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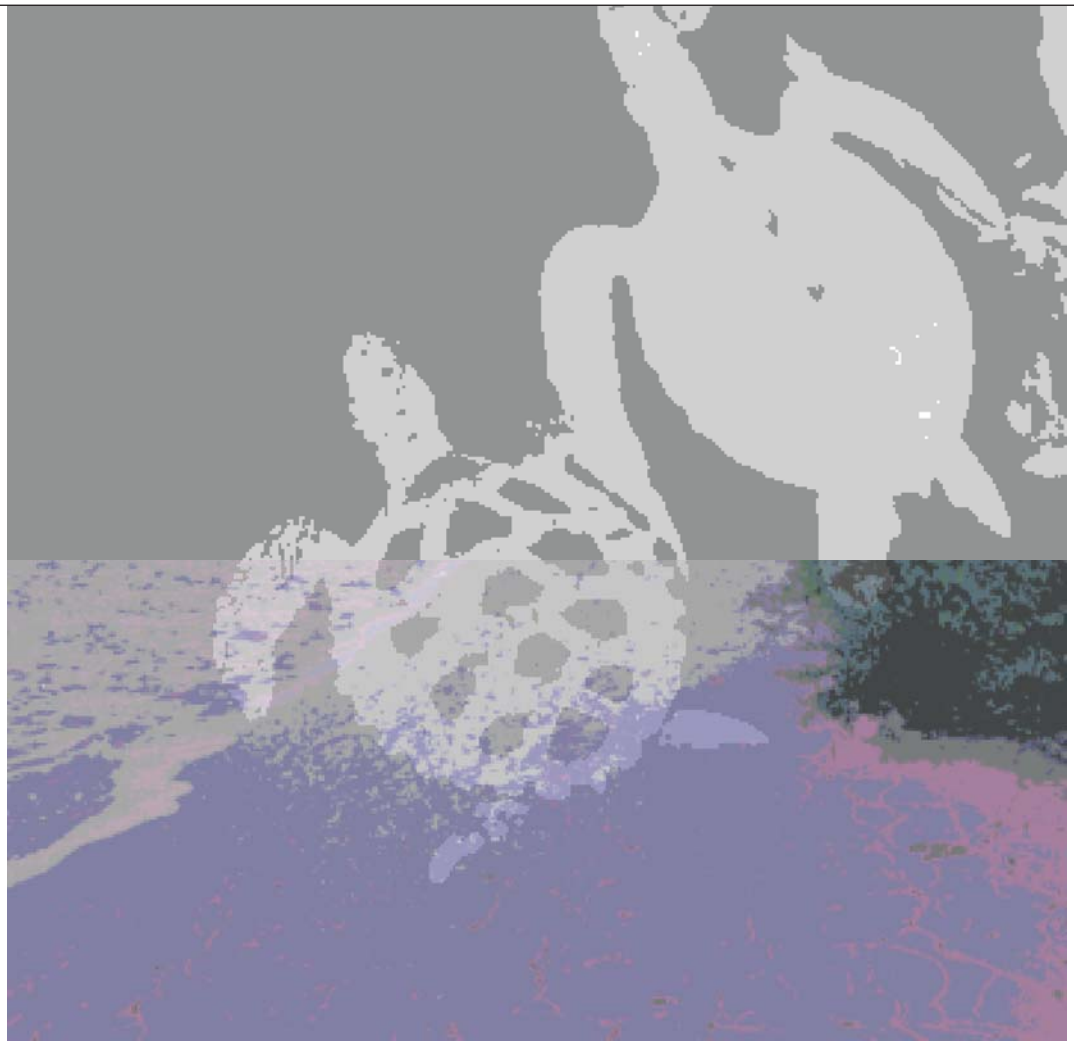

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The Maldives Marine Research Bulletin is published by the Marine Research Centre of the Ministry of Fisheries, Agriculture and Marine Resources. The bulletin aims to improve understanding of the Maldivian marine environment and to promote sustainable utilization of marine resources by providing a means of disseminating relevant information. Each issue is dedicated to a single theme, on any marine topic, but with particular emphasis on fisheries and marine life. Bulletins will include original research results, reviews and manuals. The Maldives Marine Research Bulletin will be published in English with a Dhivehi summary. Information published in any Bulletin may be freely used, but the source should be acknowledged. All enquiries should be addressed to:

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MARINE TURTLES IN THE MALDIVE ARCHIPELAGO

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MINISTER'S PREFACE

I am privileged to introduce this forth volume of the Maldives Marine Research Bulletin. This special volume focuses on the status and management of Sea turtles in the Maldives. The most important objective of this volume is the publication of a historical report on marine turtles in the Maldives archipelago by Dr. J. Frazier and S. Salas with NT Hassan Didi in 1984. It is therefore, my honour to present this comprehensive document on the status of the sea turtles in the Maldives some 15 years ago.

Maldivians are traditionally excellent sailors and fishermen, plying among the islands of the archipelago and trading across to Sri Lanka and India as well. Historically Maldives is well known for sea turtles and its trade. Early historic accounts of the Maldives, dating from the 12th century writings of Al-Idrisee, show that the Maldive was an important source of tortoise-shell for foreign traders. More recently shells have been traded between Maldives and Sri Lanka, the Archipelago providing raw tortoise-shell for Sinhalese artisans, and the much appreciated Maldive-fish.

The exploitation of sea turtles and eggs remained minimal during the early part of this century. This is related to the belief of religious scholars, preaching that it was illegal to eat turtle meat. As a result turtle meat was not eaten in the country, although local consumption of eggs evidently occurred.

The exploitation of sea turtles and eggs was minimal during the early part of this century. This related to the belief of religious scholars, preaching that it was considered forbidden to eat turtle meat. As a result turtle meat was banned eaten in the country, although local consumption of eggs was evident. However, some turtles, mainly green turtles were caught as bait for shark fishing, and oil extracted from the meat was used as a wood preservative in fishing crafts.

The rescinding of the ban in late 1940's caused widespread killing of sea turtles for meat and a small amount for local trade. This increased with the introduction of the tourism industry in the early 1970's. Immature turtles were caught and prepared in large numbers for the tourist market due to their high price. Evidently Japanese fishermen working in the country at that time passed the skill of stuffing turtles.

The Ministry of Fisheries and Agriculture has statutory responsibility for the rational and sustainable management of all living marine resources within the Exclusive Economic Zone (EEZ) of Maldives. Concerned with high levels of exploitation the government has taken a number of legislative and management actions specifically with regard to marine turtle conservation. Minimum size limits have been imposed very early on prohibiting the capture of Hawksbill turtles less than two feet in carapace length and other turtles less than two and half carapace length. Export of any unprocessed product of Hawksbill turtles were banned starting from 1980 but export of processed ornamental jewellery made from tortoiseshell was permitted. Sale and display of turtles below the imposed size limit in the shops was also banned.

The most recent legislative measure to conserve turtles came into effect in June 1995. Continued decrease of the turtle populations and concerns raised by environmentalists and resort operators lead to a Presidential Decree banning the catch or killing of any turtle species from the territorial waters of Maldives for a 10-year period. This decree came into effect under Section 10 of Fisheries Law No. 5/87.

A total ban on collection of eggs has not been considered yet. The main reason for this is that turtle eggs have traditionally been used as a food source by the island communities. However work is in progress to identify the most important nesting islands, which will eventually lead to a complete ban on the collection of eggs from some of these islands.

I praise the authors of this special volume for their impressive work on status, management issues relating to the sea turtle populations in the Maldives. I believe this will be a valuable contribution to our knowledge of sea turtles, and this would eventually lead to increased “general awareness among the public” which is essential for the successful management of these resources

Abdul Rasheed Hussein,
Minister of Fisheries, Agriculture and Marine Resources

EDITORIAL

It is with great pleasure that we are publishing the fourth volume of the Maldives Marine Research Bulletin. This issue focuses on a different theme from the previous issues. This volume takes into consideration a historical document and the present day knowledge about the biology and conservation of the seas turtles.

Since traditional time, sea turtles have been exploited in the Maldives for their meat and their eggs. The hawksbill turtle was only exploited for the esteemed tortoise shell. With the environmental active groups concern of the declining sea turtle populations, the sea turtles were protected on the 24th of June 1995 for a ten-year moratorium period by a Presidential decree, which did not take into account of the turtle eggs. As a result the sighted turtle nests are sought after for the eggs, which are considered as a delicacy. However, there has been a lot of awareness programs about the protected species and I am very happy to state that the younger generations are growing up aware of the facts and will have a lot of impetus on the conservation issues.

I am greatly indebted to Dr. Jack Frazier for giving his consent to publish the work, which was conducted sixteen years ago in the Maldives. I would also like to thank him for taking the time to review the paper and present it duly.

I would also like to thank Mr. Hussein Zahir for providing an update on the status of sea turtle populations in the Maldives with emphasis on nesting sites from the fieldwork conducted and as well as for the Dhivehi summary provided.

Finally, I would like to thank Miss Zeena Ali for typing out the Frazier Report and Ms. Mariyam Hussein for the dhivehi script.

Editor
Zaha Waheed

MARINE TURTLES IN THE MALDIVE ARCHIPELAGO

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INTRODUCTORY NOTE

The following report was prepared in 1984 after carrying out preliminary surveys in Ari, Baa, Laamu, and Malé Atolls. It was intended to return and complete the work, but unfortunately this was not possible, and as such the report was never completed or updated. In an effort to make available the information that was obtained during the preliminary surveys of 1983, the report is now being included in this volume.

J. Frazier
September 2000
Front Royal, Virginia, USA

ABSTRACT

All five pantropical species of marine turtles have been recorded in the Maldives. Two, *Chelonia mydas* (L.) and *Eretmochelys imbricata* (L.), breed regularly and occur throughout the Archipelago. The other three species, *Lepidochelys olivacea* (Eschscholtz), *Dermochelys coriacea* (L.) and *Caretta caretta* (L.) in order of frequency, are common to rare. The populations are dispersed and small – evidently much depleted from half a century ago. Changing traditions and increased exploitation on both turtles and their habitats, coupled with bourgeoning human populations and habitat perturbations, pose difficult questions for the future of these resources.

1. INTRODUCTION

There is no detailed report on marine turtles in the Maldive Archipelago, although the islands have a long history of trade in turtles, and provide vast areas of nesting and feeding habitats that appear to be ideal for tropical island species. In order to compile what little is known of marine turtles, their requisite habitats, and interrelated human situations, past and present, this report draws from a variety of sources.

2. GEOGRAPHY

The Maldive Archipelago lies at the southern edge of the Arabian Sea, 520km west-southwest of the Indian main (Figure 1). It sits atop the Laccadive-Maldive Ridge, a major oceanic feature which extends in nearly a straight line along the 73rd Parallel from 14° N to below the Equator, evidently as far as 8° S, and includes the Chagos Archipelago. Each of the three archipelagos on the Ridge is administered separately: Laccadives ("Lakshadweep") by India, Maldives as an independent republic, and Chagos as the British Indian Ocean Territory (BIOT), a Crown Colony.

All of the Maldives, except for the three southern-most atolls, rise from the steep-sided plateau which is 270 to 380m deep, 650km long and 130km at the widest. Deeper shelves at 1,280 to 1,650m link the main plateau with the outlying atolls of Minikoi (administered by Lakshadweep) to the north, and Suvadiva to the South. There may be no shelf between Suvadiva and Addu, the southern-most atoll in the Republic, and the situation with Fua Mulaku is unknown. These shelves, or marine plateaus, drop rapidly to the sea floor 2,380 to 3,660m to the West and 1,830 to 2,560m to the East. In

contrast to other mid-oceanic ridges, the Laccadive-Maldive Ridge is aseismic (Stoddart, 1966a). Whether the plateau and its islands were ever closer to the continent is not known.

The Maldive Archipelago is composed of more than 20 discrete "atolls", or ring-shaped clusters of islands, that fall generally into two parallel lines (Figure 1). This is one of the largest concentrations of these formations anywhere, and the word "atoll" or "atholu" derives from Dhivehi, the Maldivian language. Each atoll usually represents the top of a steep-sided seamount, which rises from the plateau. More than 1,200 islands are distributed over an area greater than 87,000km^2, but the total land area is estimated to be only 298km^2 (Maniku *et al.*, 1977).

3. GEOLOGY

The islands are coralline cays, rarely more than 2m above sea level. Sand shifts continuously through action of wind and sea, and banks, beaches and cays come and go as sand is deposited and eroded. Four types of lithified strata have been described: reef rock, relict reef rock, cay sandstone and beach rock (Stoddart *et al.*, 1966). Only the last named is common, and both seaward and lagoonward coasts are dominated by sandy beaches. The northern islands are reported to be generally more fertile, but Fuah Mulaku, in the south, is famous for its agriculture and relatively lush vegetation. There is little soil other than a shallow surface layer of coralline sand mixed with some organic matter. Spicer and Newbery (1979) and Newbery and Spicer (1979) studied soils on Villingili Island, Addu Atoll.

4. METEOROLOGY

The climate of the region is dominated by two monsoons. The Southwest Monsoon, from June to August or September, is typified by high winds and heavy rains. The weather is normally more clement from November through March, during the Northeast Monsoon. Variable weather occurs in the transition between monsoons. The highest air temperature recorded is 32.8 °C in April. A record 20.6 °C in January is the lowest (Hackett, 1977).

As with other environmental data, there are few records on rainfall. From north to south, annual totals are similar, but the northern atolls have a distinct peak in rainfall at the beginning of the Southwest Monsoon. The southern atolls have generally unsettled weather with rainfall more evenly distributed throughout year (Hackett, 1977). At Addu Atoll, in the South,

mean annual rainfall was reported to be 2,382.5mm; at Malé Atoll it was 2,055.9mm. The greatest monthly rainfall was in October, and the January value was second (Stoddart, 1971).

5. OCEANOGRAPHY

Sea surface temperatures show little fluctuation, rarely varying below 27° or above 31°C. Surface currents reverse with the monsoons, running eastward during the Southwest Monsoon, and westward from December to April. Tides are semidiurnal, with maximum amplitude of 2m (Hackett, 1977). Salinity data are in Stoddart (1966b).

6. MARINE FLORA

Marine algae include 21 Cyanophyceae, 163 Rhodophyceae, 83 Chlorophyceae, and 18 Phaeophyceae, many of which are recorded in stomach contents of sea turtles. Several marine angiosperms are recorded, but there are no large pastures. Mangrove forests are small (Hackett, 1977).

7. MARINE FAUNA

The coral reefs in Maldives are some of the richest in the world and there is no greater diversity of coral in the western Indian Ocean (Rosen, 19--). The J. Stanley Gardiner Expedition, the John Murray Expedition, and the Cambridge Expedition each made extensive marine collections (see Stoddart, 1966c for references). Fishes are abundant and diverse; for millennia the islanders have exported fish, and fishing is the primary occupation (Munch-Peterson, 1978).

8. TERRESTRIAL FLORA

These small, remote islands have a scanty flora. More than 50 species of Dicotyledons, 17 species of Monocotyledons, and 3 species of fern are reported from Vilingili Island, Addu Atoll (Fosberg *et al.*, 1966, Sigee, 1966). Forests of *Pisonia grandis* R. Br. probably covered much area before being cleared for settlements and agriculture (Spicer and Newbery, 1979). Coconut groves, apparently self-seeded, occupy large areas of most islands, and there is also intensive agriculture of annual crops on some islands.

9. TERRESTRIAL FAUNA

The terrestrial fauna is likewise depauperate. There are no large indigenous predators, although introduced cats and rats are on some islands with permanent human inhabitants, and rats are a serious problem for coconut plantations on uninhabited islands (being a Muslim country, no dogs are allowed in the Maldives). Large predatory birds include frigate birds (*Frigata* spp.), boobies (*Sula* spp.), herons and egrets (*Ardea* sp., *Butroides* sp., and possibly other genera), and crows (*Corvus splendens* Viellot), as well as non-resident raptors (Watson *et al.*, 1963). There are no large lizards or resident populations of crocodiles and only one snake is known. Populations of land crabs can be sizeable and include; coconut crabs, *Birgus latro* L., hermit crabs, *Caenobita* spp., and especially ghost crabs, *Ocypode* spp.

10. HISTORY

The Republic of Maldives has been an independent island state for most of its history. Colonial intervention was short-lived and sporadic, reflecting the transition from one major power to another in the Indian Ocean, and the disdain Maldivians have for being colonized. Aryan people from India may have settled the islands before Christ, although other accounts state that Buddhists from Sri Lanka settled in the 6th century A.D. The language, "Dhivehi", is an ancient form of Sinhala of the Indo-European Group. Whatever may have happened, sailors and fishermen from the region had probably visited the islands well before they were permanent settlements.

For much of their history, the Maldives have been a Sultanate. In 1153 the ruler (Sultan) converted to Islam, and the populace quickly followed. From 1558 until 1573 the Portuguese controlled Malé Atoll as a satellite of their colony in Goa, India. In the 17th century the islands were a Sultanate under Dutch protection, based in Sri Lanka. When the British took control of Sri Lanka, the Maldives fell under their control, and formally became a protectorate in 1887. The Sultanate was abolished in 1932 and the Republic inaugurated in 1953. After a brief period, the Sultanate was resumed, and the Republic then restored in 1968. A British airbase was on Addu Atoll (or Seenu) during World War II and between 1965 and 1978.

The Republic is divided into 5 districts with 19 administrative atolls; only 210 islands are permanently inhabited. Malé is the Capital, as it has been since the time of the Portuguese. In 1972 the total population of the

Archipelago was estimated to be 122,673, of which 15,279 were on the tiny capital island of Malé (Republic of Maldives, 1983), and in 1984 the estimates were 160,000 and 40,000 respectively.

Minicoy Atoll, in the Eight Degree Channel, was politically part of the Maldives at one time, but for some centuries it has been under Laccadive administration. Territorial fishing rights are claimed over an area of 561,454km^2 .

Early historic accounts of the Maldives, dating from the 12th century writings of Al-Idrisee, show that the islands were important source of tortoise-shell for foreign traders. In recent years there have been strong trade ties between the Maldives and Sri Lanka, the Archipelago providing raw tortoise-shell for Sinhalese artisans, and the much appreciated Maldive-fish. Maldivians are traditionally excellent sailors and fishermen, plying among the islands of the archipelago and trading across to Sri Lanka and India as well. Readable accounts of the Maldives are given by Maniku *et al.* (1977) and Bevan and Greig (1982).

11. MARINE TURTLES

In reviewing the status of marine turtles in the western Indian Ocean (Frazier, 1975, 1990) it is striking how little is recorded from the Maldive Islands, although they have for centuries been important suppliers of tortoise-shell. The thousands of remote islands should provide prime nesting habitat for turtles, and the vast coral reefs probably provide ample food and shelter for large numbers of turtles.

Arab writers, e.g., Al-Idrisee in the 12th century and Ibn Battuta in the 14th century, documented the fishery for tortoise-shell, but they found little else about sea turtles significant enough to record.

The first biologists' records of marine turtles in Maldives were made at the end of the 19th century, and these are also very scanty. Chun (1903)

Laidlaw (1902) found *Eretmochelys imbricata* (L.) common off the Maldives and the Laccadives and plentiful around Malé Atoll. Gardiner (1906:1050) reported a gravid *Dermochelys coriacea* (L.) from Addu Atoll.

Deraniyagala (1956) visited the Archipelago in 1932, and has written more about the sea turtles there than anyone else: *Chelonia mydas* (L.) was very

common; it was not eaten at Malé, but was eaten on some other islands. In a single night in December, 6 females were netted for Deraniyagala. Nine newly hatched turtles were observed on Hulhule Island, Malé Atoll, on 22 December 1932. He suggested (1939:241) that *C. mydas* bask during the daylight on beaches of the Maldives, a habit that it is known from remote islands in the Galapagos (Snell, 1983) and French Fregate shoals, Hawaii (Whittow and Balazs, 1979, 1982) – and occasionally claimed (incorrectly) to be unique to the French Fregate shoals.

Deraniyagala (1956:13) considered *Eretmochelys* to be more common in the southern atolls, and he thought *Dermochelys* was very rare. A nest, reputedly of the latter species was reported on Hulhule island, but this refers to the same event reported earlier by Gardiner (1906).

On the basis of a nest with eggs 42 and 44mm in diameter, and tracks the size of *Chelonia*, Deraniyagala (1956) deduced that *Caretta caretta* (L.) also nested. However, no specimen of this turtle has been confirmed from the Maldives until the present report, and the egg sizes reported are not unusual for *Chelonia* (see below).

Phillips (1958:219) recorded two young *Eretmochelys* at Malé in December 1956. Colton (1977:170) spent over a year in the Maldives and claimed that: "The coral reefs of Maldives are also home to the loggerhead, green, olive ridley, and leatherback sea turtles – all, like the hawksbill, endangered species". She saw shells of *Eretmochelys, Chelonia,* and *Lepidochelys* offered for sale to tourists, and presented photographs of the first two. It is unlikely that she had any evidence of either *Caretta* or *Dermochelys*.

Didi (1983) summarized an account of Mulhado (or Mulhadhoo) Island, famous for large numbers of nesting turtles half a century ago. He also described past developments and the decline of turtle populations in the Maldives.

A claim (Anon., n.d.: 5.18) that four species *(Chelonia mydas, Eretmochelys imbricata, Dermochelys coriacea,* and *Caretta caretta)* are caught and breed in Maldives was evidently based on a review of published accounts. However, no sources for this information were given.

12. METHODS

A preliminary survey of the Maldives involved four phases: meetings in, and day trips from, Malé – intermittently between 21 December 1983 and 26 January 1984; an excursion to Baa Atoll, including the islands of Kunfunadhoo, Eydhafushi, Maadhoo, and Thulhaadhoo – from 28 December 1983 to 7 January 1984; an excursion to Laamu Atoll, including the islands of Hithadhoo, Gaadhoo, Dhanbidhoo, Isdhoo, Maabaidhoo and Maamendhoo – from 10 to 17 January 1984; and an excursion to South Malé Atoll (Rannaalhi Island) and Ari Atoll, including Dhangathi, Hurasdhoo, and Hukuruelhi Island from 21 to 24 January 1984. Mr. N. T. Hassan Didi, Senior Under Secretary of Fisheries, participated in the last two trips, Mr. Jadullah Jameel, Junior Under Secretary of Fisheries, in the trip to Baa, and Mr. Hassan Maniku, Senior Fisheries Development Officer, in several trips from Malé.

Wherever possible Island Chiefs and experienced fishermen were interviewed about turtles. In addition, Mr. N. T. Hassan Didi (NTHD) has spent nearly 60 years observing and enquiring about turtles in the Maldives.

Island names, which are in Dhivehi (an ancient form of Sinhala), are now written in Thaana, which is similar to Arabic script. There are various ways to transliterate these to Roman script, so as standards we use "Map of Maldives" (Anon., 1979) and "The Islands of Maldives" (Maniku, 1983). Atoll names are given (usually in parentheses) after each island name that is mentioned.

13. THE FINDINGS

13.1 Species Accounts

13.1.1 *Chelonia mydas* (L.)

Common names: The name "Vela" (or "Wela") is heard throughout the Archipelago, from to north to south and is used exclusively for the Green Turtle, *Chelonia mydas.* Curiously, the name has not been previously recorded except for Deraniyagala (1956:13), and neither its meaning nor its origin are clear. It has no obvious similarity with any other turtle name in the Indian Ocean (Frazier and Salas, unpublished.)

Occurrence: Vela are found throughout the Archipelago. Nesting was confirmed at Kunfunadhoo and Maadhoo Islands (Baa), and spoor or remains of *C. mydas* were found on Hukuruelhi (now changed to Hukurudhoo) Island (Ari) and Gaadhoo, Hithadhoo and Isdhoo islands (Laamu) (Table 1).

Population structure: Adults and immatures are found throughout the Archipelago (Table 2). Carapaces of less than 75cm long (far below adult size) were commonly offered for sale in the late 1970's, as shown in photos in Colton (1977), and this size class is still commonly displayed for sale in Malé. In November 1983, NTHD photographed an animal with a carapace that was little more than 10cm long. It was offered for sale, but it is not clear if it was wild-caught or captive-reared.

Feeding biology: A large marine pasture, with *Syringodium isoetifolium* (Ashers.) Dandy and *Thalassia hemprichii* (Ehrenb.) Aschers. in Petermann, was examined east of Thulhaadhoo (Baa). However, it does not seem to be an important feeding area. There are large pastures of *Thalassia hemprichii*, with smaller patches of *Thalassodendron cilliatum* (Forsk.) den Hartog, along the eastern and southern sides of Laamu Atoll, and the waters between Funadhoo and Baraasilhoo, in the southeast of the atoll are reputed to be a favourite haunt of feeding turtles. Large marine pastures are evidently rare in the Maldives.

Breeding biology: Data on nesting season are available only from Gaadhoo (Laamu), where there is a peak between June and December and a lull from March to May. Nesting is evidently restricted to night-time, although long ago it may have occurred in late afternoon and early morning (Didi, 1983). Nests are made in a narrow coastal strip, from the beach crest to 17m inland; 95% of all nests are within 10m of the beach crest. Most nests are shaded, and many are under heavy shade.

Nest JGF 4208 was 82cm deep, with the top of the hatched egg shells at 73cm. The same nest had approximately 110 shells of hatched eggs and 3 unhatched eggs. JGF 4218 had approximately 110 fresh laid eggs.

Eggs from three clutches were measured; diameters ranged from 40.8 to 46.1mm, averaging 42.2. Egg weights from one clutch varied from 39.5 to 41.0g, with an average of 40.6 (Table 3).

Body size and characteristics: The few measurements we have, that evidently come from adults (Table 2), are of normal size for the species in the Indian Ocean. Scalation and coloration are also normal. Two females seen at Thulhaadhoo (Baa), and Isdhoo (Laamu), however, were all spotted, without concentrations of dark pigment in the postero-medial corners of the carapace scutes and without chestnut-red bull's-eyes, unlike the coloration that is normal for females in the western Indian Ocean (Frazier, 1971).

Local accounts: A number of islands are known for their nesting turtles, presumably Vela. "Mulhadhoo" (Thiladhunmathi), in the extreme north, has some fame: hundreds of turtles are reported to have nested each night (Didi, 1983). At Baa Atoll, Kunfunadhoo and Maadhoo, and formerly Dhunikolhu, Fares, Maarikilu and Miriyandhoo are known for the large numbers that nest, or once nested. Nesting is also reported from other islands, e.g. Olhugiri and Kanifushi. These islands are scattered about the Atoll, and all are uninhabited except the first named, which has recently had a tourist resort built on it.

The best turtle island in Ari Atoll is said to be Hukureulhi. In Meemu Atoll, there is evidently an island in the southwest with a reputation as a turtle rookery. At Thaa Atoll, Kanimeedhoo Island in the south was once known for turtles. The only island in Laamu Atoll that is known today for its turtles is Gaadhoo.

Every atoll is likely to have its turtle island(s), but the above examples, despite the scanty nature of the data, are all that is documented at present. It seems that there is more nesting in the north and more on the eastern side of the Archipelago.

Vela are said to be most accessible during the change between monsoons and December-January, when they can be caught using hook and line at the surface, outside the atolls. Smaller animals are reported to be inside the atolls, and they are said to be lighter (whiter) in colour. At Mundhoo (Laamu) turtles as small as 20cm long are found on sea grass beds. Copulating pairs are found during theses months also, when males appear 4 or 5 times more common. Females caught at sea can have shelled eggs as well as enlarged follicles. There are said to be two kinds of nesting Vela, one with a round back and one with a slightly longer back.

At Thiladunmathi there was year round nesting with a peak at the beginning of the Northeast monsoon, starting in about November. Nesting at Baa Atoll

was claimed to be most active during December-January, when the current runs west to east. In mid-August 1983, eggs were exploited from Kurendhoo (Lhaviyani). At Gaadhoo (Laamu), the only place for which there are quantitative data, nesting goes on most of the year with a peak from June to December.

Population size: There are very scanty data relevant to the numbers inhabiting or even nesting in Maldives. Nesting spoor observed on 18 islands (Table 4) indicates that several hundred turtles nest yearly. Taken together with what is estimated by experienced people from other islands (Table 5), there may be about 1000 nesting. Considering the entire Archipelago, it is likely that several thousand Vela nest each year.

It is unanimous, in every atoll from which there is information that the numbers nesting have declined catastrophically. Evidently tens of thousands of turtles once nested in Maldives.

13.1.2 *Eretmochelys imbricata* (L.)

Common names: The name "Kahambu" is used throughout the Archipelago and is used exclusively for the Hawksbill Turtle, *Eretmochelys imbricata*. It was recorded by Deraniyagala (1956:13) and a variant, "Carhambu", was reported by Laidlaw (1902). There is no obvious relationship between this name and any other used in the Indian Ocean (cf. Frazier and Salas, unpublished)

Occurrence: *E. imbricata* occurs throughout the Archipelago. Nests were found on Kunfunadhoo (Baa) and Baros (North Malé). Specimens were seen in Baa, North Malé, South Malé, and Laamu Atolls, and photographed at Vaavu (Table 6). There is probably nesting, at least in small numbers, on most uninhabited islands in all of the atolls.

Population structure: Turtles with carapaces less than 60cm long were commonly displayed for sale in the late 1970's (see photos in Colton, 1977), and immature animals are still the most common to be seen for sale. The few animals we handled (Table 7) were all immatures. Scales, coloration, and other morphometric features are all normal for the species in the Indian Ocean.

Feeding biology: Stomach contents of JGF 4212 show entirely sessile soft bodied invertebrates – sponges especially. This sample is being further analysed. The predominance of sponges in the diet is expected for this

species, and the rich coral reefs in Maldives must provide a vast and well-stocked feeding area for *Eretmochelys.*

Breeding biology: Nests of *E. imbricata* are made in the same areas as those of *C. mydas*, concentrated in a narrow zone from the beach crest to 10m inland. The majority of nests are shaded, often heavily.

Only one confirmed nest was examined; JGF 4207, which emerged on 30 December, had about 125 hatched eggshells that were between 40 to 50cm deep. Diameters of two unhatched eggs varied from 34.5 to 37.8mm (Table 3).

Local accounts: Kahambu are reportedly caught most often at the end of the Northeast Monsoon, from December to March. This turtle is rarely seen outside the atolls. It is commonly seen near coral reefs of uninhabited islands. The northern reefs of Goi Fehen Fulhadhoo Atoll, i.e. Fulhadhoo, Fehendhoo and Goidhoo islands, are said to have large numbers, as are the reefs near Rannaalhi (South Malé) and Mahibadhoo (Ari).

Mating has been seen in Baa Atoll in December-January. Very few Kahambu are known to nest, but when they do nest they seem to use the same beaches, as do the Vela. The main period of nesting in Baa Atoll is said to be December, but they reportedly nest throughout the year. On Baros (N. Malé) a nest was made on 17 November 1983; two nests in 1980 had a total of 365 eggs. Hatchlings, evidently of this species, emerged from a nest on Rannaalhi (S. Malé) in February.

The attitude toward eating flesh of Kahambu varies: it may be relished just like that of Vela (e.g. Maavah Island, Laamu), rejected while Vela is eaten, or neither Vela nor Kahambu may be eaten. Representatives of nine different islands (7 in Laamu Atoll) reported eating: both (6), Vela only (1), neither (2).

Records of poisoning from turtle meat in Maldives appear to be few. In 1978 there was a case in one of the southern atolls. The only turtle regularly implicated in cases of poisoning in the Indian Ocean is *Eretmochelys imbricata.*

Population size: Data on *E. imbricata* are inadequate to do more than guess about population size. With nesting evidently occurring in all atolls, but

never in concentrations, there are likely to be hundreds of animals nesting each year.

13.1.3 *Lepidochelys olivacea* (Eschscholtz)

Common names: "Va washi" is a name heard infrequently north of Malé. It means "round frame", as in a drum, and evidently is used for the olive Ridley, *Lepidochelys olivacea,* a turtle that is distinctively round in shape. It is also called "Va" (or "Wa") "Washi Vela".

First record: No specimens of *L. olivacea* from Maldives are known to exist, but at least two individuals have been photographed by NTHD. The carapace of one was about 25 inches (~61cm) in straight length and a life-size sketch of the other, on 6 March 1977, has a straight length of nearly 44cm. Both are below adult size.

Local accounts: The colour of "Va Washi" is said to be similar to that of Vela, *C. mydas,* although, lighter or more yellow, and it is smaller in size. Neither nesting nor gravid females have been seen. There is no particular season when these turtles are reported to be more common, but they are said to be mainly in the lagoons, particularly in the deeper areas where there are plants. Stomach contents include seaweeds. This turtle is occasionally caught for oil, but the flesh is considered to be poisonous. Not one of a dozen Island Chiefs from Laamu Atoll had any knowledge of this turtle, and it seems to be unknown in the south of the Archipelago.

13.1.4 *Caretta caretta* (L)

Common names: The only common name that has been reported for this turtle in Maldives is "Varvohori" (Deraniyagala, 1956: 13). It is unlikely that this name is relevant, for there is only one confirmed record of this species in Maldives.

First record: On 13 December, 1981, NTHD photographed a female turtle about 2½ feet (76cm) long. The shape of the head, with a slightly protuberant beak, the posterior of the carapace, with a prepygal swelling, and the 5 pairs of pleural scutes all confirmed that this is *C. caretta.*

13.1.5 *Dermochelys coriacea* (L.)

Common names and local accounts: From the descriptions that were provided for a turtle called "Musimbi" or "Mussimbi" (Deraniyagala, 1956:13), there is a little doubt that it is the Leatherback, *D. coriacea.* It was described regularly with several distinctive features: grows to large size

(>1 m), has ridges down the back, with a pointed end to the shell, and produces large amounts of oil. Not infrequently the eggs or turtle itself are said to be poisonous. Two other themes are commonly recounted about Musimbi: the eggs are distinctive, for they are joined together or have hair (or root) like structures: they were even said to be blue coloured by one ex-Atoll Chief of Baa. A second point is that the turtle jumps when it is on land; impossible as it is, this claim seems to be based either on an inference from the condition of tracks or on the repetition of some remarkable account that now is legend.

A fisherman from Thulhaadhoo (Baa) had not heard of "Musimbi" but a turtle 3 to 4 feet long (approx. 1m) that was black and could be seen outside atolls was "Dhevi". This is the Dhivehi word for "demon". Clearly, sightings of this turtle are rare; a man of more than 60 years of age who lives on Gaadhoo (Laamu), one of the best turtle islands, had never seen a Musimbi. Each of the few people that have seen this turtle has seen no more than one.

Curiously, "Musimbi" is the Dhivehi term for Mozambique, being evidently a corruption or earlier form of it. African slaves did arrive in Maldives via returning pilgrims who acquired them on their *Hajj* to Mecca. There also seems to have been trade between eastern Africa and Maldives, and this could also explain the presence of cultural elements in Maldives that have an African origin. *D. coriacea* does nest in Mozambique, but the turtle also nests in Sri Lanka, which is considerably closer to Maldives, so the origin of the name is not clear.

14. LOCAL LEGENDS AND LORE

Aside from local accounts, summarised in the species accounts above, there are several local stories about turtles. These give an indication of how much interaction there has been between man and turtle.

An epic song tells of a shark fisherman who captures turtles for bait, including finally the "King of Turtles". Another humorous verse compares the chicken, which lays an egg and then makes a lot of noise cackling, and a turtle, which lays more than a 100 eggs and says nothing.

There is a belief, at least at Laamu Atoll, that a turtle will nest when an unmarried girl becomes pregnant. The turtle may even come up the beach in

front of her house. At Maavah Island (Laamu) the penis of a turtle is thought to be aphrodisiac.

A practice of the past was to slaughter a turtle (Vela) and bless the ground with its blood before crops were planted. This predates the arrival of Islam in Maldives and is understandably discouraged by the authorities nowadays.

When the airport was under construction on Hulhule Island (North Malé), a limestone turtle was unearthed. It is about 20cm long and carved with realistic representation of body parts. The ventral surface has a small rectangular niche. In older times a holy verse from the Koran would have been placed in the niche and the effigy buried under the house in a mixture of Islamic and pre-Islamic beliefs to bring good fortune.

15. EXPLOITATION

Human exploitation on marine turtles in the Maldives shows a pattern of progressively greater utilisation and predation. When the islands were first colonised turtles may have been taken for local consumption only, and international trade was probably insignificant. In fact, depending on the strength of the religious beliefs at the time – i.e., Hindu and then Buddhist – there may have been no significant killing of turtles for any motive. However, there is simply insufficient information from this early period to know what form of exploitation was prevalent.

Exploitation for local trade and consumption must date back hundreds of years. Turtle eggs have been brought to kith and kin in the capital and also collected for sale between islands. This may once have been an important occupation at islands such as Mulhadhoo (Thiladhunmathi) (Didi, 1983). Fifteen years ago 2,000 to 3,000 eggs were collected annually at Kunfunadhoo (Baa) and sold 6-8 eggs/Rf.

At some point, international trade in hawksbill shell developed, and the Maldives developed international fame as a source. This was the case at least by the time of the Islamic era (i.e., 1153 AD). Local consumption of eggs evidently occurred, but the killing of the turtles was minimal. The interpretation of the Koran left turtle meat as “haraam”, or unclean. Some turtles, mainly *Chelonia mydas*, were killed each year to provide bait for shark fishing and oil for preserving wooden boats.

In the beginning of the 1950's a local religious leader argued that turtle meat is not banned by the Koran. Although this may be the case, most oriental Moslems consume only eggs of sea turtles. The effect of rescinding a previous ban was widespread killing of sea turtles for meat and a small amount for local trade.

In 1972 the tourist industry began in earnest, and nearly twice as many tourists visited in a year, as there was citizens in the capital. A fisherman could suddenly earn the equivalent of a month's income (300 Rf in 1984) with the sale of a single carapace to a tourist. Immature turtles, that had previously been ignored, were caught and prepared in large numbers to sell to tourists – mainly Italian and German. The art of processing or stuffing turtles was evidently learned from Japanese fishermen who were working in the area. There are no figures for this trade, but the numbers of shells and turtles displayed, and the numbers of departing tourists that openly carried objects, was great, as Colton (1977) has described. In a single day in 1977 some 400 turtles were for sale in just shops near the waterfront on Malé. (Colton, in litt.), so the total numbers for sale in just Malé was about 1,000 on that day.

Before 1968 raw tortoise shell was selling for 30-40 Rf/kg, but the competition for thick shell drove the price for better quality products up to 60-70 Rf/kg. By 1970 the central government had begun keeping records of tortoise shell exports; the decade of figures available (Table 8), shows a rapid rise from 1970 to 1974 and then a gradual slowing down and decline. Although this is symptomatic of overexploitation, it is impossible to interpret these figures without knowing the volume of the direct exportation by tourists.

In late 1980 the export of whole turtle shells was banned, and a second regulation banned the catching, sale or display for sale of small shells (less than 60cm for *Eretmochelys,* and 75cm for other species i.e., *Chelonia mydas*; Didi, 1983). These seemed to have reduced direct exportation by tourists, but even in 1984 the vast majority of shells displayed for sale in Malé or in tourist resorts are well below minimum legal size. The average tourist is not about to carry home a turtle shell nearly a meter long – no matter how exotic it seems.

In Maldives, marine turtles are caught most easily while nesting, and on many inhabited islands every turtle that has the misfortune to nest there is likely to be caught. They are also caught in nets; today this involves mainly

accidental capture in shark nets. Turtles in waters less than 10m deep can be hooked with grapnels or caught by free divers. In shallow waters they can be chased with a boat to tire and catch them.

There are no figures available to evaluate the total annual capture of turtle in the Maldives. Export statistics for tortoise-shell give no indication of exploitation on *Chelonia mydas* for local consumption or on turtles or turtle parts sold locally in the tourist trade. Estimates by island chiefs, and other experienced people (Table 9), on turtle capture indicate tremendous variation from one island to another and it is uncertain how realistic these figures are. In several cases, however, the estimated captures equal the estimated nestings.

16. LEGISLATION

Three legislative acts in Maldives have dealt specifically with marine turtles. On 6 February 1978 the Majlis (Parliament) passed Bill No. 24/78 which prohibits the catching of *Eretmochelys imbricata* under two feet (61cm) in carapace length, and all other turtles less than 2½ feet (76cm) in carapace length. This is the only law, which regulates the catching of turtles.

Bill No. 31/79 prohibits the export of any item of *Eretmochelys imbricata* that is in the raw form. Articles manufactured from *E. imbricata* are permitted.

A regulation of the Ministry of Fisheries bans the sale and display for sale of turtles below the size specified in Bill 24/78. This regulation has been in effect since 1980, but is not usually enforced.

In addition, the use of spear guns, spears and explosives was banned in 1970s. This limits the legal ways the turtles can be captured.

17. RESERVES

There are as yet no specific reserves in the Maldives. However, there are several situations, which create areas which function as reserves.

On inhabited islands the Island Chief can set a policy to regulate resource utilisation. The only example relevant to marine turtles is Gaadhoo

(Laamu). Here, the population of several hundred people (~480) has decided that no nesting turtle will be killed, and only eggs will be collected. The eggs are auctioned and the proceeds put toward village needs, e.g., the school or mosque. This arrangement is so well agreed upon that when, on a rare occasion, a male turtle followed a female to the beach and laid quietly at the foot of the beach while she ascended it to nest, the beach patroller at the time was uncertain as to whether stranded males were fair game (the situation being so unusual) and ran to ask the Island Chief what to do. The resolution was probably not in favour of the male, but he had gone back to sea before the patroller returned.

It is known that turtles nest in fair numbers at Gaadhoo and when boats of other islands visit, the residents are careful to inspect them to ensure that no turtles are being poached.

Only the Government can own land, but uninhabited islands are rented to citizens of Maldives (and only Maldivians) for 1 Rf/each coconut tree on the island. The lessee, or his manager, sets the general policy of how the island and its reefs are to be used. Years ago it was usual that lessees would prohibit the killing of Vela on their island(s). This restriction is now unusual, if indeed it exists at all.

Some islands that were formerly uninhabited are now developed as tourist resorts. A few (the minority) cater to serious SCUBA divers and the resorts have built up reputations for the quality of their marine environments. At Rannaalhi, for example, the management has established a steep set of fines (e.g., $100) to discourage the collection of corals and molluscs by tourists. Other established resorts have similar, although less stringent rules.

Twenty three small uninhabited islands have been leased by the Direction of Tourism (at 2 Rf/year for each) to keep them from being developed and maintain some uninhabited islands (Appendix). Mr. Ahmed Zahir, Director General of Tourism, is well informed about the necessity of maintaining reserves, and hopes to develop a more extensive system.

18. DISCUSSION

The relative commonness of *Chelonia mydas* and *Eretmochelys imbricata* and relative rareness of *Dermochelys coriacea* in the Maldives is consistent with the situations at other Indian Ocean islands. *Lepidochelys olivacea* is generally rare away from mainland areas, and that it apparently occurs

regularly in Maldives may be a manifestation of the proximity of major breeding areas on the Indian subcontinent. By the same token, *Caretta caretta*, with the largest population in the world at the north end of the Arabian Sea, should occur in Maldives more regularly than in the norm for other Indian Ocean Islands; but this species is rare in the Archipelago.

The individuals of *C. mydas* that were observed were comparable to those from other Indian Ocean localities. However, the coloration of adult females is more like that of adult males on Aldabra; they are more melanistic than females in the western Indian Ocean. One could speculate that the Maldive turtles may show characteristics intermediate between those in the western Indian Ocean and those in the east Pacific (which are extremely melanistic): *viz* there may be a cline in coloration across the Indo-Pacific.

Marine pastures are evidently few and of relatively small area in Maldives. Possibly they can sustain the numbers of adult *C. mydas* that occur nowadays, but it is unlikely that the Maldivian pastures could feed the much larger populations that are said to have occurred earlier in the 1900s. Like so many other island-breeding population of this species (Meylan, 1982), it is likely that turtles migrate to Maldives from feeding grounds on larger continental platforms: the Gulf of Mannar is relatively close and a likely feeding area for turtles nesting in Maldives. The contention that nesting is more common in the north and east of the Archipelago is consistent with this hypothesis. No tagged animals have been recovered, but given the relatively small numbers of *C. mydas* that have been tagged in the region this is not surprising, and well organised tagging studies are needed to investigate the dispersal and migratory habits. Some people believe that each island in the Maldives has its own population; this would be consistent with what is known of other island populations, and several distinct feeding populations could be breeding in Maldives.

Several migratory habits, involving movements over large distances, have been explained evolutionarily by linking them to continental drift (Carr, and Coleman, 1974). However, it is unknown whether or not the Maldives were formerly closer to India.

The timing of the breeding season on Gaadhoo is apparently completely out of synchrony with that in Sri Lanka, and slightly later than that in Aldabra and elsewhere in the western Indian Ocean. However, much too little is documented precisely about breeding seasons in the Region – particularly

the Maldives. Indeed, various accounts would have it that there are several different breeding seasons in different parts of the Archipelago (this strengthens the idea of more than one population breeding in the Archipelago).

Immature *C. mydas* are frequently displayed for sale, and there does seem to be a regular presence of this life stage. The claim that immatures occur predictably in certain areas indicates that the Maldives is not just a breeding ground, but provides other habitats for *C. mydas* in the region.

Although the data are inadequate, there is little doubt that the Maldivian population of *C. mydas* has undergone a drastic decline in numbers. This pattern has been repeated throughout the Indian Ocean (Frazier, 1980) and is complicated by overexploitation and perturbations on breeding grounds but also on feeding grounds and other requisite habitats, which may be distant and politically separate from the breeding area (Frazier, 1983).

Examples of *Eretmochelys imbricata* that are found in the Maldives are comparable to those from other Indian Ocean localities. However, despite its abundance, the species is poorly studied. There is evidently a resident population, with individuals in most age classes, feeding and living on the vast coral reef systems. Inter-atoll movements are possible: a turtle, apparently of this species, with a metal ring was caught in Baa Atoll in 1975, and in the 1970's *E. imbricata* were being raised, ringed, and released at Villingili, 100km to the south in North Malé Atoll.

The timing of the breeding season is apparently comparable to that in the western Indian Ocean. Data on nesting will be difficult to obtain as this turtle is a dispersed nester that uses the same areas as *C. mydas,* which has concentrated nesting.

With centuries of exploitation for export and now intensified demands from a large tourist community, it is unlikely that the *E. imbricata* population has not been dramatically reduced from former levels. The absence of data makes it impossible to study historic trends or even to estimate present day population size.

If, indeed, *L. olivacea* occur regularly in Maldives this raises the question from where these turtles emanate, for breeding is not known in these islands. Flotillas of turtles, evidently of this species, have been seen at sea moving northward up the coast of eastern India (Silas *et al.*, 1984); the east

Pacific populations of *L. olivacea* seem to occur in large numbers thousands of km from the continent. If the Maldives is within the range of normal oceanic distribution of *L. olivacea*, this warrants further study. If immatures of these turtles occur predictably in certain areas within lagoons and feed on plant materials, there are several more aspects of their basic biology that could be illuminated for the first time in this Archipelago.

19. RECOMMENDATIONS

Because less than 20 islands, from five atolls, were surveyed, it is not possible to determine which are the best turtle islands in the Maldives, but with the little information available there is no doubt that sea turtles were much more common 30 years ago than they are today. Both the Government and private citizens are interested in managing the turtle populations as natural renewable resources, and there are certain steps that must be taken immediately, before the possibilities of success are very much reduced.

ACTIONS

1. Solicit information about turtles from island and atoll chiefs as well as turtle fishermen – a questionnaire was prepared in March 84 by JGF for this purpose.
2. Survey the islands known as "best turtle islands" to establish the actual status of the populations.
3. Create sanctuaries or protected areas where turtles are (or were) found most abundant – notably nesting and feeding areas. Along with protecting nesting and feeding habitats for turtles it would be possible to protect the few small islands that remain with vestiges of the original vegetation. These islands have "Loss" *(Pisonia grandis)* forests and often populations of nesting sea birds. Hurasdhoo (Ari) is an excellent example, and there are said to be other Loss islands: in a northern atoll. At Olhugiri (Baa), and in Suvadiva atoll in the south. The small, uninhabited atolls of Wattaru and Kaashidhoo should be included in a sanctuary system.
4. Completely stop the killing of all nesting females for the next 15 years.
5. Establish closed and open seasons for collecting turtle eggs and fix the quantity of eggs that can be collected from each island.
6. Keep accurate records of all turtle products exploited, i.e., numbers of turtles and turtle eggs taken with at least date and locality.

7. Prohibit, or at least carefully monitor, the sale of turtles and turtle eggs in Malé.
8. Establish serious sanctions for:
   a) tourist resorts and curio shops that keep shells for display or sale e.g., by cancelling licences or stiff fines;
   b) anyone catching or killing protected turtles or eggs; and
   c) make island leases dependent on co-operation with the management schemes. Establish a system with rewards and punishments to encourage the support of a sea turtle recovery programme. The rewards can be assistance to buy new boats, or special credits for the acquisition of engines or other desired goods. Also the public approval of the local leaders will be of significant importance.
9. Prepare and distribute a pamphlet for all arriving tourists explaining the necessity of protecting sea turtles – the largest wild vertebrate to be found regularly in the islands, and informing them about the punishment applicable to transgressors of the laws and regulations in Maldives as well as in Europe.
10. Translate into Dhivehi the Sea turtle colouring book and other children's books, adapting it to local necessities, and distributing them to Maldivian school children.
11. Organise a network system with the island and atoll chiefs to implement the programme.
12. Utilise the money collected from fines to pay rewards and turtle management programmes.
13. Begin pilot projects to investigate the potential of ranching hawksbill to supply tortoise shell for a cottage craft industry.

JUSTIFICATIONS

1. Because the country is composed of more than 1,200 islands distributed in 21 atolls, soliciting information from local people will facilitate the location of important turtle areas.
2. To establish rational management for this natural renewable resource it is necessary to know what has to be managed.
3. The creation of protected areas, if properly established and managed, will speed the recovery of the populations and decrease the time until turtles can again be utilised, under a rational plan.
4. This measure, a complete ban on killing females, will be very unpopular, but if exploitation pressure continues at the present rate the future can only be devastation of turtle stocks. It is relevant to point out

that several responsible, knowledgeable people have, in conversations, requested that the ban be instated.

5. Turtle eggs are an important protein source in the islands away from Malé; however, egg collection is so intense that hatching recruitment is virtually eliminated on the few islands where concentrated nesting still occurs. The prohibition of selling eggs will stop the widespread collection of them, keeping the collection only for personal consumption. After studies it will be possible to establish which seasons have the highest hatching success, and it will be possible to allow the trade in periods when the success is relatively low and there is no major recruitment for the turtle populations.
6. The only way to manage a resource over the long run is by having accurate detailed records of exploitation.
7. Because of the biggest human population and most economical power is in the capital, it essentially functions as a colonial power over the outlying islands, exploiting their natural resources. This measure, the control or monitoring of turtle products, will be easily implemented by controlling their arrival in the harbour and the fish market at Malé.
8. Written laws have little value if they are not followed and not enforced. If there is no intention to enforce a law it best not to expend the effort getting it passed and set a precedent of un-enforced laws.
9. It is very important that tourists know that the Maldives is trying to manage its sea turtle populations, by rehabilitating decimated stocks, and the tourists can help – or at least not interfere – with the programme. West Germans, an important percentage of the Maldivian visitors, will generally be very respectful if they are informed about the conservation programme.
10. To create a real awareness about the status of natural resources for the future, it is important to educate the future citizens of the country.
11. The political organisation of the country outside Malé concentrates in the atoll and island chiefs; serious crime is not common in the Maldives, and the co-operation of chiefs will make it possible to control the situation in every island and atoll.
12. If a resource has been destroyed money will not replace it, but money will help development programmes for rehabilitation and recovery.
13. The issue of turtle ranching and farming is very emotional and there are few precedents for success. There is potential for a ranching project in Maldives, and a ***small*** pilot project is needed to test the situation.

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APPENDIX

Islands leased by the Direction of Tourism:

- Huragadu (Haiyhuraafalhu)
- Hathikolhu Finolhu
- Raiyfalhu Hura
- Boahuraa
- Kanuhuraa
- Kalhuhura
- Kohdhipparu
- Iruvaa Kaduhura
- Akirifushi
- Oidhuni Finolhu
- Maniyafushi
- Maimagu Finolhu
- Furahani
- Fuhgiri Finolhu
- Feydhoo
- Foojaadi Finolhu
- Dhoonihoali
- Dhefinolhudheytherey Finolhu
- Tholhimaraa Huraa
- Aanugandu Finolhu
- Hikey Finolhu (Galufalhugaionna)
- Kohdhipparu Finolhu
- Vaagali

Table 1. Specimens of *Chelonia mydas* from Maldives

JGF No.	Island (Atoll)	Date	Specimen	Remarks
		1983 December		
4204	Kunfunadhoo (Baa)	28	skull	adult, found on SW beach, collected.
4205	Kunfunadhoo (Baa)	29	femur & scute	on SW beach (probably same animal as JGF 4202), collected.
4208	Kunfunadhoo (Baa)	31	egg shells & embryo	exhumed from nest that emerged night of 30 Dec., collected.
4211	Maadhoo (Baa)	31	egg shells & embryo	exhumed from nest that emerged 30 or 31 December, collected.
		1984 January		
4209	Thulhaadhoo (Baa)	2	shell, head & flippers	remains of adult female, collected (with H. Didi to send on).
4210	Thulhaadhoo (Baa)	2	carapace	adult, scuteless, in the sea, measured.
4213	Baros (North Malé)	8	juvenile	hatched ~ 13 months ago, measured.
4218	Gaadhoo (Laamu)	10	fresh eggs	sample of 10 measured.
4222	Maavah (Laamu)	14	hatchling	20 days old, keep in Chief's well. At Dhanbidhoo.
4223	Maavah (Laamu)	14	hatchling	20 days old, keep in Chief's well. At Dhanbidhoo.
4224	Isdhoo (Laamu)	14	female	adult, caught last night, measured.
4225	Hithadhoo(Laamu)	13	pleural scute	adult (?), collected.
4226	Isdhoo (Laamu)	15	assorted bones	immatures and adults, discarded by islanders, collected.
4227	Hukurueli (Ari)	23	bones	adult, collected (with H. Didi to send on).

Table 2. Measurements and observations of *Chelonia mydas* in Maldives (see Table1 for more data).

		Measurements (mm)							Scalation							1st. White Marg.	Epizoa	Comments
JGF No.	Sex	Carapace Length			Carapace Width		Nt	Plastron	Cp	Head	Plastron							
		Medial		Lateral														
		St	CV	CV	ST	CV		Ln		PO	Im	Ax	In	Pa	Ig			
4209	F	950	1020	1035	720	930		770	N		4/4	3/3		sm			Ch	Black spotted
4210	?		1030															
4213	?		163	164		150	2	132	N	4/4	4/4	2/3 *	1/1 *	3	lg			*pores; 13 months old
4222	?	54							(1)	5/5	5/5	4/3	1/1	sm	lg	5th		20 days old
4223	?	56							N	5/5	4/4	3/3	1/1	sm	lg	4th		20 days old
4224	?F		1015	1020		935	0		N	4/4							B	Black spotted

Abbreviations –

Measurements: Medial (from midline of cervical to posterior-most projection of supracaudal); Lateral (from anterior-most projection of carapace to posterior-most projection of supracaudal); "St" = straight line; "Cv" = over the curve; "Nt" = depth of supracaudal notch.

Scalation: "Cp" = carapace ("N" = normal, "(l)" = carapace normal except 12 pairs of marginals, excluding supracaudals); "Po" = postoculars; "Im" = inframarginals; "Ax" = axillaries; "In" = inguinals; "Pa" = postanal ("sm" = small, "3" = 3mm long); "Ig" = intergular ("lg" = large).

1st. White Marg. = First marginal on which white line begins.

Epizoa: "Ch" = *Chelonibia;* "B" = barnacles.

Table 3. Measurements of sea turtle eggs in Maldives.

JGF No.	N	Diameter* (mm)		Weight	
		min	max	x (sd)	x (sd)
Chelonia mydas					
4208	2	44.4	46.1	45.5 (0.62)	/
4211	10	40.5	43.1	41.7 (0.63)	/
4218**	10	40.8	43.5	42.1 (0.61)	40.6 (0.52)
Total		40.5	46.1	42.2	40.6
Erytmochelys imbricata					
4207	2	34.4	37.8	33.6(1.26)	/

* Three perpendicular diameters were measured for each egg

** One extraordinary egg had a minimum diameter of 38.9mm and weight of 33.0g.

Table 4. Nest spoor and estimates of population size of sea turtles in Maldives.

		NEST PITS					ANNUAL ESTIMATES	
Atoll	Island	+	?	+ and ?	-	All	Nests	FF
Baa	Kunfunadhoo	81	24	105	23	128	420	210
	Eydhafushi	0	0	0	0	0	1	1
	Maadhoo*	64	10	74	5	79	296	148
	Thulhaadhoo	0	0	0	0	0	0	0
	Subtotal	145	34	179	28	207	716	358
N. Malé	Baros	1	0	1	0	1	1	1
	Kuda-ban'dos	0	0	0	0	0	1	1
	Kani	0	0	0	0	0	1	1
	Vilingili*	0	0	0	0	0	2	2
	Malé	0	0	0	0	0	0	0
	Subtotal	1	0	1	0	1	5	5
S. Malé	Rannaalhi	0	0	0	0	0	3	3
Ari	Dhangethi*	0	0	0	0	0	3	3
	Hurasdhoo	0	1	1	0	1	4	2
	Hukuruelhi	1	5	6	1	7	24	12
	Subtotal	1	6	7	1	8	34	20
Laamu	Hithadhoo	0	0	0	0	0	2	1
	Maamendhoo	0	0	0	0	0	0	0
	Gaadhoo+	10	50	60	10	70	240	120
	Dhanbidhoo*	0	0	0	0	0	1	1
	Isdhoo	1	4	5	1	6	20	10
	Subtotal	11	54	65	11	76	263	132
	TOTAL	158	94	252	40	292	1018	515

* = Nest survey not thorough.

+ = numbers approximate, spoor too dense to interpret reliably.

Nest Pits: + = thought to have eggs, ? = uncertain, - = thought not to have eggs.

Annual estimate derived by: nests = 4 x number of + and ? nests (assuming spoor seen is representative of an average 3-month period); FF (number of females) = half of annual nests, assuming each female nests twice in a season.

Where no spoor were seen, the annual estimates are based on interviews with local people.

Table 5. Estimates made by Island Chiefs, and other experienced people, of Vela *(Chelonia mydas)* nesting activity in Maldives, from questionnaires administered in 1984.

Atoll	Island	Years ago*	Numbers Estimated Nesting		Calculated Number Nesting Annually	
			Formerly	Presently	Formerly	Presently
Thiladhunmathi	Mulhadhoo	(50)	150-200/night	1-2/night?	20,000?	400?
Baa	Dhunikolhu	(40)	10-15/night	1/2-3/mo	400	6
	Fares	(40)	10-15/night	1/2-3/mo	400	6
	Kunfunadhoo	(10)	10-15/mo	3-4/mo	150	40
	Maadhoo	(40)	10-15/night?	2/mo	400?	24
	Maarikilu	(40)	10-15/night	1/2-3/mo	400	6
	Miriyandhoo	(40)	10-15/night	1/2-3/mo	400	6
Ari	Dhalgathi			2-3/yr		3
	Hurukuelhi			2/mo		24
South Malé	Rannaalhi			3/yr		3
	Vaagali			2-3/mo		36
Laamu	Dhanbidhoo			1/yr		1
	Fonadhoo			1/6 mo		2
	Gaadhoo	(60)	10/night	<1/night		200
	Gamu			1/yr		1
	Isdhoo	(10)	8/mo	3/mo	96	36
	Kalhaidhoo			1/yr		1
	Mabaidhoo			2/mo		24
	Mundhoo	(10)	1/mo	0		0
	Uvadevfushi			8/yr		8

Where there is some uncertainty about an estimate it is indicated by "?".

Table 6. Specimens of *Eretmochelys imbricata* from Maldives.

JGF No.	Island	Atoll	Date	Specimen	Remarks
			1983		
No	Felidhoo	Vaavu	November	photographs	immature, photographed by H. Didi.
			December		
4206	Kunfunadhoo	Baa	29	mandible	adult(?), found on beach, collected.
4207	Kunfunadhoo	Baa	30	egg shells & embryo	exhumed from nest that emerged 30 Dec., collected.
			January 1984		
4212	Dhigalhi (?)	Baa	4	carapace limbs, stomach contents	immature, collected (with H. Didi to send on).
4214	Baros	North Malé	8	alive	hatched on Baros, 18 months old, measured.
4215	Baros	North Malé	8	alive	hatched on Baros, 18 months old, measured.
4216	Baros	North Malé	8	alive	hatched on Baros, 18 months old, measured.
4217	Baros	North Malé	8	alive	hatched on Baros, 18 months old, measured.
4219	Hithadhoo	Laamu	12	alive	immature from nearby, measured.
4220	Hithadhoo	Laamu	13	alive	immature from nearby, measured, tagged and released.
4221	Dhanbidhoo	Laamu	13	carapace bones	immature, collected.
4232	Vaagali	South Malé	ca 1	scutless carapace	immature, collected by Sigee, measured.

Table 7. Measurements and observations of *Eretmochelys imbricata* in Maldives (see Table 6 for more data).

	Measurements (mm)								Scalation							1st. Dent. Marg.	Comments
JGF No.	Carapace Length				Carapace Width		Nt	Plastron	Cp	Head	Plastron						
	Medial		Lateral														
	St	CV	St	CV	ST	CV		Ln		PO	Im	Ax	In	Pa	Ig		
4212	545	570	550	580	430	490	3.5		N							6th	
4214		227		227		191	6.0	170	N	3/3	4/4	3/4	1/2	abs	1g	6th	
4215		249		249		204	10.0	187	N	3/3	4/4	3/3	1/1	abs	1g	6th	
4216		223		228		194	6.0	168	N	3/3	4/4	4/3	2/2	3	1g	5th	
4217		242		247		209	7.0	188	N	3/3	4/4	3/3	1/1	5	1g	6th	
4219		325		327		312		246	N	3/3	4/4	3/3		8	1g*		* black spots
4220		378		385		333	20.0	281	N		4/4	2/2*	*	5	1g*	5th	* black spots

Abbreviations –

Measurements: Medial (from midline to posterior-most projection of supracaudal); Lateral (from anterior-most projection of carapace tp posterior-most projection of supracaudal); "St" = straight line; "CV" = over the curve; "Nt" = depth of supracaudal notch.

Scalation: "Cp" = carapace ("N" = normal); "Po" = postoculars; "Im" = inframarginals; "Ax" = axillaries; "In" = inguinals; "Pa" = postanal ("abs" = absent, or length in mm); "Ig" = intergular ("lg" = large); "1st. Dent. Marg." = First dentate marginal.

Table 8. Tortoise – shell exported from Maldives (Data from the Ministry of Fisheries)

YEAR	METRIC TONNES	VALUE (Rf)
1970	0.680	22,260
1971	0.270	7,998
1972	0.270	7,350
1973	1.560	41,210
1974	5.580	324,962
1975	4.110	156,863
1976	6.440	542,299
1977	6.030	812,810
1978	1.895	181,237
1979	4.520	347,373
1980	0.040*	
1981	4**	1,195

* worked tortoise-shell together with black coral
** number of "pieces" (i.e., shells or stuffed turtles).

Table 9. Estimates made by Island Chiefs, and other experienced people, of turtle capture in Maldives, from questionnaires administered in 1984.

Atoll	Island	Original Estimates		Calculated Annual Amount	
		Vela *(C. mydas)*	Kahambu *(E. imbricata)*	Vela	Kahambu
Baa	Eydhafushi	<6-40/boat/mo	6-40/boat/mo 8/boat/mo	180-1200	180-1200 240
	Thulhaadhoo	2-4/boat/day (10-12/boat/mo)		100-120	
Ari	Dhangethi	2-3/yr?	2-3/yr	3	3
	Hurukuelhi	2/mo		24	
Laamu	Dhanbidhoo	1/yr?	1/yr?	1	1
	Fonadhoo	1/mo	1/mo	12	12
	Gaadhoo	0	0	0	0
	Gamu	0	0	0	0
	Isdhoo	3/mo*	30/yr	36	30
	Kalhaidhoo	2/yr	5/yr	2	5
	Maavah	6/mo?	6/mo?	72	72
	Maabaidhoo	0	0	0	0
	Mundhoo	0	0	0	0

* Two were caught in the first two weeks of January, one sold in Malé for Rf200 (1US$ = 7Rf)

STATUS OF SEA TURTLES IN THE MALDIVES

Hussein Zahir

1. INTRODUCTION

The Maldivian archipelago forms the central and largest part of Laccadive-Chagos ridge, which extends southwards from the Indian sub-continent to the centre of the Indian Ocean. The Maldives extends along 73°E longitude from approximately 8°N to 1°S (Fig. 1). The Maldives consists entirely of atolls and associated coral structures. Its territorial area is considerable (roughly 90,000km^2), but only a relatively small proportion of the total area (less than 300km^2) is dry land. There are approximately 1200 islands of which 199 are inhabited. A further 87 have been developed as tourist resorts in recent years, and many others have at least some more-or-less permanent inhabitants (mainly agricultural workers).

The tropical climate, together with the numerous healthy reefs with ample food supply make the Maldivian waters an ideal environment for sea turtles. Of the eight species of sea turtles, five are known to occur in the Maldives. They are:

Green turtle (*Chelonia mydas*);
Hawksbill turtle (*Eretmochelys imbricata*);
Olive Ridley turtle *(Lepidochelys olivacea*);
Loggerhead turtle *(Caretta caretta)* and
Leatherback turtle *(Dermochelys coriacea).*

2. STATUS AND DISTRIBUTION

2.1. HISTORY

Relatively little is known about the history of sea turtle exploitation in the Maldives. However, it is clear from the writings of the Arab travellers of Al-Idrisee in the 12th century, and Ibn Battuta in the 14th, that the islands have been an important source of "tortoise shell" for centuries. In reviewing the history of sea turtles in the western Indian Ocean, Frazier (1975) noted how little was recorded from the Maldives, despite its long history as an important supplier of turtle shells.

Chun (1903) visited the Maldives in 1899 and made the first biological record of marine turtles in the Maldives. The inhabitants of Kanduhulhudhoo in Huvadhoo Atoll were able to secure "about 30" green turtle specimens for him in a single night.

Gardiner (1903, 1906) visited the Maldives in 1899-1900. He noted that Hawksbill turtles *(Eretmochelys imbricata)* were common around the Maldives and the Laccadives (Laidlaw 1903). Gardiner (1906) also reported a Leatherback turtle from Addu Atoll.

Deraniyagala (1956) reported on a brief zoological collecting visit to Maldives made in 1932. He recounted that Green turtles *(Chelonia mydas)* were very common. They were not eaten at Malé (the capital) but eaten in some other islands. In a single night six female turtles were netted for him. Hawksbill turtles *(Eretmochelys imbricata)* were considered to be more common in the southern atolls (Deraniyagala 1956). He thought Leatherbacks *(Dermochelys coriacea)* were very rare. A nest, reputedly of a Leatherback turtle was reported from Hulhule Island, but this may have referred to the same event reported by Gardiner in 1906 (Frazier, Salas and Didi, 1984). Deraniyagala (1956) deduced that Loggerhead turtles nested in the Maldives on the basis of egg samples and tracks at two nest sites. However no specimens of this turtle were confirmed from the Maldives until 1981 (Frazier, Salas and Didi, 1984).

Phillips (1958) recorded Hawksbill turtles during his visit to Malé in December 1956. Colton (1977) spent a year in the Maldives and claimed that coral reefs of Maldives are home to Hawksbill, Loggerhead, Green, Olive Ridley and Leatherback turtles. She also claimed that these species were endangered.

Didi (1983) gave an account of Mulhadhoo island, famous for large numbers of nesting turtles half a century earlier. He also described the past developments and the decline of turtle populations in the Maldives. Didi (1993) subsequently reviewed much of the available information on turtles in Maldives in Maldivian language.

The first (and to date, only) review of turtle status in the Maldives was carried out in 1983 (Frazier, Salas and Didi, 1984). That review confirmed that the Green and Hawksbill turtles occur throughout the Maldives, and breed regularly. Nevertheless, populations of both species were much depleted from half a century before. Frazier *et al.* (1984) also noted that the

Olive Ridley, Leatherback and Loggerhead turtles are, in order of frequency, uncommon to rare.

In 1988, the Ministry of Fisheries, Agriculture and Marine Resources (MOFAMR) started the regular collection of data on turtle capture and nesting. Monthly reports of turtle capture and egg harvesting from various islands are reported to MOFAMR through the island offices in each inhabited island. The accuracy and consistency of these data are sometimes questionable, however, they do give some indication on the level of exploitation of these resources.

2.2. SPECIES ACCOUNTS

2.2.1. GREEN TURTLE (*Chelonia mydas*)

Occurrence
Green turtles (*velaa*) are found throughout the archipelago. Nesting was confirmed from several atolls by Frazier *et al.* (1984). Measurements of adults are of average size for this species in the Indian Ocean (Frazier *et al.*, 1984). Scalation and colouration were also observed to be normal. However, two females were spotted without concentration of pigments in the postero-medial corners of the carapace scutes and without the chestnut-red bull's-eye unlike the colouration that is normal in the Western Indian Ocean (Frazier 1975).

Population structure
Adults as well as immature turtles are found throughout the archipelago. Carapaces of less than 75cm long were commonly offered for sale in the 1970's and 80's (Colton 1977; Frazier *et al.*, 1984). Captive rearing in some island resorts also confirms the occurrence of all size classes.

Limited tagging data would seem to suggest that Maldivian Green Turtles are part of a wider Arabian Sea or Indian Ocean stock. A Green turtle tagged in Oman in 1990 was recovered in Maldives in 1992. Also a Green turtle tagged at Vaadhoo Resort in South Malé Atoll (04°7'N 73°27'E) on 9 Oct 1996 was recovered off Kerala, south India on 14 November 1996 (Tokihiko Sakamoto, per. comm.). Carapace length at release was 382mm (420mm tape).

Population size

It is difficult to estimate the population size due to the dispersed nature of nesting beaches. The islands are relatively small, scattered and isolated, making them difficult to monitor. There are very scanty data relevant to nesting in the country. Nesting spoors observed indicated several hundred turtles nest yearly (Frazier *et al.*, 1984). Turtle statistics compiled by MOFA (1988-1995) provides an annual summary of turtles nesting and caught in the country (Table 1). The data are incomplete, and where Olive Ridleys occur they are likely to be lumped with Green turtles. The available data account for over 11,000 (Green) turtles nesting and 3,000 (Green) turtles caught from 1988-1995. Total numbers are believed to have decreased in recent years (Frazier *et al.*, 1984; Didi, 1993).

Table 1. Reported nesting and exploitation of Green Turtles in the Maldives
Source: Island offices, compiled by EPCS / MOFA

YEAR	NO. NESTED	NO. CAUGHT	NO. OF EGGS EXPLOITED (x 100)
1988	1706	699	2085.34
1989	1379	385	1600.38
1990	1075	425	1132.36
1991	1414	498	1532.37
1992	794	326	806.68
1993	2048	444	2119.84
1994	1576	442	1568.53
1995	1048	118	988.66

Breeding

A number of islands are known for their nesting turtles. Mulhadhoo island in the extreme north was well known for its turtle nesting: hundreds of turtles are reported to have nested each night (Didi 1983). Nesting is evidently restricted to nighttime at present, although in the past it may have occurred in the late afternoon and early morning (Didi 1983). Every atoll is likely to have its turtle nesting islands. Data available on nesting season from Gaadhoo (Laamu Atoll, South Maldives) indicated a peak from June to December and a lull from March to May (Frazier *et al.*, 1984). Nests are made in a narrow coastal strip from the beach crest to 17m inland and 95% of all nests are with in 10m of the beach crest (Frazier *et al.*, 1984).

Available information indicates more nesting in the north and eastern side of the archipelago (Frazier *et al.*, 1984). Evidently there are more reported nesting island in the north than south of the country (Appendix 1). Analysis of incomplete turtle data indicates that in terms of the number of islands used for nesting the north of the archipelago is the most important region (Price 1995). However the numbers of nesting females and egg counts (reproductive activity) are much greater in the south.

Frazier *et al.* (1984) observed at Kunfunadhoo (Baa Atoll) a nest 82 cm deep with the top of the hatched shells at 73 cm. The nest had approximately 110 shells of hatched eggs and 3 un-hatched eggs. They also observed 110 fresh eggs from another nest. Eggs from three clutches were measured. The diameters of the eggs averaged 42.2 mm and the weight of the eggs averaged 40.6 g.

Feeding
Large sea grass pastures are rare in the Maldives. Marine pastures with *Syringodium isoetifolium* and *Thalassia hemprichii* do occur off Thulhaadhoo in Baa Atoll (Frazier and Salas 1984). Small patches of *Thalassia sp*. are common in most island lagoons. However it was not observed as an important feeding area. Green turtles are found close to coral reefs. Evidently coral reefs may act as a source of food for Green turtles in Maldives.

2.2.2. HAWKSBILL TURTLE (*Eretmochelys imbricata*)

Occurrence
Hawksbill turtles occur throughout the Maldives. They were recorded by Gardiner (Laidlaw, 1903; Gardiner 1906) and Deraniyagala (1956). Frazier *et al.*, 1984, found nests and specimens at several islands throughout the country. Recent nesting was confirmed at Vaadhoo in South Malé Atoll (Tokihiko Sakamoto, per. com.).

Population structure
Turtles of all sizes are found throughout the archipelago. Turtles with carapace length less than 60 cm were commonly displayed for sale in the late 1970's. However, such immature turtles are not commonly seen after a ban imposed by the government prohibiting to catch undersized turtles. Scale coloration and other morphological features are all normal for the species in Indian Ocean (Frazier *et al.*, 1984).
Population size

As for *Chelonia mydas*, data available for *Eretmochelys imbricata* are inadequate. Nesting evidently occurs in all atolls. The number of nestings reported was over 18,400 between 1988 and 1995 (EPCS/MOFA, 1996). The number of turtles caught for the same period was over 14,500 (Table 2). Total numbers are believed to have decreased in recent years (Frazier *et al.*, 1984; Didi, 1993).

Table 2. Reported nesting and exploitation of Hawksbill Turtles in the Maldives
Source: Island Offices, compiled by EPCS / MOFA

YEAR	NO. NESTED	NO. CAUGHT	NO. OF EGGS EXPLOITED (X10)
1988	184	2313	2209.3
1989	486	2658	1706
1990	3719	1557	1068.3
1991	695	875	1779.6
1992	487	6383	1400.5
1993	11820	492	1534.2
1994	126	196	1644.9
1995	915	50	1381.9

Breeding
Nesting occurs throughout the archipelago. Nests are made in the same areas as those of *C. mydas*. Nests are concentrated on the narrow stretches of beaches from the beach crest to approximately 10m inland. The majority of the nests are shaded.

Nesting was confirmed by Frazier *et al.*, 1984. Hatchlings emerged from one nest on 30 December. The nest had about 125 hatched egg shells at a depth of 40-50 cm. Diameters of the two unhatched eggs were 34.5 and 37.8 mm.

The analysis of incomplete turtle data indicates more Hawksbill nesting islands in the north than in the south (Table 3 and Appendix 1). However the number of females and egg counts are greater in the south (Price 1995). Nesting beaches may be more suitable (less rocky) in the south.

2.2.3. OLIVE RIDLEY (*Lepidochelys olivacea*)

This species is uncommon in the Maldives, although it is fairly well known to islanders in the north of the Maldives, where it is known as "*va washi*". On local accounts, the colours of these turtles are said to be similar to that of *C.mydas*, although the colours of the scutes are lighter and yellower. In addition, the size is smaller and the overall shape more rounded then that of the Green turtle (Frazier *et al.*, 1984).

No museum specimens of *Lepidichelys olivacea* from Maldives are known to exist. Two specimens of below adult size (about 60cm and 44cm straight carapace length) were photographed by Mr. Hassan Didi (Frazier *et al*., 1984). Another two *L. olivacea* (35cm and 55cm curved carapace length) were caught and released alive during an offshore fishing survey carried out during 1987-88 (Anderson and Waheed, 1990). One was caught on 19 January 1988 at 6° 56'N, 73° 33'E by drifting gillnet, and the other was caught on 15 August 1988 at 1° 47'N, 74° 26'E also by gillnet (R.C.Anderson, pers. comm.). Several other specimens were seen offshore in northern Maldivian waters by Ballance *et al.* (1996).

Table 3. Regional differences in turtle nesting beaches, number of nesting females and number of eggs observed (Data from EPCS of Ministry of Fisheries and Agriculture (MOFA)). Information extracted from Price 1995.

	No. of islands (1994/95)	No. of females (1994)	No. of eggs (1994)
Region 1			
Haa Alifu	15	19	1328
Haa Dhaalu	17	93	11275
Total	32	112	12603
Region 1			
Shaviyani		85	8513
Noonu	19	39	5385
Raa	?	354	45449
Baa	?	288	33598
Lhaviyani	?	10	1243
Total	?	776	94188
Region 3			
Meemu	?	1	382
Faafu	?	13	1236
Dhaalu	?	83	9926
Thaa	?	48	6143
Laamu	7	71	7857
Total	?	216	25544
Region 4			
Gaafu Alifu	8	19	1328
Gaafu Dhaalu	8	510	31400
Gnaviyani	0	0	0
Seenu	0	0	0
Total	16	529	32728

? Data not compiled

Feeding
Eretmochelys imbricata appears to be in omnivorous scavenger and feeds mainly on invertebrates and sponges. Stomach contents observed shows entirely soft bodied sponges and invertebrates (Frazier *et al*., 1984). Divers sometimes see Hawksbills underwater feeding on sponges, particularly underneath coral rocks (R.C.Anderson, pers. comm.). The presence of numerous coral reefs with sponges and other invertebrates must provide extensive feeding grounds for this species.

No nesting has been reported, nor have any gravid females been seen (Frazier *et al.*, 1984). There is no particular season reported for these turtles to be more common. Within the atolls they are seen in the deeper areas of the lagoons where there may be seaweed and sea grasses (Frazier *et al*., 1984). However, within the Maldives as a whole they appear to be commonest offshore (Anderson and Waheed, 1990; Ballance *et al*., 1996). They also appear to be much commoner in the north of Maldives than in the south.

In summary, within the Maldives, Olive Ridleys are not known to nest; are commonest offshore and in the north; and (from the only four specimens measured) are subadults. It seems likely therefore that the Olive Ridleys that do occur in the Maldives may be migrants from the major nesting areas in the northern Indian Ocean such as Orissa and/or Pakistan.

2.2.4. LOGGERHEAD TURTLE (*Caretta caretta*)

This species is very rare in the Maldives. The only local name that has been reported for this turtle in the Maldives is "*varvohori*" (Deraniyagala 1956). It is unlikely that this name is relevant; indeed, it may be a corruption of the name *va washi*, which applies to the Olive Ridley. There is only one confirmed record of the Loggerhead turtle in the Maldives: a female specimen with a carapace length of 76cm, photographed by Hassan Didi in 1981 (Frazier *et al*., 1984). The shape of the head with a slightly protuberant beak, the posterior of the carapace with a prepygal swelling and the 5 pair of pleural scutes all confirmed that this was *C. caretta* (Frazier *et al*., 1984).

No information is available on population structure, population size, breeding or feeding biology in the Maldives.

2.2.5. LEATHERBACK TURTLE (*Dermochelys coriacea*)

This species is rare in Maldives. However, it is recognized locally as a distinct species and is known as "*musimbi.*" The descriptions given by local people who have seen it are distinctive: large size (>1m length) with ridges down the back.

Gardiner (1906) reported a gravid *Dermochelys coriacea* from Addu Atoll. A single Leatherback was caught and released alive during an offshore fishing survey, carried out from 1987-1988 (Anderson and Waheed 1990). It was caught on 27 November 1988 at 5º 34'N 74º 5'E, entangled in a gillnet (R.C.Anderson, pers. comm.). The carapace length was 120cm.

On local accounts, sightings of this turtle are rare. A person of more than 60 years of age who lived on Gaadhoo (Laamu Atoll), one of the best turtle nesting islands, had never seen a *musimbi* (Frazier *et al*., 1984). Each of the few people who have seen this turtle has seen no more than one.

No quantitative data are available for population structure, population size, breeding and feeding biology.

3. EXPLOITATION

Historic accounts of Maldives show that the turtle trade dates back to at least the 12th century. Certainly exploitation for trade and consumption must date back hundreds of years. When the islands were first colonised, turtles may have been taken for local consumption only and international trade was probably insignificant (Frazier *et al*., 1984).

The exploitation of sea turtles and eggs remained minimal during the early part of this century. This related to the belief of religious scholars, preaching that it was illegal to eat turtle meat. As a result turtle meat was not eaten in the country, although local consumption of eggs evidently occurred. Some turtles, mainly green turtles were killed to provide bait for shark fishing and oil for preservation of wooden boats.

The rescinding of the ban in late 1940's caused widespread killing of sea turtles for meat and a small amount for local trade. This increased with the birth of the tourism industry in the early 1970's. A fisherman could earn the

equivalent of a month's income (Rf300 in 1984) with a sale of a single carapace to a tourist (Frazier *et al*., 1984). Immature turtles that had previously been ignored were caught and prepared in large numbers to sell to the tourist market. Japanese fishermen working in the country at that time evidently passed the skill of stuffing turtles.

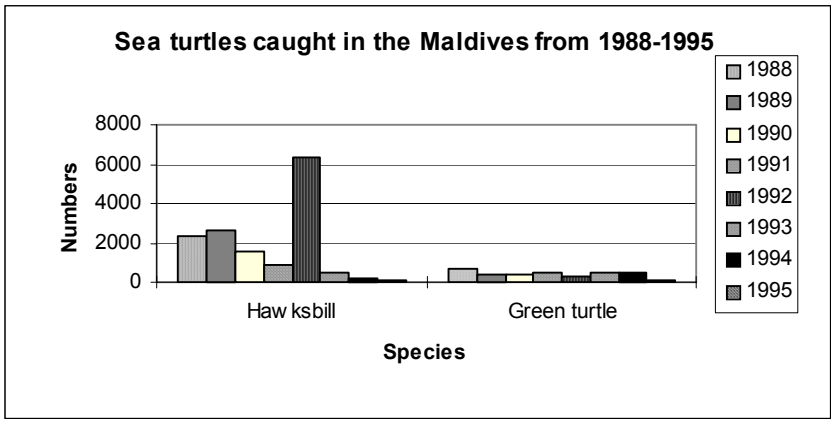
The most common method of capture of sea turtles in the Maldives is while they are nesting. In many islands almost all the turtles that nest there are likely to be caught. They were also caught in nets and by jigging with a leaded hook. In shallow waters they can be chased with a boat to tire them.

The Ministry of Fisheries, Agriculture and Marine Resources has been responsible for compiling turtle data for the country, starting from 1988. There is an overall decrease in the number of turtles being caught from 1988-1995 except for hawksbill turtles for the year 1992 (Fig. 2). The increased catch rate for the hawksbill in 1992 may be due to an increase in demand for turtle shells for that year. Although the trend of captures for both Hawksbill and Green turtles in downward, it is not clear if this is the result of decreasing populations or decreasing demand for turtle products. It is again emphasized that the turtle data are far from complete.

Tortoise shell exports for the year 1979 were estimated at over 4.5 tonnes. Similar figure for the year 1995 (when there was a temporary lifting of the export ban to allow disposal of stocks) was estimated at around 2 metric tonnes (MOFA, 1995). Export statistics for turtle shells give no indication of the scale of exploitation of Green turtles for local consumption or of turtles or turtle parts sold locally in the tourist trade.

Concerned with the level of exploitation of sea turtles in the country the Government of Maldives imposed its first control in 1978, limiting the size of the turtles that can be caught for both commercial use and local consumption. However it does not forbid or state any measures against harvesting of eggs. An inventory of turtle shells that were for sale in Malé in 1979 (after the size limit ban) documented 6500 hawksbill shells and 900 Green turtle shells that were below the size limit. Despite the various efforts by the Government to conserve turtles, there has been few instances of infringement of laws and regulations.

Figure 2. Reported capture of sea turtles in the Maldives
Source: Island offices, compiled by EPCS / MOFA



4. THREATS (MANAGEMENT CONCERNS)

The major threat to turtles in the Maldives is human exploitation. Persistent over-exploitation of adult females and unregulated collection of egg have caused major concern for the status of sea turtles in the Maldives. Populations of both the Green and Hawksbill turtle are believed to have declined in recent decades, although there is little or no data to substantiate this general feeling.

The second major threat to turtles is loss of nesting beaches. Economic developments in the country are resulting in more uninhabited islands being developed as resorts or other industrial purposes, disturbing potential nesting beaches. Lights from the beaches of existing resorts and inhabited islands may cause problems to the hatchlings, disorienting them in their race to the sea. Sand mining on some islands leads to beach erosion, which in turn may lead to building of sea walls, virtually eliminating turtle nesting.

There are no large indigenous predators in the islands. Domestic cats and rats are permanent inhabitants on many islands. There are few predatory birds, but herons and crows inhabit some islands and may be a threat to the hatchlings. Land crabs may also be a concern in some islands.

Solid waste disposal on the shore in some islands is a minor concern. Accidental death by ingesting plastic debris may occur and will undoubtedly increase if waste disposal is not regulated.

Local fishing practices in the country both subsistence and commercial fishery is not a threat to the sea turtles. The major fishery in the country is live bait pole and line fishery. Shark long lining and gillnetting are minority activities. The offshore fishing survey of 1987-88 (Anderson and Waheed, 1990) demonstrated that drift gillnetting was uneconomic in the Maldives, so this fishing method never became established in the country. However, near-shore gillnetting for reef fishes may sometimes cause accidental capture of sea turtles. Furthermore, there existed a turtle fishery where individuals are caught by leaded hooks, especially in the 70s that may have contributed to the decrease in the population of some species.

5. LEGISLATIONS

The Ministry of Fisheries, Agriculture and Marine Resources has statutory responsibility for the rational and sustainable management of all living marine resources within the Exclusive Economic Zone (EEZ) of Maldives.

A number of legislative actions in the Maldives have been undertaken specifically with marine turtle conservation. The parliament passed the first such bill (No. 24/78) on 6 February 1978, prohibiting the capture of Hawksbill turtles under two feet (61cm) in carapace length and other turtles less than two and half (76cm) carapace length. Bill no. 31/79 prohibited the export of any unprocessed product of Hawksbill turtles; the export of processed ornamental jewellery made from tortoiseshell was permitted. In conjunction with the Bill no. 24/78, the then Ministry of Fisheries released a circular (by-law) banning the sale and display of turtles below the size limit specified in the Bill. This regulation became effective from 1 April 1980.

The most recent legislative measure to conserve turtles came into effect from June 1995. Pressures from environmentalists as well as resort operators lead to a Presidential Decree banning the catching or killing of any turtle species from the territorial waters of Maldives for a 10-year period. This decree came into effect under section 10 of Fisheries Law no. 5/87.

Apart from the existing national legislation the Government of the Maldives is signatory to a number of regional and international conventions and agreements. Maldives signed the Convention on Biological Diversity at the Rio Summit in June 1992 and has been ratified later on. At the regional level, Maldives is a member of the South Asian Co-operative Environment Programme (SACEP) an affiliated body of the South Asian Association for Regional Co-operation (SAARC).

Maldives has not yet acceded to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). All the species of marine turtles that are known to occur in the Maldives are on CITES Appendix I, which refers to the most endangered species of CITES convention. The Government should accede the CITES and the Bonn Convention on migratory species in order to meet the objectives of turtle conservation regionally and internationally.

6. MANAGEMENT STRATEGIES

At present there are three major controls on the exploitation of sea turtles in the Maldives:

1. A ten-year ban on the catching or killing of sea turtles in the country, from June 1995.
2. A ban on the importation of turtles and turtle products into the country, starting August 1995.
3. A ban on the sale of turtle and turtle products in the country, starting January 1996.

A total ban on collection of eggs has not been considered as yet. The main reason for this is that turtle eggs have always been used as a traditional food source in the island communities. However work is in progress to identify the most important nesting islands in order to completely ban collection of eggs from these islands.

There are no designated nature reserves in the Maldives. However, there are some areas, which may function as reserves. There are over 70 tourist resorts, mostly in the central Maldives, each occupying an individual island. Each resort manages its own house reef, and most are strongly conservation oriented. It is not permitted by Law, to carryout any kind of fishing near

the house reefs of the resorts. Therefore any residential species that inhabit these areas are effectively protected.

In 1995, fifteen dive sites were designated as marine protected areas in the tourism zone (central Maldives). A further 10 sites declared in 2000 similar to 1995 sites has now totalled 25 sites throughout the country. This has been due to the conflict between the fishery and tourism industry and these sites are exclusively designated for non-extractive tourism use and scientific research except the live bait fishery, a subsidiary for the pole and line fishery in the country. It is believed that these sites would serve as conservational areas and would assist in maintaining the biological diversity in these areas. Furthermore, a Marine Protected Area System Project funded by AusAID and implemented by Ministry of Home Affairs, Housing and Environment is currently ongoing the purpose being establishing model MPAs that are practical for the environmental and socio-economic issues in the Maldives.

There is a need to ensure that existing rules and regulations on the conservation and management of marine resources in the country are more seriously complied. The level of awareness on environmental conservation in the general public need to be increased and has been a priority area of the implementing agencies of such rules and regulations. A number of programmes have been developed that would lead to a more complete understanding of turtles and their conservation requirements. These include:

1. Increasing awareness through the media.
2. Preparation of a booklet.
3. Preparation of posters.
4. Preparation of a logo for the national conservation programme.
5. Lecture series to schools.

Four resort islands and two industrial islands have shown an interest in conservation of sea turtles in those islands. Here, hatchlings from protected nests are nurtured to an appropriate size and then released to wild to aiming to increase their chance of survival. One island resort (Vadoo Diving Paradise in South Malé Atoll) has been actively involved in sea turtle conservation from February 1992. Their research activities include nesting research, blood sampling for DNA studies, blood examination for parasite identification and treatment, and tagging. Captive reared Hawksbills and Green turtles are being tagged and released to track their movements locally

and regionally. 175 turtles (59 Hawksbill and 116 Green) were released during 1994-1996 (T. Sakamoto, pers. comm.).

Few NGOs have been active in the Maldives in marine turtle conservation. BLUEPEACE (an NGO) have been an active voice in the country in turtle conservation and other similar issues from 1990. Increasing awareness among the general public through media is one of their priority areas. Mr. Mohamed Zahir a journalist who writes on environmental as well as conservation issues has been an active campaigner in increasing awareness about the sea turtle exploitation in the Maldives.

7. FURTHER ACTION NEEDED TO CONSERVE MARINE TURTLES

7.1. INSTITUTIONAL ARRANGEMENTS

The Ministry of Fisheries, Agriculture and Marine Resources (MOFAMR) is legally responsible for the conservation of sea turtles in the Maldives. The present level of trained people available in the Marine Research Centre (MRC) of MOFAMR is inadequate to carry out a countrywide conservation and awareness programme. Properly trained staff in biology and management of sea turtles is needed for designing and implementing a conservation strategy.

The recent ban on catching of sea turtles for 10 years does not include collection of turtle eggs and the exploitation of eggs still continues. The Government should consider protection of nesting beaches. A nation-wide ban is not realistic and may upset the public. Establishment of closed and open season for collecting eggs and controlling the quantity of eggs that can be collected from each island would be effective.

7.2. BASIC PROTECTION MEASURES

The traditional pole and line tuna fishery that exists in the Maldives for centuries is not a problem for turtle conservation. Drift nets and gillnet are used minimally only for the local fishery. The Government discourages any type of passive gear for fishing. Therefore, accidental capture of sea turtles in the existing modes of fishing is minimal.

Appropriate fines should be levied for people who are involved in the illegal trade and anyone catching or killing protected turtle species. It is also important to make island leases dependent on co-operation with management schemes. A reward and punishment system to encourage the support of a sea turtle recovery programme can be implemented.

Distributing leaflets to all arriving tourists explaining sea turtle conservation measure in the Maldives can increase public awareness. Billboards can be posted in large public gathering places such as parks and airports. Video spots can also be exhibited on television. Information in local language in the form of leaflets and colouring books can be distributed to schoolchildren.

7.3. HABITAT PROTECTION

Maldives as yet does not have marine reserves as conservation areas except few protected dive sites. It is important to protect the already identified nesting beaches from exploitation. It is important to identify other important nesting and feeding areas and designate them as sanctuaries or protected areas. Such areas will be ideal to study the local population of sea turtles.

Beach erosion and beach developments are a concern for the nesting turtles to find a suitable nest. Implementing the presently formulated regulation on sand mining can mitigate Beach erosion. Coastal development structures such as groyns and breakwaters to protect properties from beach erosion minimize or eliminate the accessibility of gravid turtles to the beaches. Therefore, all developmental projects must be asked to prepare Environmental Impact Statements (EIS). Permission to implement any development projects must be based on the environmental issues concerned and the soundness of the mitigation measures discussed in the EIS.

8. ACKNOWLEDGEMENTS

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PRELIMINARY FINDINGS OF THE SURVEY OF THE NESTING BEACHES IN HAA ALIFU ATOLL, MALDIVES

Hussein Zahir

ABSTRACT

Thirty-seven islands in Haa Alifu Atoll (northern most administrative atoll) were field surveyed to confirm turtle nesting. Twenty-two islands were uninhabited island, where contrasting levels of nesting were observed. Preliminary finding of this survey indicate that some island in the atoll may potentially be an important turtle rookery in the Maldives.

1. INTRODUCTION

Maldives archipelago consists of over 1200 islands and numerous sand cays. Historically, Maldives is infamous for the abundance of sea turtles and their exploitation. Five species of sea turtles have been recorded from the Maldives (Frazier, 1984). Little is known on the extent of turtle nesting in the islands of Maldives High demand for the products of sea turtles especially the Hawksbill (*Erytmocheleys imbricata*) in the 1970's has led to heavy exploitation. As a result regulatory measure such as minimum size limit for harvesting of these resource have been imposed as a management strategy in 1978 (Fisheries Law 24/78). Recently sea turtles in the Maldivian waters have been protected by a presidential decree. It has been declared under this decree that all species of sea turtles are protected for 10 years starting from June 1995.

Frazier in 1984 did a study on the sea turtles of Maldives and did a limited survey of some islands in few atolls. He reports that it was difficult to determine which are the best turtle islands in the Maldives, but with the little information available there is no doubt that sea turtles were much more common 50 years ago than they are today. Recommendations from this report include: Survey the islands known as "best turtle islands" to establish the actual status of the populations and creation of sanctuaries or protected areas where turtles are (or were) found most abundant.

Therefore, the objectives of this study were based on the recommendations from the above study to widen the existing knowledge on the existing

nesting population of sea turtles in the country. As such a nation wide survey to identify the best turtle nesting islands and to set up a management strategy for selected island has also been the objective of this study.

2. METHOD

Field surveys were carried out in the Northern most administrative unit of the Maldives, Haa Alifu Atoll from 10 – 22 February 1999. A total of 37 islands, 22 uninhabited and 15 inhabited islands were visually surveyed for turtle tracks and nesting pits. Recent and old tracks were identified where possible to estimate the population density for each island. In addition to this, estimation of the length of the favourable portion of the beach for the islands was also carried out to assess the conditions and environmental threats to these beaches.

3. FINDINGS

Preliminary analysis of the survey results indicate there is a wide range of differences in nesting preferences. There is no clear pattern indicating that larger islands are more favourable to nesting than small islands. Of the 22 uninhabited islands surveyed only three have nesting spoor in excess of 100. In Mulidhoo the total number of annual nests estimated is 360 with an approximately 1.6km long beach. In Hodaafushi, the annual estimate is 228 with an approximately 4.5km long sandy beach all around the island. The third most favoured island for nesting was Vangaaru with an annual estimate of 112. The length of the accessible beach for nesting was approximately 2km. The annual nesting estimates for each island was calculated by multiplying the sum of the recent and old nests observed in each island by a factor of four (assuming nesting spoors seen as representative of an average three month period). The annual nesting estimates for each island are given in Table 1. The total number of females for the whole atoll was estimated as 700. The number of females presumably nesting on each island was estimated by halving the estimated annual nests, assuming each female nest twice in each season. The total number of inhabited islands in the atoll is 15 and assessment of the beach for nesting in these islands were based on the information provided by the island folks confirming nesting. The island of Mulhadhoo still has a favourable beach for nesting, which was reputed for high levels of nesting in the past. A total of 11 nests were confirmed from this island giving an annual estimate of 44 nests and 22 females.

Beaches or part of the beach in the majority of the island are faced with heavy erosion. Many of the islands in the periphery of the atoll especially the beach to the out side of the atoll consisted of large pebbles and can be categorised as rocky. These islands do not have a wider lagoon to buffer the effect of wave energy. Thus it was considered unlikely that these areas are used for active nesting. Visual surveys for nesting spoor do not reveal any sign of nesting in these parts of the beach

Table 1. Preliminary analysis of the sea turtle nesting beach survey at Haa Alifu Atoll in Feb 1999. Calculations for the annual estimates for nests and females based on the method used by Frazier *et al*, 1984.

Name of Islands	**Beach length**	**Nest pits**			**Annual estimates**	
Uninhabited Islands		**Recent**	**Old**	**All**	**Nests**	**No. of females**
Huvahandhoo	941	7	18	25	100	50
Ungulufinolhu	1550	0	3	3	12	6
Gallandhoo	680	2	9	11	44	22
Maanaafaru	240	5	16	21	84	42
Meedhaafushi	240	6	9	15	60	30
Govvaafushi	160	0	6	6	24	12
Maafinolhu	na	0	6	6	24	12
Velifinolhu	na	1	4	5	20	10
Kudafinolhu	240	3	2	5	20	10
Umarahoiyfinolhu	1540	0	0	0	0	0
Matheerah	280	0	1	1	4	2
Innafinolhu	1956	1	10	11	44	22
Vangaaru	1972	4	24	28	112	56
Madulu	622	1	3	4	16	8
Gaamathikolhudhoo	nd	0	0	0	0	0
Mulidhoo	1680	9	81	90	360	180
Dhonakulhi	3872	5	11	16	64	32
Naridhoo	750	2	5	7	28	14
Beenaafushi	927	0	10	10	40	20
Alidhoo	1195	3	5	8	32	16
Maafahi	2418	2	8	10	40	20
Hondaafushi	4606	11	46	57	228	114
Inhabited islands						
Mulhadhoo		4	7	11	44	22

4. DISCUSSIONS

Based on the findings it was evident that some of the islands in the atoll still have high numbers of nests. However it would be premature to say that these are the best turtle-nesting islands of the Maldives or even to the northern part of the Maldives. This survey is the first island-by-island survey to assess the nesting population of sea turtles in the Maldives. Therefore assessment of the island in other atolls is important to document the best turtle nesting islands in the country. Information from such surveys would be useful in protecting these beaches from egg harvesting.

Currently the Presidential decree for the protection of the sea turtles in the Maldives prohibits, killing, catching and exploitation of any of the five species of turtles found in the Maldivian waters. This total ban on killing of sea turtles became effective in June 1995 and would continue to be so for 10 years starting from that date. However, it has been legal to harvest eggs and the exploitation of eggs in many parts of the country is very much active.

Information collected through island folks during the survey came to the general conclusion that the turtles in the region are increasing since the ban. Awareness among the people was high and the urge for the conservation and management measure taken by the government to increase the turtle population throughout the country. It was noticed by the author that many island folks support the idea of protecting the eggs from harvesting. Many believe the current measure taken to protect the turtles are effective and strongly believe that that protection of the nesting beaches especially from egg harvesting should be an important part of the campaign to revitalise the diminished turtle populations in the country.

Ministry of Fisheries, Agriculture and Marine Resources (MOFAMR) has the mandatory responsibility for the conservation and sustainable management of all living marine resources in the country. The Presidential decree for the protection of all species of Marine turtles in the Maldivian waters, in addition to the 10 year ban on killing also allows MOFAMR in its capacity for the management of marine resources, to identify and designate and protect critically important nesting beaches from egg harvesting. This survey and similar to follow would therefore, be invaluable for identifying important nesting beaches in the country.

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