the vicinity of Anse Cimitiere but not in the vicinity of the most important nesting beach Grand Anse (Alain Cedras). At Curieuse, erosion at Grande Anse is the norm at this time of year, but the problem appears to have been exacerbated by the tsunami. At Intendence beach on Mahe no nest damage was recorded (Anders Dimblad).

There are little foreseen long term impacts on the nesting beaches as Seychelles beaches are highly dynamic and erode and accrete every year during the North west monsoon and southeast trade winds depending on the direction towards which they are facing. However gradual erosion at the top of the beach near the tree line could ultimately cause the trees to become unstable and fall. If this happens it will greatly affect the stability of the beaches.

Impacts to seagrass beds
Most of the seagrass beds that were destroyed by the tsunami have now recovered to pre-tsunami state. Based on this statement it can be said that the tsunami has had little short term impact on the foraging habitat of Green turtle (*Chelonia mydas*). However, a number of reef sites in the Seychelles inner islands have been affected by the tsunami. This could potentially affect food sources of Hawksbill turtles (*Eretmochelys imbricata*) that feed on sponges from coral reefs in the short term (Obura and Abdulla 2005; UNEP 2005).

Impacts to conservation infrastructure
Short term impact on conservation infrastructure has been mostly in the Marine National Parks were patrol boats were damaged and outboard engines were destroyed. This prevented proper monitoring of park activities in the first 2 months after the tsunami. As a result the turtle nesting sites monitoring was not carried out with the same regularity as in the past. Communication equipment and infrastructure such as housing for the rangers were also heavily damaged. As a result funds that could have been used for conservation action on the ground were re-channeled to repair damage caused to infrastructure. There was no loss of life of any conservation personnel. Long term impact of the tsunami to conservation infrastructure is that it has more or less delayed new projects in some of the marine parks by about 1 year as funds had to be re-channeled in the year 2005 to repair things that were previously in good working order.

<u>British Indian Ocean Territories</u>

Prepared by Charles Sheppard

British Indian Ocean Territory (BIOT) was impacted by the Tsunami of December 2004. The tsunami occurred during the peak hawksbill turtle nesting season & during a period when green turtles also nest. (Note: hawksbill turtles have a clearly defined nesting season, while green turtles probably nest year-round.).

The tsunami destroyed nests when it washed away large amounts of sand and coastal vegetation along the following (surveyed) sections of coastline (Sheppard, 2005):

Diego Garcia Atoll:

- Diego Garcia. On the north eastern coast of the atoll, large waves smashed through the vegetation along a section of a few hundred metres. In the damaged area, shoreline shrubs and all young and intermediate -size palms were removed. But, north and south of that on the same coastline, there was no evidence of damage.

Great Chagos Bank:

- Eagle Island. On the east coast waves punched through a section of several hundred metres and stripped away the Scaevola bushes and young palms. This effect continued around the northern tip and down the western facing side for some hundreds of metres too, illustrating the complicated refraction patterns of the waves.
- North Brother. The little beach was drastically changed & enlarged, and the entire eastern half was clearly affected.
- South Brother. Areas of shoreline shrubs removed at the south-eastern end.

Solomon Atoll:

- Boddam Island. Apparently no areas of stripped vegetation, but sand banks were shifted and much sand was apparently pumped into the lagoon. Substantial erosion occurred and there were "steps" of 1-2 m high everywhere. Yacht visitors reported several turtle nests high on the shores had their eggs exposed - to be eaten by hermit crabs & rats.

Coastal erosion is a serious long term ongoing problem in Chagos (Sheppard et al., 2002). The tsunami probably accelerated coastal erosion by 1-2 years (Sheppard, 2005).

There were no impacts to marine turtle conservation projects or their infrastructure.

Overall Sheppard (2005) inspected most of the islands of the group in February 2005 and assessed insofar as possible what impact the tsunami had on the coastline and near shore habitats. The tsunami 2005 of 2004 is unlikely to have had any impact on leatherback turtles of the British Indian Ocean Territory (BIOT) and minimal impacts to green and hawksbill turtle populations.

Oman

The tsunami hit the coastline of Oman, however, no reports of major damage to coastal communities have been found. It is no known whether any impacts occurred to marine and coastal environments. It is likely that there were very few, if any, impacts to marine turtle nesting or foraging populations.

Iran

The tsunami reached the coastline of Iran, however, there have been few accounts of specific impacts to coastal communities or the marine and coastal environment. It is likely that there were very few, if any, impacts to marine turtle nesting or foraging populations.

Yemen

The tsunami impacted the coastline of Yemen. UNEP (2005) provide a detailed assessment of the impacts of the tsunami on Yemen's peoples and environemt. To briefly summarise, the main impacts occurred to the coastline of Socotra Island and the coastline of Al Mahra Governorate. The most severe reported impacts occurred to the livelihoods of fishermen who lost valuable boats, nets and traps. There is a concern that nets and traps that were washed out to sea may increase mortality of threatened marine wildlife. No quantitative assessment of the impact to the marine ecosystems have occurred, however good baseline data for many reef and mangrove areas exist due to the recent completion of large GEF and IUCN funded projects. It is not known what impacts the tsunami had on marine turtle populations in Yemen.

Somalia

Prepared by Mark Hamann

The impacts of the tsunami of Somalia's marine environment or marine turtle populations (nesting and foraging) are not known. The tsunami had the largest impact on communities in the Puntland region in north east Somalia, however the damage was felt along 650km of Somalia's Indian Ocean coast. According to the UNEP's National Environmental Desk Assessment (UNEP 2005), "due to the absence of appropriate national institutions there are no mechanisms to assess the damage to coral reefs by natural hydrological related disasters and human activity and plans for their protection. An assessment of the coral reefs is therefore needed to determine the extent of damage caused by the tsunami and other natural disasters as well as general degradation arising from long years of pressure from human activities and management neglect". In addition the UNEP (2005) report has provided details of increased health problems to Somalian communities due to the stirring up of hazardous, and often radioactive waste deposits along the beaches of North Hobyo (South Mudug) and Warsheik (north of Benadir). The current situation along the Somalian coast presents a very serious environmental hazard for east Africa (see Marine Pollution Bulletin, 2005, 50; 492).

Kenya

Prepared by Gladys Okemwa

The tsunami had a moderate impact to the coast of Kenya. Weather conditions on the 26 December were sunny and calm and within the normal range for the northeast monsoon. The tsunami occurred at low tide and consisted of a sudden upsurge in the tide level by two to three metres above the highest spring tide level. Most of the impacts were in the central part of the coast adjacent to Mambrui. The tsunami occurred during the low part of the nesting season (nesting mainly occurs between June and October). The potential short and long term impacts to the nesting beaches were inundation of nests still incubating, increased debris on the beaches, erosion of the foredune and subsequent alteration of beach profiles. The potential short and long term affects on foraging habitats include increased stress and degradation of sea grass and coral reef habitats and potentially permanent shifts in important turtle foraging areas.

However, these impacts have not been well investigated and no quantitative data exist. In the absence of data on impacts to habitat it is difficult to examine the actual influences the tsunami had on marine turtle populations. However, it is suspected that the direct take of marine turtles for food may increase to offset the increased economic pressure placed on fishing-based communities.

In addition to the environment impacts, the tsunami also had a moderate impact on Conservation programs and conservation infrastructure. Hatcheries established to protect marine turtle nests were flooded and received some structural damage, there was the loss or flooding of some research equipment and access roads to nesting beaches. These impacts will inevitably slow the progress being made my Kenyan authorities to protect marine turtle populations in Kenya. Overall more awareness and education is needed especially at a national level on the environmental impacts of the tsunami, including the generation of quantitative data. Efforts should be put in place to maintain and replenish (where possible) natural preventative barriers such as mangroves and coral reefs. Early warning and contingency plans also need to be developed.

Tanzania

Prepared by Catharine Muir

The tsunami had a low impact to the coast of Tanzania. The tsunami hit during low tide and consisted of two small waves approximately 0.5 to 1 metre in height. No major impacts to the coastal zone have been observed or documented. There is some anecdotal evidence of small scale infrastructure damage at the port in Dar es Salaam. There were no impacts to marine turtles, or marine turtle conservation projects

French territories of the Indian Ocean (Mayotte, La Reunion and Iles Eparses

Prepared by Stephane Ciccione

The tsunami had a very low impact, with waves approximately two metres high washing in on the northern and western sides of the islands. Anecdotal reports indicate that there was no loss of lives, and approximately 200 boats and some port infrastructure were damaged at La Reunion. There were no impacts to conservation infrastructure. There were no impacts of marine turtle nesting beaches, nor are there believed to have been any impacts to the offshore habitats.

Madagascar

Prepared by Mark Hamann

The tsunami had a low impact on Madagascar's coast. Wave ranging in size from 1.5 to 10m hit the southeastern towns of Manakara, Sambava and Vohemar. There is no information on whether the tsunami affected turtle nesting beaches or foraging habitats. However, no leatherback turtle nesting has been recorded from Madagascar and whether Madagascan waters serve as important habitat for the species is unknown (George Hughes pers. comm.)

South Africa

Prepared by Ronel Nel

The tsunami had a low impact to the coast of South Africa. The province of KwaZulu-Natal was protected by the island of Madagascar. Hence, although the tsunami occurred in the peak of the turtle nesting season there was no impact to any of the marine turtle nesting beaches. The Eastern Cape was most affected, and the furthest eastern point that the tsunami reached was Struisbaai. There are no known impacts of the tsunami to important marine turtle foraging habitats.

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