
MARINE TURTLES IN THE COMORO ARCHIPELAGO

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August 1984

VERHANDELINGEN DER KONINKLIJKE NEDERLANDSE AKADEMIE VAN
WETENSCHAPPEN, AFD. NATUURKUNDE, TWEEDE REEKS, DEEL 84

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North-Holland Publishing Company, Amsterdam, Oxford, New York, 1985

ISBN 0-4448-5629-3

For Jane

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GENERAL INTRODUCTION

Studies in the Comoro Archipelago form part of a larger project to assess the status and distributions of sea turtles in the western Indian Ocean (Frazier, 1975; 1980*b*; 1982; Hughes, 1982), an ambitious venture that still continues (Frazier, in prep.). The Comoro Archipelago has been little studied, and the sea turtles there have been virtually ignored by biologists. None the less, there are relatively large numbers of turtles nesting in these islands, and the adjoining shallow water areas, with some of the richest reefs in the western Indian Ocean, may provide important feeding habitats for many turtles. This report is the first detailed account of marine turtles in the Comores. Based on merely four month's observations, it is but a preliminary statement, but because follow-up studies are likely to be few – there have been none in over a decade – the results are presented in detail to facilitate future comparative studies.

The spellings of place names used in the present work are taken from detailed maps of the Institut Géographique National (France, 1958, 1959). As the language spoken in Comores is akin to swahili, it might best be written with an Arabic alphabet. However, being an ex-French colony, local names are spelled in roman script with french phonetics – far from an ideal system – and there are thus numerous alternative spellings for some words, (e.g., the word for '-island' on French maps varies from 'Chissioua' to 'Chissioi' to 'Zissioua' to 'Sisoa'). In addition, some local place names are used for more than one location: there are three beaches called 'M'Sanga Nyamba' on Mohéli Island. To avoid confusion the serial number is also given when referring to beaches.

The methods used for measuring were simple: beach lengths and widths were estimated by pacing all or part of the supralitoral beach platform. Distance from beach crest to nest pit was measured by pacing inland from the crest and recording nearby nest pits. Eggs, collected during laying or from oviducts of nesting females slaughtered by natives, were weighed with a 100 g Pescola spring balance and measured along three perpendicular diameters with vernier calipers. Usually eggs were measured within 24 hours of oviposition, but under heavy work loads measuring was delayed a day. Hatchling turtles were taken from emerging nests and weighed with the spring balance; vernier calipers

were used for linear measurements. Specimens larger than hatchlings were measured with a flexible tape, over the curve of the shell: curved carapace length (CCL) – the greatest median length from the centre of the cervical to the posterior-most tip of a supracaudal; curved carapace width (CCW) – the greatest width perpendicular to the long axis of the body; plastron length (PL) – the greatest median length, from the anterior-most tip of the intergular to the posterior-most tip of the postanal; head width (HW) – the greatest distance, perpendicular to the long axis of the head, slightly posterior to the two tympana. Names of epidermal scales are as described in Zangerl (1968: 315) with two modifications: the last (posterior) pair of marginals are the ‘supracaudals’; the scale posterior to the anals on the plastron is the ‘postanal’.

Statistical analyses involving large data matrices were performed at the Office of Computer Services, Smithsonian Institution, using Statistical Package for the Social Sciences (SPSS) release 8.0C-2 (Nie et al., 1975). Specific statistical tests that were used, but not available on SPSS, include the t-test for kurtosis (g_2) (Sokal & Rohlf, 1969: 112-118, 137, 171), the G test ‘variation’ of χ^2 (Sokal & Rohlf, 1969: 599), analysis of covariance (Snedecor & Cochran, 1967: 432 ff.), and the t test for comparing two regression coefficients (Bailey, 1964: 97-99).

The four major islands of the Archipelago form a natural unit; they are geographically and geologically close. Certain aspects of this report must, however, treat the Comoro Archipelago in separate parts. There are political, historical, biological, and management reasons for this division. The Federal and Islamic Republic of the Comores forms a political entity, comprising the islands of Grande Comore (or ‘Ngazidia’), Mohéli (or ‘Mwali’), and Anjouan (or ‘Johanna’). With a culture that is mainly Swahili-Arabic, these three islands have, for the most part, had relatively loose ties with France. Anjouan and Grande Comore are steep-sided, geologically young, and provide little nesting or feeding habitat for marine turtles. They are densely populated and have pressing human problems. Mohéli is distinctive with a significant amount of shallow water and a considerable amount of undisturbed beach habitat. It provides food not only for its own population, but also for those on Grande Comore and Anjouan. Within the Republic only Mohéli is of major importance to marine turtles.

The island of Mayotte forms a second political entity; it is a French Department. Historically Mayotte has had longer and closer ties with France, and people of Malagassy ancestry make up much of the population. This island is a marine paradise with immense and complicated barrier, patch, and fringing reefs, making it unlike any other island in the western Indian Ocean.

A separate treatment of these islands is warranted from the biological evidence. Marine turtles have strong philopatry when nesting, especially the Green Turtle, *Chelonia mydas* (L.), one of the two species that is common in the

Comores. From other studies of island systems (e.g., Hendrickson, 1958) interchanges between islands seem to be rare. The Hawksbill, *Eretmochelys imbricata* (L.), the other common turtle occurring in Comores, is apparently sedentary in habits. Hence, the turtles that occur at the various islands could be considered to be distinct populations. After the separate treatments of the populations at each island, comparisons between the islands are made; as most information is available for Mohéli and Mayotte, this discussion is limited mainly to these two islands.

Conservation and management of marine turtles is an international problem, and many studies of the biology of these animals are needed for rational management of their populations. However, management is also a political issue, for each state must legislate and enforce its own laws. Separate discussions of separate sovereign states is often the most appropriate means to make relevant information available to policy makers. Hence, the final section presents separate recommendations for two political entities.

DESCRIPTION OF THE ARCHIPELAGO

Geography

The Comoro Archipelago includes four major islands: Grande Comore (or 'Ngazidia'), Mohéli (or 'Mwali'), Anjouan (or 'Johanna'), and Mayotte. Between 40 and 60 km apart, these islands rise as isolated sea mounts at the northern end of the Mozambique Channel, east of northern Mozambique on the African mainland and west of northern Madagascar. They lie between $11^{\circ} 22'$ and $13^{\circ} 5'$ S and from $43^{\circ} 13'$ to $45^{\circ} 18'$ E (Figure 1), and are flanked to the east by Recif Vailheu and to the west by Banc du Geysier.

The Comores are volcanic in origin, possibly Miocene. Grande Comore, geologically youngest, is dominated by the Kartala Volcano, which had minor eruptions in September/October 1972 and April 1977 (Simkin et al., 1981). It is the largest and highest island, 64 km long by 31 km wide, and covers 950 km² (Figure 2). Kartala rises to 2,361 m. Lava fields and small volcanic cones are conspicuous over the island, notably in the northern half. Grande Comore has a paucity of soil and water; there are no permanent streams. No freshwater lakes exist, but Niamaouy Crater Lake in the extreme north is connected to the sea, and there are several seawater basins on the west coast, south of Iconi vil-

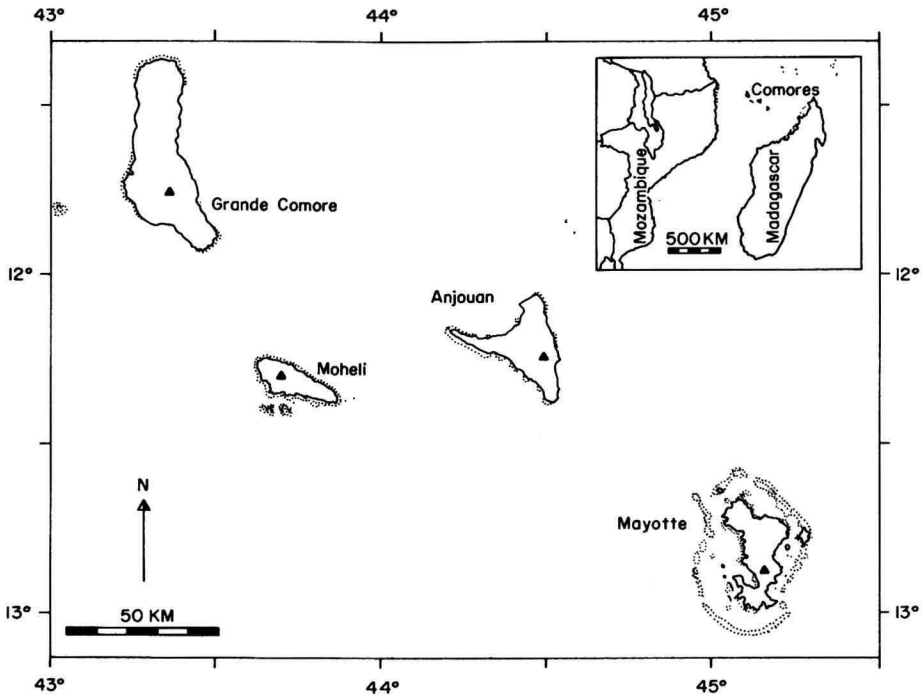


Figure 1 The Comoro Archipelago, showing position in the Mozambique Channel (inset); reefs are indicated by dotted lines, highest point on each island, by a triangle.

lage. The shoulders of Kartala are cloaked in rain forest. Choua-Chandroudé (or Ile aux Tortues) is the only offshore island. It is 300 m off the northwest and about one ha in area.

By contrast, Mohéli Island is smallest and lowest. Only 790 m high, it is 29 km long (northwest to southeast) and 12 km wide, and has an area of 216 km² (Figure 3A). A hogback ridge runs most of the length. There are several permanent streams and ample soil. It is completely vegetated. Much of the lower part is planted in coconut or ylang-ylang (*Cananga odorata* DC.), and the high ground has good forest cover, although in secondary growth. The crater lake Dziani Boundouni is in the southeast. A dozen islands lie off the south and southeast coasts of Mohéli. From east to west they are: Chissioua M'Chaco, C. Gnandza, C. M'Bouzi (east), C. Chikoundou, C. Foro, C. Méa, C. M'Bougo, C. Chandzi, C. Ouénéfou, C. M'Bouzi (south), C. Canzoni, C. Dzaha and C. Magnougni. In the south especially these islands appear as emergent sections of ridges that radiate out from the centre of Mohéli. Chissioua Ouénéfou is longest and highest, over 3 km long and 195 m high. It is also the most important turtle island at Mohéli, and Mohéli is one of the most important turtle islands of the western Indian Ocean.

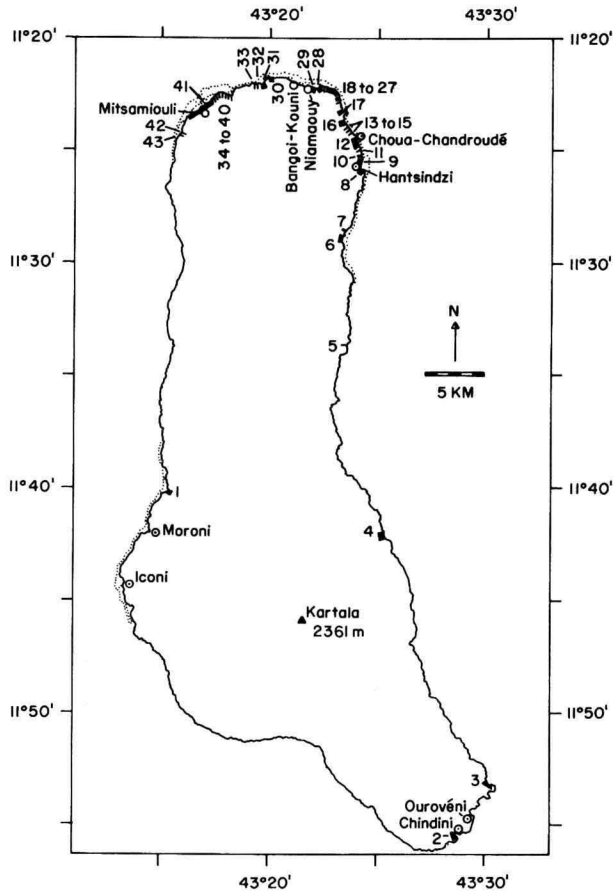


Figure 2 The island of Grande Comore; individual beaches are numbered 1 to 43 (see Table 1 for details); reefs are indicated by dotted lines; Niamaouy crater lake and Choua-Chandroudé island are shown in the northeast; towns mentioned in the text are shown by open circles.

Anjouan is often said to be the most beautiful of the Comoro Islands. Shaped like a triangle, its north-south side is 35 km long, and the east-west dimension is 37 km: the area is 378 km² (Figure 4). N'Tingui, near the centre of the island, rises to 1,595 m. Three major ridges radiate out from this point to the three angles of the triangle. The island has ample soil and is well watered. There are numerous permanent streams and two small crater lakes near the centre. It is completely vegetated, but much of the island is covered in coconut, ylang-ylang, vanilla, cloves and other export crops. Even the steep upper slopes are cultivated. Some rain forest is left in the Forêt de Moya, toward the south. There are

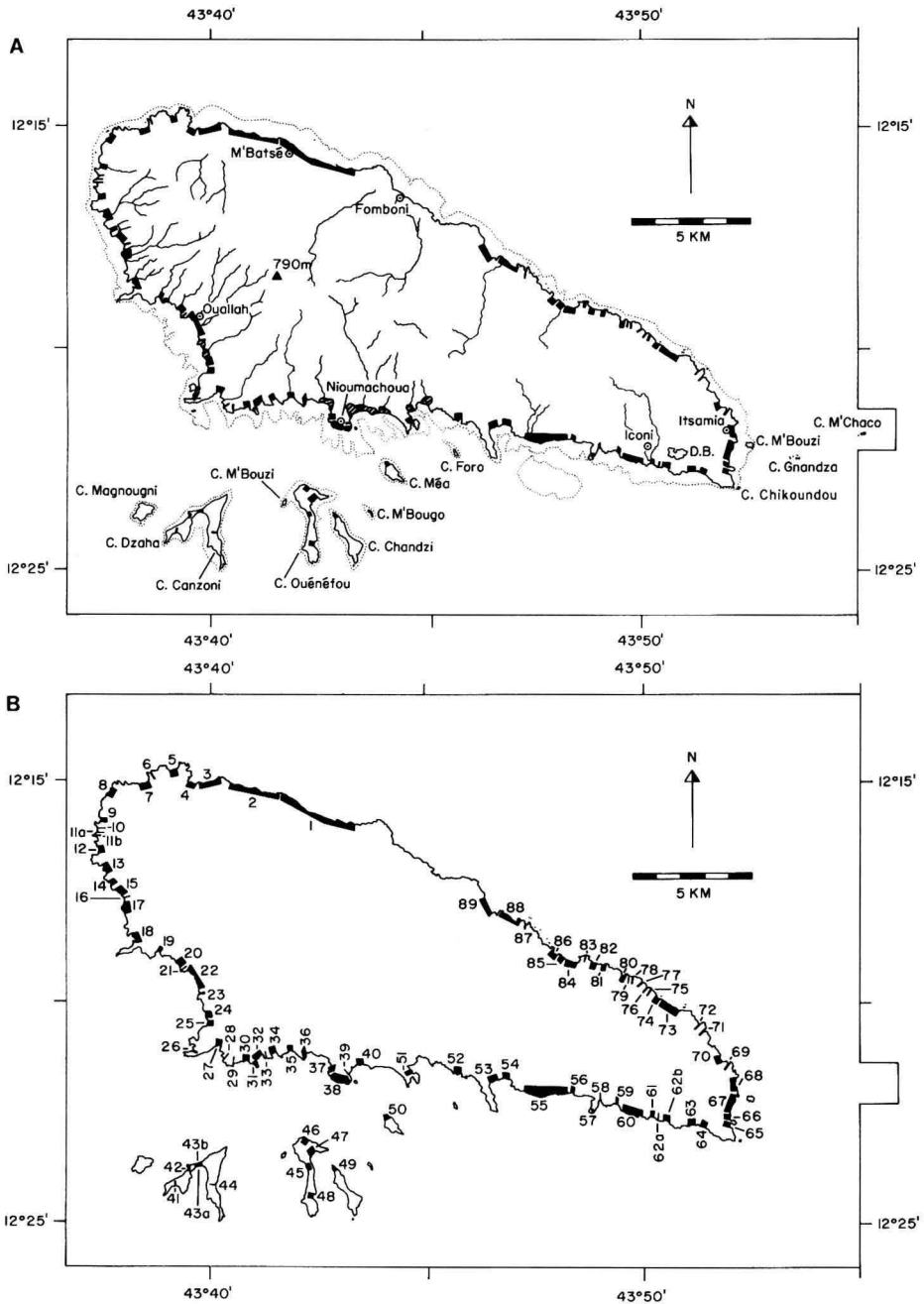


Figure 3 The island of Mohéli (see Table 2 for details). A – Geographic features: permanent streams and high points are shown; reefs are indicated by dotted lines, mangrove woods by hatched areas; Dziani Boundouni crater lake (D.B.) is shown in the southeast; thirteen major offshore islands are labeled; towns mentioned in the text are shown by open circles. B – Individual beaches are numbered 1 to 89.

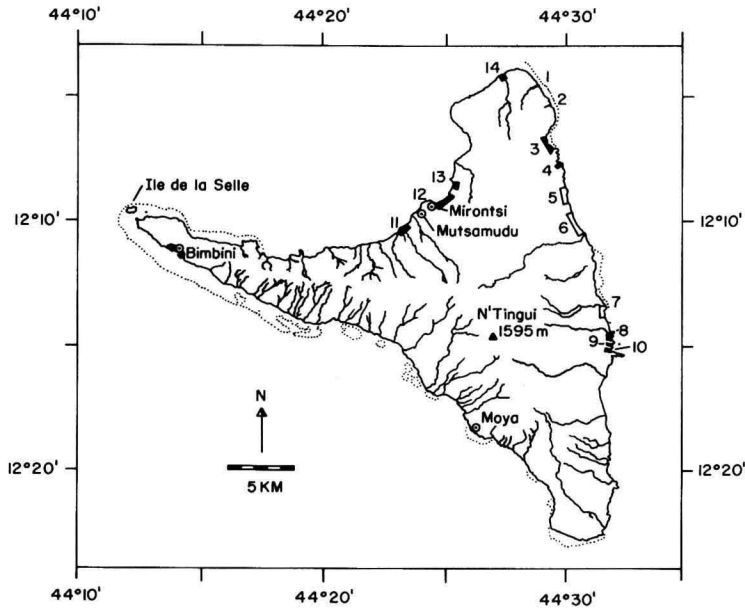


Figure 4 The island of Anjouan; individual beaches are numbered 1 to 14 (see Table 3 for details); permanent streams are shown; reefs are indicated by dashed lines, mangrove woods by hatched areas (near Bimbini); towns mentioned in the text are shown by open circles.

nearly a dozen offshore rocks, but only one significant island. Ile de la Selle, off the western point, is about 0.3 km², and 101 m high.

Mayotte is the eastern-most island of the Comoro Archipelago and the oldest of the four islands (Esson et al., 1970) (Figure 1). Bénara, the highest point, rises to 660 m in the centre of the island, and there are two other peaks, each above 570 m, in the north and south, but generally the terrain is low and rolling. The main island is about 38 km north-south by 20 km east-west; its outline is an undulating complex of bays, peninsulas and headlands (Figure 5A). Some of the bays, such as Moya on Pamanzi Island, are clearly old crater walls, but most of the volcanic rock has decomposed.

The main island is ringed almost entirely by a barrier reef that lies from 2 to 10 km from the shore. In the northeast the barrier reef is nearly 2 km wide. Several sand cays rise from the southeastern and western reefs, and there are half a dozen deep passes in the reef, mainly in the east and north.

Fringing reefs line most of the mainland shore. Between the barrier reef and the main island is a massive lagoon that is dotted with a dozen islands and many patch reefs. Circling Mayotte clockwise starting in the northwest, the major offshore islands (excluding cays and small rocks) include: Chissioi M'Zamboro,

Malandzamiyajou, Malandzamiyatsini, C. Andréma, C. M'Songoma, Gombé-Doumé, Zissioua Ziné, Zissioua M'Tsanga, Dzaoudzi, Pamanzi, Sisoa Bouzi, C. Boué, C. Pouhou, C. Pingoï, C. Bandélé, C. Bambo, M'Sanga Tsoholé, C. M'Bouini, C. Caroni, and C. Sada. Mayotte is well watered, with many temporary and perhaps 20 permanent streams. There is a crater lake on Pamanzi Island in the northeast, 'Dziani Dzaha,' and a fresh water pan in the west of the main island, 'Dziani Caréhani.'

Small forested areas remain, but most of the land is cultivated. Hill rice and other food crops are grown over much of the Island. Coconuts and other export crops such as ylang-ylang and coffee occupy significant areas, but there appears to be less land under these plantations than at the other islands. See Saint-Ours (1957) and Benson (1960: 5 ff.) for more details and France (1958; 1959) for detailed relief maps.

Climate

Islands of this size and altitude induce numerous local effects on the weather. However, generalisations of the coastal situation, are most relevant to this report.

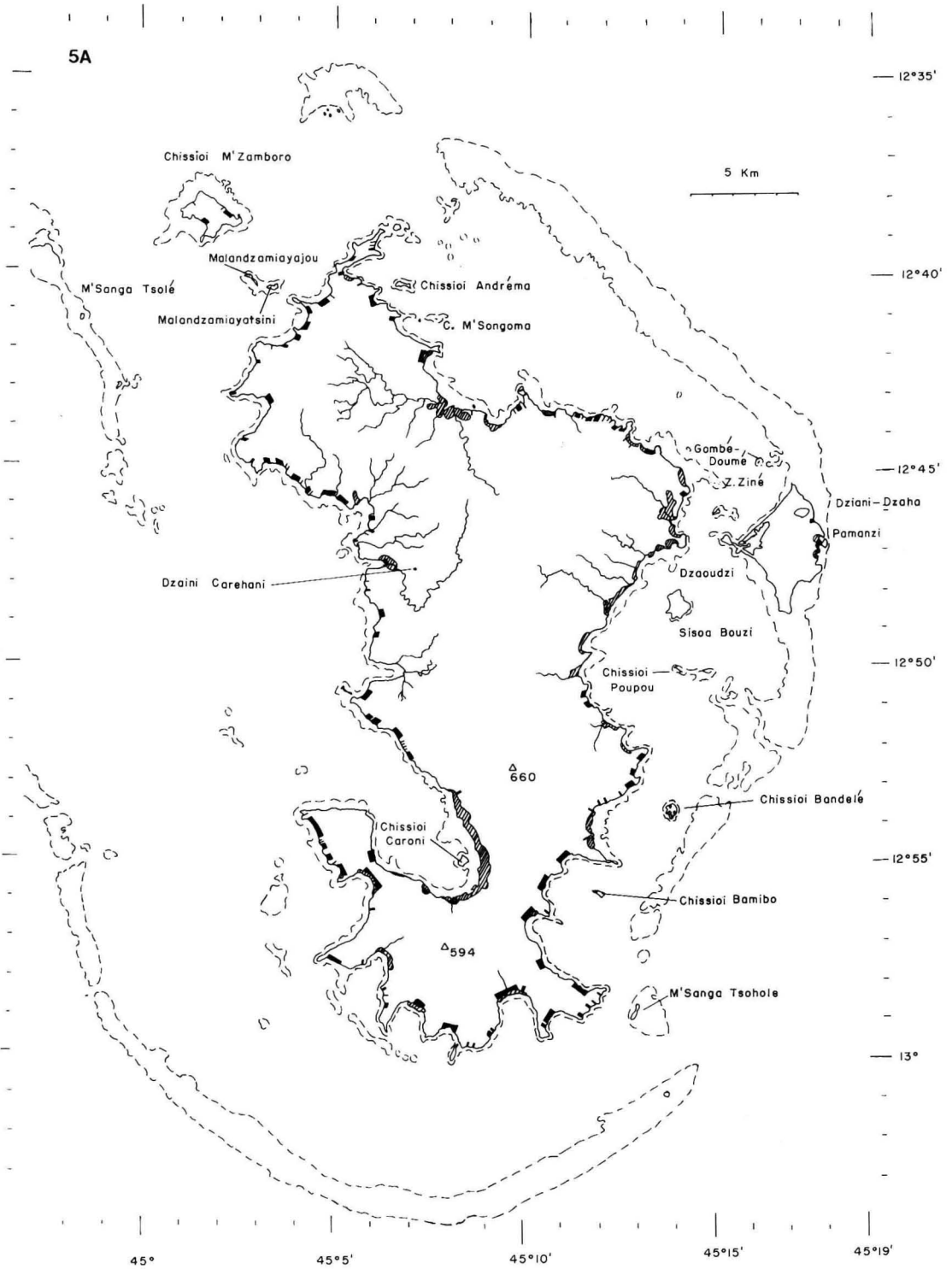
There are three main seasons. 'Kousi,' the Southeast Trades, blow from April to September. 'Niobene,' northerly or variable winds, last through September and November. 'Kaskazi,' or northerly winds, blow from December to March. The Southeast Trades, as is usual, are constant and fairly strong, about 16 km/h. The Comores are not usually on the direct paths of cyclones, but they are commonly subject to the side effects of storms that pass into the northern Mozambique Channel.

Air temperatures are tremendously variable, depending on altitude. Frosts may occur on the top of Kartala, but at sea level temperatures are equable, and there is little diurnal variation. The season of Southeast Trades is coolest, namely May to August.

Rainfall, like temperature, varies tremendously according to altitude. The average annual fall for 25 years at Moroni, Grande Comore, was 2,627 mm. From 1952 to 1957 annual precipitation at Fomboni, Mohéli, varied from 730 to 1,459 mm, while at Nioumachoua, on the southern side of the same island, it varied from 867 to 1,242 mm between 1951 and 1957. The 15 year average at Mutsamudu, Anjouan, was 1,899 mm. Rainfall records at Dzaoudzi indicate

Figure 5 The island of Mayotte (see Table 4 for details). A – Geographic features: permanent streams and high points are indicated, reefs are shown by dashed lines, mangrove forests by hatched areas, and major offshore islands are labeled. B – Individual beaches which were inspected are numbered 1 to 127, those which were not inspected are indicated by letters.

5A

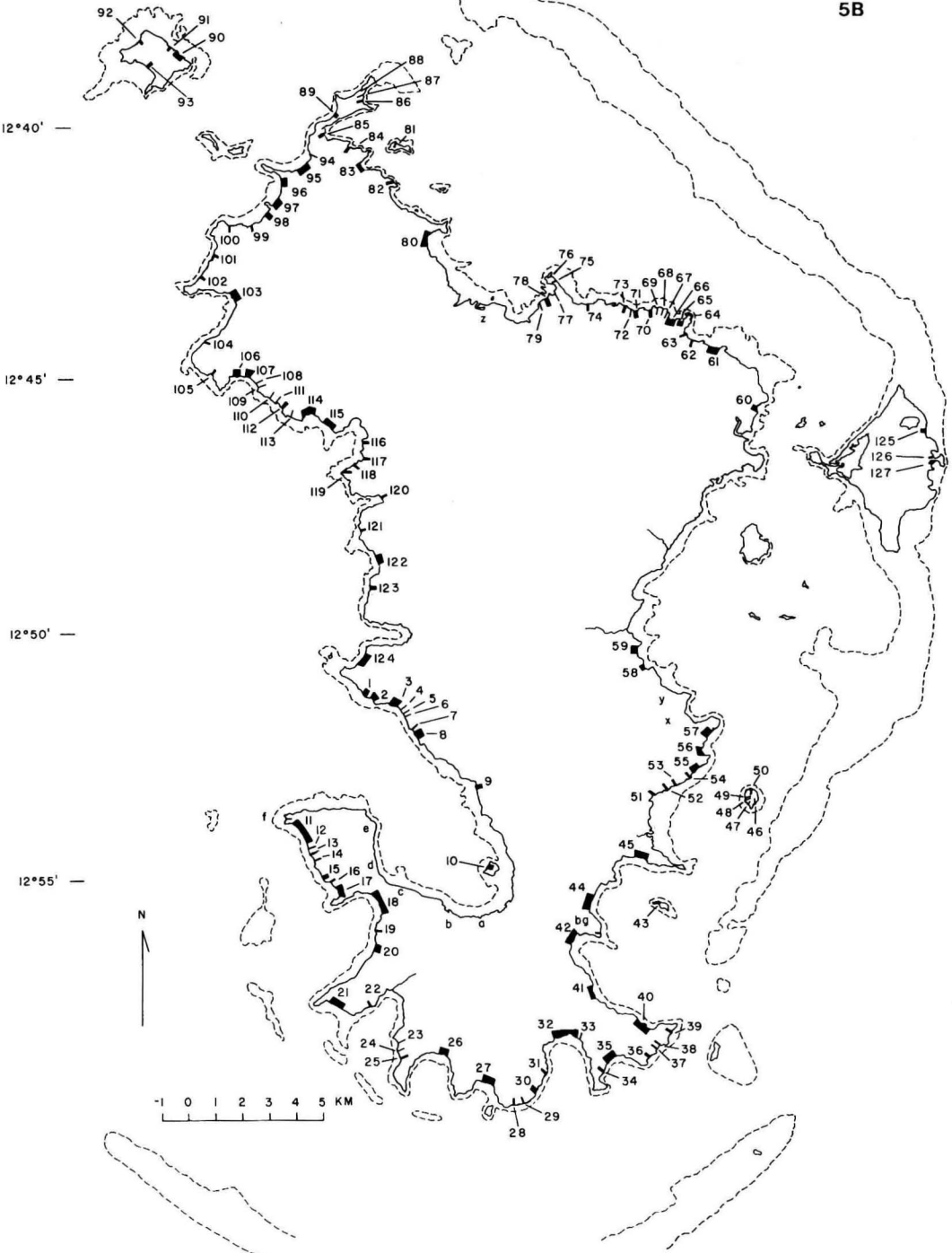


45°5'
12°35' +

45°10'

45°15'

5B



that Mayotte is drier than other islands; the annual average from 1931 to 1955 at this coastal station was 1,094 mm. All of these stations are coastal, just above sea level. On the western slopes of Kartala, the annual total rainfall has reached nearly 8,000 mm. The main rainfall in Comores is from November to April (Benson, 1960: 10, 11).

Oceanography

The South Equatorial Current sweeps by the Comores all year long, but in the Southeast Trades it may reach speeds of 4 knots (= 7.4 km/hr). The main current branches and sends streams south down the Mozambique Channel, both east and west of Comores, first on clearing the northern-most point of Madagascar, and second on meeting the African mainland. There are also north-south components in this main east to west stream, and sometimes they reach greater speeds than the 'main' stream (Knauss and Taft, 1963). A drift bottle released on Aldabra was recovered on Mohéli, a straight line distance of 835 km at nearly 225° (Frazier, in prep.). Mayotte, being east and south of the other islands in the Archipelago, is probably more affected by the south-bound branch of the Equatorial Current than the west-bound branch.

With data from four stations south and east of Comores, Knauss and Taft (1963) concluded that: the main stream reaches its highest speeds at its western end (i.e., approaching the Comores), and also the pressure gradient is greater in the west than in the east – opposite to the situation in other equatorial oceans. They found no evidence of upwelling, spreading of thermo-cline, or vertical mixing, but there must be some local mixing or upwelling effects at the Comores, as the stream collides with the islands. Knauss and Taft (1964) also pointed out that there is no Equatorial Undercurrent in the western part of this ocean.

Hydrographic details of the Mozambique Channel in October and November 1957 are given by Menache (1963). Briefly, he reported that the northern sector had a surface temperature of 29° C and salinity of 35.20 ppt. McGill (1973: 64) reported an average surface temperature of 25° during the period May-June-July, and he summarised other oceanographic work. However, there are relatively few studies from the immediate vicinity of the Comoro Archipelago (see Düing, 1970; Zeitzschel, 1973).

Flora and Fauna

The flora is described in Humbert (1936 – present), and Benson (1960) also gave a valuable summary of the vegetation; quoting from Gachet's (1957) unpublished and partially classified forestry report, he listed the major areas of forest. There were less than 250 km² of forest two decades ago, and now there

must be less. This represents less than 16% of the total land area, some of which is unsuitable for forest (e.g., the lava flows of Grande Comore).

On Mayotte, for example, Benson (1960: 16) reported 'a few tattered relics of primary evergreen forest left'. Evidently, most of the vegetation was cleared for sugar, which is no longer commercially grown, so there is a considerable area of secondary forest. The flora lacks elements of the high altitude mist forest found on the other, steeper islands. Mayotte's many protected bays harbour large mangrove woods. The largest of these, in the Baie de Bouéni, stretches over 6 km of shore line and is more than 1/2 km deep in places. There are small and scattered mangrove woods on Mohéli.

Some beaches are colonized by typical strand plants, pan-tropical or Indo-Pacific in distribution, while others are backed by dense forests and have little if any strand vegetation. In general it is the first vegetation type which occurs on beaches most important to nesting turtles.

The fauna is not well studied, with the exception of the birds. Benson (1960; 1961) treated the avifauna of the Archipelago in detail, and Forbes-Watson (1969) added further information. Blanc (1971) discussed the reptiles, and Tattersall (1977) reported on the lemurs. Milne-Edwards and Oustalet (1888) described both mammals and birds.

The marine biota is also poorly studied. Fourmanoir (1956) investigated fishes, and Polunin (1974), Crown of Thorns Starfish, *Acanthaster planci* (L). Guilcher et al. (1965) studied the coral reefs at Mayotte, and an excellent description of the marine environment of this island is given by Hentig (1973).

Most renowned of all the Comorian animals is the Coelacanth, *Latimeria chalumnae* Smith, (Smith, 1957). Recent international expeditions to Comores have specialized on this so-called 'living fossil.' A general account of both marine and terrestrial fauna is in Prosperi (1957).

Political Status

The early political history of Comores is complex. At one stage Anjouan was the seat of the Sultan and controlled Mohéli. Fighting and factions among the islands, and particularly between the islands and the Sakalava of northwestern Madagascar, lead to Mayotte's appealing to France for protection. Grande Comore, Anjouan and Mohéli all came under French protection in 1886, and they became a colony in 1912. The entire Archipelago was administered as a dependency of Madagascar from 1914 to 1946, and it attained separate status in 1947 (Guy, 1954: 6).

A unilateral declaration of independence (UDI) was made on June 6, 1975, creating the Federal and Islamic Republic of Comores. As before independence, the capital is Moroni, on Grande Comore. During UDI there was disagreement over the status of Mayotte, which has always had closer ties with

France, and a referendum determined that it would remain with France, as a Département d'Outre Mer; its capital is on the island of Dzaoudzi.

Historical Summary

Comores were probably inhabited by Arabs no later than the 11th Century. Bantu slaves from eastern Africa were brought over and much of the present-day population stems from these ancestors. Sakalava raiders from northwestern Madagascar sailed to Mozambique, but also ravaged Comores, especially Mayotte, on numerous occasions. This was one of the major factors in Mayotte's appealing to France for protection and the consequent establishment of the islands as a French colony.

Until independence in 1975, land was owned primarily by French plantation concerns, and the economy was based mainly on the export of copra, essences for perfume manufacture (ylang-ylang especially), and spices (mostly vanilla and cloves). The more accessible lowland areas were usually under export crops while the steeper mountain slopes were subjected to slash and burn cultivation by the subsistence farmers. French plantations were smaller on Mayotte than on the other islands.

A population census in 1966 yielded estimates of 124,210 for Grande Comore, 10,845 for Mohéli and 91,650 for Anjouan (France, 1966). The calculated human densities per km² were thus: 131 – Grande Comore, 50 – Mohéli, and 242 – Anjouan. The population has grown, probably between 3 and 5% per annum, in the last decade, and clearly the Comores are one of the most densely inhabited areas in the western Indian Ocean. Hence, it is of little surprise that emigration has been considerable, and there are sizeable enclaves, virtually colonies, of Comorians in Madagascar and East Africa (Guy, 1954: 5; Thompson & Adloff, 1965: 270). Useful accounts of the history are in Bulpin (1958); Faurec (1961); Manicacci (1939); Toussaint (1966); and Vienne (1900).

Ethnographic Features

At present, there is little evidence of a sophisticated 'turtle culture' in the Comores. However, Petit (1930: 233) described the use of remora sucker fish at Moroni to catch turtles. This involves a complicated procedure and a highly developed technique, which indicates that at one time there was a turtle culture. On Mayotte many people are excellent sailors, and they have more seaworthy vessels than on the other islands. However, most of the natives are subsistence farmers, who fish only secondarily.

With the exception of the Creole and French expatriates, who were relatively few in number before independence and are even fewer now, the population is Moslem. Hence, there are food restrictions, but these are not standard over

the islands. Some people claim that turtles (and other sea foods, except fish) are unclean and cannot be eaten; some even go so far as to say that turtles, just as dogs, cannot be touched (but this is most likely to be from personal superstition rather than strict religious doctrine). Other followers of Islam eat turtle readily. Those of Malagasy ancestry have few food restrictions and tend to be less inhibited than other Comorians. On Mohéli it is said that immigrants from Anjouan eat turtles and those from Grande Comore do not; although there are exceptions, this is a reasonable generalisation. A major part of the population of Mayotte has a Malagassy ancestry and this gives the people a temperament different from that in the rest of the Archipelago; although they are Moslems, the interpretation of the Faith is not as strict, and there is little fear of eating turtles.

Chelonia mydas is eaten by many Comorians, but *Eretmochelys imbricata* is generally regarded as poisonous, or at least said to cause 'bouton' (pimples or boils) or white patches in the skin. These claims may refer to allergic reactions, or they may be merely superstitions. However, *Eretmochelys* meat is rejected as poisonous in many areas in the western Indian Ocean, but not all turtles of this species are poisonous, for some people do eat them without problems. Two young men on Mayotte claimed that some people prefer the meat of *Eretmochelys* – this is the only place in the Western Indian Ocean where I have heard of this preference. The problem of toxicity needs further study, but on the whole this turtle is not eaten in Comores.

'M'Rouhie' is a rare type of turtle reputed to be so poisonous that even touching it can be fatal. Crows that fed from the carcass of this turtle evidently died, and from this its toxic properties were probably assumed. The animal in question is thought to be *Dermochelys coriacea* (L.), which is occasionally poisonous (see Section on Unidentified Species).

Knowledge or legends of these toxic properties have doubtless contributed to the belief that turtles are unclean. It is probably those people who are least familiar with turtles that are most reluctant to touch or eat them.

The vast majority of the people are subsistence farmers and labourers on plantations. High human densities make food a problem and animal proteins are not readily available – even in fishing villages. The Comorians fish most coastal areas intensely, but they are generally not a seafaring people (except those of Malagasy heritage on Mayotte). Their knowledge of turtles is poor and capture methods are limited essentially to encountering nesting females. Detailed accounts of sociology and ethnography are in Gevrey (1870), Robinseau (1966) and Vienne (1900).

Summary of the Fishery

There is no large commercial fishery in Comores, indeed the extant fishery is insufficient to feed the local population. Despite the density of coastal popu-

lations and commonness of local boats on Mayotte, fish is always in short supply, and most fish is caught for consumption by the family and friends. The demersal fishery is extremely limited, except at Mayotte, because there is so little shallow water. Hand line fishing is common from outrigger canoes; netting is less common, and spearguns have been used almost exclusively by non-Comorians. Traditional poisons are used widely in small intertidal pools. In general, exploitation is intense and the fish populations show this in smaller numbers or mean sizes and greater flight distances from swimmers than would otherwise be expected. There is a small, seasonal, pelagic, nearshore fishery, notably off the north end of Anjouan, and off the south of Mohéli.

Fish are sold where the boats are beached and rarely in markets. On the southern islands off Mohéli, men have seasonal fishing expeditions where the catch is sun-dried for later consumption, or sale. Mohéli seems to have the most fish per capita, but the catch is still insufficient.

Comores are not known as turtle islands, and Fourmanoir (1956) did not mention turtles in his review of the fishery. Yet, Parsons (1962: 51) stated that substantial numbers of *Chelonia* nested here but were much reduced; it is not clear how he obtained this information. Likewise, in his review of *Eretmochelys*, Parsons (1972: 52) mentioned that Comores, along with Madagascar and Nosy Be (= Nosy Bé), exported tortoise-shell, implying that their contribution was significant, but no further information was given.

Chelonia are taken for personal consumption, and on Mayotte they are infrequently marketed. There is a small and irregular trade in *Eretmochelys* scutes. If there has been an organized turtle fishery of significance in Comores, it has almost certainly been for tortoise-shell, and probably it has been of short duration.

Research History

As indicated above, there has been little biological research in Comores, but Benson (1960: 6-8) provided a useful summary of pastwork. There has been only one study of marine turtles in the Comoro Archipelago; this consisted of two periods: three months between 5 January and 7 July 1972 and a month from 21 May to 23 June 1973 (Frazier, 1972; 1975: 171 ff.; 1977).

FEEDING HABITATS

There is a paucity of shallow water in Comores. Grande Comore is particularly lacking, for its marine slopes drop virtually to the sea bed within a few km

of the shore (Figure 2). There are small fringing reefs in the north, northeast, southeast and west, but they cover little more than 60 km of coast, and the majority of these reefs is very depauperate, or even barren, without great variety in life or texture. Sea grass pastures are limited to the northeast, near Choua-Chandroudé, but there seems to be far less than one km².

Mohéli is relatively well endowed with shallow water, particularly in the south, where deep waters may begin more than ten km from the Island (Figure 3A). Fringing reefs encircle the Island, but the most diverse reefs are in the south, notably around the offshore islands. The main marine pastures are also in the south, at Ouallah, Nioumachoua, Iconi and Itsamia, but in total there are probably not more than 5 km².

Anjouan shelves even more steeply than does Grande Comore (Figure 4). There are small fringing reefs on the east coast and in the southwest, but they cover less than 55 km of coast, and generally are not rich. The western point, at Bimbini, evidently has a very complex fringing reef. There seem to be no marine pastures of any consequence.

Mayotte's barrier reef provides a large area of protected water and complicated live reefs (Figure 5). Marine pastures are common both within the lagoon and on the outer edge of the barrier reef. Large pastures of *Thalassodendron ciliatum* (Forsk.) den Hartog were conspicuous in the southwest and northeast close to shore, and at Moya on the outside of the island there is a large pasture in shallow water. *Chelonia* were seen near or over pastures in the northeast, both inside and outside the lagoon, and inside the lagoon in the south and southwest; the animals sighted, except those off Moya, were apparently grazing. Stranded mounds of *Thalassodendron* leaves were present on the northeast shore of the Baie de Bouéni, but in general these were not abundant. The total area of marine pasture at Mayotte may be about 100 km².

The reefs of Mayotte are outstanding and provide a large and varied surface. Barrier, patch and fringing reefs all provide excellent potential feeding habitat for *Eretmochelys*. These turtles were seen in the southeast, southwest, and west over or near reefs.

In general, although Mohéli offers good marine pastures and diverse reefs, and Anjouan evidently has rich (but restricted) reefs, there seems to be little feeding habitat for either *Chelonia* or *Eretmochelys*; Mayotte, however, provides large areas of feeding habitat. The Archipelago appears totally unsuited for *Lepidochelys*, for there are no significant areas characterised by: major fresh water effluent and low salinity, high turbidity, soft bottoms and concentrated populations of prawns (cf. Hughes, 1972: 131). Neritic habitats for *Caretta* would seem to be very limited in area and poor in quality; the molluscs known to constitute a major part of the food of this turtle (cf. Hughes, 1974b: 17) are not known to occur in the Comores in great numbers. Nothing is known of the occurrence or availability of pelagic foods that might be eaten by *Dermochelys* in

the waters around the Comores [see Brongersma (1969) for a detailed discussion of stomach contents of this turtle].

NESTING HABITATS

The coast of Grande Comore is rugged. Along most of its length lava cliffs stand 3 m or more above the sea, and depending on the wind, the surf pounds full force against them. Pocket beaches are common along many stretches of shore, but the vast majority are false beaches, completely covered at high tide (Plates I and II).

There are only 43 beaches on the island, and half of these are short, 100 m or less (Table 1, Figure 2). Almost all beaches are in the north and northeast, but there are several in the southeast. There are evidently only three beaches on the entire west coast. All together the beaches total roughly 10 km. Thirteen beaches, that make up nearly half the total beach length, were examined. Much of the east coast, from Hantsindzi to Ourovéni, was not seen.

The majority of the beaches examined had white coralline sand, reflecting the recent age of the lava; all had strand-line vegetation, characteristic of the Indo-Pacific Region. Very few beaches did not have some form of regular human disturbance. Turtle spoor was seen on only one beach, but reported on three others. More nests were possible on most of the beaches that were examined, but the large human population and intense interference must preclude many turtles from nesting on Grande Comore.

Mohéli's coast has been tempered by time and the sea. It does have frequent cliffs, but they are much less dominant and far less rugged than on Grande Comore. Instead, the island (with its offshore satellites) is generously provided with at least 92 beaches. Eighty-nine beaches were examined, 84 in detail (Table 2; Figure 3B). Mombasa and M'Batsé in the north-west of the Island are the longest beaches, 2 and more than 3 km in length, respectively. There are also many beaches of less than 100 m in length. Beaches are found right round the Island, and also on the offshore islands to the south (Plates III through VI; Figure 1). The total length of beach at Mohéli is 26.3 km. Thirty-six, or 40%, of the beaches, totalling 6.565 km, had turtle nest spoor, and these made up 25% of the total beach length. The eight longest beaches on the Island (800 m or more) made up nearly 40% of the total beach length; all but one were next to villages and certainly turtles would be discouraged from nesting there by disturbance or predation.

White calcareous sand is characteristic of the offshore islands in the south,

while brown, grey and pink terrestrial sands are found on the main island beaches. Almost all beaches are vegetated with typical strand vegetation, and many also have terrestrial scrub forests immediately inland of the strand zone. Mangroves are present at 11 of the beaches, and actually dominate several. Coconut plantations extend right down to the beach in at least 17 localities.

The beaches with the most nesting activity are mainly in the extreme eastern and western ends of the Island, along with those on offshore islands in the south. There is no obvious characteristic that is common to these important nesting beaches other than being relatively undisturbed.

Anjouan, like Grande Comore, is poor in beaches. There are only about 14 beaches, and some of these are cobble and without sand. Ten were examined, seven in detail (Table 3, Figure 4). Only the northern half of the east coast and the northwestern shore were examined. The total length of sandy beach is 6.48 km. Individual beaches range from 15 to 2,100 m long. Most, if not all, of these Anjouan beaches are of terrestrial sands. The steep contours of the Island result in narrow beaches with very limited supralittoral zones.

Ile de la Selle is without beaches as are the other smaller offshore rocks. The few beaches of Anjouan are utilized by an extremely dense human population; the result is that they are greatly disturbed by human activity. Nesting was reported from two beaches, but no first-hand evidence was seen.

At Mayotte a total of 137 beaches were recorded (Table 4, Figure 5B). About 7 km of heavily populated shoreline in the northeast of the Island and the associated islands were not examined at close range, and parts of Pamanzi Island were not checked either. Hence, about a dozen beaches have been omitted from the list. The coast had gentle slopes, and good nesting beaches were all round Mayotte and on offshore satellite islands (Plates VI: Figure 2 and Plate VII); sandy beaches ranged in length from 20 m, e.g., M'Rafeni, to more than 1 km, as at Bouéni and M' Zouazia. Of the 126 beaches whose lengths were estimated, 38% were less than 100 m; only 10% were more than 500 m. Long and short beaches were all round the island, but most of the long beaches were in the southern half. The total length of beach at Mayotte was well over 27 km.

The expanse of sand above the high water mark was narrow, never more than 15 m, and most beach widths were 5 m or less. Hence, although beaches were vegetated by typical strand species, dense forest usually occurred right up to the landward edge and often shaded much of the beach platform. Beaches inside bays are often sheltered by mangrove forests; there were at least 15 mangrove-fronted beaches. The east coast was especially fringed with these intertidal forests. Coconut plantations were behind a third of the beaches, and of all beaches examined, 37% had villages or human habitations. Only 27% had no obvious human disturbance. Sand colour varied from black, of volcanic origin, to brown, grey, pink and finally white, from marine organisms; terrestrial sands are most common.

Nineteen beaches had signs of nesting, but only half of these had more than 10 nests. Most nesting activity was recorded on the east coast of Pamanzi Island and in the southeast, near Passe Saziley Sud. Only this last named had concentrated nesting inside the barrier reef.

SPECIES ACCOUNTS

Two species, *Chelonia mydas* and *Eretmochelys imbricata*, are definitely recorded in Comores, and both nest. A third species is reported, but was never seen during the survey; it is thought to be *Dermochelys coriacea*.

Chelonia mydas (Linnaeus)

Curiously, the Comores have not been known as a Green Turtle area, but they have one of the most important breeding areas in the western Indian Ocean.

Common Names in Use

As Guy (1954: 6) points out, the various island dialects are often very different; this is especially troublesome with plant and animal names. On Grande Comore all turtles are called 'Nyamba' (Gevrey, 1870: 115, records 'Namba'), and the species are rarely differentiated. At Mohéli, species distinctions are made and three names may be applied to *Chelonia*; in order of commonness they are: 'Nyamba', 'Kasa', and 'Dusi'. On Anjouan 'Kasa' (occasionally 'Katsa') and 'Nyamba' are used. All of these names are recorded from the Swahili-speaking coast of eastern Africa, from southern Somalia through Kenya and Tanzania, to northern Mozambique. 'Dusi' is no longer used, but the other names are still in common usage.

The common names used in Mayotte are both Swahili and Malagassy in origin: 'Nyamba,' 'Kasa,' and 'Kaza' are Swahili, and 'Fanu' is Malagassy. These may be used as general names, but they are also applied specifically to *Chelonia*.

French names common throughout the region are: 'Tortue de Mer', 'Tortue Franche', 'Tortue Mangeable', and, infrequently, 'Tortue Verte'. The English name is 'Green Turtle', and less commonly 'Edible Turtle'.

Occurrence

The species occurs and nests throughout the islands. Each of the islands will be dealt with separately as their respective populations are thought to be separate (See Section on Movements and Migrations). At Grande Comore *Chelonia* was seen in the northwest, west and northeast, notably all areas where a significant amount of time was spent; other parts of the Island were not well surveyed. Records date from May to September. The species presumably occurs right round the Island and throughout the year. At Mohéli it is recorded on all sides of the Island, with important breeding concentrations in the east, south and west (Tables 2 & 5). *Chelonia* was documented from February to June, and doubtless occurs the year round. I have no firsthand records from Anjouan, but *Chelonia* is reported from the northwest and the southwest and in the month of June. Probably it occurs round the Island and throughout the year. *Chelonia* is clearly less common at the steeply shelving and densely populated islands of Grande Comore and Anjouan than at Mohéli.

On Mayotte *Chelonia* were seen in the northeast, inside and outside the lagoon, and in the southeast and southwest. Nesting spoor from this species was in these areas and also in the west. A total of 17 beaches had large nests and tracks typical of *Chelonia*, and in nine cases the remains of this species were confirmed on the beach. One other beach had bones of *Chelonia* but no nest spoor (Table 4). There was no direct evidence of these turtles in the north of Mayotte. They are thought to occur all around Mayotte and to be more abundant near marine pastures.

Chelonia and fresh nesting spoor were seen from the 7th of April until 18 June. A nesting female with two sizes of enlarged follicles on 8 June indicated subsequent nestings would have been made at the end of June and in mid-July. This species probably occurs in the protected lagoons at Mayotte throughout the year – possibly there is even a small resident population.

Population Size and Structure

Grand Comore. At the largest island immatures were occasionally captured, and they are said to be commonly netted in the Mitsamiouli area. An animal caught in a net (JFCm 787) measured 40.5 cm curved carapace length (Table 6) and was thought to be representative of the size usually taken there. Perhaps a dozen or so animals of about this size are landed in a year in this area. Immatures doubtless occur and are caught in other localities at Grande Comore, but there are no records. They may well occur throughout the year, but there are no documented dates. The immature population at Grande Comore seems to be small – probably a few hundred.

An adult male (JFCm 862) was found dead opposite Choua-Chandroudé in

the northeast (Table 6). Males were also seen while SCUBA diving off the reefs at Bangoi-Kouni (in the north) and Iconi (in the west) on 24 and 28 May 1973, respectively. No further information is available on the adult male population at Grande Comore, but it would appear to be small, probably not more than a few hundred. Considering the situation at Mohéli (see below), the adult male population is likely to occur seasonally.

No females were handled or even seen at Grande Comore. Nesting was reported by Mr. Pichard at Chindini (in the southeast), and both a nesting and hatchling emergence were reported by Mr. Chevalier from Mitsamiouli (in the northwest), from January and September respectively. Only one record of a nest pit was recorded anywhere in Grande Comore: on the beach south of Choua-Chandroudé (in the northeast) (Table 1). The species seems to nest in several localities, both north and south, but always infrequently. The annual nesting population is unlikely to be more than a dozen animals, and it is likely to occur seasonally.

Mohéli. *Chelonia* were particularly common at Mohéli. Numerous sightings were made in the south, near marine pastures and nesting beaches around the offshore islands (Table 5). One animal, sighted 29 March 1972, was clearly immature. An immature (JFCm 785) was caught by a fisherman at Fomboni on 23 March 1972. Animals of this size are suspected to occur round the Island and throughout the year, but the available information is insufficient to prove this. It is not known how large the immature population is, but Mohéli is more likely to support a population than is Grande Comore, and there are better chances for animals to be resident with the larger areas of shallow water, reefs and marine pastures.

One animal (JFCm 797), thought to be a male, was handled at Mohéli (Table 6). Males in copulation were seen off all the major nesting beaches (except N° 8); and escorts, or accessory males, were frequently recorded near the coupled pairs (Table 5). The preponderance of records from the offshore islands in the south is, at least partly, a bias caused by the great amount of observation time spent in a small boat among the islands. Nevertheless, it is possible that there is actually a concentration of males around the islands, for there are several important nesting beaches here, and copulation is commonly seen off of nesting beaches.

It is notable that no observations of males in copulation were made in June 1972 or June 1973, although nesting activity was intense in these months. The absence of observations of turtles in copula, when large numbers of females are present, indicates that mating behaviour is seasonal (see Booth & Peters, 1972: 809). This may also be taken as evidence that the male population is seasonal in occurrence. There is, however, no way to estimate the size of the male population. The concentrated predation on nesting females (see Section on Human Predation) may result in a preponderance of males. But, the fact that as many

as six escorts may gather at a breeding pair is no proof of a disparate sex ratio. Such concentrations in courting males are documented from a remote population in Australia where females actually outnumbered males (Booth & Peters, 1972: 808).

Twenty-five nesting females were handled, and 34 specimens that had been killed on nesting beaches were handled (Tables 7 and 8). Many of the slaughtered specimens were clearly female, and since the chances of capturing a male on a beach are very small, all specimens are assumed to be female. Furthermore, these two groups are assumed to be mutually exclusive, although there is a chance that a female handled while nesting could have been slaughtered at a later date, even on another beach. Sightings of animals in copulation are reported in Table 5.

The annual female nesting population for Mohéli was estimated from censuses of activity on nesting beaches. Of the 84 beaches that were examined in detail, 30, distributed all around the Island, had clear signs of *Chelonia* nesting. There were questionable signs of *Chelonia* nesting on 3 other beaches, and two others had reports of incidental nesting. Although five other beaches had *Chelonia* bones or slaughters (evidently a male on N° 22), they had no signs of nesting (Table 9). Twenty-four beaches had low nesting activity by *C. mydas*, each estimated to have less than 150 nests annually; three others had low nesting activity, possibly by *C. mydas*, and two had reports of nesting but no direct observation. Six beaches had high nesting activity, each with 450 or more estimated nests per year.

The nesting beaches of lesser importance will be discussed first. These beaches were surveyed once each; four exceptions were each surveyed on two or three different occasions: Sambadjou (N° 24), Tsinavouni (N° 65), no name (N° 66) and Itsamia (N° 68). Beaches 65 and 68 had significant amounts of nesting and were probably used by some of the same females nesting on the nearby and heavily used M'Sanga Nyamba beach (N° 67).

For each beach that was visited once only, the beach platform was checked for nesting spoor, and a tally was made of the nests estimated to have eggs and those without eggs; a third category included nests of uncertain status. The details of this procedure are described in Frazier (1975: 164 ff.).

Because none of these minor beaches had crowded nest pits, it was assumed that the spoor tallied represented roughly a three-month period. It was further assumed that the nesting activity during the period surveyed was representative of an average three-month period in the year. Hence, the annual total was estimated as 4 times the number of nest pits with eggs. If the number uncertain to have eggs was large, it was added to the number of nests with eggs before calculation of the annual estimate. It was further assumed that on average a female nests three times a season, and the annual estimate was rounded to a multiple of three to facilitate calculation of the annual number of females nesting. These

estimates were modified depending on the condition of the beach, particularly the presence of turtle bones and remains, and the state of beach vegetation. It must be emphasized that the values calculated serve only to estimate an order of magnitude, and should be used as only rough 'population estimates'; there simply is insufficient data to provide a greater degree of precision.

The four minor beaches surveyed repetitively showed seasonal increases, as did the six major nesting beaches (see Appendix 1). In these cases figures from the second survey, the time of most activity, were used in the calculation. This raises questions about the assumptions made in estimating, but unfortunately, the data are limited to these imprecise procedures.

In total there were estimated to be more than 1,000 nests annually on 27 beaches with low *Chelonia* nesting activity. Estimates for the six major nesting beaches were derived individually for each beach (see Appendix 1). The total estimate for major beaches was 4,500 nests for the year 1972. Spot checks on all but the most important beach in 1973 showed that there had been some increases and some decreases compared with the same month of the preceding year, but on the whole the numbers nesting did not seem to be greatly altered.

The total for all beaches on Mohéli was 5,550 nests annually. To estimate the annual number of females nesting it was assumed that on average a female nests three times a season. In fact, many populations have females that are thought to nest at least this often (Hendrickson, 1958: 499 ff.; Hirth, 1971: 3: 4; Schulz, 1975: 71), and there is evidence that the Mohéli population is similar (see Section on Breeding Biology). Hence, the population estimate should be a conservative maximum. The estimated annual nesting population at Mohéli is 1,850, or in the order of 2,000.

Anjouan. The situation at this island seems similar to that at Grande Comore. No *Chelonia* were seen here. Mr. Chevalier showed me the carapace of a sub-adult that he shot (with speargun) at Mirontsi, in the north (JFCm 786; Table 6). There is doubtless a small population of immatures at Anjouan.

No adult males were seen or reported, but they probably occur off the reported nesting beach at Moya. The population must be small.

No signs of nesting were seen anywhere along the east coast from Banda M'Tsanga in the north to Bambao halfway down the coast. However, both Comorians and French alike reported nesting on Moya beach, in the southwest. Mr. Chevalier also reported a beaching of a gravid female on Mirontsi beach in the north; this animal's carapace was examined (JFCm 863; Table 6).

The lack of information makes it difficult to estimate population size, but it seems unlikely that there would be more than a few dozen animals nesting annually on Anjouan.

Mayotte. Immature *Chelonia* were seen in the northeast and in the south of Mayotte. They were said to be common in the lagoon. Possibly they are resident at this island, for there is a considerable area of sheltered water.

Male *Chelonia* were seen off of both Saziley and Moya, important nesting areas. They were seen nearly every time I went skin diving at Moya, and although some turtles would flee, many would appear, as if by magic, and show considerable interest in me. The competition for females is evidently intense; five males were seen milling about a single female. However, these observations cannot be taken as evidence for an overabundance of males, for the females may not be as conspicuous (cf. Booth & Peters, 1972: 808). Since nesting females bear the brunt of human predation, one might expect that males are more numerous; however, there is no means of estimating the numbers of immature or male *Chelonia* at Mayotte with the few data available.

Seven females were tagged and released (Table 10), and 43 carcasses were examined, 37 in 1972 (Table 11) and 16 in 1973 (Table 12). All but one carcass were on Moya and Papani nesting beaches of Pamanzi Island. Most of these turtles were clearly females, with short tails and/or eggs; as the chances of catching a male are small, all of these specimens are assumed to be nesting females.

An estimate of the number of nesting females can be made, based on the survey of nesting beaches. Of the 127 beaches examined, 17 had signs of *Chelonia* nesting. Fourteen nesting beaches were visited only once, and they had less evidence of nesting than did the other three beaches that were observed over a period of two weeks. Hence, the groups will be treated separately.

None of the 14 beaches had crowded nests, so the nesting spoor observed was assumed to represent the nesting activity of three months. The calculations were the same as those described above for Mohéli. The total estimate for the 14 beaches is 275 females nesting annually (Table 13). This is considered to be a maximum.

The three beaches on Pamanzi Island were studied in greater detail. Estimates were derived by two methods: calculating changes after a two-month interval, and direct observations and counts over a two-week period. In order to estimate the yearly total, several assumptions were made: that the periods under observation were representative; that none of the females slaughtered during the observation period ever nested during the same period (i.e., that the individuals nesting are distinct from those slaughtered); and that the average female nests three times in a season.

The two Moya beaches were examined on 7 April and two months later on 10 June. The new nest pits that were made and the turtles that were slaughtered during this period were recorded. Three and six females were slaughtered, respectively at Moya North and Moya South, during this two-month period. Over the same time, six and 33 nests were made on these beaches, so the total number of females that might arrive in one year would be 30 and 102, respectively. The total annual estimate for the Moya beaches would thus be 132 (Table 14). No estimate was made for Papani beach.

All three of the Pamanzi beaches were observed from 28 May until 10 June, when I was camping at South Moya. During this two-week period, the numbers of nests and slaughtered animals were recorded (Table 15). The estimated values for one year are comparable to those from the above method, although Moya North had less slaughters and more nests, while Moya South had the converse. However, the estimates for the total numbers of females for these two beaches are almost identical. The total estimate for the three Pamanzi beaches is 287 females in a year.

The total estimate for Mayotte, 275 from minor beaches and 287 from Pamanzi beaches, is 562. Less than 600 female *Chelonia* are estimated to attempt to nest annually at Mayotte.

The number of nesting beaches that are available but unused or little used suggests that Mayotte could support considerably more nesting *Chelonia*. Beaches inside the lagoon may, however, be unacceptable to this species. The Pamanzi beaches, which are the only beaches on Mayotte that face directly onto the open ocean, are heavily used, while larger beaches facing onto the lagoon are little used. There is no way to evaluate the annual estimate, for there are no comparable data. With the intensity of present exploitation on nesting females, it is likely that the population has declined, and some local people claim that this has happened.

Comores. In total, the immature population in the Archipelago would seem to be small, some hundreds probably. However, further studies, especially at Mohéli and Mayotte, may alter this estimate.

The adult male population is likely to be larger than the adult female population, by virtue of the selective predation on nesting females (see Section on Human Predation). However, there is no way of estimating its size.

With a dozen females on Grande Comore, 1,850 on Mohéli, a few dozen on Anjouan, and less than 600 on Mayotte, there would be about 2,500 females nesting annually in the Comores.

Aside from Parson's (1962: 51) comment that the Comoro population has declined, there seems to be no information on population trends of *Chelonia* at these islands. There is every reason to suspect that the numbers have declined because of the increased human populations with their increased effects on nesting habitats and increased predation, but there is no way to document the past situation. The only relevant anecdote applies to the Sambadjou beach on Mohéli. Mr. J. C. Boyer showed me the site of an old house where a man once lived and slaughtered turtles on nearby beaches; there were not enough turtles in this section of Mohéli now to warrant his presence.

Movements and Migrations

The status of immature turtles is a mystery anywhere, and there are no data

from the Comores that will resolve this. In view of the limited areas of shallow water, it is likely that at least some of the immatures at both Grande Comore and Anjouan are migrants, or part of a mobile population that passes by the Comores, and not long term residents of these respective islands. Mohéli, which has a much greater area of shallow water and grazing habitat, may well have its own immature population. Immature *Chelonia* that occur at Mayotte could also be residents.

The movements of adult males are likewise a mystery. It is probable that at least some of the adult males that occur in Comores are migrant. At Grande Comore and Anjouan migration is even more likely, for these two islands have small areas of shallow water and provide little feeding habitat.

The situation with nesting females is little clearer. None of the 24 Mohéli females and none of the 7 Mayotte females tagged while nesting has been recaptured, in Comores or elsewhere. Considering what is known of other, better studied populations, several assumptions can be made. A female is likely to nest several times in one season on the same beach. This has been shown for both mainland and island nesting populations. Sometimes the ability to home on a particular stretch of beach is remarkable and this ability is seen both within a single season and between seasons (Carr & Carr, 1972; Carr, 1975: 552; Carr, Carr & Meylan, 1978: 35-37; Schulz, 1975: 75). Populations that nest on islands are known to be true to a 'home' island. Hendrickson (1958: 497) reported that only 215 of 5,748 records of returning females involved changes, and 125 of these were between islands less than 500 m apart. The Comoro Islands are about 50 km, one from the other, so the chances of such interchange would seem even less.

However, with the amount of human disturbance that exists in the Comores, it is likely that some females may break tradition and leave the home beach. It is known that a female disturbed while nesting may move a considerable distance from her home site (Carr, 1975: 553). In the Comores, the magnitude of these movements may involve simply swimming along the coast to a nearby beach, or even going right round the island to a distant beach. Movements between islands do not seem probable, but there is a record of an internesting movement (caused through disturbance in handling?) of 40 km between Galapagos Islands (Carr, 1975: 553).

At least a sizeable proportion of the nesting population is likely to migrate from nesting to feeding grounds; again this assumption is based on the findings of the other populations, although some western Indian Ocean populations may be relatively sedentary (Frazier, 1981). The most likely areas where Comoro turtles would feed are the west coast of Madagascar and the mainland coasts of Tanzania and Mozambique. It is entirely possible that populations feeding in two or more areas have one common rookery (Carr, 1975: 550).

Morphometrics

Immatures. Only three immature *Chelonia* were handled. One specimen (JFCm 787) was captured by fishermen, presumably using nets, in the Mitsamiouli area of Grande Comore, and purchased and pickled by the owner of the Hotel Maluga about September 1971 (Table 6). A second immature (JFCm 785) was captured by fishermen in the Fomboni area of Mohéli; it was purchased, measured, tagged and released. Both of these animals were just over 40 cm in curved carapace length, and at this size they would appear to be at least two years old (cf. Schmidt, 1916: 22; Frazier, 1971: Figure 4). The immature taken at Anjouan by Mr. Chevalier was over 80 cm long and clearly several years old.

Males. Only two specimens thought to have been males were handled (Table 6). One (JFCm 862) with a long tail, and thus unquestionably male, was 98.5 cm long. Compared with the much better documented, nearby, Aldabra population (Frazier, 1971: Figure 7) this animal was of adult size. A carcass (JFCm 797) found at Ouallah beach, Mohéli, was thought to be that of a male. No sign of tail or pollex claws was seen; but the carapace, relatively short and narrow, was characteristic of a male (Frazier, 1971: 387; see below). In addition, the body cavity contained a large volume of marine plants that had clearly been eaten by the turtle. Females, at least nesting animals, rarely have much food in the stomach (see also Carr, 1975: 552). In comparison with the Aldabra data, this animal is also of adult size. Evidently, the carapace of adult male *Chelonia* in Comores is smaller and relatively narrower than that of adult females, comparable to the situation on nearby Aldabra (Frazier, 1971: 387).

Females. No females from Grande Comore were handled and only one carapace from Anjouan (JFCm 863) was examined (Table 6). There is nothing remarkable about this specimen; its measurements conform with those of the large series of females from Mohéli (Tables 7 and 8). A female said to have nested at Mitsamiouli, Grande Comore in January 1972 was reputed to weigh 200 kg. While this is heavy, it is not outside the known range of weights for the species (Hughes, 1974a: Table 7). However, the weight could well have been estimated and not actually measured.

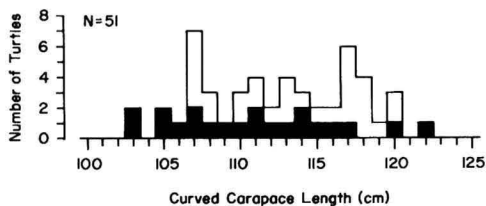


Figure 6 Size-frequency distribution for curved carapace length of *Chelonia mydas* at Mohéli, Comores; sample includes 21 nesting females (black) and 30 specimens found dead on nesting beaches assumed to be nesting females (white)(see Tables 7 and 8).

More specimens were handled at Mohéli than anywhere else in the Comoro Archipelago: 25 nesting females, of which 21 were measured (Table 7) and 34 carcasses, of which 30 were measured (Table 8). The carcasses were all on nesting beaches; about half of these were clearly females with short tails and/or eggs in the body cavity. There seems little reason to doubt that all of these carcasses were females, the chances of a male being captured on a nesting beach are so small. Consequently, Tables 7 and 8 will together be considered to represent females from the population at Mohéli in 1972.

Curved carapace lengths of nesting females range from 102.5 to 122.0 (mean \pm one standard error = 112.322 ± 0.704) (Figure 6). There is no significant difference between the lengths of live and dead specimens ($F_{20,29} = 1.35$, N.S. [not significant]; $t = -1.90$, d.f. = 49, N.S.), but the latter show a bimodal distribution. The peaks are neither an effect of season nor locality, for values falling in both peaks occur throughout the study period and in several localities. Neither the distribution of dead nor live and dead animals shows statistically significant kurtosis (dead: $g_2 = -1.376$; $t = -1.65$; total: $g_2 = -1.059$; $t = -1.61$; see Sokal & Rohlf, 1969: 112-118, 137, 171). Thus, the apparent bimodality can be given little importance; and the distribution will be assumed to be approximately normal.

Curved carapace width varies from 95 to 115 cm (103.141 ± 0.603). There are no significant differences between nesting females and slaughtered specimens ($F_{20,29} = 1.73$, N.S.; $t = 0.22$, d.f. = 49, N.S.), and there is no locality or season effect, but the distribution does not show one distinct mode (Figure 7).

Curved carapace width is positively related to curved carapace length (Figure 8). There is an indication that dead animals were relatively narrower, but in an analysis of covariance (see Snedecor & Cochran, 1967: 432 ff.) there are no significant differences between the regression lines for live and dead specimens:

	<i>linear equations</i>	<i>log log transformation</i>
variance ratio	$F_{28,19} = 1.22$, N.S.	$= 1.25$, N.S.;
slopes	$F_{1,47} = 3.57$, N.S.	$= 3.11$, N.S.;
elevations	$F_{1,48} = 3.10$, N.S.	$= 2.95$, N.S.

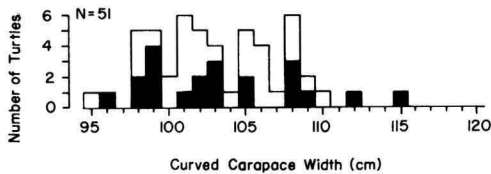


Figure 7 Size-frequency distribution for curved carapace width of *Chelonia mydas* at Mohéli, Comoros; sample includes 21 nesting females (black) and 30 specimens found dead on nesting beaches assumed to be nesting females (white)(see Tables 7 and 8).

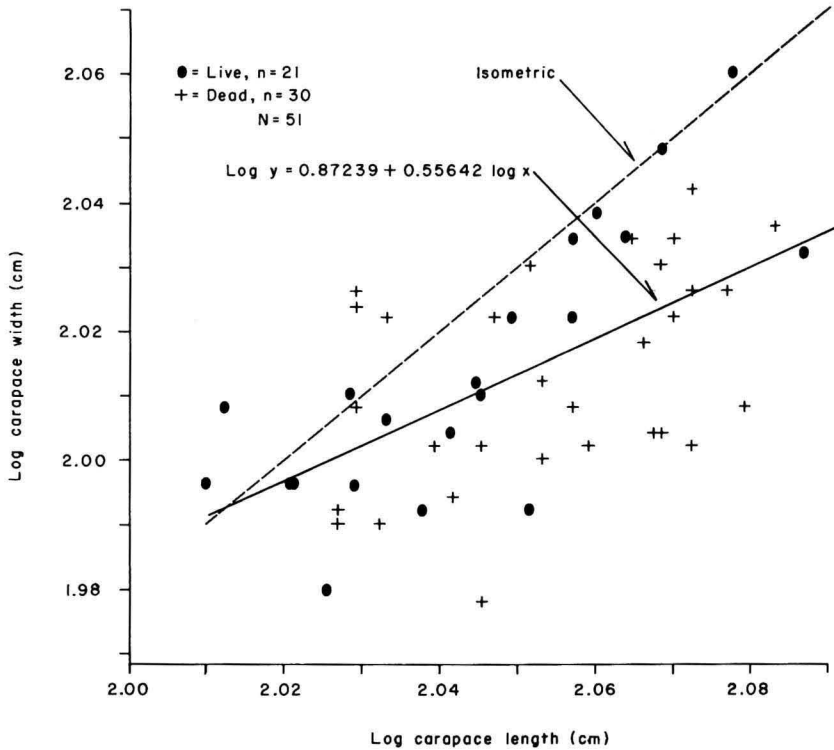


Figure 8 Relationship of log curved carapace width to log curved carapace length in female *Chelonia mydas* at Mohéli, Comores, showing least squares fitted line and theoretical isometric line.

In these adult females, relative curved carapace width decreases with increasing curved carapace length: the slope for the total population of log log transformed data in Figure 8 is 0.55642, considerably less than 1.0, the isometric line ($t = -4.22$, d.f. = 49, $p < 0.001$; for comparison of two regression coefficients, see Bailey, 1964: 97-98). This indicates that the width-length relationship in females is allometric (see Huxley, 1972: ix ff.)*.

* There is apparently not unanimous agreement on the terminology. I here use 'allometry' as Huxley (1972: ix) defined it: 'different rates of growth of parts of the body relative to that of the body as a whole' (italics mine). His use of the term 'heterogonic' (p. 8) is synonymous. 'Isometry' is here used for the condition in which a body part changes in size at the same rate as the body as a whole. This is synonymous with his use of the term 'isogonic'. Huxley treats isogony as a special case of heterogony, but they are used here as mutually exclusive phenomena, which is consistent with the roots of these words: 'allo' or 'hetero' meaning 'other' or 'different' and 'iso' meaning 'equal' or 'same'.

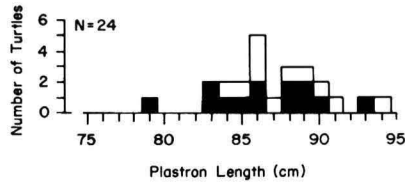


Figure 9 Size-frequency distribution for plastron length of *Chelonia mydas* at Mohéli, Comores; sample includes 13 nesting females (black) and 11 specimens found dead on nesting beaches, assumed to be nesting females (white)(see Tables 7 and 8).

Plastron length measurements are normally distributed with a range from 79 to 94 cm (87.054 ± 0.689) (Figure 9). There is no significant difference between nesting and dead animals ($F_{12,10} = 1.48$, N.S.; $t = -0.96$, d.f. = 22, N.S.). Plastron length is strongly related to carapace length (Figure 10), and an analysis of covariance shows no significant difference in the regression lines for live and dead animals:

	<i>linear equations</i>	<i>log log transformation</i>
variance ratio	$F_{9,11} = 1.54$, N.S.	$= 1.49$, N.S.;
slopes	$F_{1,20} = 2.65$, N.S.	$= 2.73$, N.S.;
elevations	$F_{1,21} = -0.00$, N.S.	$= 0.01$, N.S.

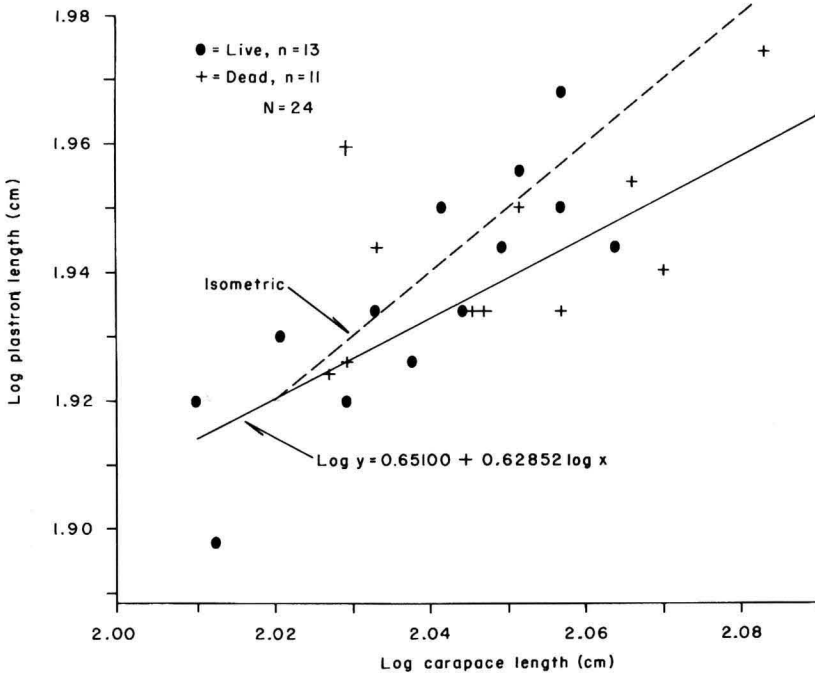


Figure 10 Relationship of log plastron length to log curved carapace length in female *Chelonia mydas* at Mohéli, Comores, showing least squares fitted line and theoretical isometric line.

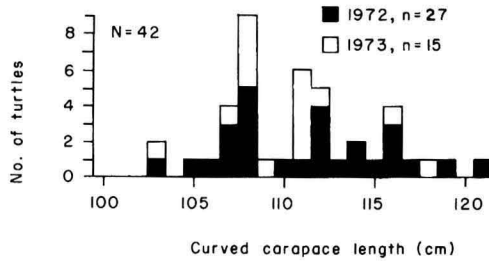


Figure 11 Size-frequency distribution for curved carapace length of female *Chelonia mydas* at Mayotte, Comores; sample includes 27 from 1972 (black) and 15 from 1973 (white) (see also Tables 10, 11 & 12).

Relative plastron length shows the same trend as does relative carapace width: it decreases with increasing carapace length. The slope of the predictive line for log log transformed data is 0.62852, significantly less than that of the isometric line ($t = -2.92$, d.f. = 22, $p < 0.01$). This indicates an allometric reduction in plastron length.

At Mayotte, with few exceptions, only nesting females from beaches on Pampanzi Island were available for study (Tables 10, 11 & 12). Seven females were examined and released, and 43 carcasses were measured: 37 in 1972 and 16 in 1973. In most cases these specimens were known to be females by their short tails or the presence of eggs; as the chances of capturing a male on a nesting beach are small, all the carcasses from nesting beaches are assumed to be females.

Curved carapace length varied from 102.5 cm to 121.0 cm, averaging 110.76 (± 0.648) (Figure 11). The major mode is at 108 cm, but there are two other modes at 111 and 116 cm. There is no significant difference between the animals from 1972 and those from 1973 ($F_{14,26} = 1.56$, N.S.; $t = 0.99$, d.f. = 40, N.S.). The kurtosis from the multiple modes is not statistically significant ($g_2 = -0.280$; $t = -0.39$).

Curved carapace width varies from 93.5 cm to 114.0 cm, averaging 101.50 (± 0.724) (Figure 12). The mode is at 102 and central to the distribution. There

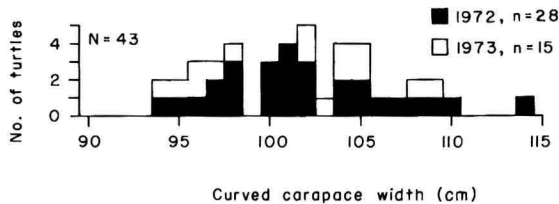


Figure 12 Size-frequency distribution for curved carapace width of female *Chelonia mydas* at Mayotte, Comores; sample includes 28 from 1972 (black) and 15 from 1973 (white) (see also Tables 10, 11 & 12).

is no significant difference between 1972 and 1973 ($F_{14,27} = 1.00$, N.S.; $t = 0.57$, d.f. = 41, N.S.).

Curved carapace width is strongly related to curved carapace length (for the log log transformed data: $r = 0.69283$, d.f. = 40, $p < 0.001$) (Figure 13). An analysis of covariance shows no significant difference in the regression lines for specimens from 1972 and 1973:

	<i>linear equations</i>	<i>log log transformation</i>
slopes	$F_{1,38} = 0.188$, N.S.	$= 0.300$, N.S.;
elevations	$F_{1,39} = 0.000$, N.S.	$= -0.010$, N.S.

The slope of the fitted line for the log log transformed data (0.85335) is not significantly less than 1, the isometric line ($t = 1.04$, d.f. = 40, $p < 0.1$).

Plastron length varies from 79.0 to 92.5 cm (86.281 ± 1.006) (Figure 14). The mode is central at 86.0. All 16 measurements are from 1972, so there is no way to investigate this parameter in the 1973 population.

Length of the plastron is strongly related to the length of the carapace (for

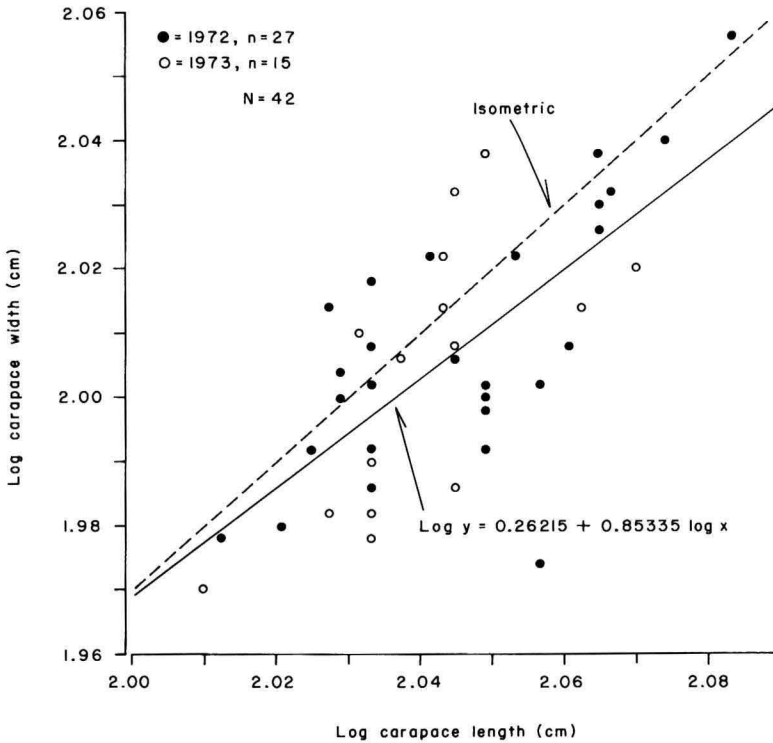


Figure 13 Relationship between log curved carapace width and log curved carapace length in female *Chelonia mydas* at Mayotte, Comores; showing least squares fitted line and theoretical isometric line.

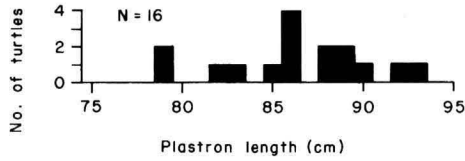


Figure 14 Size-frequency distribution for plastron length of female *Chelonia mydas* at Mayotte, Comores; all from 1972 (see also Tables 10, 11 & 12).

log log transformed data: $r = 0.67010$, $d.f. = 14$, $p < 0.01$ (Figure 15). This relationship is not significantly different from isometry ($t = -0.91$, $d.f. = 14$, $p > 0.1$).

Although Mohéli females on average had longer and wider carapaces and longer plastrons than did the Mayotte females, there are no significant differences between the measurements of the two groups (Table 16). The inter-relationships between these body measurements for turtles from the two islands are also similar. For the plot of carapace width on carapace length, using log log

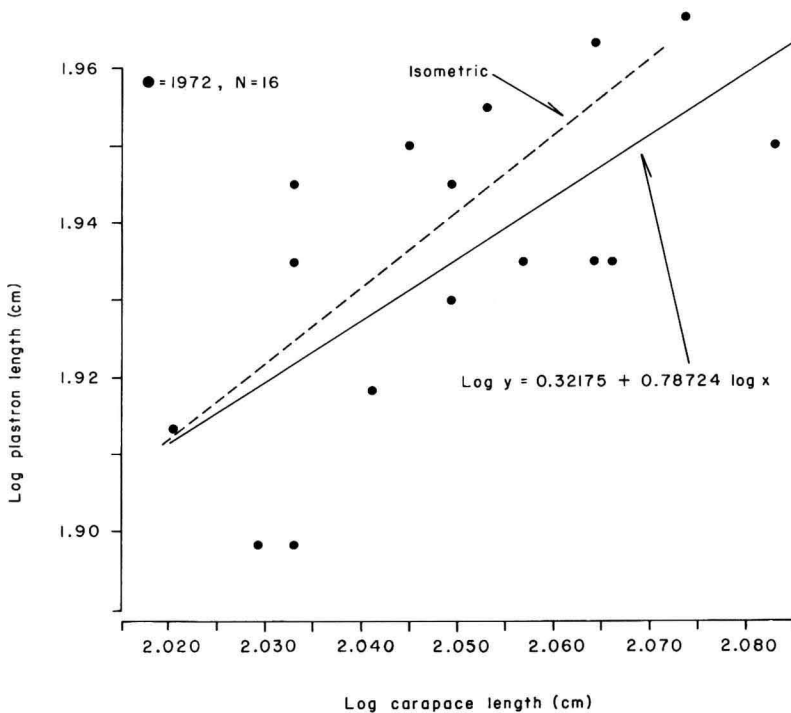


Figure 15 Relationship between log plastron length and log curved carapace length in female *Chelonia mydas* at Mayotte, Comores; showing least squares fitted line and theoretical isometric line.

transformed data (Figure 16), the analysis of covariance shows no significant difference:

variance ratio	$F_{40,50} = 1.03, p > 0.05;$
slopes	$F_{1,90} = 2.78, p > 0.05;$
elevations	$F_{1,91} = 0.57, p > 0.05.$

Likewise, the plot of plastron length on carapace length, for log transformed data (Figure 17), shows that values from the two islands are totally intermingled. The analysis of covariance yields no significant differences:

variance ratio	$F_{14,22} = 1.74, p > 0.05;$
slopes	$F_{1,36} = 0.19, p > 0.05;$
elevations	$F_{1,37} = 3.70, p > 0.05.$

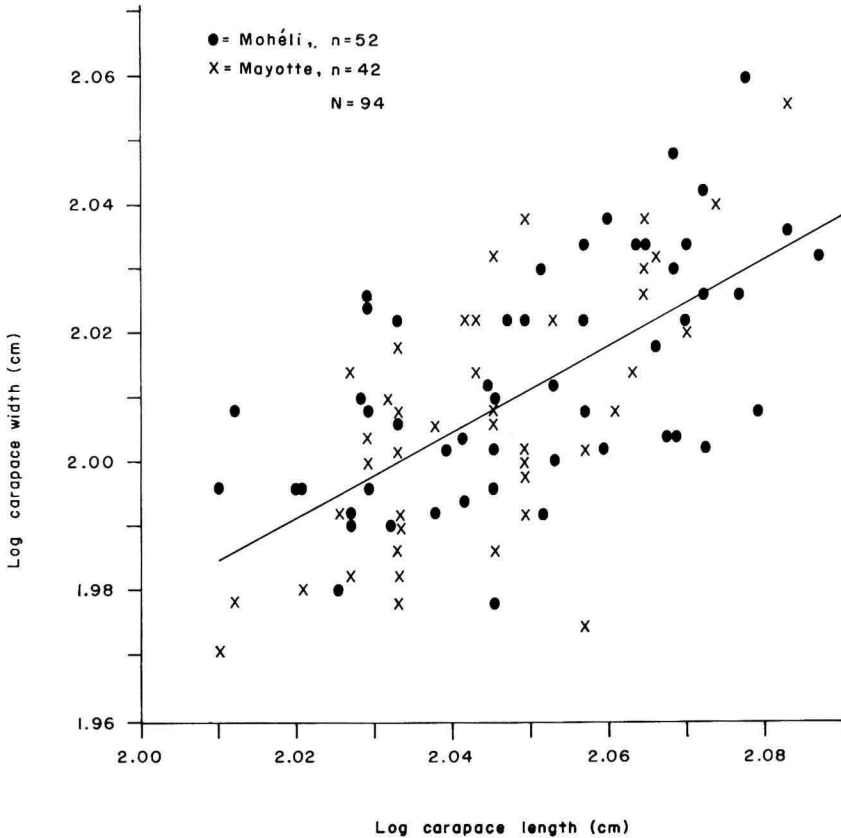


Figure 16. Relationship between log curved carapace width and log curved carapace length in female *Chelonia mydas* at Mohéli and Mayotte islands, Comores; showing least squares fitted line.

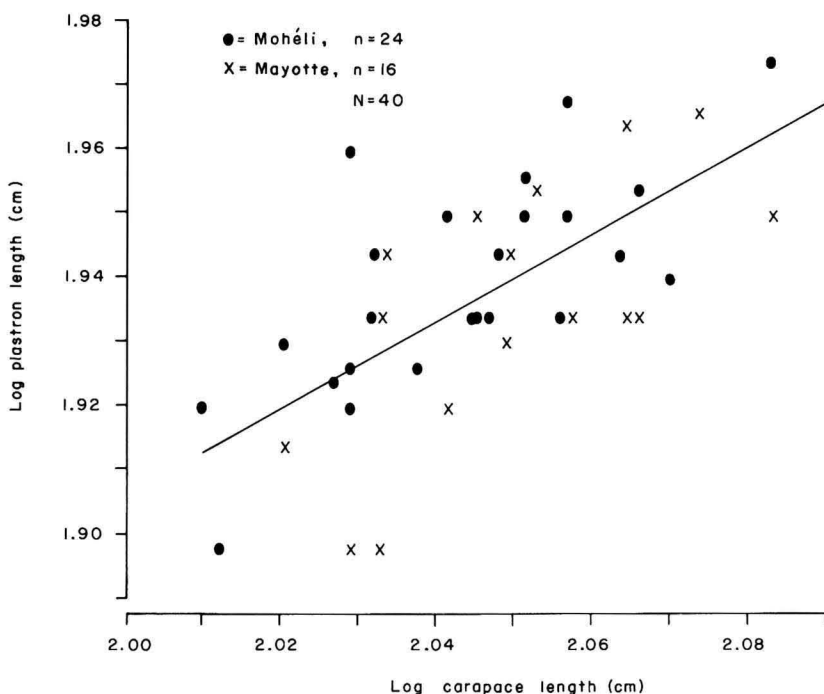


Figure 17 Relationship between log plastron length and log curved carapace length in female *Chelonia mydas* at Mohéli and Mayotte islands, Comores; showing least squares fitted line.

On morphometric grounds, the Mohéli and Mayotte females appear indistinguishable.

Hatchlings. Turtles were caught while emerging from nests, and samples from five clutches, distributed over three beaches on Mohéli, were measured (Table 17). Only hatchlings from Clutch 2 were weighed. The average weight was 21.65 g, however, they were not weighed until two days after emerging. On Aldabra, hatchling *Chelonia* lost approximately 1 g per day immediately after emerging (Frazier, 1971: 383), so the values for Clutch 2 may be about 2 g lighter than when the animals first emerged.

Carapace lengths of 36 hatchlings from four clutches on Mohéli averaged 49.18 mm (Table 17). A oneway analysis of variance shows that between clutch variation is much greater than within clutch variation. The animals of Clutch 3 were largest and significantly longer than those from either Clutches 2, 4, or 5 (Table 18).

Carapace widths of these same animals averaged 39.21 mm (Table 17). Again, between clutch variation was significantly greater than within clutch variation, and Clutch 3 was largest, being significantly larger than Clutches 2 or 4 (Table 18).

Plastron lengths of these 36 hatchlings averaged 40.74 mm (Table 17). A oneway analysis of variance shows considerable heterogeneity between the four clutches (Table 18). Clutch 2 was significantly larger than Clutches 4 or 5, while Clutch 3 was significantly greater than Clutches 2, 4, or 5.

Head width of these hatchlings averaged 15.46 mm (Table 17). The between clutch variation is significantly greater than within clutch variation. As before, Clutch 3 was largest, with significant differences between it and Clutches 2 and 4; Clutch 5 was significantly greater than Clutch 2 (Table 18).

In all of the measurements, Clutch 3 was largest. The other three clutches varied in the order of size, depending on which parameter was involved, but between clutch variation was always greater than within clutch variation. Strictly speaking, the data from these clutches should not be pooled, but despite this heterogeneity, the samples are all from Mohéli and their grand average will be used as a general estimation of this population.

It is of interest to examine the interrelationships between various morphometric parameters. The weights of hatchlings in Clutch 2 show a strong positive relationship with carapace length (Figure 18).

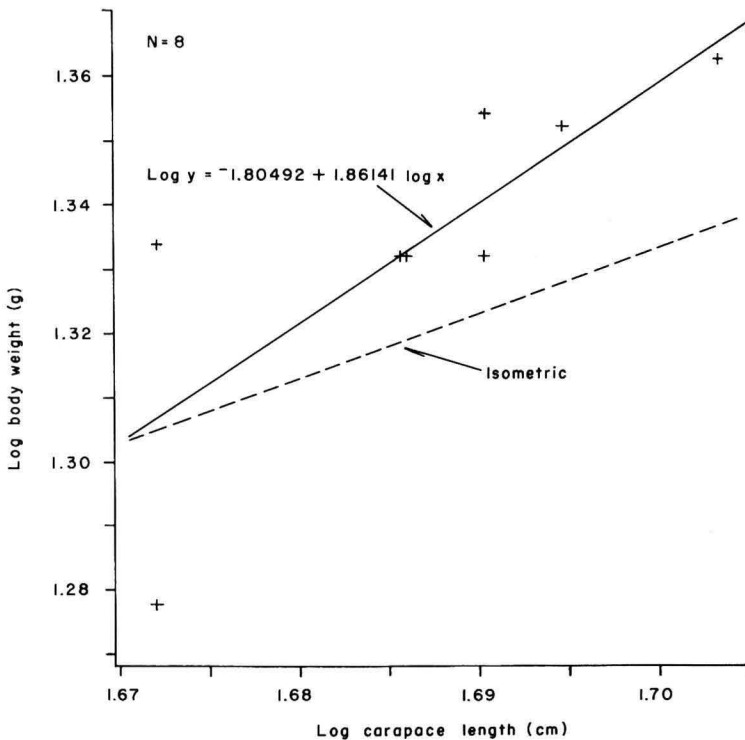


Figure 18 Relationship between log body weight and log straight carapace length in eight hatchling *Chelonia mydas* from Clutch 2 at Mohéli, Comores; showing least squares fitted line and theoretical isometric line (see Table 17).

The line fitted to these log transformed data has a slope of 1.86141. This is not statistically different from a slope of 1 ($t = 1.38$, d.f. = 6, $p > 0.1$), indicating that the weight-length relationship is approximately isometric in newly emerged turtles. However, the conclusion is dependent on this small sample size; the weight-length relationship is generally a power function (Huxley, 1972).

Carapace width shows a positive relationship to carapace length in the hatchlings from Mohéli (Figure 19). This is statistically significant in Clutch 2 ($r = 0.82339$, d.f. = 6, $p < 0.02$), but not in the others. An analysis of covariance showed no significant heterogeneity between regression lines for the different clutches:

	<i>linear equations</i>	<i>log log transformation</i>
slopes	$F_{3,28} = 2.79$, N.S.	= 2.91, N.S.;
elevations	$F_{3,31} = 2.78$, N.S.	= 2.69, N.S.

A significant relationship between carapace width and carapace length is shown by the pooled, log log transformed data ($r = 0.54355$, d.f. = 35, $p < 0.001$).

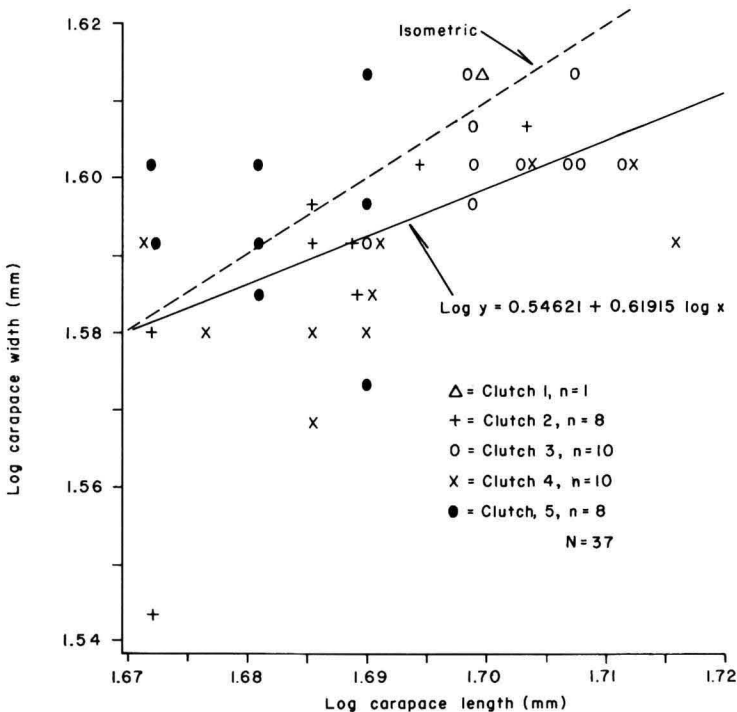


Figure 19 Relationship between log straight carapace width and log straight carapace length in hatchling *Chelonia mydas* from five clutches at Mohéli, Comores; showing least squares fitted line and theoretical isometric line (see Table 17).

The slope of this line (0.61915) is significantly less than 1, the isometric line ($t = -2.36$, d.f. = 35, $p < 0.02$), indicating that the width-length relationship in hatchlings is allometric.

Plastron length is strongly related to carapace length in all clutches but number 3; it is statistically significant in Clutches 2 and 4 ($r = 0.83851$, d.f. = 6, $p < 0.01$; and $r = 0.72799$, d.f. = 8, $p < 0.02$, respectively) (Figure 20). An analysis of covariance indicates that there is no difference in the slopes of lines for the individual clutches, but that the elevations of these lines are different:

	<i>linear equations</i>	<i>log log transformation</i>
slopes	$F_{3,28} = 0.25$, N.S.	= 0.24, N.S.;
elevations	$F_{3,31} = 17.33$, $p < 0.001$	= 17.51, $p < 0.001$.

The regression line for the pooled data, after log log transformation, has a slope of 0.94738. There is no significant difference between this and a slope of 1 ($t = -0.31$, d.f. = 35, $p > 0.1$), indicating that the relationship is approximately isometric.

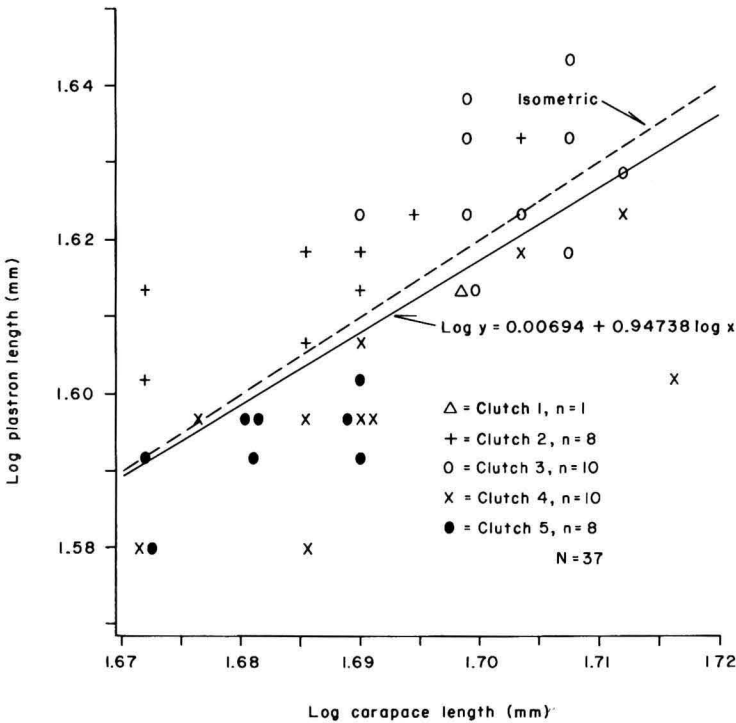


Figure 20 Relationship between log plastron length and log straight carapace length in hatchling *Chelonia mydas* from five clutches at Mohéli, Comores, showing least squares fitted line and theoretical isometric line (see Table 17).

Head width shows a weak relationship with carapace length (Figure 21). It is significant in only Clutches 2 and 4 ($r = 0.78022$, d.f. = 6, $p < 0.05$; and $r = 0.63753$, d.f. = 8, $p < 0.05$, respectively). An analysis of covariance shows no differences in slopes between the clutches, but a significant difference in elevation is indicated:

	<i>linear equations</i>	<i>log log transformation</i>
slopes	$F_{3,28} = 2.37$, N.S.	$= 2.40$, N.S.;
elevations	$F_{3,31} = 5.41$, $p < 0.01$	$= 5.47$, $p < 0.01$.

Although only two of the four clutches have statistically significant regressions, the two parameters are strongly related in the pooled data (for the log log transformed data: $r = 0.50196$, d.f. = 35, $p < 0.01$). The slope of the total data set, 0.48623, is considerably less than 1 ($t = -3.63$, d.f. = 35, $p < 0.001$), indicating that there is an allometric reduction in head width.

The weight data indicate a nearly isometric relationship with carapace length. A similar trend comes from the pooled data on plastron lengths. It is notable, however, that in the largest clutch, number 3, there is no significant re-

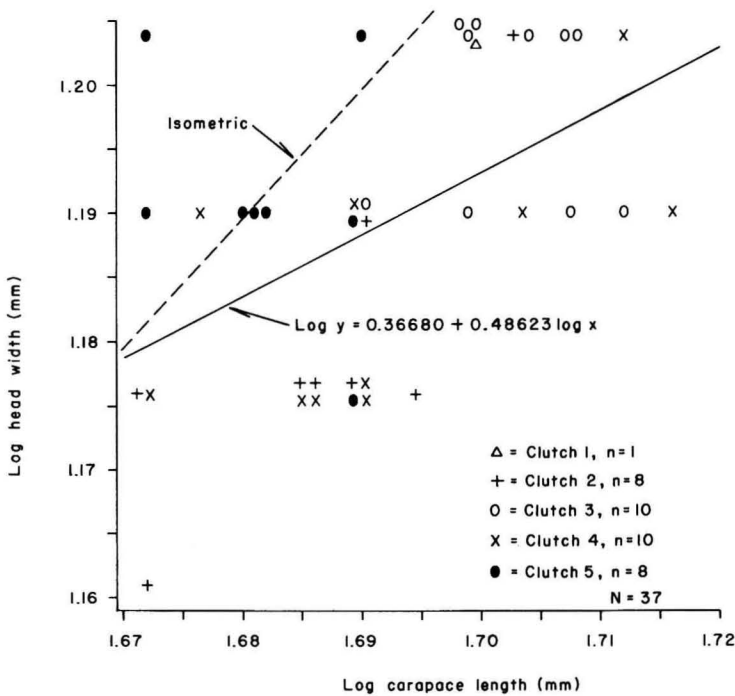


Figure 21 Relationship between log head width and log straight carapace length in hatchling *Chelonia mydas* from five clutches at Mohéli, Comores, showing least squares fitted line and theoretical isometric line (see also Table 17).

relationship between plastron length and carapace length. If the linear relationship breaks down at large body sizes, it suggests that there may be an allometric change in relative plastron length, although the slope of the pooled data is approximately 1. In the plots of both carapace width and head width with carapace length, the trends have slopes significantly less than the isometric line, indicating allometric reduction. The larger hatchlings have narrower carapaces and heads.

There is a general lack of data for comparing the Mohéli hatchlings with hatchlings from other western Indian Ocean islands. Nearby Aldabra Atoll was reported on by Frazier (1971) and Hughes (1974a) gave information from Europa and Tromelin islands (Table 19). Aldabra's hatchlings were largest of all, with significant differences between the Mohéli hatchlings in all parameters but plastron length. Weights from Europa and Tromelin are greater than those recorded from Clutch 2 on Mohéli. However, considering that the Mohéli weights may be about 2 g light because of the delay in measuring the animals, there may be no significant difference between the weights of these populations (Table 19).

Carapace lengths from Mohéli are larger than those from either Tromelin or Europa, and in comparison with the latter the difference is significant. Carapace widths on Mohéli are narrower, however, but this difference is significant only in comparison with Tromelin. There are no comparative data on plastron lengths from either Europa or Tromelin. Head widths from Mohéli are significantly less than those from either Europa or Tromelin (Table 19).

It is curious that the Mohéli hatchlings have longer carapaces, but narrower heads and carapaces than the hatchlings from Europa or Tromelin. Also, the Aldabra hatchlings are significantly larger than the Mohéli animals in all parameters but plastron length, in which the measurements from the two populations are nearly the same. The interrelationships of these morphometric parameters do not seem to be the same in these different populations.

Hughes (1974a: Figure 12) reported that carapace width and length were strongly related in hatchling *Chelonia* from both Europa and Tromelin, the slopes of the least squares regression lines were 0.5066 and 0.7785, respectively. The Europa line is similar to the line for pooled data from Mohéli (untransformed data: slope = 0.4852), but there are insufficient data to test these lines. Why Mohéli hatchlings would have longer but narrower carapaces is not clear.

Evidently the relationship between plastron length and carapace length breaks down with large body size, as seen in both Clutch 3 from Mohéli and in the pooled data from Aldabra. This indicates that hatchlings have a maximum plastron length, despite overall body size. If this is the case, it could be related to the fact that turtles are 'folded' across the plastron during embryonic development in the typical foetal position. As Ewert (1979: 380) has described, at full term turtles have 'highly contorted fetuses that nearly fill the interior.'

A newly hatched turtle must 'unfold,' or straighten out before it can locomote and continue to develop normally. Before hatching the embryo must transport the yolk sac into the abdominal cavity. Possibly there is a maximum plastron length above which unfolding or normal embryonic development is impeded, given the restraints of the volume within the egg and the physical problems involved with a growing embryo. Goode & Russell (1968) suggested that in chelid turtles the speed with which the yolk sac is absorbed is related to the position of the embryo within the limited volume inside the egg. Embryos with open access to the plastron could absorb the yolk faster than those that were more tightly packed into the egg.

The embryo's ability to move within the egg could also be important. In a study of the motility of snapping turtle embryos, *Chelydra serpentina* (L.), Decker (1967) reported that both carapace and plastron '...imposed serious restrictions on the activity of the trunk region.' A plastron could be so large that it would inhibit or prevent motility, but it is not known how this might affect the embryo, for certain complex neonatal behaviours seem to occur successfully without the benefit of foetal 'practice' (Smith & Daniel, 1946).

Head width varies little despite differences in body size, although there is a weak relationship in Mohéli hatchlings. Hughes (1974a: Figure 13) presented a plot of head widths on carapace lengths for 50 hatchling *Chelonia* from Europa; this showed considerable variation, but no analysis was presented. These observations indicate that there is a minimum head width. In vertebrates the head grows to full embryonic size before the trunk, and variation in head size is less than in sizes of other, postcephalic body parts. A hatchling turtle may not function efficiently without a critical mass of nervous tissue, particularly that related to olfactory and optic facilities, while variations in amounts of postcranial tissues may be less critical. Discussions of the embryonic and adaptive implications of the cephalo-caudal law of embryogenesis are many (see review in Ewert, 1979 and Huxley, 1972: 132 ff., for a discussion of the 'Law of Antero-posterior Development').

Growth and Size Comparisons

Eight hatchlings from Clutch 2 on Mohéli were taken to Moroni, Grande Comore and reared by Phillippe Richeux. The holding tank was about 1 m² and held about 20 cm of seawater; it was out-of-doors and shaded, and the turtles were fed chopped fish daily. Animals 1, 2, and 6 were given away early in the experiment. Number 8 died after approximately one month; number 4 died after approximately two months. Both of these animals were preserved by drying. Animals 3, 5, and 7 were measured alive on 30 June 1972, when they were three months old. As the ages of numbers 4 and 8 are uncertain, and as small changes in body proportions (especially head widths) may have occurred on

drying, the final measurements for these two animals should be taken as approximate (Figure 22).

The changes in body measurements that occurred after three months indicate: 1) carapace length increased about 0.4 mm per day; 2) carapace width increased about 0.3 mm per day; 3) plastron length changed slightly more slowly; and 4) head width increased less than 0.1 mm per day. The weights of three animals (numbers 3, 5, and 7) increased from 21.5, 22.6 and 22.5 g respectively, to over 100 g each (exact weights were not obtained because the maximum of the balance was 100 g). This is an increase of at least 80 g in three months, or at least one gramme per day. These rates of increase are comparable to those of other studies of growth under captive conditions (cf. Frazier, 1971: Fig. 4; Lebeau & Lebrun, 1973).

As these animals grew longer, they grew relatively wider. The slope of the regression of log carapace width on log carapace length is 1.0876, and this is significantly greater than the isometric slope of 1 ($t = 4.71$, d.f. = 8, $p = < 0.002$) (Figure 23).

These five hatchlings showed relative shortening of the plastrons as their car-

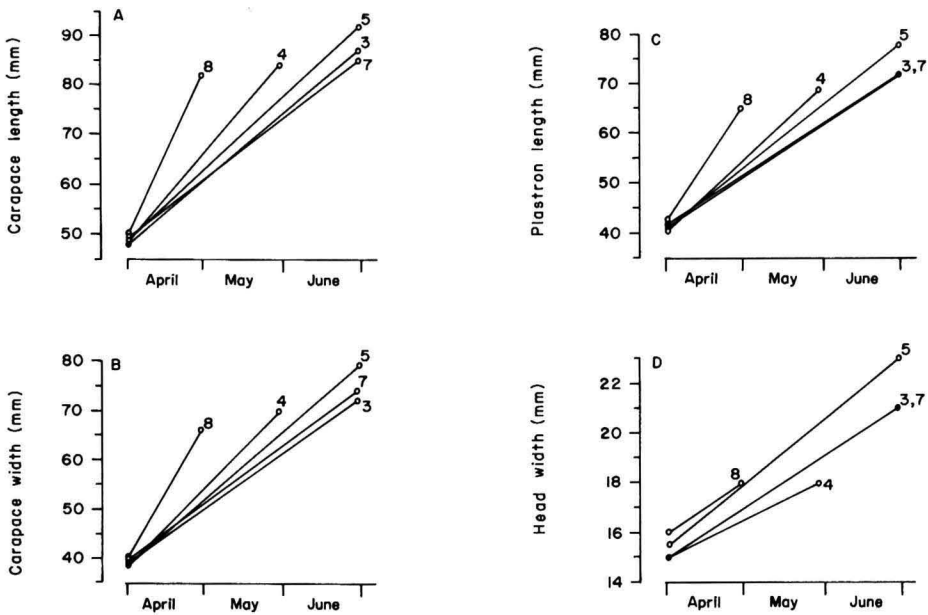


Figure 22 Increase in body measurements of five captive-reared *Chelonia mydas* from Clutch 2, Mohéli, Comores: A – Straight carapace length; B – Straight carapace width; C – Plastron length; D – Head width; all measurements in mm; (individual turtles are indicated by the numbers: 3, 4, 5, 7 and 8), ages of animals numbers 4 & 8 are not certain.

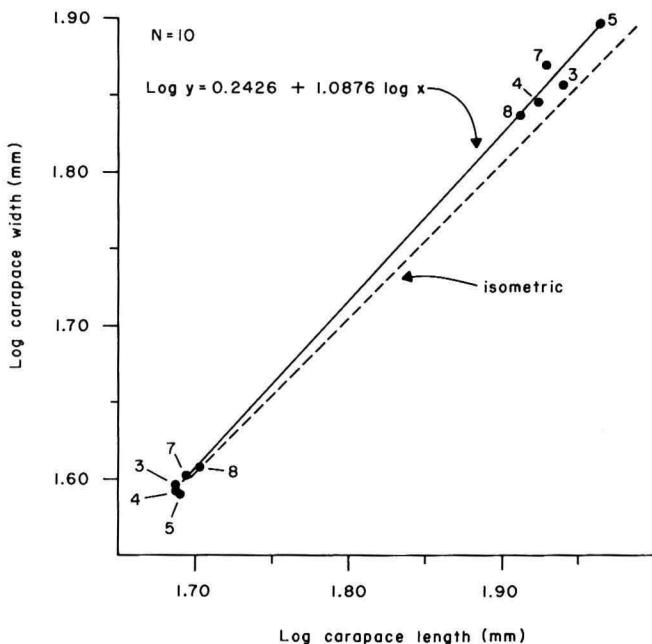


Figure 23 Change in log straight carapace width with increasing log straight carapace length in five captive *Chelonia mydas* from Clutch 2, Mohéli, Comores, showing least squares fitted line and theoretical isometric line; (individual turtles are indicated by the numbers: 3, 4, 5, 7 and 8).

apaces grew longer. However, this trend was not significantly different from isometry ($t = -1.37$, d.f. = 8, $p > 0.1$) (Figure 24).

Relative head width also decreased with increasing carapace length. This reduction was very different from the isometric condition ($t = -12.75$, d.f. = 6, $p < 0.001$) (Figure 25).

Comparisons between individuals are sometimes used to investigate changes that occur during growth, but these comparisons must be interpreted with care. The growth data on hatchlings show that an individual's carapace becomes relatively wider as it increases in length, but in hatchlings and adult females the longer carapaces are relatively narrower (Table 20). Hence, the ontogenetic change within individuals is not always reflected by comparisons between individuals.

Plotting all of the Mohéli data on log carapace width vs log carapace length shows an overall increase in relative carapace width, from hatchlings to adults; the predictive line is significantly steeper than 1 ($t = 15.01$, d.f. = 97, $p < 0.001$) (Figure 26). A simple linear equation accounts for a major portion of the scatter ($R^2 = 0.99944$, $F_{1,97} = 171,616.97$), however the relationship may be more complicated. The predictive line fits most of the data points very well,

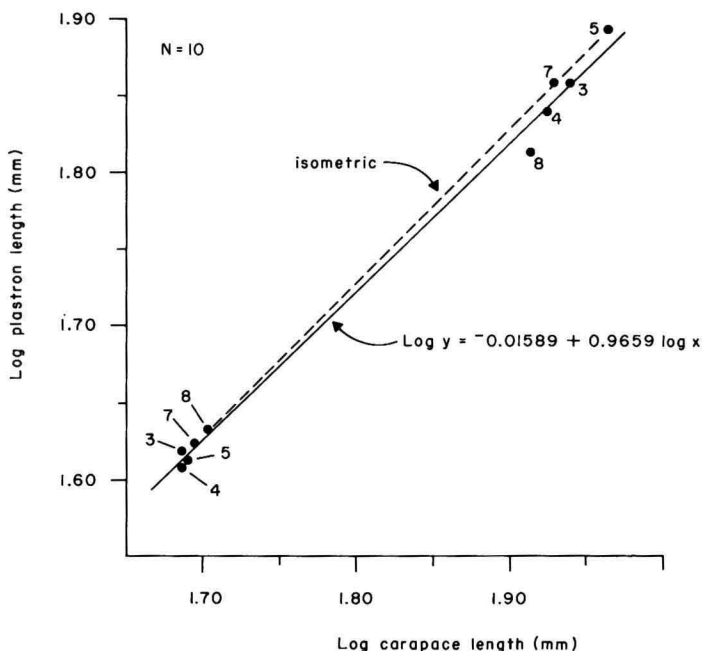


Figure 24 Change in log plastron length with increasing log straight carapace length in five captive *Chelonia mydas* from Clutch 2, Mohéli, Comores, showing least squares fitted line and theoretical isometric line (individual turtles are indicated by the numbers: 3, 4, 5, 7 and 8).

but the immatures, at about the middle of the line, are noticeably above it. The curve appears steep from hatchlings to immatures, then decelerates below 1. This indicates allometric acceleration followed by allometric reduction and conforms to the general field impression of changes in turtle shapes as the animals get larger; however, more data from immatures, at the middle of the line, are necessary to confirm this.

Changes in relative plastron length with the different data sets are consistent from one group of measurements to another. Individual growth in hatchlings shows an allometric reduction, and plots between hatchlings and between adult females show that larger animals have relatively shorter plastrons (Table 20). All of these data taken together indicate a curve which is below the isometric line ($t = -6.77$, d.f. = 66, $p < 0.001$) (Figure 27). The reduction is most marked in animals larger than immatures, and especially notable in the single male plotted (below the cluster of points for nesting females).

Relative head width also shows a consistent trend: growing hatchlings, comparisons between individual hatchlings, and comparisons between animals of various sizes all show conspicuous decreases in relative head width (Figure 28). The curve is well below the isometric line ($t = -39.00$, d.f. = 40, $p < 0.001$).

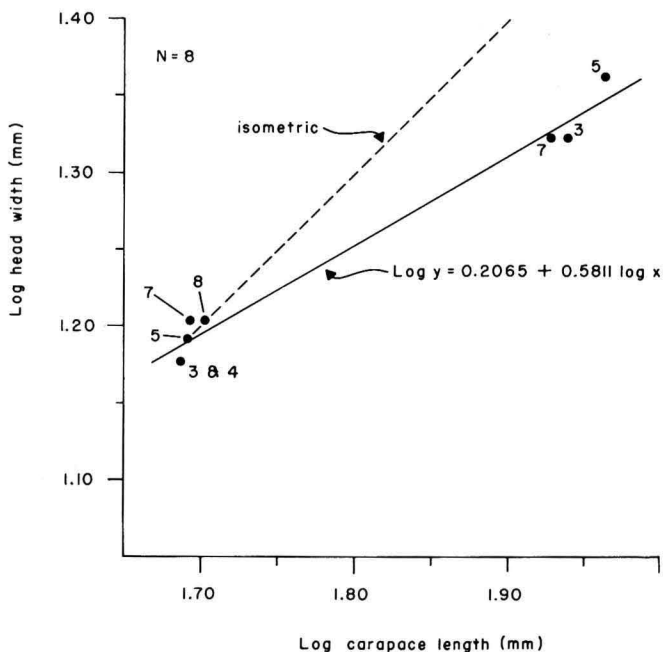


Figure 25 Change in log head width with increasing log straight carapace length in three captive *Chelonia mydas* from Clutch 2, Mohéli, Comores, showing least squares fitted line and theoretical isometric line (individual turtles are indicated by the numbers 3, 4, 5, 7 and 8).

For Mayotte the few comparisons that can be made are between nesting females. These indicate an allometric increase in both carapace width and plastron length with increasing carapace length; however, a larger range of values is likely to show changes consistent with those that occur at Mohéli.

All of these changes in relative body proportions have been described in *Chelonia* at nearby Aldabra Atoll: narrowing of the carapace, shortening of the plastron and narrowing of the head (Frazier, 1971: 383 ff.). These types of allometric changes probably occur throughout the range of the species.

Scalation

Each of the three immatures examined (Table 6) had normal scalation of the carapace, plastron, postoculars, axillaries and inguinals. Number 787, however, had 6 vertebrales, which is not usual. No data on scalation were recorded for either of the two males. The scalation of females from Mohéli and Mayotte is summarized in Table 21. The most common ('normal') condition is: cervical – single; vertebrales – five; supracaudals – one pair; pleurals – four pairs; marginals – eleven pairs; inframarginals – four pairs; intergular – single and large; gulars,

humeral, pectoral, abdominal, femoral, and anal – one pair of each; axillaries – three pairs; inguinal – one pair; and postocular – four pairs. The size of the postanal is variable. Scallation of Mohéli and Mayotte females is comparable.

In the main, these scale conditions are characteristic of the species, but rarely have they been reported in detail. Information from five other localities in the western Indian Ocean Region (viz., Europa Is., Tromelin Is., St. Brandon Islands, Mozambique and South Africa) show the same characteristics of scales (Hughes, 1974a: Table 2).

The scalation of the hatchlings from five Mohéli clutches is summarized in Table 22. The 'normal' condition is the same as that reported above with nesting females, with the following exceptions: hatchlings show less variation in inframarginals, but more variation in inguinals and also in postoculars. The animals of Clutch 3 show considerably more variation in marginals, but more constancy in pleurals, axillaries and inframarginals than do some of the others.

If hatchlings show greater variation in scalation than do adults, this indicates

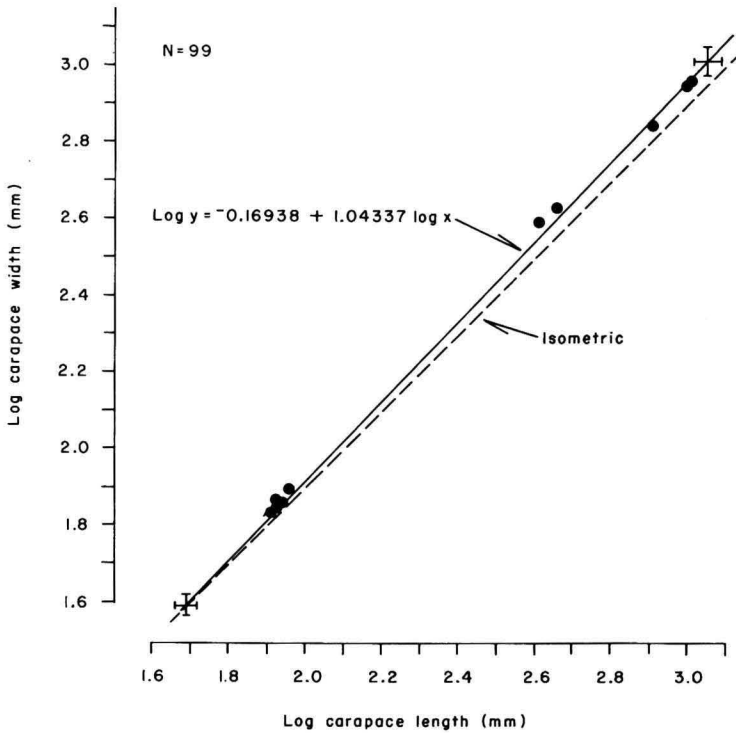


Figure 26 Change in log carapace width with increasing log carapace length in *Chelonia mydas* at Comores, showing least squares fitted line and theoretical isometric line; average (\pm t standard deviations) for hatchlings and nesting females are shown by crosses at bottom and top of line.

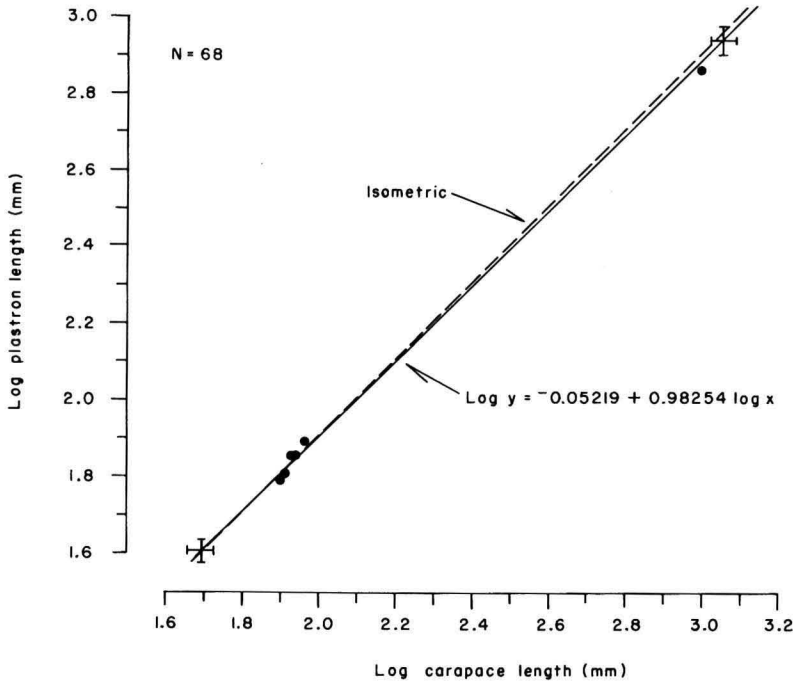


Figure 27 Change in log plastron length with increasing log carapace length in *Chelonia mydas* at Comores; showing least squares fitted line and theoretical isometric line; averages (\pm t standard deviations) for hatchlings and nesting females are shown by crosses at bottom and top of line.

that stabilizing selection may be in operation. Individuals with characteristics away from the norm may be at a selective disadvantage. However, to corroborate this process, as opposed to ontogenetic normalization, it is necessary to show that the scale characteristics of an individual do not change as it grows and matures, as Gadow (1899) once claimed.

Coloration

The three immature *Chelonia* examined (Table 6) had carapaces marked with conspicuous chestnut-red blotches and a dominant pattern of raying. The scales on the dorsal surfaces of the limbs, head and neck were likewise dominated with the chestnut (Plate VIII). This pattern is absolutely typical of immature *Chelonia* in the western Indian Ocean.

The adult males seen while skin diving at Mayotte were coloured with black spots and did not have conspicuous amounts of chestnut-red pigment or pigment distributed in rays. The carcass from Ouallah, Mohéli (JFCm 797), presumed to be male, had a black spotted carapace. This pattern is characteristic of

males on Aldabra (Frazier, 1971: 390) and supports the assumption that 797 was a male.

The coloration of females from several beaches on Mohéli was noted. Of 40 animals, 92.5% had concentrations of dark pigment in all, or some, carapace scutes (Table 23; Plates IX through XII). A larger proportion of live than dead animals had concentrations [$\chi^2(G) = 6.54$, d.f. = 2, $p < 0.05$, Sokal & Rohlf, 1969: 599]. Thirty-eight of these females were examined for the presence of chestnut-red pigment in the centre of the dark concentration mentioned above (Table 24). In total, 76% showed this characteristic. Again, the live animals showed the coloration more strongly [$\chi^2(G) = 7.02$, d.f. = 2, $p < 0.05$]. This suggests that scute color changes after death, perhaps as a result of desiccation or exposure to the sun. If this assumption is true, then chestnut-red centres are probably found in 95% of the nesting female population, rather than 76%.

Thirteen of the above specimens were also checked for the amount of dark pigment distributed in rays. Values ranged from 5 to 95%, averaging 47.3% ($\pm 7.8\%$), and live animals had more pigment in rays, but the difference was not significant ($F_{4,7} = 1.49$, $t = 1.85$, d.f. = 11).

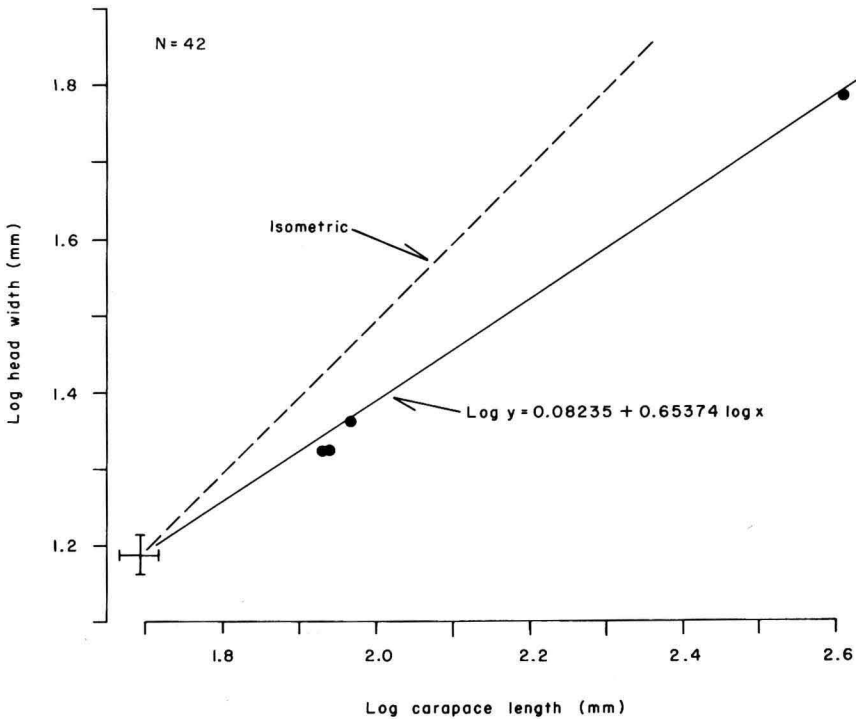


Figure 28 Change in log head width with increasing log carapace length in *Chelonia mydas* at Comores; showing least squares fitted line and theoretical isometric line; average ($\pm t$ standard deviations) for hatchlings is shown by cross at bottom of line.

Females examined at Mayotte were also colored similarly to females at Mohéli. All of the 38 specimens examined had at least some pleurals with concentrations of dark pigment, and 84% had concentrations in all scutes (Table 23). If coloration is changing after death, as seems to happen on Mohéli, this value will be low, but sample sizes are too small for comparing live vs dead for 1972. There was no significant difference between the observations of 1972 and 1973 [$\chi^2(G) = 1.72$, d.f. = 2, $p > 0.05$].

Of the 29 specimens examined, 93% showed the presence of chestnut-red pigment within concentrations of all or some scales; 86% had this coloration in all scales (Table 24; Plate XIII). However, this figure may be low if there is colour change after death. There is no significant difference between 1972 and 1973 [$\chi^2(G) = 2.78$, d.f. = 2, $p > 0.05$]. Two animals had 75% and 60% of the dark pigment outside the concentrations distributed in rays.

There is no evidence for any population differences between the coloration of the Mohéli and Mayotte turtles. Comparing Mohéli females with those from Mayotte in respect to scores for scutes with concentrations of dark pigment gives a $\chi^2(G)$ of only 2.26 (d.f. = 2, $p > 0.05$). Scores for scutes with chestnut-red centres also show no significant difference [$\chi^2(G) = 3.90$, d.f. = 2, $p > 0.05$].

In summary, almost all females had at least some carapace scutes with conspicuous dark concentrations of pigment; the majority – possibly the vast majority – also had chestnut-red centres to these concentrations, and a considerable amount of pigment outside the concentration was arranged in rays and not spots. These observations are similar to those made on nesting females at Aldabra Atoll (Frazier, 1971: 390).

The same hatchlings as those measured (see Section on Morphometrics) were also observed for characteristics of coloration. As usual for the species, they were dark above and light below. The only quantified observation relevant to hatchling coloration was the position of the beginning of the *solid* white border on the marginal scales (Table 22). The most common position is the posterior of the third marginal, but it can begin as far forward as the middle of the second and as far back as the anterior of the fourth.

Body Condition

One of 16 Mohéli females had major damage to a front flipper; one of 19, had major damage to a hind limb. No animals with damaged shells were seen, except JFCm 730 which had broken supracaudals (Tables 7 & 8).

One female at Mayotte had the left hind limb stumped and the posterior of the plastron (anal scales) highly asymmetric. The proximity of the two abnormalities indicated that they might be related, possibly from an accident when

the animal was small (Plate XIV: Figure 1). A second female had a 'hunch-backed' carapace.

Feeding Habits

Samples of stomach contents from four nesting Mohéli females (JFCm 795, 854, 857 and 858) and one animal presumed to be a male (JFCm 797) were examined. In all instances the contents were marine plants, algae and angiosperms. More detailed analysis on samples from JFCm 854, 857 and 858 are shown in Table 25. At Mayotte *Chelonia* were seen over or near marine pastures both in the lagoon and on the seaward fringe. Stomach contents from four nesting females slaughtered on Pamanzi Island showed *Thalassodendron ciliatum*, several species of brown algae, small gastropods, and small pebbles. In general, stomachs and intestines that were examined contained very little. Unfortunately, the samples were lost, but the predominance of plant material is normal for adults of this species. The absence of conspicuous animal matter and a preponderance of *Thalassodendron ciliatum* is the norm for adult *Chelonia* in the western Indian Ocean, and the feeding habits of the Comoro *Chelonia* are comparable with what is known from other parts of the species' range (cf. Ferreira, 1968; Frazier 1971: 394; Mortimer 1976).

Breeding Biology

Mating behaviour. Information on mating behaviour at Mohéli is limited to sightings of copulations which were recorded from 26 February to 1 April 1972 (Table 5). As pointed out earlier, there were no observations in June 1972 when nesting was most intense. A male at Bangoi-Kouni, Grande Comore, on 24 May 1973, approached us while underwater, indicating that depending on the availability of receptive females, mating could occur as late as the end of May. No copulations were seen at Mayotte, but single males often approached me while I was swimming off of Moya beach in late May and early June 1972. They were curious and almost aggressive, apparently searching for mates. Five males were seen milling around a single female, evidently trying to mount her. Mating is evidently seasonal, occurring before the peak in nesting. This is consistent with findings elsewhere (Frazier, 1971: 377; Booth & Peters, 1972: 809).

Thirty-four Mohéli females were scored for the condition of their copulation marks (notches cut into the females' third marginals by the pollex claws of the mounted males). As the nesting season progressed, there was an increase in both the occurrence and size of these marks (Figure 29).

Copulation notches were scored for 14 Mayotte females, 13 of which were at Pamanzi in June 1972. The preponderance of animals had conspicuous

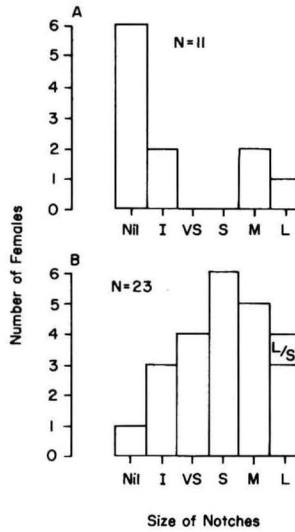


Figure 29 Seasonal changes in copulation notches of *Chelonia mydas* at Mohéli, Comores: A – February and March, B – June. Sizes of notches are indicated as follows: Nil = no notches or irritations, I = irritations but no notches, VS = very small, S = small, M = medium, L = large, L/S = large notch on one side/small notch on the other.

marks: 1 – large; 9 – medium; 1 – small; 1 – very small; 1 – irritations only; 1 – no marks. This is comparable to the situation on Mohéli in June.

If it is assumed that mating *always* results in copulation marks, then it would seem that females nesting early in the season are laying *before* they have copulated. However, given the information on the timing of mating season presented above, this seems unlikely, and it would appear better *not* to assume that mating always results in copulation marks (see Frazier, 1971: 377). Rather, copulation notches, which are cut into bone about two cm thick, are more likely the result of multiple copulations, numerous occasions of weakening the bone through several mountings. The creation of these notches could be further facilitated by a calcium deficit: laying large clutches (hence using a large amount of calcium in egg shells) and not feeding during the nesting season could easily produce this deficiency.

Booth & Peters (1972: 809) and Wood & Wood (1980: 500) indicate that a female mates only once in a season, but the observations reported do not disprove multiple matings. In other studies, it is reported that males court and mount females as they enter the sea after nesting. Also, the fact that copulation marks can be asymmetrical suggests that whenever a notch is cut it is not simply a matter of being mounted; an animal bearing a notch on the left but none on the right would be scored from the left as post-copulatory and from the

right as precopulatory! The data from Comores suggest a peak in mating before the peak in nesting and multiple matings for females.

The diurnal pattern of mating at Comores is similar to that described in other studies (Hendrickson, 1958: 482; Frazier, 1971: 375 ff.); the majority of copulations occur before midday. Of nineteen separate copulations, 14 occurred before noon (Table 5).

Copulations were observed off all the major rookeries but notably around the offshore islands in the south. While this is likely to be the result of observer bias, it is also probable that the large area of protected shallow water is an attractive mating ground.

With the exception of three observations, all records of copulations were within 500 m of shore, whether this involved the main island or the offshore islands (Table 5). Other studies indicated that copulations occur within a few hundred metres of shore (Hendrickson, 1958: 481; Frazier, 1971: 375), but such information is clearly subject to observer bias as most observers are shore based.

Of the 19 separate copulations observed, at least seven had 'escorts.' The sex of these animals was only confirmed on two occasions, but it is assumed that all escorts were males, because females do not seem to exhibit this behaviour. On three occasions there was only one escort, while on three other occasions there were from four to six (Table 5). As Booth & Peters (1972: 810) have pointed out, as many as five males may congregate around a mated pair – even if females outnumber males. Hence, efforts to estimate sex ratios of breeding populations from numbers of escorts (e.g., F.A.O., 1968: 35; Hirth & Carr, 1970: 40) are misleading (see also Hughes, 1974a: 12).

Males are competing for receptive females, and they will eagerly explore objects they perceive as potential females. They may approach a human swimmer or a small boat, as was experienced at both Grande Comore and Mohéli. Booth & Peters (1972: 809) also relate this exploratory behaviour for males in Australia.

Nesting season. At Mitsamiouli, Grande Comore, there are two records of nesting, both by Mr. Chevalier: a nest emergence in September, 1971 (from a nesting presumably in July) and a nesting in January 1972. The male(s) sighted underwater on 24 May 1973 off Bangoi-Kouni, in the north, was evidently attracted to swimmers and was probably searching for receptive females.

It would be stretching the data to claim that the nesting season at Grande Comore extends from January to July (or from July to January), for nesting is too sporadic to really qualify for a nesting season. More likely, the situation at Grande Comore is best described by saying that nesting can occur at least from January to July, but infrequently at any time. That it occurs during the first half of the year and not the second is inferred from the situation on Mohéli, Mayotte (see below), and Aldabra (Frazier, 1971: 375; Gibson, 1979).

There are considerable data from Mohéli (Tables 7, 8, 9), and it is clear that

nesting lasts from late February until at least late June. In the light of the generalized breeding biology that is typical of the species throughout its range (see Frazier, 1971: 379; Hirth, 1971: 3: 4; 1980), it is possible to deduce a longer nesting season. Nest emergences the nights of 30 and 31 March, at beaches 47 and 45, respectively (Table 9), indicate nestings in late January (i.e., two months before nest emergences). Three females killed on nesting beaches, numbers 8 and 12, on the night of 26 June (Table 8) had enlarged follicles that were probably to have been laid about two weeks late. Female JFCm 858 had two follicle sizes, so presumably she would have laid twice at about two-week intervals, first in early July and second at the end of the month. There is little doubt that the nesting season at Mohéli extends at least from late January to late July.

It is clear from seasonal changes in the amount of nesting spoor on Mohéli beaches, i.e., the numbers of females beaching nightly and the number of nest emergences in a night (Table 9), that there is an increase in nearly all Mohéli beaches from February to March and again from March to June. For the month of April data are only available for the first day, and none are available for May. However, working back from the dates of nest emergences to two months earlier (inferred date of laying), it appears that nesting was nearly as active in April as it was in June.

Evidently the nesting season at Mohéli peaks in about June, having begun at least in January, so it may continue for a large part of the year. This is consistent with anecdotal information I was given by residents, and comparable with the seasonality on Mayotte, Aldabra (Frazier, 1971: 410; Gibson, 1979), and Maziwi Island, Tanzania (Frazier, in prep.) but not with that on Europa, Tromelin and St. Brandon Islands (Hughes, 1974a: 14). On Aldabra nesting occurs year round with a peak in the austral winter. It occurs at least ten, and most probably twelve months on Maziwi, also peaking about the same time. On Europa, Tromelin and St. Brandon, Hughes claims that nesting is year long, but the peak is in the austral summer.

The information regarding a female nesting at Mirontsi, Anjouan in 1969 did not include the month, so nothing can be said of the nesting season on that island. It seems likely that what little nesting does occur would coincide with the peak at Mohéli.

At Mayotte recent nesting was recorded at the Moya beaches from 7 April until 10 June 1972, and on 18 June 1973. From the condition of the spoor, it was clear that nesting occurred from at least late February. A female with two sizes of enlarged follicles, that nested on 8 June, probably would have nested twice again, in the end of June and in mid July. Mayotte's nesting season is evidently similar to that on Mohéli and Aldabra, where there appears to be a peak during the trade winds, from May to August. There may be nesting throughout the year.

Nesting behaviour. Seven Mohéli females were observed during their nest-

ing activities (Table 26) and more than a dozen others were seen in various stages of nesting (Table 27). A few Mayotte females were also observed, but with an emphasis on tagging and censusing, few detailed observations could be made on nesting behaviour. Yet the nesting process in Comores is typical of the species (see Table 26; Plate XIV: Figure 2; and Frazier, 1971: 379).

Many of the times presented in Table 26 are approximate, so the data are applicable only for a preliminary statement. Beachings times seem to be related to the time of high tide (and hence to state of tide – spring or neap). During spring tides, which are full just after dusk, the animals are leaving the sea a few hours after dusk; during neap tides, which are full about midnight, they are beaching just after midnight. During neaps, ten of eleven records are before high tide; all of the three spring tide records are from after the high tide. Beachings during neap tides also occur nearer to the time of high tide than do spring tide beachings. All beachings at spring tides are more than two hours after high tide; all beachings during neap tides are less than two hours (and many are less than one hour) from high tide.

The timing of beachings, near to high tide, is most probably related to access to the beach and ease in getting up the beach face. The fact that neap tide beachings precede the high tide and are closer to it may be because the high neap tide rises very little, and to get its full benefit the animals must be on time.

It is possible that there is also a social stimulus affecting the animals to aggregate off the rookery and nest together. This would swamp predators and also function in spacing nests out, reducing nest destruction by the females themselves.

All beachings occurred at night, which is a rarely broken rule with this species. Female JFCm 713 did leave the sea just before daybreak on beach N° 45 and laid during daylight. Daylight nestings that do occur are known from remote areas where there is seldom disturbance by humans (see Hirth, 1971: 3: 4). The west beach of Chissioua Ouénéfou (beach number 45) is in fact remote and undisturbed by people or predators large enough to bother a female *Chelonia*.

All beachings at Mayotte were also at night, but one animal (JFCm 720) nested, apparently undisturbed, while it was photographed with several powerful lights. The left hind flipper of this same animal was stumped, and useless in sand excavation, yet it used alternate strokes of the hind limbs. Another curious observation was made on female JFCm 717 on the 5th of June. She spent 24 hours upside down on the beach, and on being turned right side up proceeded to nest and lay 31 eggs.

Nesting periodicity. While there is no direct information on this topic at Comores, there is sufficient information to infer that *Chelonia* nests about three times a season on Mohéli and Mayotte (there are no relevant data from either Grand Comore or Anjouan). Mr. E. Laurette of Fomboni, Mohéli, speaking from considerable experience, claimed that females typically have many

hundred yolked eggs. Three Mohéli specimens slaughtered by local peoples on beaches 8 and 12, all on the night of 26 June 1972, confirmed this. Female JFCm 854 contained many large follicles (15 to 20 mm in diameter) in the body cavity; presumably it had laid before it had been killed, for no shelled eggs were found. Female JFCm 857 had 157 shelled eggs and large numbers of small follicles (10 mm or less in diameter). Female JFCm 858 had 158 shelled eggs and large numbers of follicles of two sizes (about 15 to 20 mm and about 10 mm or less). A complement of three clutches is clearly indicated by the latter.

Similar evidence is available from Mayotte. Female JFCm 825 had a full complement of shelled eggs as well as large numbers of enlarged follicles of two sizes; females JFCm 820 and 826 each had shelled eggs and over 100 large follicles. Other well documented studies indicate one female may lay as many as seven clutches per season (cf. Frazier, 1971: 379; Hirth, 1971: 3: 4), although there is some disagreement as to whether the counting technique is valid (Schulz, 1975: 71).

Site tenacity. This species shows an uncanny ability to return to the same beach area for repeated nestings. The behaviour has been well documented in Sarawak, Borneo (Hendrickson, 1958: 497), Tortuguero, Costa Rica (Carr & Carr, 1972), Ascension, South Atlantic (Carr, 1975: 552) and Surinam (Schulz, 1975: 75), and it seems to be the norm for the species. It is assumed that *Chelonia* at Mohéli and Mayotte exhibit site tenacity also, and that each major nesting beach has a group of turtles that returns regularly to nest on it.

Clutch size. In seven Mohéli clutches, the number of eggs varied from 85 to 158, averaging 122.44 (\pm 9.95) (clutch size was determined by counting eggs as they were laid, by allowing each egg to pass through my hand on its way from the turtle's ovipositor to the egg hole, or by counting eggs that were found within the body cavity of a slaughtered female). Five Mayotte clutches varied from 104 to 139 eggs, with an average of 121.6 (\pm 7.325); JFCm 820 with 138 eggs, had 151 enlarged follicles, and JFCm 826 had 108 eggs with over 100 enlarged follicles. These values are similar to the Tromelin average (129) but less than that from Europa (152) (Hughes, 1974a: Table 19a).

The Mohéli clutch size data are distributed in four 'clumps': 85 to 86 (two clutches); 101 to 109 (two); 120 to 128 (two); and 157 to 158 (three). As both large and small clutches were laid on both eastern and western beaches and in both early March and late June, there is no obvious season or locality effect. There does, however, appear to be a positive relationship between carapace length and clutch size, although it is not statistically significant ($r = 0.53959$, d.f. = 6) (Figure 30). There is no significant relationship between Mayotte clutch sizes and carapace lengths ($r = 0.42531$, d.f. = 3, $p > 0.1$).

Hughes claimed (1974a: 16) that there was no such relationship on Europa, but that female length and clutch volume and/or weight (= mass) were related on Tromelin. However, his Europa data (his Figure 21) could be interpreted in

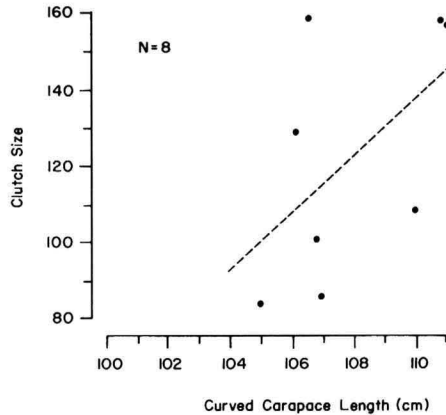


Figure 30 Relationship between clutch size and curved carapace length in *Chelonia mydas* at Mohéli, Comores; least squares fitted line ($y = 7.32559x - 667.77302$) is not significant.

another way: along with random error there is probably the effect of serial clutch number on clutch size; clutch size may well diminish from first to last clutch, and these factors must be reckoned with. The positive relationship between female length and clutch size seems to occur in means of different populations (Frazier, 1971: 380), and it is suspected to occur in individuals within a population (see also Hirth, 1980).

Egg size. Samples of ten eggs (chosen at random) from each of two Mohéli clutches and each of four Mayotte clutches were measured (Table 28). Mohéli diameters vary from 41 to 45 mm and calculated egg volumes vary from 38.8 to 46.7 cm³. Calculated clutch volumes were 6,600 and 6,726 cm³.

At Mayotte eggs within a clutch showed little variation, but there was considerable difference between clutches. The eggs from female 720 were about half the weight of those from the other three females, so they will be discussed separately. In the remaining three turtles, egg diameters ranged from 42.5 to 48.0 mm. Individual egg weights varied from 48.0 to 60.0 g, and the clutch averages ranged from 50.2 to 56.8 g. Calculated volumes of individual eggs varied from 42.6 to 56.7 cm³, and averages for each of the three clutches increased from 44.8 to 53.2 cm³. The calculated clutch volume for female 820 was 6,297 cm³. There is 100% correlation between female size and egg size in these three animals (Figure 31).

These calculated volumes are comparable with the volumes reported for Tromelin (evidently actually measured), which were found to vary with the length of the female (Hughes, 1974a: Table 20). Egg diameters are likewise comparable with the values reported for Tromelin and Europa (Hughes, 1974a: Table 19a), but less than the Aldabra figure (Frazier, 1971: Table 2). However,

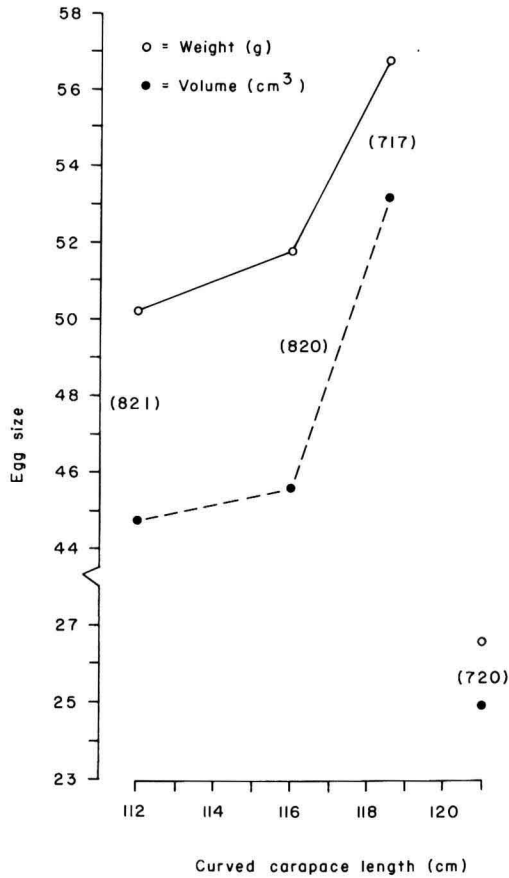


Figure 31 Relationship between egg size (weight and volume) and curved carapace length in female *Chelonia mydas* (JFCm number indicated in parenthesis) at Mayotte, Comores (see also Table 28).

these one-diameter values could be misleading, for turtle eggs are rarely perfect spheres and are sometimes quite ovoid; more data are needed before sound comparisons can be made. Contrary to Hirth's claim (1971: 3: 7), it was *not* usual to find abnormally small or shaped eggs in the Mohéli clutches: none was encountered in the nine clutches examined.

The case of Mayotte female JFCm 720 is curious; her clutch had the normal number of eggs, but the eggs were half the normal size. This turtle had a stumped left hind limb and asymmetric plastron, and may have been either severely injured as immature, or suffering from congenital malformations. It is difficult to say whether or not the small size of her eggs was directly caused by the injury, or by the nutritional and energetic problems that might result from having a stumped flipper.

Although these eggs were half-sized, they produced viable embryos. They were, thus, not the same as the abnormally small eggs that occasionally occur in small numbers in an otherwise normal clutch. The few small eggs that appear in normal clutches are without yolk, and hence non-viable.

Incubation and emergence period. Ten eggs laid on 9 June 1972 by JFCm 720 at Moya north were transplanted to a beach on Dzaoudzi and excavated on 6th August by Dr. R. von Hentig. After 58 days of incubation, four eggs had live embryos, and from a photograph taken by Dr. von Hentig, these embryos had external yolk sacs about 1.5 cm in diameter and carapaces about 3 cm long. By 60 days most *Chelonia* eggs are ready to hatch, so these were apparently developing more slowly than usual. This may have been because of low sand temperature and not the small egg sizes; however, a transplanted clutch of half-sized eggs is hardly a good norm.

There are no other data from Comores on this topic. In previous discussions of nesting season it has been assumed that it takes roughly two months from the time eggs are laid to the time hatchlings emerge from the nest. Actual incubation time is presumably several days less. These assumptions are based on the findings of other studies (e.g., Hendrickson, 1958: 504; Carr & Hirth, 1961; Schulz, 1975: 90; see also Frazier, 1971: Table 2). Both Hendrickson and Schulz showed that the length of the emergence period varies with season, probably as a function of temperature of incubation.

Hatching and emergence success. Depressions, about 15 to 20 cm in diameter, with tracks of hatchlings leading to the sea, were recorded on six nesting beaches on Mohéli (Table 9). One emergence was observed on Moya south; at dusk 45 hatchlings entered the sea. Because the Pamanzi beaches were heavily used, it was not possible to find depressions from nest emergences. Clearly, hatchlings are emerging on these beaches, but no other figures are available. Hughes, (1974a: Table 13) gives information on hatching and emergence success from Europa.

One emergence on Chissioua Ouénéfou was witnessed (Table 29) and observations relevant to predation will be discussed in the Predation Section. A behaviour not previously reported in hatchlings was seen in hatchlings that emerged from the nest before the main body of the emergence. The first movements of their flippers were not locomotory as is usual, but resembled the nest digging movements of a female. Several digging strokes were made, with much hesitation, and then the animals began locomoting more rapidly, heading toward the sea. The digging movements may have been attempts by each animal to cover itself with sand and thereby shade itself from direct sunlight (Plate XV). It would appear that the repertoire for nesting behaviour is present in newly emerged *Chelonia* regardless of sex. Thermoregulatory responses in hatchlings of this species have been reported by Bustard (1970: 225), but sand covering of this type has not been reported in hatchlings. Hughes, (1974b: 40)

reported flipper movements that covered the animal with water and moist sand, but this was only reported in nesting females that had been stranded by low tides in the daytime.

Nest Habitat Utilisation

The vast majority of nest pits on Mohéli occur within the first few metres above the beach crest (Figure 32). Nests below this level are very rare: only 5% of all nests with eggs were below the high water mark. At the same time, few nests are made farther than 5 metres inland from the beach crest: 82% of all nests with eggs were between 0 and 5 m inland. No nest pits were found more than 15 m inland. Nesting is concentrated in a narrow zone above the high water mark, but this concentration is as much a reflection of the availability of suitable habitat as a selection on the part of nesting females – nesting habitat simply occurs in narrow strips. There is no difference in the distribution of total numbers of nests with eggs and without eggs [$\chi^2(G) = 21.98$, d.f. = 20, $p > 0.05$].

All nest pits on Mayotte fell between -2 and +8 m from the beach crest, and 91% were from 0 to 5 m (Figure 33). This narrow zone in which nesting occurs is a reflection of the widths of beaches available; the vast majority are less than 10 m wide. Nest pits thought to have eggs rarely occurred below the beach crest; less than 2% were in this category. More than 13% of nest pits without eggs were below the beach crest; the distributions of nest pits with and without eggs are different [$\chi^2(G) = 50.06$, d.f. = 11, $p < 0.001$].

On both Mohéli and Mayotte, nesting beaches are narrow, and considering just nests with eggs, nesting on Mohéli is slightly more inland from the beach crest. This difference is statistically significant [$X^2(G) = 49.24$, d.f. = 116, $p < 0.001$]. However, a higher proportion of nestings on Mayotte seems to be successful: 54% of all Mayotte nests were scored as successful while only 48% of those on Mohéli were with eggs; the difference is highly significant [$\chi^2(G) = 34.46$, d.f. = 2, $p < 0.001$]. If only nests that could be scored as either with or without eggs are included, the proportions of successful nesting for Mayotte and Mohéli are 67% and 55%, respectively. Again, the difference is highly significant [$\chi^2(G) = 18.16$, d.f. = 1, $p < 0.001$]. The higher nesting success on Mayotte may be related to the greater degree of overcrowding by turtles on Mohéli.

There are several lines of evidence, besides general impressions, that these narrow beaches are being overcrowded during peak nesting. The proportion of nest pits thought *not* to contain eggs increases as nesting activity increases from February/March/April to June (Figure 34). This was not true on beach 24, a small beach with very little nesting and nests well spaced out. And, it is not certain on beach 47, but if the incomplete February count – representing about

32A

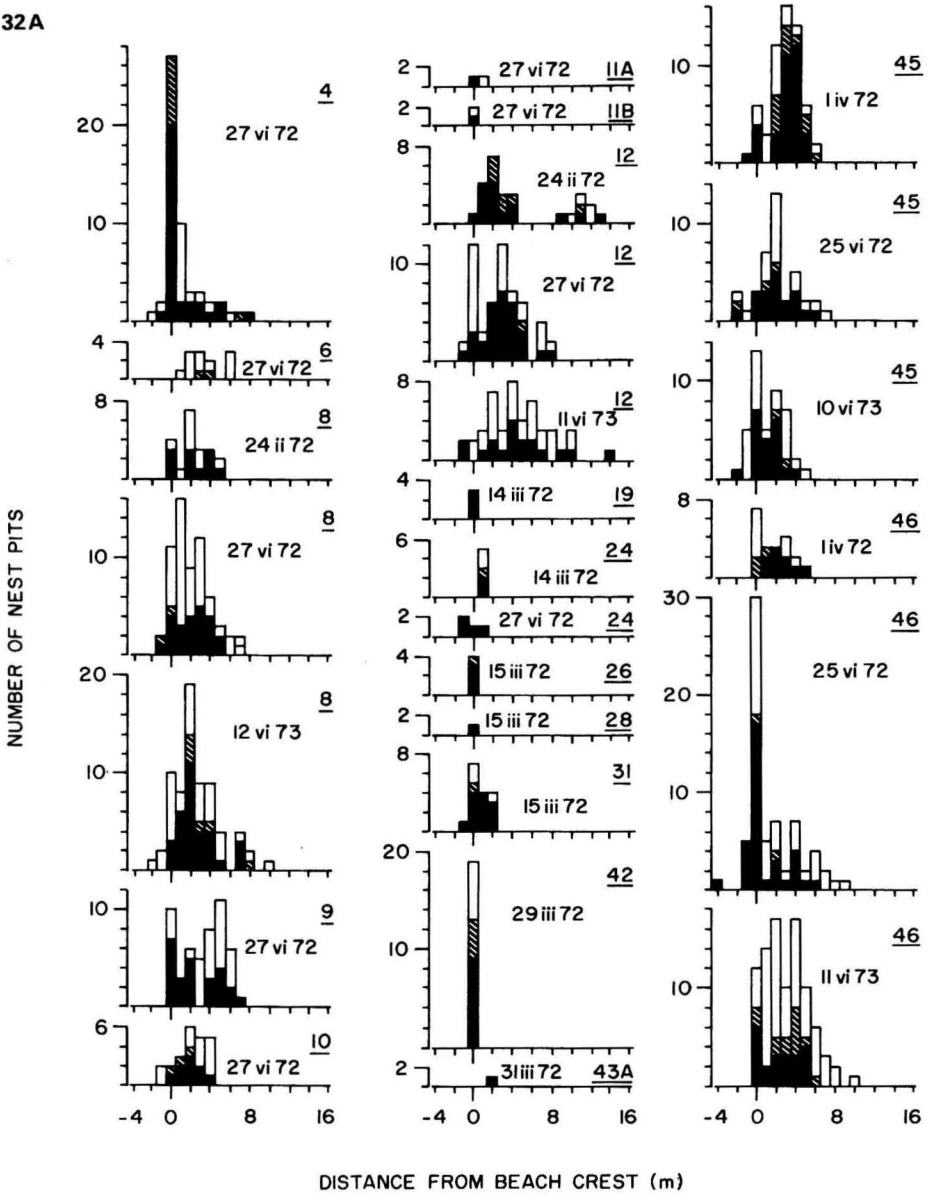
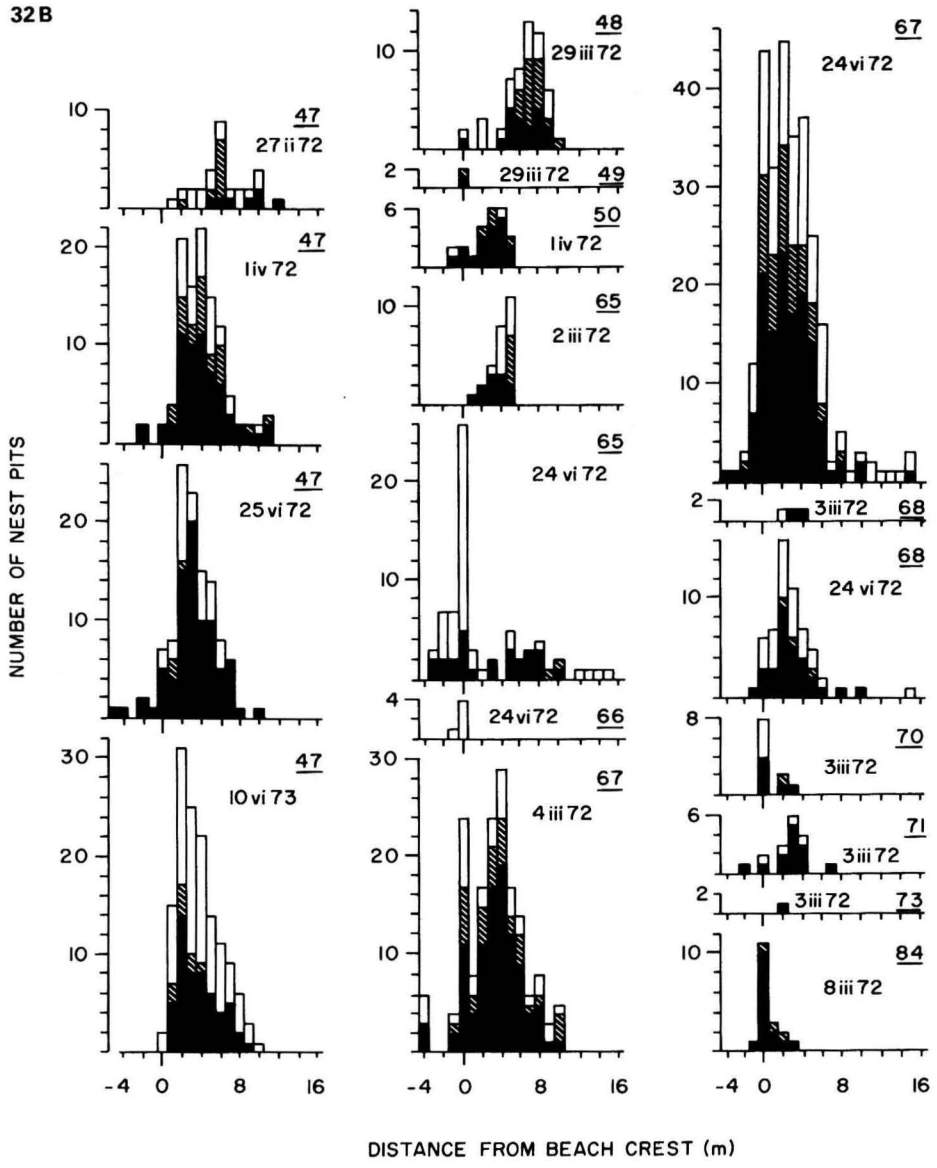
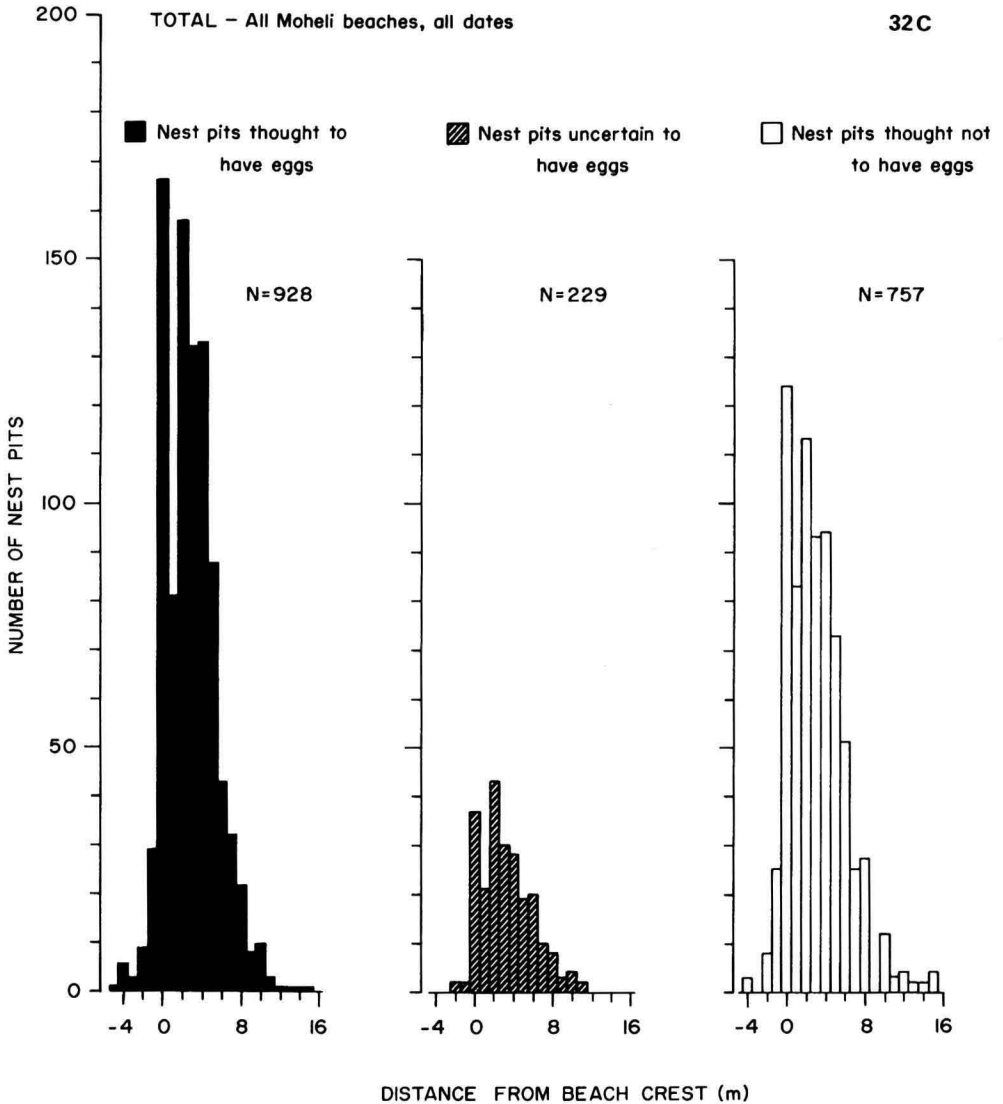


Figure 32 Distance from beach crest distributions of *Chelonia mydas* nest pits from 29 beaches at Mohéli, Comores; A & B – beach number and date of observation are indicated; nine beaches with more than one date of observation; C – total (see also Tables 9 & 31).

32B





1/10 of the beach – is rejected, then this beach also conforms to the general pattern.

The number of sites of egg shells exposed on these beaches also increases as the nesting season progresses (Table 30). Beach 24 had none exposed at any time, but this beach had very little nesting. Beach 67 had nine sites of egg shells in March and eight in June. However, all nine March sites had been exposed by dogs' digging, whereas, only one of the eight June sites had obviously been exposed by dogs. Exposure of egg shells (and buried eggs) is often due to females digging up nests during their own nesting efforts.

Increased nesting activity aggravates the disturbance to the sand, decreasing moisture content. This results in poorer sand conditions and reduces the chances of a successful nest being made. The net effect is more abortive attempts before successful nesting, which further aerates the sand and reduces the quality of the nesting habitat. The system quickly becomes a positive feedback loop, and the chances of digging up a previously made nest are greatly increased (cf. Bustard & Tognetti, 1969; Frazier, 1980a: 232 ff.).

The main nesting zone moves toward the sea as the season progresses (Table 31), with the modal nesting zone shifting from between 2 to 4 m inland of the beach crest to between 0 and 2 metres. Seasonal changes in beaches could explain such shifts in nesting if erosion were cutting the beach crest farther inland. This phenomenon could not, however, explain the situation reported here, for most of the nest pits had been recently dug and their positions relative to the beach crest were very similar to when the respective females nested. This is not to say that some nest pits were never recounted on subsequent visits – certainly some were. Furthermore, the Mohéli beaches appeared to be relatively stable and did not undergo large enough changes to account for these shifts in modal nesting zone. It seems rather that the females are nesting closer to the sea during peak nesting. The sand closer to the beach crest may be moister and less friable than that inland, and this would make it advantageous to nest closer to the sea.

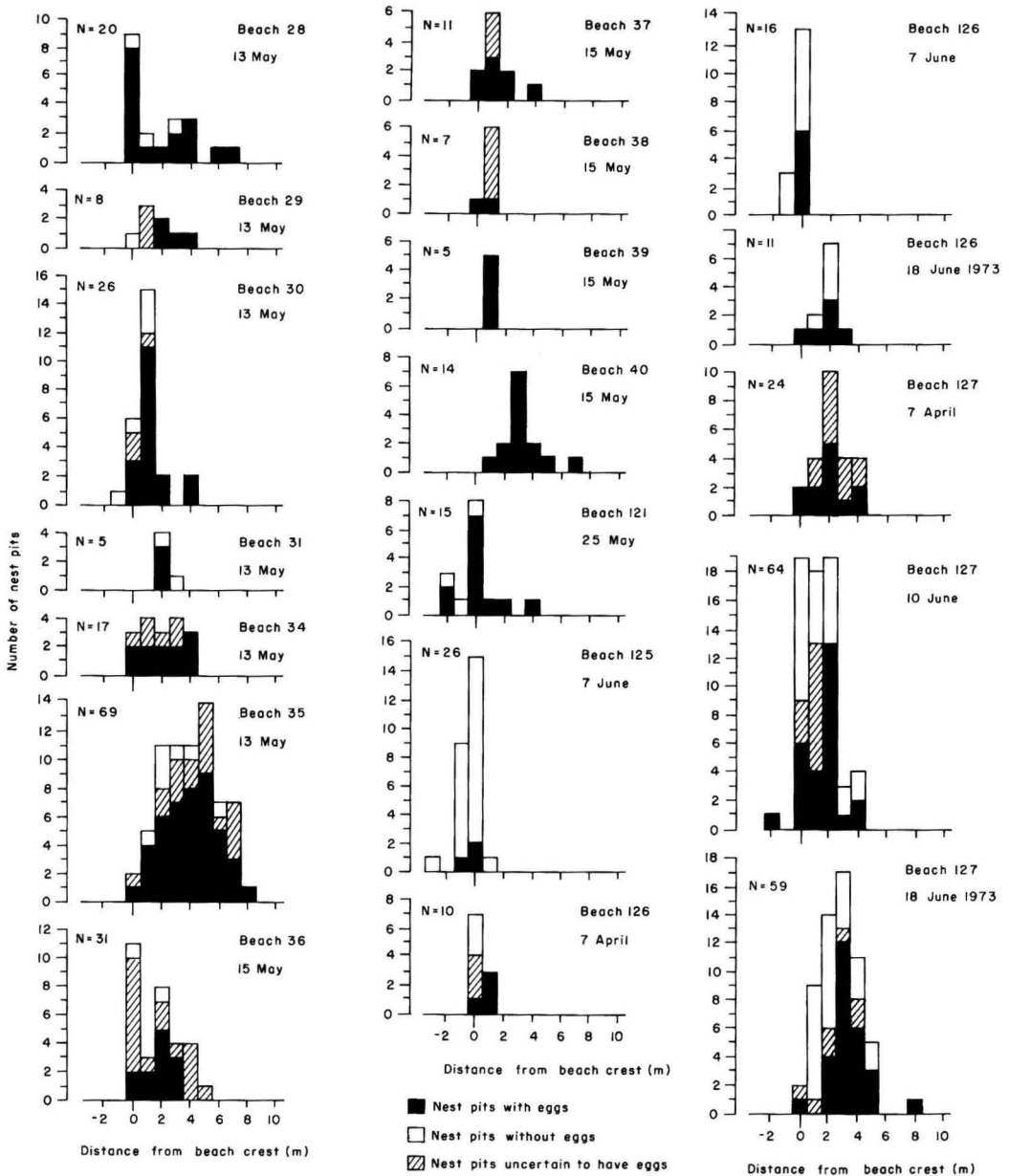
The Pamanzi beaches also appeared overcrowded, for there was considerable nesting activity concentrated in very narrow areas. Excluding nest pits uncertain to have eggs, nearly 52% of the nest pits in Pamanzi were scored as without eggs, while only 13% of nest pits on other beaches were without eggs. This difference is highly significant [$\chi^2(G) = 61.58$, d.f. = 1, $p < 0.001$], and is further evidence that these beaches are being so heavily disturbed by nesting turtles that many nesting efforts were unsuccessful – a symptom of an overcrowded beach (cf. Bustard & Tognetti, 1969; Frazier, 1980a: 232 ff.).

Eretmochelys imbricata (Linnaeus)

The significance of the *Eretmochelys* population at Comores has doubtless been overshadowed by the Archipelago's proximity to and historic ties with Madagascar and the much greater turtle populations at that island. Furthermore, the difficulty in assessing the status of a population of this species leaves many very basic questions unanswered.

Common Names in Use

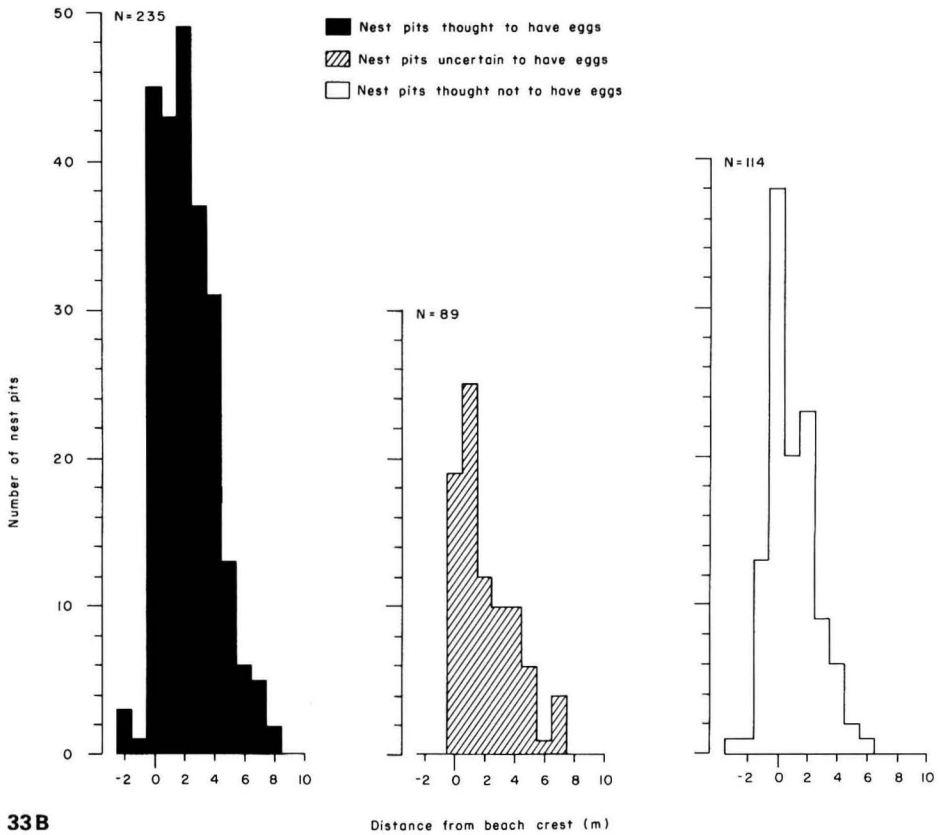
Throughout the Comores this turtle is known as 'Nyamba'; Gevrey (1870: 115) recorded 'Namba' for all turtles, and Mr. A. Malida, a schoolboy at Nioumachoua, Mohéli, reported 'Gnamba.' The turtle is known more specifically as



33A

Figure 33 Distance from beach crest distributions of *Chelonia mydas* nest pits from 15 beaches at Mayotte, A – beach number and date of observation are indicated, three beaches with more than one observation; B – total (see also Tables 13, 14 & 15).

TOTAL - ALL MAYOTTE BEACHES, ALL DATES



33B

‘Nyamba Malé,’ which translates as ‘Money turtle,’ for this is the turtle of trade. On the Swahili-speaking coast of eastern Africa, from southern Somalia to northern Mozambique, this species is referred to as ‘Ng’amba’ and this name is clearly related to the Comorian name. In Swahili, ‘gamba’ means ‘scale,’ and it is probably from this word that the name ‘Ng’amba’ is derived. ‘Fanu’ is a general name for marine turtles used in Madagascar; on Mayotte it was used for *Chelonia*, but it might also be used for *Eretmochelys*. French names, common throughout the region, are ‘Caret’ and ‘Tortue d’ écaille.’ The common English name is ‘Hawksbill Turtle.’

Occurrence

Eretmochelys is evidently resident at all the Comoro Islands, which will be dealt with individually, as their respective populations are thought to be separate (see Section on Movements and Migrations).

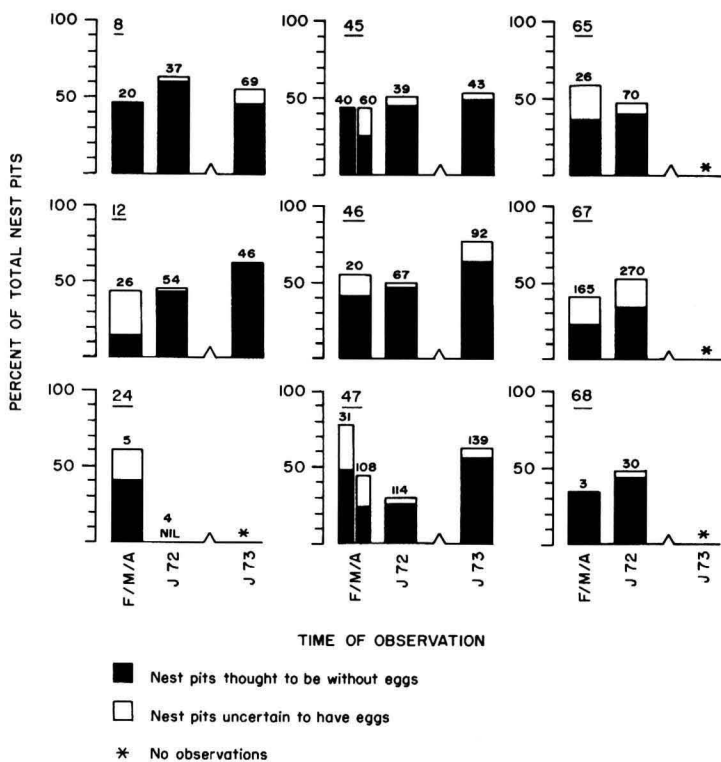


Figure 34 Seasonal change in percent of *Chelonia mydas* nest pits thought to be without eggs (black) and uncertain to have eggs (white), from 9 beaches on Mohéli, Comores; observations: F/M/A = February/ March/ April (2 observations for this period for beaches 45 and 47, February observations on beach 47 represent about 1/10 of the beach); J 72 = June 1972; J 73 = June 1973; figure above each bar is the total number of nest pits for that observation (see also Table 31).

At Grande Comore, there are records from: south of Choua-Chandroudé, in the northeast; Mitsamiouli, in the northwest; Itsandra, Moroni and Iconi in the west; and Malé in the southeast. As there are records from the five months of the year when observations were being made, it is likely that the species occurs throughout the year (Tables 32 & 33).

At Mohéli this turtle was recorded at the offshore islands in the south and at the east and northwest of the main island (Tables 32 & 33). Nesting spoor was observed on at least 14 beaches extending from the southwest to the northeast (Table 34). Records occurred from late February until late June, and the species is suspected to be present also during the second half of the year, when no observer was present.

There is but one record at Anjouan, from the northwest in June. Although

the species may not be common here, it is suspected to occur generally around the island and throughout the year.

At Mayotte single turtles were seen in shallow water in the northeast, east, south and west of Mayotte, in May and June. Nesting spoor was on four beaches, in the northeast, east and southeast, and bones of this turtle were also seen on beaches in the north (Table 4). The species is probably resident throughout the year, and with the vast areas of reef that encircle the Island, it must occur widely.

Eretmochelys was recorded most frequently at Grande Comore, but there was much more nesting activity at Mohéli; the species is probably more common at Mayotte and Mohéli.

Population Size and Structure

At Grande Comore all of the animals measured and observed were immatures (Tables 32 & 33; see Section on Morphometrics). There is evidently a small, perhaps moderate, population at this island. Breeding is not recorded, and the adult population, if it occurs, must be small.

At Mohéli, immatures were recorded, but fewer were observed than at Grande Comore where the larger and more affluent human population would buy trophies as they became available, making it more likely to see them. Mr. A. Malida, in answering a questionnaire on turtles, wrote that the species is not hunted much at Mohéli because the flesh is poisonous and the animal is of little value to the fishermen. The immature population at Mohéli, with the greater area of reef and shallow water, is expected to be much larger than the data suggest.

Nesting spoor was recorded on at least 14 beaches around Mohéli. The amount of nesting spoor recorded indicates a small population, but the main nesting period may not have been observed, and *Eretmochelys* spoor is ephemeral – even fresh it is often inconspicuous. Nevertheless, the annual nesting population is probably well below 50.

Too little is known from Anjouan to speculate; both immature and adult populations would appear to be small.

At Mayotte all of the live animals seen were smaller than adults, but nesting occurs, and several dead adult specimens were seen on nesting beaches. Adults and immatures of both sexes probably occur, but immatures seem to be more common. Nesting spoor was confirmed on only three beaches, and three nests with eggs were recorded. The annual nesting population of *Eretmochelys* at Mayotte is certainly greater than three, but dispersed and ephemeral nests of this turtle serve as poor indicators of population size.

Movements and Migrations

Little is known about the migrations of *Eretmochelys*, and there is no direct evidence from Comores. None of the four animals tagged and released have been reported recaptured (Table 33). Mayotte probably has a resident population, and the quantity of rich, live reef at this island may serve as important feeding habitat for turtles that nest at other islands in the Archipelago.

Movements of up to 27 km have been recorded in the archipelago system of Seychelles (Diamond, 1976: 208). Carr, Hirth & Ogren, (1966: Table 5) reported movements from the Tortuguero, Costa Rica, rookery of up to 325 mi. (= 523 km, erroneously converted in Carr & Stancyk, 1975: Table 3, to 463 km). The species is obviously capable of long distance movements and could arrive at either side of the Mozambique Channel having started from Comores. There is, however, a suggestion that *Eretmochelys* is more sedentary than is *Chelonia* (cf. Carr & Stancyk, 1975: 167). While movements among islands in the Archipelago, and to and from the Archipelago, probably do occur, it seems likely that each island has its own population.

Morphometrics

Immatures. The nine animals measured at Grande Comore ranged from 34.0 to 67.0 cm in curved carapace length, and three specimens from Mohéli and one from Anjouan fell within this range (Figure 35). The grand average was 44.03 m (± 2.658). The smallest *Eretmochelys* reported nesting on Cousin Island, Seychelles was 83.0 cm in curved carapace length (Diamond, 1976: 202), and the smallest nesting female found on Maziwi Island, Tanzania, was 87.0 cm in curved carapace length (Frazier, unpublished data). There is little question that all of the Comoro animals reported here are immatures.

Carapace width measurements ranged from 29.5 to 58.0 cm, averaging 38.82 (± 2.149). Plastron lengths varied from 25.5 to 50.0, with an average of 33.37 (± 2.403). Head widths ranged from 5.2 to 9.0, averaging 6.45 (± 0.456) (Figure 35). The size-frequency distributions for each of these variables have distinct modes at the lower ends of the respective size ranges. Evidently a preponderance of small animals are being caught, possibly because they are the largest part of the population.

Carapace width increases with carapace length. The relationship appears isometric, for the slope of the regression line of the log log transformed data (0.90562) is not significantly different from the isometric line ($t = -1.84$, d.f. = 11, $p > 0.05$).

Plastron length also appears to be related to carapace length in an isometric way. The slope of the log log plot is 1.06817, not significantly different from 1 ($t = 1.80$, d.f. = 9, $p > 0.1$).

Head width shows a relationship that is also approximately isometric. The slope of the log log transformed data (0.86528) is not significantly different from 1 ($t = -1.86$, d.f. = 6, $p > 0.1$).

The failure of these t-tests to show significant differences between the log log transformed data and the isometric line may be related to the small sample sizes involved, rather than the presence of a true isometric relationship. Analysis of morphometric relationships of a larger range of animals indicate that allometric changes are occurring (see Section on Size Comparisons).

Hatchlings. A sample of eight hatchlings caught and killed by *Ocypode* sp. on 26 February, 1972, at Chissioua Ouénéfou, Mohéli were collected and measured. They are all assumed to have emerged from the same nest on beach N° 47. Weights two days after emergence ranged from 11 to 13.5 g, averaging 12.62 (± 1.070). Because these were not recorded immediately after emergence, weights are likely to be about 1 or 2 g light (cf. Frazier, 1971: 383).

Carapace lengths varied from 39 to 43 cm, a range of almost 10% of the

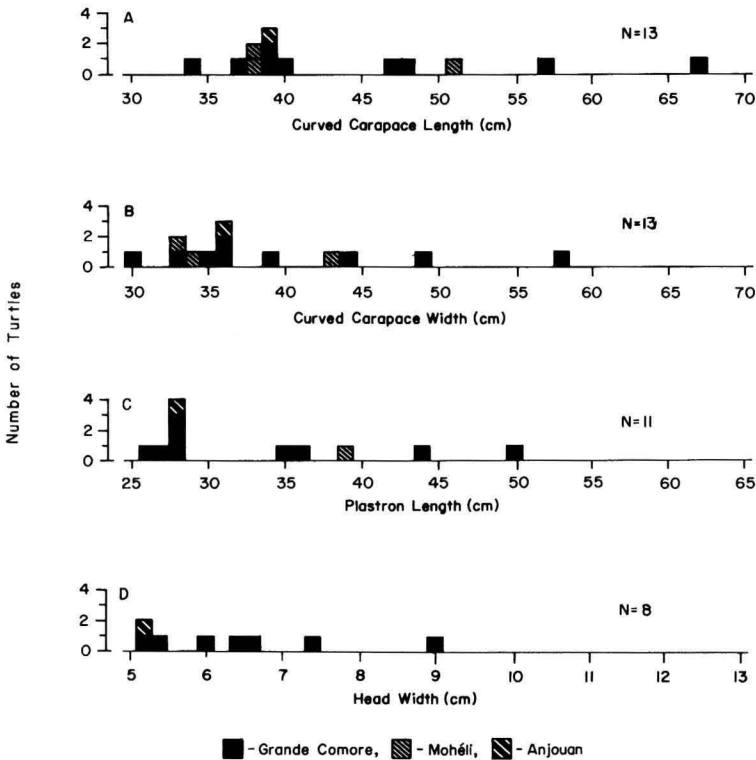


Figure 35 Size-frequency distributions of body measurements of *Eretmochelys imbricata* at Comores: A – Curved carapace length; B – Curved carapace width; C – Plastron length; D – Head width; N ranges from 8 to 13 (see Table 33).

mean, 41.10 (± 1.036). Carapace widths varied from 30 to 33 cm, again nearly 10% of the average, 32.30 (± 1.033). Plastron lengths ranged from 31 to 35 cm (33.72 ± 1.043). Head widths varied from 14 to 15.5 cm (14.74 ± 1.045). There was no significant relationship between weight and carapace length in these hatchlings ($r = 0.20023$, d.f. = 6, $p > 0.1$), and no significant relationships between carapace width and carapace length ($r = 0.15103$, d.f. = 6, $p > 0.1$) or head width and carapace length ($r = 0.39610$, d.f. = 6, $p > 0.1$). Plastron length and carapace length are strongly related ($r = 0.72707$, d.f. = 6, $p < 0.05$). Small sample sizes may account for the lack of significant correlations.

Size Comparisons

Plotting measurements of immatures together with hatchlings of *Eretmochelys* reveals morphometric trends not evident in analyses of these data separately. Carapace width increases relative to carapace length; the slope of the log log transformed data is 1.04741, which is significantly greater than the isometric line ($t = 5.56$, d.f. = 21, $p < 0.001$) (Figure 36). Relative plastron length decreases with increasing carapace length; the slope of the log log transformed data

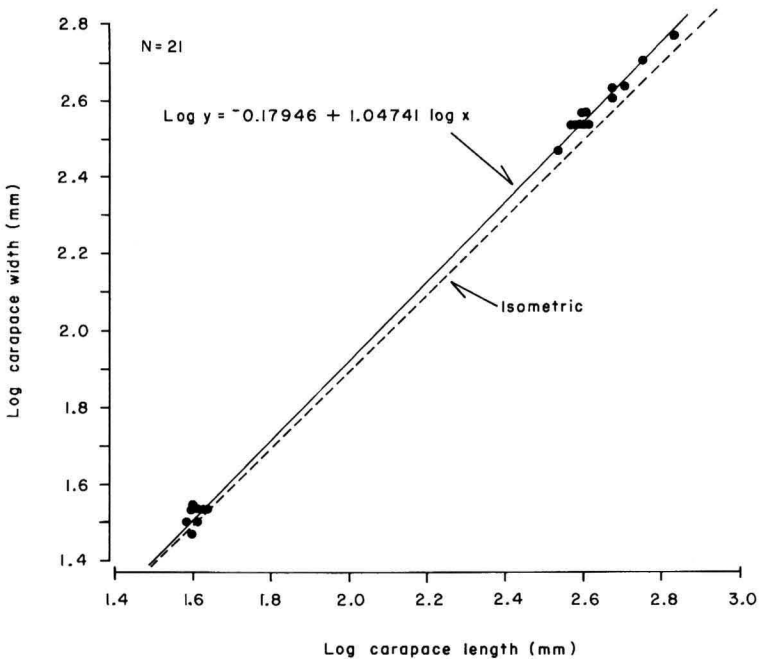


Figure 36 Relationship between log curved carapace width and log curved carapace length in hatchling and immature *Eretmochelys imbricata* at Comores; showing least squares fitted line and theoretical isometric line.

is 0.95616, significantly less than 1 ($t = -7.08$, d.f. = 17, $p < 0.001$) (Figure 37). Head width shows a dramatic allometric reduction, the regression line of the log log transformed data has a slope of only 0.60931, considerably less than the isometric line ($t = -25.79$, d.f. = 01, $p < 0.001$) (Figure 38).

These trends are the same as those seen earlier for *Chelonia*. As hatchlings increase in size to immatures, the carapaces get relatively wider, the plastrons get relatively shorter and the heads, relatively narrower.

Scalation

Immatures. Lepidosis in the immatures was typical of the species; in 12 cases the carapace was unvarying in having five vertebrals, four pairs of pleurals, and 11 pairs of marginals, in addition to a single cervical and pair of supracaudals. In 10 of these specimens there was no variation from the normal six pairs of plastron scales, and the intergular was always conspicuous in size. Inframarginals were a constant four per side. Axillaries were variable with two pair, three pair and asymmetric combinations of two and three scales per side. Inguinals were usually one per side, but cases with none or two on a side were each recorded once. The postanal varied from small to moderate in size. Eight animals

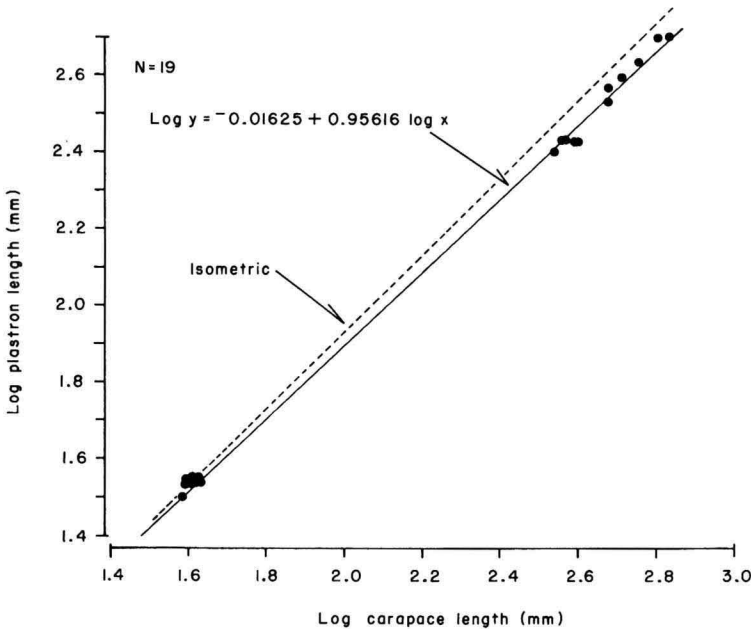


Figure 37 Relationship between log plastron length and log curved carapace length in hatchling and immature *Eretmochelys imbricata* at Comores; showing least squares fitted line and theoretical isometric line.

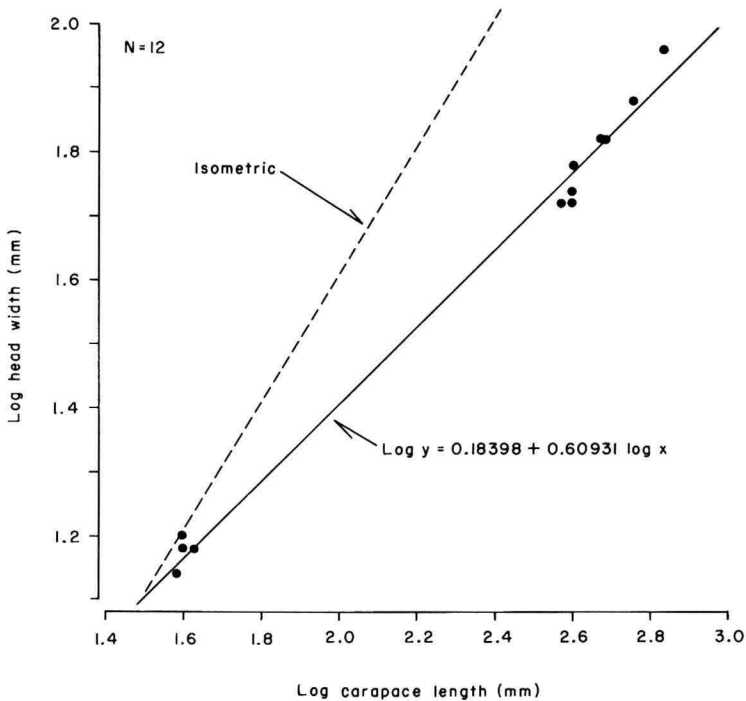


Figure 38 Relationship between log head width and log curved carapace length in hatchling and immature *Eretmochelys imbricata* at Comores; showing least squares fitted line and theoretical isometric line.

had three left and three right postoculars; one individual had three and one half on each side (two complete scales and one partially divided) (Table 33).

The most anterior marginal to form a dentate projection was determined by passing a vertical pencil anteriorly along the edge of shell to the most anterior marginal that would stop the pencil. This scale varied from the fourth to the eighth, counting posteriorly, not including the cervical. The position of the scale was related to carapace length, the smaller animals being more denticulate (Figure 39). Clearly, this character can be of little use in describing different populations.

The condition of keels also shows a strong relationship with body size. Animals with carapaces less than 40 cm long had keels on all vertebrae. In the smaller turtles, these were very pronounced on the second, third, fourth, and fifth vertebrae. As the animals get larger, the anterior scales had less pronounced keels, to the point where only the fourth and fifth showed prominent ridges. The first vertebral may actually lack any sign of a keel in animals with curved carapace lengths of 40 cm or longer (Figure 40).

Keels occurred on all pleurals in smaller animals, and they were prominent on

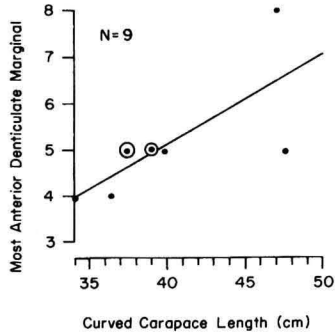


Figure 39 Relationship between the most anterior denticulate marginal and curved carapace length in immature *Eretmochelys imbricata* at Comores; least squares fitted line is $y = 0.18480x - 2.24173$; $r = 0.72194$, d.f. = 7, $p < 0.05$.

the second, third, and fourth. In larger animals only the posterior keels were prominent, and in some cases the anterior pleurals had no traces of keels.

Plastron keels showed a similar phenomenon. Prominent ridges ran antero-posterior and from the humerals to the anals on both sides of the midline. In the larger specimens, 47.0 and 47.5 cm in curved carapace length, the keels on the humerals were absent (Plates XVI and XVII: Figure 1).

Keel characteristics were thought by Agassiz (1857: I, 382), and also Carr, 1952: 377), to be distinctive of major races: the Indo-Pacific was reported to

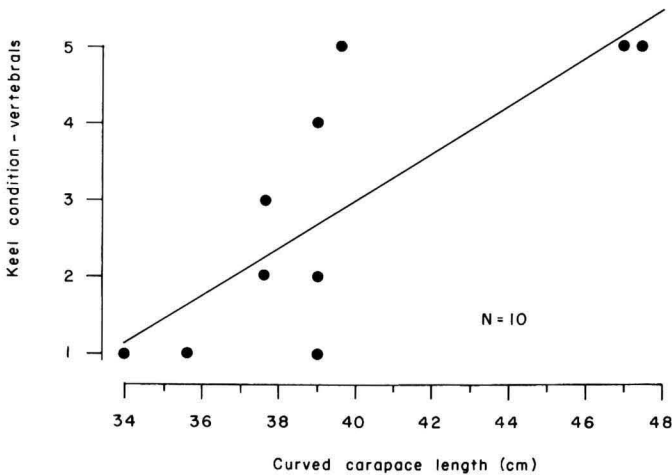


Figure 40 Relationship between condition of vertebral keels and curved carapace length in immature *Eretmochelys imbricata* at Comores: 1 - all with strong keels; 2 = all with keels, strong on 2nd to 5th; 3 = all with keels, strong on 3rd to 5th; 4 = all with keels, strong on 4th to 5th; 5 = keels on 2nd to 5th; least squares fitted line: $y = 0.31011x - 9.41434$, $r = 0.77209$, d.f. = 8, $p < 0.01$.

have more prominent keels in both carapace and plastron. Specimens from Aldabra (Frazier, 1971: 399), and Comores do not conform to Agassiz' description in regard to keels, and since the condition of this character is dependent on the size (and age?) of the animal, it is of little use in distinguishing populations.

Hatchlings. Those measured had typical scalation: they all had normal carapaces and plastrons; the intergular was large in all cases. Six animals each had four pairs of inframarginals and two other turtles each had three scales on one side and four on another. Six hatchlings each had three pair of axillary scales, and two other individuals each had two scales on one side and three on another. One pair of inguinals occurred in each of six turtles, and two other animals each had one scale on one side and two on the other. One hatchling was atypical in each instance, but the atypical condition was shared by three other individuals for each of the three scale types. Six hatchlings each had three pairs of postoculars. The postanal was of moderate size in five, and large in three hatchlings.

There were conspicuous keels on all pleurals. Neither the vertebrae nor the plastron were keeled.

Coloration

In all 10 immatures examined, plastron colour was yellow (Table 33). Seven animals had black centres to the intergulars and one specimen had two black spots in this scale. All eight of these animals had black centres to the scales in the axillary and inguinal areas. The carapace scutes were dark, mottled with grey, yellow and off-white. Dorsal scales of head and limbs were all black, outlined by light-coloured sutures or borders between scales (Plate XVII: Figure 2). This last feature is thought to be distinctive of the Indo-Pacific populations (Carr, 1952: 366). It has been reported at Aldabra (Frazier, 1971: 399), but is evidently not always present in turtles from the southern African region (Republic of South Africa, Mozambique and Madagascar) (Hughes, 1974a: 18). Animals with 'blond' or cream-coloured tortoise-shell may occur in Comores, but as elsewhere in the region, they must be rare.

Hatchling coloration was typical of *Eretmochelys*. The dorsal surface was reddish-brown while ventral parts were mat black. This pattern is the reverse of pelagic countershading, and suggests that *Eretmochelys* and *Chelonia* hatchlings have very different life styles.

Feeding habits

A preliminary analysis of the stomach contents of JFEi 21, an immature from Moihani, showed four types of sponges (Class Demospongiae): *Aaptos* sp. and *Tethya* sp. (Tethyidae), *Amphimedon* sp. or *Niphates* sp. (Niphatidae) and *Stelletta* sp. (Stellettidae) (K. Ruetzler, pers. com.). These findings are consistent with

those reported by Carr & Stancyk (1975: 162) – a preponderance of sponges and sessile, soft-bodied invertebrates.

Breeding Biology

Although most specimens were handled at Grande Comore, all information on breeding biology is from Mohéli. Nesting at Grande Comore is not likely to be successful with the large human population.

Nesting season. A Comorian on Mohéli informed me that ‘Nyamba’ nests from December to March, and this is consistent with my observations. Recent nesting spoor was recorded from 3 March (beach N^{os} 67 & 69) until 31 March (beach N^o 47) (Table 34). An emergence of hatchlings on the night of 26 Febru-

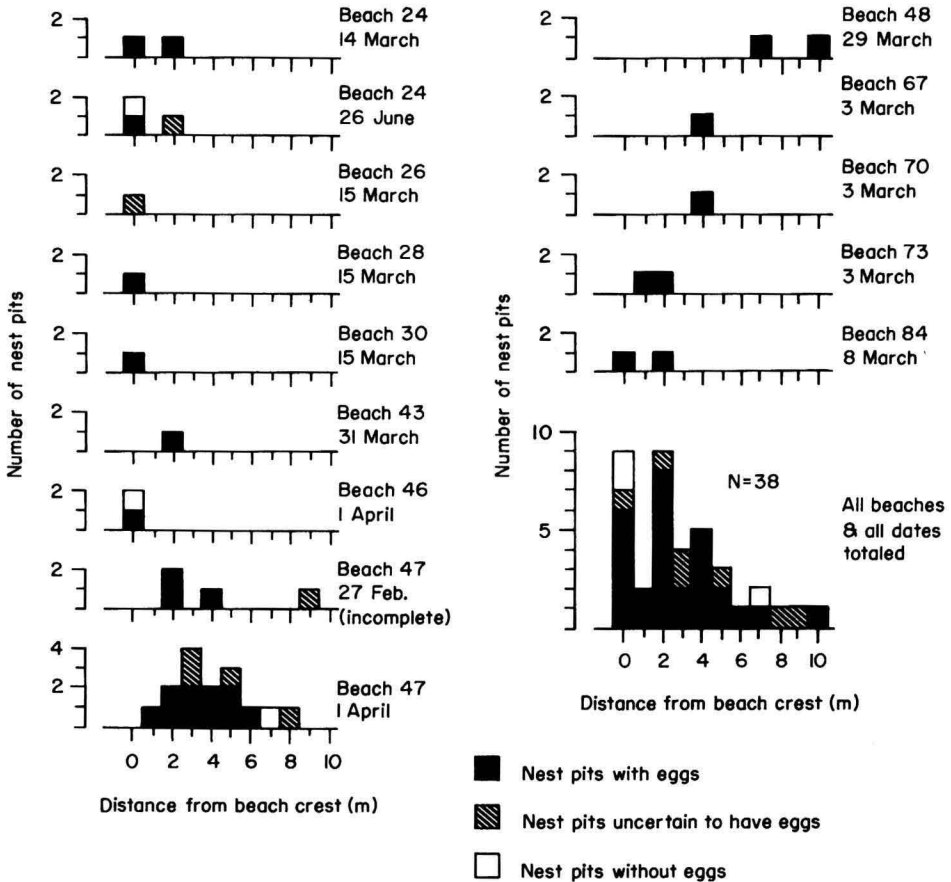


Figure 41 Distance from beach crest distributions of *Eretmochelys imbricata* nest pits from 12 beaches (two each with two dates of observation) at Mohéli, Comores (see also Table 34).

ary indicated a nesting around the end of December (assuming roughly two months for incubation and emergence). There was no sign of recent *Eretmochelys* nesting on any of the major *Chelonia* beaches visited in June. A possible record from beach 43b was made on 8 June 1973, but the beach was not examined from close up, and the tracks may have been from *Chelonia*.

On Mayotte recent nesting spoor was seen in April and May of 1972. At the end of April Dr. R. von Hentig caught a newly hatched *Eretmochelys* at Dzaoudzi, which probably came from a nest made in February or March. The nesting season of *Eretmochelys* at Comores evidently extends from late December, at the latest, until May.

Incubation and emergence success. The nest emergence that was recorded on 26 February took place between 19.00 and 20.30 hrs. Out of approximately 100 hatchlings, at least 10 were captured by *Ocypode* crabs; the remainder evidently made it to the sea (see Section on Non-Human Predation).

Nest Habitat Utilisation

Only 38 nest pits of this species were recorded on Mohéli (Figure 41). The majority occurred between the beach crest and four metres inland; only about 24% of the pits were from five to 10 metres from the beach crest. The mode was at two metres, and as with *Chelonia* there was also a mode at the beach crest. The data are too scant to suggest overcrowding, but this seems unlikely to occur in a dispersed nester like *Eretmochelys*.

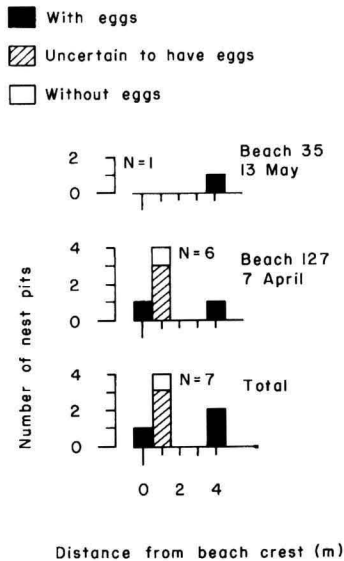


Figure 42 Distance from beach crest distributions of *Eretmochelys imbricata* nest pits on two beaches at Mayotte, Comores.

At Mayotte nesting was done in the first few metres above the beach crest (Figure 42). *Eretmochelys* may nest closer to the vegetation than do *Chelonia*; on Cousin and Maziwi Islands they seek out vegetation for nesting. Since both species nest on the same beaches, this would facilitate niche separation.

Unidentified Species

There is evidently a third species of marine turtle in the Comores, although no specimen was seen. Mr. A. Malida knew of 'M'Rouhie,' a type of turtle distinct from 'Dusi' and 'Nyamba.' It was characterized by having a remarkable beak. A carcass that washed up on a beach (evidently near to Nioumachoua, Mohéli) was eaten by crows (*Corvus albus?*), which died shortly thereafter. From this, the animal is said to be so poisonous that even touching it could be fatal (see Section on Ethnographic Features). Since *Dermochelys* is occasionally reputed to be poisonous (Halstead 1970 (III): 618 ff.) and does have a unique beak, it conforms to this sketchy description. That this is the most pelagic and wide-ranging of all turtles makes it likely to occur as a vagrant. The name 'M'Rouhie' is not obviously related to any other names from the region.

At Saziley village in the southeast of Mayotte, I was told of three types of turtle: 'Kasa,' 'Nyamba Malé' and 'Roya.' The first two names are commonly used for *Chelonia* and *Eretmochelys*, respectively; the third name is phonetically very similar to 'M'Rouhie'.

NON-HUMAN PREDATION

The beaches of the Comores are subject to rather heavy predation, considering these are oceanic islands. *Ocypode* spp., ghost crabs, were recorded on more than half the beaches of Mohéli that also had turtle spoor, and some beaches had as many as three species of crab (Table 2). *O. ceratophthalmus* (Pallas) and *O. madagascariensis* Crosnier (or *O. kuhlii* De Haan) were seen on the littoral beach face. *O. cordimana* Desmarest was thought to be the third species, occurring in the supralittoral. *Ocypode* sp. were also observed on Grande Comore (Table 1) and Mayotte (Table 4), and they are expected to occur on Anjouan.

No turtle nests tunnelled with *Ocypode* burrows were recorded, but egg predation by the crabs is likely to occur. Crab predation on emerging hatchlings of both *Chelonia* and *Eretmochelys* was observed. The tracks of approximately 100 hatchlings that had emerged from under a *Colubrina asiatica* Rich. bush,

three to four metres from the beach crest were recorded on 26 February 1972 at 20.30 hrs. on beach 47, Chissioua Ouénéfou. At least 10 hatchlings were taken by ocy-podes; both *Ocy-pode ceratophthalmus* and *O. madagascariensis* were found with dead or nearly dead turtles. Several of the *O. ceratophthalmus* were buried in the sand, each beside a hatchling. All hatchlings showed head damage, and many of the heads had been crushed from the side, notably near the eyes (cf. Hendrickson, 1958: 521). This predation occurred despite the fact that three dogs had been running on the beach and must have frightened the crabs.

On 31 March 1972, *O. ceratophthalmus* were seen preying on hatchling *Chelonia* on the other side of Chissioua Ouénéfou, at beach 45 (Table 29). At about 18.15 hrs. two crabs approached the site of an emerging nest from which 10 hatchlings had already left and about 50 others were soon to leave; several turtles were exposed on the surface of the sand. One crab passed them by, less than 1 m away. The other moved cautiously toward the depression with turtles and clasped the flipper of one in its chela (I then interfered and rescued the turtle). Minutes after the initial crab attack, the nest emerged and approximately 50 turtles went directly to the sea. About five crabs moved to intercept the turtles and three or four succeeded in capturing a hatchling (again, I interfered and rescued the turtles).

The night of the 31st another nest emerged and the next morning one *Ocy-pode* was seen with an object thought to have been a turtle; it was chased by a crow which stole the object.

Ocy-podes patrol nesting beaches from dusk to dawn, with variations in activity dependent on tide. From the above accounts of their predation, it seems they may take about 10% of the hatchlings, but this predation rate will depend on number of hatchlings and number of crabs involved. On the whole, the crabs may not be inflicting serious damage on the population, for they are likely to be more successful with the individuals that are weak and probably doomed anyway.

Hughes (1974b: 10, Table 3) presents data on *Ocy-pode* predation on *Caretta* emergences in Tongaland, Natal. He found that there was tremendous variation in rate of predation. Although the crabs are important predators, they were particularly successful with the animals that are weak and unable to orient well. Frith (1975) reported predation by *O. ceratophthalmus* on *Chelonia* hatchlings at Aldabra, and it is also reported from Yemen (F.A.O., 1968: 16; Hirth and Carr, 1970: 16).

One Tabanid fly was collected while feeding from the carapace sutures of female JFCm 713, as the turtle completed her nest covering on Chissioua Ouénéfou the morning of 1 April. *Neavella albipectus* (Bigot) was recorded on nesting females on Aldabra (Frazier, 1971: 394). Its effect on the turtle must be minimal, for the fly feeds on diurnal, terrestrial prey; there are few turtles that meet these requirements.

Two other types of dipteran were seen on beach 45 on 31 March. Both oviposited within a cm of exposed hatchling *Chelonia* at about 17.30 hrs., before the main emergence. Presumably one of these flies is a nest parasite; the other may be a parasite on the first. From the damage that occurs to nests on some of the major beaches of Aldabra, dipteran nest parasites can be of considerable importance.

Varanus lizards, although important nest predators on mainland Africa and India, do not occur in Comores.

Frigate birds, *Fregata* spp., are known locally as 'M'Chaco', the general name for large seabirds. Previous records in ornithological publications indicate that frigates concentrate on the two main seabird islands off the south of Mohéli: Chissioua M'Chaco in the east, and Chissioua Magnougni in the west. Records from Grande Comore are few, and from Anjouan, even fewer. Birds are seen at sea, between the islands (Benson, 1960: 104; Pocklington, 1967: 40-41; Forbes Watson, 1969: 8). Previous records were made in the months of September and October. My own sightings are from January to June. The greatest concentrations, of some hundreds of frigates, were seen in March off Chissioua Magnougni. Both *F. minor* (Gmelin) and *F. ariel* (G. R. Gray) were recorded. Breeding is not documented in Comores, although it may well occur.

These birds are efficient predators on emerging and swimming hatchlings and can completely eliminate the entire number that emerge from a nest (Hughes, 1974b: 11). However, their activities are restricted to daylight hours, so their overall effect may not be of great significance as most emergences are nocturnal. Furthermore, the concentrations of birds in March probably occur after the peak in *Eretmochelys* hatching and before the *Chelonia* peak. No predation by frigate birds has been recorded in Comores, but it is likely with the birds concentrated near the major nesting beaches in the south of Mohéli.

The Grey Heron, *Ardea cinerea* L., is known on Mohéli as 'Konogondro'. Benson (1960: 31 ff.) recorded it from all of the Comoro islands, mainly at sea level. He indicated it was least common on Grande Comore and most common on Anjouan. The species is clearly resident, although breeding is as yet undocumented. My records are only from Mohéli, but they indicate that the bird occurs all around the Island. Records from nesting beaches are common, especially on Chissioua Ouénéfou where the species was seen from February to June. They evidently fly to beaches around dusk and seem to remain active well after sunset. I suspect they patrol beaches and prey on hatchlings as they emerge, but this was not actually observed. The bird is large and powerful; its crepuscular habit and large size may make it an important potential predator on emerging hatchlings.

The Black Kite, *Milvus migrans* (Boddaert) is generally common throughout the Archipelago and there may be migrant as well as resident populations (Benson, 1960: 36). My records include the west and southwest of Grande Comore

and the South of Mohéli, notably the offshore islands. It was seen from January to June. Benson saw mainly solitary birds, but many of my sightings involved several birds.

A nest emergence was watched on 31 March 1972 on beach N° 45, Chissioua Ouénéfou (Table 29). The first turtle to leave the nest was seen at 12.00 hrs, but it was not until 16.00 hrs, after three other hatchlings had emerged, that predatory birds were seen. Kite predation on hatchlings was recorded at 16.25, 17.00 and 17.05 hrs. Three of 10 hatchlings that left the nest before the main emergence fell prey to *Milvus migrans*. None was taken during the main emergence, but this was probably due to my presence on the beach. These birds are not likely to exert a major predatory pressure; they are limited to the diurnal period and are generally dispersed.

Hughes (1974b: 10) mentions that the related *Milvus aegyptius* (Gmelin) occasionally takes *Caretta* hatchlings that emerge by day in Tongaland, Natal. It seems not to be a major predator.

The Barn Owl, *Tyto alba* (Scopoli), is known as 'Bunde' (or 'Bunde Sera'). It is recorded from all islands in the Archipelago, and while there are no breeding records, it is clearly resident (Benson, 1960: 59 ff.). My records are from Chissioua Ouénéfou and M'Samouheo, Mohéli, between February and June. A crepuscular predator with catholic feeding habits, it is suspected to take hatchlings, especially since it occurs near major turtle nesting beaches. The over-all effect of the species is not likely to be great, as the birds are well spaced out.

The Pied Crow, *Corvus albus* Müller, is called 'Gawa'. Benson (1960: 87) reported it as common throughout the Archipelago and documented nesting on Mayotte. My records list it from the west and southwest of Grande Comore and right round Mohéli, including most of the major nesting beaches, which they evidently patrol. Hatchling predation was recorded on 31 March 1972 at beach 45, Chissioua Ouénéfou (Table 29). Of ten hatchlings that emerged between 12.00 and 18.15 hrs, one was taken by a crow. The next morning a crow stole what appeared to be a hatchling from an *Ocypode* crab. On 25 June, on the same beach, a hatchling carcass was found with crow tracks, and its condition was similar to that of crow-eaten hatchlings seen on Aldabra. This is a diurnal bird, so its predation on hatchlings would be limited to daylight emergences. Frith (1975) reported predation by *Corvus albus* on *Chelonia* hatchlings on Aldabra.

The Heron, because it is large and nocturnal is probably the most important single threat, but all of these avian predators taken together could exert considerable predation pressure, if several species work a beach at the same time.

Feral dogs, *Canis familiaris* L., are known as 'Mbwa'. They were not recorded from the beaches of either Grande Comore or Anjouan, but they probably occur. At Mohéli they were especially important nest predators, although there were no signs of dogs on any of the offshore islands. On 3 March 1972

at M'Sanga Nyamba in the southeast (N° 67), 10% of the nest pits thought to have eggs had been dug out, apparently by dogs. On Tsinavouni North (N° 65), two of 11 nests thought to contain eggs, nearly 20%, were dug up by dogs. The dogs were particularly active in this part of the island, and packs were said to kill goats. Fresh spoor was seen only in the southeast of Mohéli, but dug out nests were recorded on most beaches, except those on the offshore islands (Table 2). Because they were able to locate and dig up nests, feral dogs were the most important predators on the main island. A pack of dogs might be able to successfully attack a nesting female, but I know of no evidence for this.

Dog tracks were recorded on 36 of all Mayotte beaches examined. Eight of the 19 beaches with nesting spoor had nests dug up, probably by dogs. These introduced, feral mammals are probably the most important non-human predators on turtles on Mayotte.

Feral dogs are reported to be important predators on mainland Africa (Hughes, 1974b: 10), Arabia (F.A.O., 1968: 16; Hirth & Carr, 1970: 16) and Pakistan (Salm, 1975a: 7; 1975b: 56).

Cat-like animals, probably genets (*Genetta* sp.) in the main, were found generally around the islands. Their spoor was not recorded on beaches of either Grande Comore or Anjouan, but they were expected to occur on both islands' beaches. A third of the Mohéli beaches, including those on offshore islands, had clear footprints (Table 2). Cat-like tracks (*Genetta*?) were recorded on 22 of 129 beaches that were examined on Mayotte. No direct evidence of predation was recorded, but these are swift and efficient predators and could cause havoc at an emergence. There seems to be no displacement by dogs, for spoor of both was commonly seen on the same beach. The 'genets' may be digging up nests in parts of the island where dogs are not common. Hughes (1974b: 10) recorded predation on *Caretta* nests by *Genetta rubiginosa* Pucheran, and by the mongoose *Atilax paludinosus* (G. Cuvier) in Tongaland, Natal. Apparently their role is minor. In Kenya, viverrids destroy nearly all nests laid on the mainland (Frazier, in prep.).

The large predatory fishes that abound on Mayotte's reefs are likely to prey on sea-going hatchlings. At the other islands there are smaller fish populations, so they are likely to be less significant.

Predation by all of these animals, except the feral dogs, is 'natural,' and turtle populations have survived for untold ages with these pressures. Control measures are unwarranted and unlikely to be successful, except with the feral dogs, where control programs are not only warranted but needed.

HUMAN PREDATION

Turtles are killed throughout the Comores, and while this is widespread and common, the pattern of exploitation is complex. The eating habits of the Comorians are inhibited because of Moslems beliefs, but there is considerable variation in their habits (see Section on Ethnographic Features). Thus, the people of two villages less than 1 km apart may behave very differently in regard to marine turtles: they may exploit them freely, or they may refuse to even touch them.

When exploited, turtles are nearly always captured while nesting. I was told that copulating animals at the surface could be captured by approaching cautiously in an outrigger canoe and fastening a noose round a flipper. It would be difficult: first, not to frighten the animals and second, not to capsize once the noosed animal sounded. This technique cannot be very successful, or very effective at taking large numbers. Immatures are taken in nets, but usually this is accidental. Small animals may be shot with spearguns, but it is mainly the non-Comorians who have access to these weapons. Petit (1930: 233) claimed that catching turtles by remora sucker fish was practised at 'Moroni' (probably an imprecise reference to Grande Comore or to the Comores in general), but I have no evidence, either direct or verbal, of this practice.

At Grande Comore, where there has been a ready market for the sale of non-comestible turtle products to non-nationals, *Eretmochelys* are captured for sale. There is little demand for this turtle at Mohéli, but there may be a small market at Anjouan. It is unlikely that 'M'Rouhie' would meet with any direct predation, unless it were tangled in a net.

Chelonia is generally taken whenever it is available. The unsophisticated capture techniques are coupled with unsophisticated and wasteful slaughter techniques. Eggs, both shelled and unshelled, flippers, neck, tail and calipee are almost always left on the beach to rot, and often there is a large amount of muscle left in the discarded carapaces (Plate IX: Figure 2). Nine of 13 recent carcasses that were observed on 24 June 1972 at Mohéli beach number 67 had about half of the easily consumable meat wasted. All of six recent carcasses seen on 27 June at beach number 12 were also poorly slaughtered with a great amount of waste.

Rate of predation is variable. On the densely populated and protein-lacking islands of Grande Comore and Anjouan, few nesting turtles would be spared in spite of the fact that very few nest. Comorians and turtles alike fare much better on Mohéli. Yet, predation rate is highly variable from one beach to an-

other and from year to year. Of the 30 beaches on Mohéli with *Chelonia* nesting spoor, 14 had remains of slaughtered turtles and/or bones. Five other beaches had no signs of nesting, but all of these had remains of slaughtered turtles and/or bones (Table 9).

These last five beaches included numbers 13, 22, 38, 59 and 60. The remains of turtles were: a site of old bones, an animal that 'washed up dead', two animals brought in (probably from the offshore islands), an old plastron, and an old carapace. On none of these beaches was there evidence of any significant or recent slaughtering of animals. None of these beaches seems to have a nesting population, so they have not been included in the estimation of predation rate at Mohéli.

Active predation of *Chelonia* at Mohéli is concentrated on twelve beaches (Table 35). These beaches occur all around the Island, and include all the major nesting beaches – with the exception of number 45, on the west side of Chis-sioua Ouénéfou. Neither of the other Ch. Ouénéfou beaches (numbers 46 and 47) had predation of significance.

There are no figures on rate of exploitation for any of these beaches. An estimate had been made, based on: the number of carcasses found after several visits, proximity of potential turtle hunters, and any local information on the turtles of specific beaches (Table 35). These estimates are very rough, and should be taken only as a preliminary guide. Estimated rate of exploitation varies from 1 to 35% of the estimated annual nesting population on the respective beach. The estimated annual crop at Mohéli is 185. This represents 13% of the estimated annual nesting population from all those beaches with predation and 10% of the estimated total nesting population at Mohéli.

At Mayotte, turtles are evidently killed wherever they are encountered. Bones of sea turtles were seen on 12 beaches, four of which had no sign of nesting. *Chelonia* remains were far more common, occurring on nine beaches while *Eretmochelys* bones were on three. Some bones had knife marks, and the turtle remains found on beaches were assumed to have been left after the animals had been killed by people.

Although slaughtered turtles were found right round the Island, it is difficult to know who is killing them. Those people from villages speaking a Malagassy tongue usually eat turtle meat (as well as many other things seemingly strange for Moslems); but many of the 'Maori' people not claiming descent from the Malagassy and speaking a Swahili tongue, will not eat turtle. The animals were not necessarily killed by the people living closest to the site of the slaughter. Inhabitants of the Malagassy villages of M'Zamboro and M'Jago in the northwest are said to hunt turtles at Saziley in the south and Pamanzi in the northeast; they may actually camp on these beaches for a few nights while hunting.

Not only *Chelonia* are killed for food, but some people at Mayotte claimed to prefer the meat of *Eretmochelys*. Most slaughter is for personal or family use,

but there are small markets for meat and tortoise-shell (see Section on Commercial Exploitation).

There are no sophisticated techniques for catching turtles at Mayotte; nesting females are simply turned on the beaches. Some animals may be captured at sea with nooses or spear guns, but not many. The use of remora sucker fish, documented in other parts of the region, was not seen or heard of.

The predation at Moya and Papani beaches was some of the most intense in the Archipelago. Between the 7th of April and the 7th of June, a period of 61 days, at least six *Chelonia* were killed on South Moya beach, and three were killed on North Moya (Table 14). Over a two-week period, from 28 May to 10 June, two *Chelonia* were killed at South Moya, and five or six, at Papani beach (Table 15). During six of the 14 nights that I was at Moya, men patrolled the beaches for turtles, killing two of the seven females that came to this beach to nest, or 29%. Because I was working the beach nightly and claiming turtles of my own for measuring and tagging, I was displacing and competing with the turtle hunters. One night I claimed both turtles that nested, and on another night I claimed one of two; on both of these occasions I prevented the fishermen from killing turtles. Hence, the total number killed at Moya might well have been four or five out of seven, or 57% to 71%.

During the same period at least nine animals came to Papani beach and five or six of these were killed. This represents 56% to 67% of the females that arrived to nest.

Whether or not these figures are representative of an average two-week period is unknown, but another factor must be considered: a female does not simply come to a beach, nest and go away. More than half of the nests made on Pamanzi are without eggs; a female may make several nesting attempts before succeeding, and this may take her to the beach several times. In addition, a female may lay not one but two or three clutches in a season. The predation rates reported here are for a single night, not for a season. Every time a female returns to a beach to attempt to nest, she is exposed to the average nightly predation rate. If the average female crawls out onto a nesting beach with a 50% predation rate four times in a season, her chances of surviving through the nesting season are 6% ($= 0.5^4$).

This low rate of survival is coupled with wasteful practices in processing turtles. Usually turtles are slaughtered before they lay eggs, and eggs were almost always discarded. The flippers, neck, tripe and less accessible muscles were always wasted and sometimes 75% of the turtle, including easily accessible meat, was left on the beach to rot.

It must be emphasized that the above estimates are rough. No information comparable to this exists for any other population, and further work in Comores is needed to establish reliable estimates of predation rate.

EPIZOA

Encrusting and filamentous algae were common on *Eretmochelys*. Green filamentous algae also occurred on some *Chelonia*, but systematic records were not kept. Leech and their cocoons (*Ozobranchus* sp.) were found on nesting *Chelonia* at Mayotte.

Barnacles were recorded on one immature and on 10 of the 59 female *Chelonia* handled at Mohéli; they were also on nesting females at Mayotte. Scratched carapaces (Plate XVIII: Figure 1) indicate that barnacles might be knocked off females by mating males, and the occurrence of epizoa, thus reduced. Eight of the 10 immature *Eretmochelys* examined had barnacles; a dead *Eretmochelys* female at Moya had a heavy infestation of *Chelonibia* sp. on the carapace (Plate XVIII: Figure 2). However, observations on the cirripeds were not systematic, and the frequency of their occurrence is greater than indicated by these figures. *Chelonibia testudinaria* (L.) and *Platylepas hexastylus* (O. Fabricius) were recognized, but other species also occur. The numbers of barnacles per turtle ranged from half a dozen to hundreds. There was evidence of niche separation in the distribution of different species of barnacle on specific parts of the turtles (Frazier, in prep.).

Male *Chelonia* seen while skin diving at Mayotte, commonly had remora sucker fish attached to the shell (see also Fourmanoir, 1956: 222). All of these symbionts are common on sea turtles in many parts of the world.

HABITAT DEGRADATION AND DESTRUCTION

Habitat degradation through non-human agents does not seem to be a major factor in the Comores. Beaches must experience seasonal changes in sand movements, but nowhere do these seem to involve large alterations in beach character. Some beaches have zones of beach rock exposed in the littoral beach face, but on the whole these deposits do not seem to be common. The uncovering of what beach rock there is does not create significant barriers to the nesting turtles. Erosion at the beach crest occasionally produces vertical sand cliffs, but rarely are these insurmountable to a turtle.

Erosion of beaches is common at Mayotte, but not of great importance. Listings in Table 4 represent the highest erosional faces visible on each beach, but with few exceptions most of the beaches were stable. Occasionally beach rock, cobble or boulders littered the littoral beach face either preventing or impeding turtles from ascending, but usually the central area of the beach had free access. In general, non-human degradation seemed to be unimportant.

Human disturbance to nesting habitat is concentrated at villages where it is of some importance. The people of Anjouan and Grande Comore favour building houses with rocks and blocks rather than with mud and wattle. The cement for construction is obtained from the limeing of coral, and the coral is collected from live reefs. Mounds of coral or lime are very common in the Mutsamudu area of Anjouan, and it is a wonder that after generations of such exploitation that there is any living coral of significance remaining. Indeed, the west side of the north point of Anjouan is remarkably bare of coral, but it should be pointed out that not all corals are used in limeing.

Destruction of live reefs is the most important form of habitat destruction in the Archipelago, and it is most intense at the islands with the smallest apparent turtle populations. What effect it has on feeding habitats of *Eretmochelys* is unknown, but textural variation and community structure must be greatly simplified by this form of exploitation.

Siltation of reefs and marine pastures may be important on the high, heavily populated islands of Grande Comore and Anjouan. It is not likely to be a major factor on Mohéli or Mayotte which have low and well vegetated slopes that are not badly denuded; their abundant mangrove forests would help to settle out silt that does get washed to the sea.

Beach development is, likewise, most pronounced on the most populated islands; at Mohéli and Mayotte it is hardly significant. For example, beach 35 at Saziley village is one of the most important nesting beaches on Mayotte. Many large villages on Grande Comore and Anjouan are on, or close to, beaches, and while there is no major form of beach destruction, the mere presence of large numbers of humans is deterrent enough to the turtles.

Night fishing with pressure lamps is popular, especially at Grande Comore and Anjouan – so much so that a barely inhabited coast can appear to be a large city from the sea! It is said that turtles are often attracted to these lights. Disorientation of this type may not be of great importance to adults or immatures, but it could be fatal to hatchlings, slowing them and disorienting them on their critical journey to the open ocean and putting them in areas of potential predator concentration, e.g., along Mayotte's barrier reef, where this form of fishing is also common. As with other forms of human disturbance, this practice is not common at Mohéli.

In total, there is not a major problem in degeneration and destruction of turtle habitats at Comores, for it is least in evidence where it would be most critical.

COMMERCIAL EXPLOITATION, PAST AND PRESENT

In discussions of turtle trade, the Comores are rarely mentioned. Their importance has been overshadowed by the other more productive or more enterprising territories in the vicinity. Although Comores have one of the largest *Chelonia* nesting populations in the eastern Africa area, there is not the organization for slaughtering, preparing, transporting and marketing turtle products.

Past Exploitation

Despite the size of the *Chelonia* population there is no evidence that Comores has ever had anything but an incidental trade in this turtle. The historic trade in *Eretmochelys* is difficult to define, for there are no definitive records for the Comores alone. Parsons (1972: 52) in a review of the world tortoise-shell trade, suggests that these islands were important exporters, but he alludes to the problem of export statistics being mixed with those from Madagascar. Thus, he states that in 1863 more than 3,000 kg were exported from Madagascar 'and such offshore islands as Comores and Nosi By' (= Nosy Bé).

Unfortunately, import records from Zanzibar, although detailed, are just as mixed. In 1891, 1892 and 1894 (I have no records from 1893 or other years not mentioned in the span of years under discussion here) imports are listed from 'South' or 'Southern Ports and Islands'; this includes Ibo, Mozambique, Zambezi (all localities in present-day Mozambique), Comoro and other French and Portuguese possessions, including Madagascar (Great Britain, 1892-1894). It is impossible to determine what portion of these exports (Table 36) were from the Comores especially since major producers such as Madagascar and Mozambique are included.

The Zanzibar Blue Book (1917; 1918) lists imports from 'Madagascar and Comores' for the years 1916 and 1917 (Table 36); from 1920 to 1965 Madagascar is listed alone, and Comores is not mentioned. Comores are not ever listed in the F.A.O. Yearbook of Fishery Statistics (FAO, 1969-1978). Although Madagascar is listed in recent records of imports into Hong Kong and Japan, Comores is not.

Because of the administrative link to Madagascar, Comores were considered a dependency and therefore a part of Madagascar. To extract the specific export figures for Comores would be an involved project – if indeed it is now possible. Nevertheless, it does seem likely that the islands once produced significant

quantities of tortoise-shell; the size and richness of live reef at Mayotte probably supports a large population of *Eretmochelys*, and possibly after the French occupation in the 1800's some large crops were taken.

Present Exploitation

The turtle fishery in Comores is of little importance today. There is no *Chelonia* trade of significance at either Grande Comore or Anjouan. On Mohéli, a man was said to butcher nesting females at M'Sanga Nyamba in the northwest (N° 8) and pack the meat into Fomboni, some 15 km by donkey. He probably slaughtered one or two animals per week during the peak nesting season (Table 36). At M'Samouheo in the northwest (N° 12) and M'Sanga Nyamba in the southeast (N° 67), turtles were killed only for consumption in the two villages near each respective beach. *Chelonia* killed at Moya, Mayotte, are mainly for personal consumption, but occasionally a portion of the meat may be sold in the village of Labattoir. Salted meat is sometimes exported from M'Zamboro to other islands in the Archipelago, but the quantities probably never exceed 100 kg.

Eretmochelys are killed for tortoise-shell, and in 1972 this was said to bring a fisherman on Grand Comore about 500 CFA per kg (U.S. \$2.50). On Mayotte it was sold to Indian merchants for 300 CFA (US \$1.50)/kg. The pleural and vertebral scutes were the only parts collected. The present-day tortoise-shell trade in Comores is not of great importance, but prices have risen substantially in recent years, and there should be greater stimulus to market all the scutes now.

Small turtles are bought by expatriates, preserved with injections of formaldehyde and varnished for display as trophies; a fisherman could make as much as 3,000 CFA (U.S. \$15.00) on small intact animals, either *Chelonia* or *Eretmochelys*. At Mitsamiouli, on the northwest of Grande Comore, the owner of the Hotel Maluga bought turtles of either species for about 750 CFA (U.S. \$ 3.75). After injecting them with formaldehyde, and perhaps varnishing, turtles could be sold to tourists for 2,000 to 5,000 CFA (U.S. \$10.00 – \$25.00).

Obviously the fishermen make more by selling directly to the expatriate or the tourist, but even selling to the hotelier is comparatively lucrative, for small *Chelonia* are of little monetary value otherwise. Tortoise-shell from the small *Eretmochelys* is not worth as much as the animal intact. An average-sized, mature animal may produce less than two kg of raw tortoise-shell.

The tortoise-shell trade of antiquity is now competing with the stuffed-turtle trade. However, the lack of figures on either makes it difficult to know how significant this competition is. I have not seen large stocks of turtles stuffed and ready for sale, as are conspicuous in shops in Madagascar. The stuffed turtle tra-

trade has reached tremendous proportions in some places (e.g., Maldives – see Colton, 1977), and this has displaced the traditional tortoise-shell craftsmen.

Nonetheless, it is urgent that at least the nesting populations of both species be monitored at least every few years. Attempts should be made to estimate sizes of other parts of the populations, and tagging studies should be initiated. The level of human exploitation should also be monitored.

There have been interests in ‘developing’ the turtle fishery in Comores (i.e., increasing the levels of exploitation and production); in preparing a report on marine turtles in the Comores, I was requested by FAO to discuss in detail ‘the potential for the development and improvement and projected economic impact.’ These details are in an earlier report (Frazier, 1977), and are summarized below.

The turtle fishery in Comores should concentrate on supplying a quality food to its indigenous peoples. There are many reasons *not* to develop an export trade in consumable turtle products. The complexities of providing for an export market in perishable foods are great, especially given the poorly developed systems of transportation and communication in Comores. The annual sustainable crop from the islands is not likely to warrant an export market. The Convention on International Trade in Endangered Species of Fauna and Flora (CITES) makes it unlikely that many of the conventional buyers for luxury goods would be able to legally import turtle products from Comores. Furthermore, and most relevant, there is a critical need to improve the diet of the local people, particularly with proteins. Any plans to develop an export trade must be shelved until a locally based trade is proven successful *and sustainable*.

I do *not recommend* interfering with the turtle fishery in Comores. This applies to both the Federal and Islamic Republic and the Département d’Outre Mer of France.

LEGISLATIVE MEASURES, PAST AND PRESENT

Evidently there is no legislation in the Comores relevant to marine turtles, and there never has been. Resolution J.O. 17/11/23, p. 856, of 24 October 1923 prohibited the capture of marine turtles when nesting or when the carapace was not greater than 0.5 m wide (as measured across the plastron) (Hughes, 1971: 6). This legislation was enacted in Madagascar when the Comores was their dependency. It is not clear if the legislation was meant to apply to these islands, but it seems never to have been applied, and it may be ecologically unsound to protect small animals.

In comparison, the dugong, *Dugong dugon* (Müller), is said to be protected by law, but no details are available.

Mayotte is now a French Department and should therefore abide by the CITES regulations accepted by that country. As France has CITES reservations on *Chelonia* and *Eretmochelys*, however, this does not restrict trade in these species. Furthermore, internal trade with mainland France is not affected, and Mayotte may be able to trade legally with other members of the European Economic Community.

RESERVES

There are no marine reserves in Comores. Forest reserves on the slopes of Kartala and on the other islands were defined prior to independence, but none of these reserves come near to the sea.

The island beaches and reefs of Chissioua Ouénéfou, off the south of Mohéli, would make an excellent reserve system. This would include three of the six major nesting beaches in the Federal and Islamic Republic of Comores together with some very rich reefs.

There are a few forest reserves on Mayotte, but apparently no marine reserves. As well as turtle nesting beaches, mangrove forests and coral reefs need to be protected from excessive exploitation and disturbance. Moya South is the site of an abandoned governor's cottage which would be valuable for guards protecting the Pamanzi beaches.

RECOMMENDATIONS

The first detailed data on marine turtles in Comores are a welcome change from the usual. The situation in the Federal and Islamic Republic of Comores is one of the most hopeful in the Western Indian Ocean Region. The nesting population of *Chelonia* is relatively large, yet it is little exploited in comparison with other populations. Feeding and nesting habitats are generally adequate for the turtles, and there is little disturbance by humans.

The situation with *Eretmochelys* is neither as clear nor as hopeful, but there is the potential for large feeding and nesting populations in the Archipelago. Because of its poorly known, and generally endangered status, this species is not likely to contribute to a sustainable fishery.

The situation at Mayotte, unlike that at Mohéli, calls for immediate remedial measures. The waste that occurs in slaughtering turtles is reproachable. Not only are the animals inefficiently used, but too many are killed. If one in 20 females survives a nesting season, the population is unlikely to sustain this level of exploitation for long.

Nesting females must be protected, and this is critical on the beaches of Pampanzi. These three beaches need complete vigilance and protection at least during the three or four months of peak nesting, and the French Government should provide this.

Once the killing of turtles is controlled, people will have greater reason to make use of what is slaughtered, rather than just removing a few choice cuts, but the practice of killing a reproductive female, weighing more than 100 kg, for just a few kg of meat is intolerable.

Both the breeding and exploitation of marine turtles at Mayotte needs to be carefully monitored. Surveys of the numbers nesting should be made at least every few years, and any form of sea turtle trade into or out of the Island must be compiled.

There is absolutely no rational way to 'develop' the turtle fisheries by increasing takes or markets. It is essential to develop a reliable estimate of population sizes and dynamics. Long term, baseline studies are needed.

GENERAL SUMMARY

The four volcanic islands of the Comoro Archipelago vary considerably in their respective altitudes, sizes, numbers and areas of beaches, extents and types of shallow water habitats, and coral reefs. Only Mohéli and Mayotte, the two older, lower islands, have large expanses of shallow water and also sizeable turtle populations. Although the Comores are not known for their marine turtles, two species are common: *Chelonia mydas* and *Eretmochelys imbricata*. Large marine pastures surround both Mohéli and Mayotte, but far more feeding habitat seems to be available at Mayotte, with its large lagoon and complex reef system. This island also provides the richest area of active coral reefs. Nesting habitat is abundant at Mohéli and Mayotte, but beaches are narrow. The turtles

that were observed at each of the islands have been treated as belonging to four separate populations, for in other studies there is evidence of little interchange between separate island populations.

Chelonia mydas occur at all four islands, and probably throughout the year. This species was most abundant, at least in breeding populations, at Mohéli Island; and there are important nesting beaches at Mayotte. About 2,500 females are estimated to nest annually in the Archipelago, nearly 75% on Mohéli. Nesting females at Mohéli averaged 112.3 cm in curved carapace length and those at Mayotte, 110.8 cm. Carapaces of hatchlings at Mohéli averaged 49.2 mm in length. Various body measurements show allometric change: narrowing of the carapace, shortening of the plastron, and narrowing of the head. Scallation of Comoro females is normal for the species, as is coloration. Few nesting females had injuries. Stomach contents showed a predilection for marine plants, typical of this turtle.

The breeding biology is apparently normal for the species: mating is evidently seasonal and most common at the beginning of the nesting season. The nesting seasons on Mohéli and Mayotte appear to be similar, and also comparable with the situation on Aldabra and in East Africa. The peak around May-June, corresponds with the onset of the Southeast Tradewinds and is apparently six months out of phase with the main nesting seasons on islands farther south. How these seasons are influenced by climatic, hydrographic, or planktonic variables is unknown, but strong relationships are expected between environmental variables and the timing of the nesting season. Clutch size averaged about 120, and several clutches are laid each season. Most nesting occurs in the first 5 m of the beach; successful nests are generally farther inland. Some Mohéli beaches were overcrowded with nesting *Chelonia*, and the main area of nesting may move seaward as nesting intensity increases.

Eretmochelys imbricata occur at all four islands. A small amount of nesting spoor was found on Mohéli and Mayotte, but most of these turtles were seen at Grande Comore. Only immatures and hatchlings were measured. Allometric changes were found: carapaces got wider, plastrons, shorter and heads, narrower. Scallation was normal for the species. Keel conditions are related more to size/age than to subspecific status. Stomach contents showed a preponderance of sponges, typical of this turtle.

The main nesting season seems to occur before that for *Chelonia*, usual for the western Indian Ocean. Nests are made in the first few meters of beach, frequently under vegetation; this is also characteristic of this species in this region.

A third species evidently occurs in the Archipelago; it is rarely reported and may be *Dermochelys coriacea*.

Non-human predation was more noticeable at Mohéli than at Mayotte. A variety of crabs, birds, and carnivores are thought to feed on turtle eggs and hatchlings, but feral dogs cause the most destruction on Mohéli. Natives also

slaughter nesting females, but the number killed yearly is relatively small. There was little evidence of non-human predators on Mayotte, but human predation on this island is intense and likely to have far more impact on the turtles than the 'natural' predation that occurs on Mohéli. Wherever it occurs in the Comores, human predation is wasteful, and in many instances, wanton. For this reason, the Mayotte population is evidently threatened.

A variety of epizoa, common to sea turtles, were observed on *C. mydas* and *E. imbricata*. Although beach erosion is common, habitat degradation is of little importance. Human destruction of nesting and feeding habitats is also relatively insignificant, because of the low level of socio-economic development.

There is no organized turtle fishery and most killing is for subsistence. Tortoise-shell has probably been collected and traded for centuries, but it is difficult to estimate the numbers of turtles killed or quantities of tortoise-shell produced. There is little chance, and *no reason*, to increase the numbers of sea turtles caught in the Comores (i.e., to 'develop' the fishery).

Apparently there is no protective legislation for turtles or turtle habitats in either of the two political states in the Archipelago. It is imperative that nesting beaches be protected from intense exploitation – especially on Pamanzi Island, Mayotte. As well as nesting reserves, marine reserves must be set up to protect feeding habitats and rich coral reefs. Regular monitoring of these populations, to establish population sizes and annual crops, is also urgently needed.

Perhaps the most challenging problem is whether or not the two political entities can work together efficiently toward a common goal. Unfortunately, there are few examples of this in the Indian Ocean (Frazier, 1980b), but the formation of the Indian Ocean Alliance for Conservation bodes well for a change in international attitudes toward these international resources.

ACKNOWLEDGEMENTS

The field work for this project was supported by a grant from the Fauna Preservation Society and METEO, Comores; I am also indebted to the many people who assisted in this work: Halidi Mohammed Abdullah and family, Professor F. Bourlière, Jean-Claud Boyer, Marimba, Nigel and Gwen Cornfield, Charles Deltour, Professor J. Dorst, Captain Garzensky, Dr. Roland von Hentig, Dominique and Théo Laurette and family, René Legrand and family, Armand Liénard, Inspector Loisance, Drs. F. and A. Malandain, Marcel Malick, Abdullah Moindraze, Jean Nicolla, Mr. Pichard, and Phillippe Richeux and

family. The write up was supported by the Indian Ocean Program of FAO/UNDP, the Fauna Preservation Society, and the Smithsonian Scholarly Studies Program (via Dr. J. F. Eisenberg). The New York Zoological Society and Office of Endangered Species helped pay for the copying of an earlier report (Frazier, 1977). The Chelonia Institute helped with photographic and publication costs. Publication costs were also supported by a generous grant from the Royal Embassy of Saudi Arabia, and I am indebted to His Excellency Bandar bin Sultan Abdul Aziz, Ambassador, for making this possible. Dr. G. Mace gave patient and lucid advice on statistics, problems of morphometric interpretation, and also provided analysis of co-variance programs, which J. Ballou adapted; I am grateful to them and to D. Dance and C. Roberts for assistance with computation and statistics; Christine Ryan and Sigrid James for help with illustrations; Christine Ryan, Wy Holden, Virginia Garber and Susana Salas for help with typing the manuscript; and Eloise Doane, J. Ragesdale and Susana Salas for help with word processors. Two people worked long and hard to edit the final MS and correct my errors: Dr. L. D. Brongersma and Susana Salas.

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APPENDIX I

Nesting activity on six major nesting beaches on Mohéli Island (see Table 9).

M'Sanga Nyamba (beach N° 8). This beach was inspected twice in 1972, on 24 February and on 27 June. On the first visit there were 20 nest pits, 11 thought to be with eggs and nine thought to be without. Ten recent sets of tracks crossed the beach. On the second inspection five months later, 63 nest pits were counted. Twenty-four had eggs and 37 did not. Two were questionable. (In other discussions only the numbers of nest pits thought to contain eggs and thought not to contain eggs are listed; nest pits uncertain to have eggs are not listed, but the total number of pits = number with eggs + number without eggs + number uncertain.) Forty-three recent sets of tracks were estimated to be on the beach. Because of the density of tracks it was difficult to read the spoor well, but I estimated that the tracks had been made over a two-week period, and that about half of them were associated with the 24 nests with eggs. It was thus estimated that about 12 nests per week were made on this beach or, in other words, about 1 1/2 nests per night. This estimate was supported by additional observations. Two gravid females (JFCm 857 and 858) had been killed the night of June 26, and one nest had emerged. If this intensity of nesting were maintained throughout the year, there would be about 600 nests annually. The February figures, however, indicate that there may be about half as many nestings per night in certain months, and activity may go even lower than this.

On 12 June 1973 this same beach had 69 nest pits, at least 32 with eggs and 31 without. There were 28 sets of tracks, and 15 were from one (or two) night(s) before. Between 30 and 45 nests were estimated to have been made in the last two-week period, so there seemed to be more intense nesting than in the same month the year before.

The total number of nests per year on M'Sanga Nyamba (N° 8) may vary from 600 to 1,000, depending on the year. Because these estimates were based on peak season activity, the lower figure is probably a better general estimate.

M'Samouheo (beach N° 12). This beach was inspected in greater detail than the above beach, although they are only 2.5 km apart. On 24 February there were 26 nest pits; 15 evidently had eggs and four were without. Ten recent sets

of tracks crossed the beach, and there had probably been about seven nests in the preceding week. On 9 and 10 March I camped on this beach. During this time nine females came ashore and at least five individuals were involved, for that many were tagged; the four animals not handled could have been other individuals or returns of the five. Only three nests were made during this 48 hour period, but this was undoubtedly due to the disturbance caused by my tagging activity (and my 'assistants'). There might have been two or three nests per night during this period.

On 27 June there were 54 nest pits; 30 were with eggs and 23 without. Three turtles had been on the beach the night before and eight other tracks remained from the preceding days. Only one nest was found from the night before and this was evidently without eggs.

Hence, there might have been two or three turtles nesting nightly at one point in the season (March to June) and only one at another (February); possibly there are fewer at other times. There could be about 600 nests in a year.

This beach showed a reduction in nesting activity on 11 June 1973. There was a total of 46 nest pits, and only 18 were estimated to have eggs; 28 evidently did not. About 23 sets of tracks crossed the beach, and these had been made in the last fortnight or so. If there had been ten nestings in the past two weeks, there might be only 250 nests per year. Both years combined indicate that there might be less than 600 nests annually.

Chissioua Ouénéfou, west beach (beach N° 45). On 27 February there were 40 pits; 19 seemed to have eggs and 17 did not. There were recent tracks, but these were too confused to read. On the night of 31 March two females laid and there were emergences of hatchlings from two nest sites; two females also laid on the night of 30 March. On this date there were 60 nest pits; 34 with eggs and 15 without. On 25 June 39 nest pits were recorded. Nineteen were with eggs and 17 without. There were 25 sets of tracks made over the past week or so and another five made the night before; one turtle had laid eggs. There had also been two nest emergences the night before. It is curious that there were fewer nest pits in June than there had been in April, but this is a beach with much activity so it was difficult to read the spoor accurately. The sand was churned up so that many nests were obscured by subsequent nesting. Nevertheless, it seems that two nestings a week was common at least from February to June. On this basis, there were estimated to be 600 annual nestings.

On 10 June 1973 there were 43 nest pits, 20 with eggs and 21 without. There were about 28 sets of tracks that had been made over the past week or two. Nesting activity seemed to be down from the year before, with perhaps seven nests a week (or fortnight), and it was estimated that there might be 300 nestings yearly. However, this single estimate for 1973 is of limited value, especially on such an active and crowded beach.

Chissioua Ouénéfou, north beach (beach N° 46). On 27 February there were

two recent sets of tracks, but otherwise little evidence of recent nesting. On 1 April there were 20 nest pits; nine with eggs and eight without. There had evidently been a nesting the week before. On 25 June there were 67 nest pits, 34 with eggs and 31 without. There had been four nestings the night before. Thirty-nine sets of tracks crossed the beach, six had been made the night before.

The nesting activity on this beach varied from nil to four per night. If the average over the season was between one and two nests per night, there might be 450 nests annually.

A year later, on 11 June 1973, there were 92 nest pits, 21 with eggs and 58 without, a very high proportion of abandoned nest pits. Twenty sets of tracks crossed the beach, and these had evidently been made in the last fortnight. It seemed that there was not much more than one nest a night on average, or 450 nests a year.

Chissioua Ouénéfou, northeast beach (beach N° 47). On 27 February there was evidence of two *Chelonia* having nested two nights before. A portion of the beach (the southern tenth) had 31 nest pits, seven with eggs and 15 without. This low proportion of good nests may not have been representative of the entire beach. On 1 April there were 108 nest pits, 60 with eggs and 26 without. However, nearly one third of the nests thought to have eggs were old, made the year before, perhaps. Although there was one nest without eggs from the night before, there had been few recent nests in the month of March. On 25 June there were 114 nest pits, 82 were with eggs and 29 without. Twenty sets of recent tracks crossed the beach, and six others had been made the night before, but only two animals had laid. Also, there had been four emergences of hatchlings in the past few days.

As with the north beach of the island, there was considerable variation in nesting activity, with daily numbers varying from nil to two. Throughout the season the daily average could not probably be greater than one or two; the estimate was not more than 450 nests per year.

On 10 June 1973 activity was greater than that observed the year before. Over 40 sets of tracks crossed the beach, and most had been made in the last week or two. There were 139 nest pits of which 53 were thought to have eggs; 78 evidently did not. It was difficult to estimate the 'average' daily complement, but there did not seem to be more than two successful nests per day. If this rate were maintained (which is improbable) there would be 600 nests yearly.

M'Sanga Nyamba (beach N° 67). This is the most important beach in Comores. On 3 March there were 165 nest pits; 99 were with eggs and 34 without. One turtle nested on 1 March, and seven beached the 2nd, but only two nested. The last few days in February, six or more animals had nested and two had been slaughtered, but there were many other carcasses about. On 24 June there were 270 nest pits; 131 with eggs and 90 without. The preceding night there

were perhaps seven emergences of nests and 14 beachings, of which 11 turtles were tagged. It was thought that at least 14 females had beached. Only two nested, but certainly they were disturbed by my tagging and measuring activities. There were signs of about 17 nest emergences from the preceding few days, but only one nest had evidently been made the night of 22 June.

The number nesting nightly on this beach varied from two to seven. If the average over the season was five nests per night, there might be 1,800 nests in a year. Unfortunately, this beach was not surveyed in 1973.

APPENDIX II

Collections in the National Museum of Natural History, Washington D. C.

Specimens of *Chelonia mydas* (L.) and of *Eretmochelys imbricata* (L.) from the Comoro Archipelago have been deposited in the Division of Amphibians and Reptiles, National Museum of Natural History, Smithsonian Institution, Washington D.C. In the following lists the Museum's collection number (USNM) is given, together with the collector's field number (in parentheses), for each specimen; 'no #' indicates no field number.

Chelonia mydas (L.)

Grand Comore. One immature skeleton: USNM 231560 (JFCm 787/BZ); and one adult (?) male skull: USNM 231561 (JFCm 862/BW).

Mohéli. Seven wet hatchlings: USNM 231565 – 231571 (JFCm 775 – 781); one dry yearling: USNM 231584 (JFCm 752); one dry immature: USNM 231581 (no #); twelve adult (?) skulls: USNM 231564 (JFCm 919), USNM 231572 – 231580 (no #, JFCm 795/I, 796/J, 850/BK, 851/BL, 853/BN, 855/BP, 856/BQ, 861/BV), USNM 231582 – 231583 (JFCm 798/M, 799/N).

Mayotte. Twenty-six adult (?) skulls: USNM 231587 – 231589 (JFCm 801/P – 803/R), USNM 231590 – 231591 (JFCm 819/AH – 820/AI), USNM 231592 (JFCm 830/AQ), USNM 231593 – 231596 (JFCm 833/AT – 836/AW), USNM 231597 (JFCm 838/AY), USNM 231598 (JFCm 806/U), USNM 231599 – 231608 (JFCm 809/X – 818/AG), USNM 231609 – 231611 (JFCm 822/AK – 824/AM), USNM 231612 (JFCM 804/S). Twenty-five of these skulls are from Pamanzi Island (beaches 125 – 127); the last one is from M'Sanga Nyamba (beach 121).

Eretmochelys imbricata (L.)

Grande Comore. One immature skeleton and shell: USNM 231562 (JFEi 28).

Mohéli. One immature skeleton and scales: 231585 (JFEi 21); one adult (?) skull: USNM 231586 (JFEi 146).

Mayotte. Two adult (?) skulls: USNM 231613 – 231614 (JFEi 138, 139).

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Table 1. Beaches of Grande Comore (see Figure 2 for a map of beaches of Grande Comore)

Beach N°	Locality	Turtle spoor	Human dist.	Crab	Beach						More nests poss?	Date obs. (1972)
					Erosion (cm)	Sand	Slope	Length (m)	Width (m)	Veg		
1	Itsandra	nil	intense: V, R, bb	100	nil	white, coral	gentle	225	30	S, F	yes!	8 Jan.
2	Chindini	reported	intense: V, B	few	little	grey, gravelly	moderate	250	20	S,	some	12 Jan.
3	Malé	nil	intense: V, B	nil	nil	red	moderate	400	10	M, S	yes	12 Jan.
4	Foumboudzivouni	-	intense: V ?	-	-	-	-	600	-	-	-	no obs
5	Kouhani	-	rare ?	-	-	-	-	100	-	-	-	no obs
6	Bouni	-	intense: V ?	-	-	-	-	500	-	-	-	no obs
7	Ouéla	-	intense: V ?	-	-	-	-	200	-	-	-	no obs
8	Hantsindzi S	-	intense: V ?	-	-	-	-	400	-	-	-	no obs
9	Hantsindzi N	-	intense: V ?	-	-	-	-	500	-	-	-	no obs
10	N'Droudé S	-	intense: V ?	-	-	-	-	300	-	-	-	no obs
11	N'Droudé	-	intense: V ?	-	-	-	-	100	-	-	-	no obs
12	N'Droudé N	1 Cm nest pit	moderate: B	nil	200	pink	-	900	10	S	yes	2 July
13	no name	-	little ?	-	-	-	-	100	-	-	-	no obs
14 to 16	each: no name	-	little ?	-	-	-	-	200	-	-	-	no obs
17	Ivoini	-	intense: V ?	-	-	-	-	300	-	-	-	no obs

Table 1 (cont.)

Beach N°	Locality	Turtle spoor	Human dist.	Crab	Beach					More nests poss?	Date obs. (1972)	
					Erosion (cm)	Sand	Slope	Length (m)	Width (m)			Veg
18 to 27 each:	no name	-	rare ?	-	-	-	-	50	-	-	-	no obs
28	Mtsizambé E	-	rare ?	-	-	-	-	300	-	-	-	no obs
29	Mtsizambé W	-	rare ?	-	-	-	-	400	-	-	-	no obs
30	no name	nil	moderate: P	nil	nil	white, granular	gentle	200	2	S, F	few	2 July
31	no name	nil	moderate: B	nil	nil	white !	gentle	200	2	S, M	yes	2 July
32	no name	nil	rare	nil	nil	coral & lava stone	moderate	20	1	S	no	2 July
33	no name	nil	rare	nil	nil	coral & lava stone	moderate	40	1	S	no	2 July
34	Trou du Prophete	nil	little: P	nil	nil	grey	moderate	60	1	S	no	1 July
35	no name	nil	little: P	nil	nil	grey/ white	moderate	50	5	S	few	1 July
36	no name	nil	little: P	nil	nil	white !	gentle	200	10	S	yes	1 July
37	no name	nil	-	-	-	-	-	100	-	-	-	no obs
38	no name	nil	-	-	-	-	-	200	-	-	-	no obs
39	no name	nil	-	-	-	-	-	100	-	-	-	no obs
40	Hotel Maluga	reported	intense: L	nil	nil	white !	moderate	75	25	C	yes	1 July
41	Mitsamiouli	reported	intense: V	nil	nil	brown	gentle	2300	10	S	yes	1 July
42	N'Dzaouzé N	-	intense: V ?	-	-	-	-	100	-	-	-	no obs
43	N'Dzaouzé S	-	intense: V ?	-	-	-	-	100	-	-	-	no obs

Abbreviations for Tables 1, 2, 3 & 4; beaches of the Comoro Archipelago

Turtle spoor: tracks, nests or other spoor of turtles on the beach.

Cm = *Chelonia mydas*;

Cm, Ei = *Chelonia mydas* and *Eretmochelys imbricata*;

Cm/Ei? = spoor not identified to species;

Ei = *Eretmochelys imbricata*;

bones = turtle bones badly weathered and not identified to species;

reported = nesting activities were reported by local people but not observed during the study;

slaughtered = turtles transported to this beach and then slaughtered;

! = large number of this species;

? = species identity not certain;

Special and isolated cases of observations of turtles on certain beaches are indicated (e.g., JFCm 797).

Human dist.: human disturbance on the beach and the chances of a nesting turtle being discovered and disturbed; four conditions in decreasing order of disturbance are: intense, moderate, little and rare. Disturbing factors include:

A = agricultural activities (e.g., banana, coconut, rice) just inland of beach;

B = boats pulled up on beach;

bb = bathing beach;

C = coral limeing on beach;

F = fishermen's camp on beach;

H = huts inland of beach;

L = visitor's lodge or hotel inland from beach;

P = path on or along the beach;

R = road along beach;

T = turtles regularly killed on beach;

V = village on or near beach.

Carn. spoor: carnivore spoor (only Tables 2 & 4).

C = cat-like tracks (*Genetta* sp. ?);

D = dog tracks;

dd = nest dug up (by dogs?).

Crab: ghost crabs, *Ocyropsis* spp., on the beach, burrows or crabs themselves (only Tables 1, 2 & 4).

Rocks: rocks on the beach (only Table 4).

cobble = beach rock cobble;

boulders = beach rock boulders;

beach = intact strata of beach rock in intertidal zone of beach;

phos. = phosphatic beach rock.

Erosion: erosional cliff at high beach (only Tables 1, 2 & 4).

Sand: sand colour and quality.

Slope: slope of the beach; in order of decreasing slope: steep; moderate; gentle; very gentle.

Length: length of the beach, in metres.

Width: width of the beach, in metres, from beach crest to dense vegetation, or other obstacles to nesting turtles (only Tables 1, 2 & 4).

Veg: vegetation, reported in order of relative importance; symbols indicate:

C = coconut; F = forest; G = grass; M = mangrove; P = plantation; S = strand.

More nest poss?: more nests possible?, in decreasing order of response:

yes; some; few; no.

Date obs. (1972): Date(s) of observation in 1972;

no obs = no observation;

no detail = no detailed observations.

General symbols, used throughout the tables:

! = emphatic (e.g., large number of turtles nesting);

+ = presence confirmed;

/ = no observation recorded, but category probably absent;

- = no data.

Table 2. Beaches of Mohéli, Comores (see Figure 3B for a map of beaches of Mohéli)

Beach N°	Locality	Turtle spoor**	Human dist.	Carn. spoor	Crab	Beach					Veg	More nests poss?	Date obs. (1972)
						Erosion (cm)	Sand	Slope	Length (m)	Width (m)			
1	M'Batsé	nil	intense: V	/	/	/	brown	gentle	3200	-	-	yes	24 Feb
2	Mombasa	nil	intense: P, V	/	/	/	brown	gentle	2000	-	S	yes	24 Feb
3	Gnambo-Yamaoré E	nil	intense: V	/	/	/	brown	gentle	800	-	S	yes	24 Feb
4	Gnambo-Yamaoré W	Cm	moderate	/	/	30	dark brown	gentle	200	-	S	few	24 Feb, 27 June
5	Fomboni Domoni	-	moderate: P	-	-	-	brown	-	100	-	-	-	no detail
6	Domoni E	Cm	intense: B, P	nil	/	/	grey cobble	-	30	5	S, F	no	27 June
7	Domoni W	nil	intense: V	/	/	/	-	-	350	-	-	few	27 June
8	M'Sanga Nyamba	Cm!	moderate: T	nil	3 spp.	60	pink	gentle	300	7	S, F	yes	24 Feb, etc.
9	Naksambi	Cm	little	/	+	/	grey-pink	-	100	5	S, F, C	no	27 June
10	Kobéla N	Cm	little	C	+	/	-	-	20	5	S, F	few	27 June
11A	Kobéla S	Cm	moderate: B, C	/	/	/	grey	-	20	1	S, F	no	27 June
11B	Kobéla W	Cm	rare	/	/	/	grey	-	5	1	F	no	27 June
12	M'Samouheo	Cm!	intense: T	/	50	/	pink	moderate	150	1-13	S	no	24 Feb, etc.
13	Chiconi	bones	intense: V	/	/	150	dark	gentle	350	20	S	yes	23 Feb
14	Calepunda	nil	little	/	+	/	shingle	gentle	100	10	S, F	some	23 Feb

Table 2 (cont.)

Beach N°	Locality	Turtle spoor**	Human dist.	Carn. spoor	Crab	Beach					Veg	More nests poss?	Date obs. (1972)
						Erosion (cm)	Sand	Slope	Length (m)	Width (m)			
15	Foumbani	nil	moderate: P	/	+	/	brown	very gentle	350	10	S, C	some	23 Feb
16	Sangiras	nil	moderate: P	/	/	/	black, shingle	gentle	75	1-5	S, C	few	23 Feb
17	Miringoni	nil	intense: V	/	/	/	-	-	400	-	-	no	no detail
18	Damou N	nil	moderate: P	/	1000	/	dark brown	very gentle	300	-	S, M, C	few	14 March
19	Damou S	Cm	moderate: P	/	/	30	grey	very gentle	100	-	S, M, F	few	14 March
20	Madjingouéni	nil	moderate: P	/	/	/	-	gentle	300	30	M	yes	14 March
21	no name	nil	little	/	/	100	-	-	50	-	S, F	no	14 March
22	Ouallah	JFCm 797	intense: V	/	/	little	brown	gentle	900	20	S	yes	23 Feb, 14 March
23	Ouamdjawaché	nil	moderate: R	/	/	60	-	-	75	10	M, S, C	no	14 March
24	Sambadjou N	Cm, Ei	moderate: R	C	+	nil	light red-brown	gentle	200	5	S, C	some	23 Feb, etc.
25	Sambadjou S	nil	moderate: R	/	/	/	coarse	gentle	200	-	-	no	15 March
26	Mirémani W	Cm, Ei	little	/	+	+	shingle, grey-red	gentle	75	1	S, F	few	15 March
27	Mirémani E	nil	intense: B, V	/	/	/	-	-	250	1	S, F	few	15 March
28	Trandrama W	Cm, Ei	little: P	/	/	/	brown	gentle	25	1	-	no	15 March
29	Trandrama E	nil	little	/	/	/	-	gentle	30	-	S, F	few	15 March

Table 2 (cont.)

Beach N°	Locality	Turtle spoor**	Human dist.	Carn. spoor	Crab	Beach					Veg	More nests poss?	Date obs. (1972)
						Erosion (cm)	Sand	Slope	Length (m)	Width (m)			
30	Moini W	Ei	moderate: B	/	+	/	-	very gentle	300	-	S, F	yes	15 March
31	Moini E	Cm	little	/	/	/	cream & black	gentle	100	5	S, F	yes	15 March
32	Hangnatsani W	nil	moderate: H	/	/	300	pink	very gentle	400	2	S	few	22 Feb, 15 March
33	Hangnatsani E	nil	little	/	/	/	-	-	30	-	-	few	15 March
34	Hanvouba	reported	moderate: H	/	/	300	black-brown	gentle	250	2	S, C, M	few	22 Feb
35	M'Boinifoungué	nil	moderate: H, P	/	/	100	red-brown	very gentle	200	2	C, S	yes	22 Feb, 15 March
36	Béramou	nil	moderate: P	/	+	/	dark-brown	gentle	300	-	S, C, M	few	15 March
37	Nioumachoua W	reported	intense: B, V	/	/	/	pink	gentle	200	10	S, F	yes	16 March
38	Nioumachoua (main)	slaughtered	intense: B, V	/	/	/	red-brown	moderate	900	20	S, M	yes	20 Feb, 16 March
39	Nioumachoua E	nil	moderate: P	/	/	/	-	-	50	-	-	no	16 March
40	Bandani	nil	moderate: P	/	/	/	brown	gentle	200	-	M, S	no	16 March
41	Ch. Dzaha S	Cm	rare	/	/	/	white	steep	30	5	nil	few	30 March
42	Ch. Dzaha NW	Cm	little: F	/	/	/	white	gentle	150	1	S, F	yes	30 March
43A	Ch. Canzoni SW	Cm, Ei	little: F	/	/	/	pink	-	30	4	S, F	yes	30 March
43B	Ch. Canzoni NW	Cm/Ei?	little: F	/	/	/	-	-	15	-	-	-	no detail

Table 2 (cont.)

Beach N°	Locality	Turtle spoor**	Human dist.	Carn. spoor	Crab	Beach					Veg	More nests poss?	Date obs. (1972)
						Erosion (cm)	Sand	Slope	Length (m)	Width (m)			
44	Ch. Canzoni E	nil	rare	/	/	/	white	gentle	40	5	S, F	few	30 March
45	Ch. Ouénéfou W	Cm!	rare	C	few	little	white	gentle	100	6	S	no	27 Feb, etc.
46	Ch. Ouénéfou N	Cm!, Ei	little: F	C	few	/	white, fine	gentle	175	10	S, F	yes	27 Feb, etc.
47	Ch. Ouénéfou NE	Cm!, Ei	little: F	nil	3 spp.	little	white	gentle	300	10	S, F	no	27 Feb, etc.
48	Ch. Ouénéfou SE	Cm, Ei	rare	nil	/	/	white	gentle	125	5-10	S, F	few	29 March
49	Ch. Chandzi	Cm	rare	C	+	/	white & black	gentle	100	5	S, G	no	29 March
50	Ch. Méa (Ch. Choani)	Cm	rare	C	/	100	white	gentle	100	25	S, F	no	1 April
51	M'Bouemdou	-	rare	-	-	-	-	-	100	-	-	-	no obs
52	Mapiachingo	-	moderate: P	-	-	-	-	-	250	-	-	-	no obs
53	Moihani W	nil	moderate: L, R	D	few	/	red-brown	moderate, gentle	400	5	S, M	yes	22 Feb
54	Moihani E	nil	intense: B, H, L	D	50	40	brown	gentle	300	20	S	yes	20 Feb
55	Sambia	nil	moderate: V	/	/	40	red-brown	gentle	1800	5	S, C	yes	20 Feb
56	Hamvou	nil	moderate: H, P	/	/	30	dark brown	gentle	150	5	S, M, C	some	20 Feb
57	Hamoignobé W	nil	little	/	20	100-200	dark brown	gentle	75	5	S	some	2 March
58	Hamoignobé E	nil	little	/	/	/	pebble	-	30	2	-	few	2 March

Table 2 (cont.)

Beach N°	Locality	Turtle spoor**	Human dist.	Carn. spoor	Crab	Beach					Veg	More nests poss?	Date obs. (1972)
						Erosion (cm)	Sand	Slope	Length (m)	Width (m)			
59	no name	bones	little	/	/	/	light brown	very gentle	100	10	S, F	yes	2 March
60	Hagnenguélé	bones	little	/	/	/	brown	very gentle	800	2	S, C, F	few	2 March
61	Iconi	nil	little	/	/	/	-	moderate	200	5	S	yes	2 March
62A	Kadoni W1	nil	little	/	/	/	-	-	20	2	S	few	2 March
62B	Kadoni W2	Cm/Ei?	little	/	/	/	-	-	300	5	S	few	2 March
63	Kadoni E	Ei	little	/	50-100	/	-	-	300	5	S	some	2 March
64	Tsinavouni W	Cm/Ei?	little	/	/	/	-	-	200	10	S, F	yes	2 March
65	Tsinavouni N	Cm	moderate: P	C, D!	100	/	grey-pink	gentle	150	5	F, S	no	2 March, 24 June
66	no name	Cm	intense: P, T	/	/	/	light brown	gentle	150	5	-	no	3 March, 24 June
67	M'Sanga Nyamba	Cm!, Ei	intense: T, V	C, D	100	/	light brown & pink	gentle	700	10	S, F	few no	3 March, 24 June
68	Itsamia	Cm	intense: B, V	D	/	/	pink	gentle	450	5	S	yes no	3 March, 24 June
69	no name	Ei	little: P	/	/	/	shingle	gentle	15	5	-	few	3 March
70	no name	Cm, Ei	little	/	/	200	-	gentle	300	4	S	few	3 March
71	M'Sanga Nyamba	Cm	little	/	/	/	light brown	gentle	50	10	F, S	few	3 March
72	no name	nil	little	/	/	/	shingle	steep	100	-	-	-	3 March
73	Hagnamoida	Cm, Ei	intense: B, V	/	1000	200	brown	gentle	800	5	S, C	yes	3 March
74	no name	nil	little	/	/	/	shingle	-	150	20	S	yes	3 March

Table 2 (cont.)

Beach N°	Locality	Turtle spoor**	Human dist.	Carn. spoor	Crab	Beach					Veg	More nests poss?	Date obs. (1972)
						Erosion (cm)	Sand	Slope	Length (m)	Width (m)			
75	no name	nil	little	/	/	/	shingle	steep	30	5	-	few	3 March
76	no name	nil	little	/	/	/	shingle	-	50	10	S	few	3 March
77	M'Sangararou E	nil	rare	/	/	/	shingle	-	20	20	S	yes	3 March
78	M'Sangararou W	-	rare	-	-	-	-	-	100	-	-	-	no obs
79	no name	nil	rare	/	/	100	shingle	-	60	-	S, F	few	8 March
80	Goudjou-bouéni E	nil	rare	/	/	100-200	black shingle	-	150	5	S, F, M	few	8 March
81	Goudjou-bouéni W	nil	rare	/	/	/	shingle	-	150	-	S, F, C	few	8 March
82	Hamnobi	nil	rare	/	/	/	shingle	-	200	-	S, F	some	8 March
83	Tanaraki	nil	rare	/	/	/	shingle	-	50	-	S, F	few	8 March
84	Mbwamaji	Cm, Ei	little: P	/	/	60	yellow brown	gentle	400	5	S, F, C	few	8 March
85	Oua Madji	nil	little: P	/	/	/	shingle	-	200	5	C	few	8 March
86	Babani	nil	moderate: H	/	+	200	shingle at b.c.	-	300	-	S, C, F	few	8 March
87	Kahioua	nil	rare	/	/	/	-	-	50	-	F	few	8 March
88	Gnombéni	nil	intense: V	D	-	-	brown	gentle	800	-	-	-	no detail
89	Djoièzi	nil	intense: V	D	-	-	brown	gentle	700	-	-	-	no detail

** See Tables 9 and 28 for details.

Abbreviations at end of Table 1.

Table 3. Beaches of Anjouan, Comores (see Figure 4 for a map of the beaches of Anjouan)

Beach N°	Locality	Turtle spoor	Human dist.	Beach			Veg	More nests poss?	Date obs. (1972)
				Sand	Slope	Length (m)			
1	Banda M'Tsanga	bones of 2	intense: B, H	coral rubble	steep	15	S, F	no	20 June
2	Pangani	nil	little	grey	-	15	S, C	few	20 June
3	Hajoho	nil	intense: V, B	brown	-	1000	S, C, F	some	20 June
4	Chagnoungouni	nil	little	cobble, no sand	-	-	-	no	20 June
5	Harembou	nil	moderate: P	cobble, no sand	-	-	-	no	20 June
6	Ongoni	nil	intense: V, B	cobble, no sand	-	-	-	no	20 June
7	Gégé	nil	intense: P	brown	-	2100	P	no	3 April
8	Domoni, 1 N	-	intense: V	-	-	500	-	-	no obs
9	Domoni, 2 N	-	intense: V	-	-	250	-	-	no obs
10	Domoni, 3 N	-	intense: V	-	-	150	-	-	no obs
--	Moya	reported	-	-	-	-	-	-	no obs
11	Pagé	nil?	intense: V	brown	gentle	650	-	-	no detail
12	Mirontsi	reported	intense: V	brown	gentle	1200	P	few	no detail
13	M'Tsangamouhouni	nil?	intense: V	brown	gentle	300	P	few	no detail
14	Joumbi	-	little	-	-	300	-	-	no obs

Abbreviations at end of Table 1.

Table 4. Beaches of Mayotte, Comores (see Figure 5 for a map of beaches of Mayotte)

Beach N°	Locality	Turtle spoor**	Human dist.	Carn. spoor	Crab	Rocks	Beach					Veg	More nests poss?	Date obs. (1972)
							Erosion (cm)	Sand	Slope	Length (m)	Width (m)			
1	Doujani N	nil	little: P	/	+	cobble	/	grey	gentle	200	< 5	S	few	10 May
2	Doujani S	nil	little: P	/	/	cobble	/	grey	gentle	250	5	F, S	few	10 May
3	Mutsagnougni (A)	nil	moderate: V, C	/	/	/	/	grey	gentle	500	< 5	S, F	few	10 May
4	Mutsagnougni (B)	nil	little: P	/	/	cobble	/	-	-	< 50	-	S, F	few	10 May
5	Mutsagnougni (C)	nil	little: P	/	/	/	/	-	-	75	-	S, F	few	10 May
6	Mutsagnougni (D)	nil	little: B, A	/	/	/	/	grey	gentle	60	-	S, F	few	10 May
7	Mutsagnougni (E)	nil	little: A	D	/	boulders	/	brown	gentle	50	-	S, F	few	10 May
8	Mutsagnougni (F)	nil	little: A	D	/	/	100	grey	gentle	300	< 5	S, F	few	10 May
9	Proani	nil	little: A	/	/	/	/	-	-	125	-	S, F	few	10 May
10	Chissioi Caroni	nil	rare	/	100	/	/	pink	moderate	125	-	S, F	few	10 May
A	Tsimkoura Titi	/	intense: V, B	-	-	/	100	mud	-	-	-	M, S	no	10 May
B	Caroni	/	intense: V, B	-	-	/	100	mud	-	-	-	M, S	no	10 May
C	Magiméouni	/	intense: V, B	-	-	/	100	mud	-	-	-	M, S	no	10 May
D	M'Jimbiani	/	intense: V, B	-	-	/	/	mud	-	-	-	M, S	no	10 May
E	Agnoundro	/	intense: V, B	-	-	/	/	mud	steep	-	-	M, S	no	10 May
F	Bouéni	/	little	-	-	cobble	/	sand	steep	75	1	S	no	10 May

Table 4 (cont.)

Beach N°	Locality	Turtle spoor**	Human dist.	Carn. spoor	Crab	Rocks	Beach					Veg	More nests poss?	Date obs. (1972)
							Erosion (cm)	Sand	Slope	Length (m)	Width (m)			
11	Bouéni N	nil	intense : V, A	/	/	/	/	brown pink	gentle	1000	-	S, F	few	11 May
12	Bouéni S	nil	moderate: P	/	/	/	/	-	-	100	-	F, S	few	11 May
13	M'Taanga (A)	nil	moderate: P	/	/	/	300	soil	-	150	-	F, S	no	11 May
14	M'Taanga (B)	nil	moderate: P, A	D	/	beach	/	-	-	200	-	F, S	few	11 May
15	M'Taanga (C)	Cm	moderate: P, A	/	/	/	/	pink	moderate	200	-	F	some	11 May
16	Bambao-Ouest N	nil	moderate: P	C, D	+	/	/	pink brown	moderate	60	-	F	few	11 May
17	Bambao-Ouest S	nil	intense: V, B	C, D	+	/	/	brown	moderate	600	-	S, F	some	11 May
18	M'Zouazia	nil	intense: V	/	/	/	/	-	moderate	1000	-	S, F	some	11 May
19	M'Tsangamouji	nil	intense: V	/	/	/	/	fine black	moderate	125	-	S, F	some	11 May
20	Boinatza	nil	intense: V	/	/	/	/	fine black	-	-	-	F	few	11 May
21	Rassi Gouja W	nil	intense: V, B	/	/	/	/	pink brown	steep	600	-	F, S	some	11 May
22	Rassi Gouja E	nil	rare	C, D	/	/	/	-	-	100	-	S, F	few	12 May
23	Rassi Banda-kouni (A)	nil	rare	C, D	/	/	/	fine black	moderate	75	-	S, F	few	12 May
24	Rassi Banda-kouni (B)	nil	rare	/	/	/	/	-	-	50	-	F	few	12 May
25	Rassi Banda-kouni (C)	Cm?	rare	C, d	/	/	/	brown	moderate	200	-	F	few	12 May

Table 4 (cont.)

Beach N°	Locality	Turtle spoor**	Human dist.	Carn. spoor	Crab	Rocks	Beach					Veg	More nests poss?	Date obs. (1972)
							Erosion (cm)	Sand	Slope	Length (m)	Width (m)			
26	M'Ronabèja	nil	intense: B	D	/	/	/	dark brown	moderate	400	-	F	few	12 May
27	M'Bouini	nil	intense: V	D	/	/	20	brown	very gentle	600	-	S, F	few	12 May
28	Chariffou (A)	Cm	rare	C, D, d	/	/	/	black	moderate	100	7	S, F	some	13 May
29	Chariffou (B)	Cm	rare	D, d	/	/	/	black	steep	40	-	F	some	13 May
30	Chariffou (C)	Cm	rare	C, D, d	+	/	/	black	moderate	200	-	F	few	13 May
31	Chariffou (D)	Cm	little: B	D	/	/	/	black brown	-	100	-	F	few	13 May
32	Dapani W	nil	little: P	/	/	/	/	black	-	1000	-	M, F	few	13 May
33	Dapani E	nil	little: P	/	/	beach	100	brown + soil	gentle	75	0	S, F	few	13 May
34	Saziley W	Cm	rare	/	/	/	/	black	moderate	175	-	F	few	13 May
35	Saziley E	Cm!, Ei	intense: V	d	/	/	/	grey	gentle	600	-	S, F	some	13 May
36	Magikhavo S	Cm	intense: V	D, d	+	beach	/	pink	moderate	175	-	S, F	some	15 May
37	Magikhavo N	Cm	moderate: B	d	+	/	/	pink	steep	125	-	S, F	few	15 May
38	Magikhavo NE	Cm	rare	/	+	/	/	black	moderate	100	-	S, F	few	15 May
39	Saziley Bé S	Cm	rare	d	/	beach	100	white	-	100	-	F	few	15 May
40	Saziley Bé N	Cm	moderate: B	d	+	phos.	/	-	-	700	15	S, F	yes	15 May
41	M'Samudu	nil	intense: V, B	/	/	/	/	brown	-	500	-	S, F	yes	15 May
42	Miambani	nil	intense: V	C, D	+	/	40	-	-	600	-	S	yes	15 May
BG	Rassi Abambo	nil	rare	/	/	/	/	grey	-	75	0	F	no	15 May

Table 4 (cont.)

Beach N°	Locality	Turtle spoor**	Human dist.	Carn. spoor	Crab	Rocks	Beach					Veg	More nests poss?	Date obs. (1972)
							Erosion (cm)	Sand	Slope	Length (m)	Width (m)			
43	Chissioi Bambo	nil	rare	/	30	/	/	white- grey	gentle	40	0	F	no	15 May
44	Bambo-Est	nil	intense: V, B	C, D	+	/	/	brown	gentle	700	-	S, F	some	16 May
45	Tsatoundou	nil	intense: V, B, A	D	/	/	/	brown	moderate	600	-	S, F	some	16 May
46	Chissioi Bandélé (A)	Ei?	rare	/	/	/	/	pink	gentle	30	10	S, F	yes	16 May
47	Chissioi Bandélé (B)	nil	rare	/	/	/	/	pink	gentle	25	0	S	no	16 May
48	Chissioi Bandélé (C)	nil	rare	/	/	/	/	pink	steep	30	0	F, S	no	16 May
49	Chissioi Bandélé (D)	nil	rare	/	/	/	/	-	-	30	0	F, S	no	16 May
50	Chissioi Bandélé (E)	nil	rare	/	/	beach	/	pink	steep	100	15	S	yes	16 May
51	M'Ro Mouhou	nil	moderate: P, A	/	/	/	/	brown	-	50	-	M, S	some	16 May
52	Gnambadao	nil	intense: V, B	/	/	/	/	-	-	60	-	S	some	16 May
53	M'Rafeni W	nil	moderate: P	/	/	/	/	brown pink	-	60	0	F, S	no	16 May
54	M'Rafeni E	nil	moderate: P	/	/	/	/	brown	-	20	0	S, F	no	16 May
55	Sakouli	nil	moderate: P	/	/	/	/	brown	moderate	400	-	S, F	no	16 May
56	Hamouro S	nil	intense: V	D	/	/	/	brown	gentle	300	-	S	some	17 May
57	Hamouro N	nil	little: P	/	/	/	/	brown	-	300	-	S, F	some	17 May

Table 4 (cont.)

Beach N°	Locality	Turtle spoor**	Human dist.	Carn. spoor	Crab	Rocks	Beach					Veg	More nests poss?	Date obs. (1972)
							Erosion (cm)	Sand	Slope	Length (m)	Width (m)			
X	Handré	/	intense: V	-	-	/	/	mud	-	-	-	M	no	17 May
Y	Gogorakandza	/	moderate: P	-	-	/	/	mud	-	-	-	M	no	17 May
58	Ilohi S	nil	moderate: P	C	/	/	/	brown	-	200	-	F	few	17 May
59	Ilohi N	nil	intense: V	/	/	/	/	-	-	200	-	M, F	few	17 May
60	Hamaha	nil	little: P	/	/	cobble	100	brown	gentle	200	-	S, F	no	18 May
61	Magikhavo II (A)	nil	intense: V	D	/	/	50	black	moderate	500	-	S, F	few	18 May
62	Magikhavo II (B)	nil	moderate: P	/	/	/	/	black	-	50	-	S, F	few	18 May
63	Magikhavo II (C)	nil	moderate: P	/	/	/	/	brown	-	75	-	M	few	18 May
64	Pointe Kongo	nil	rare	C	/	/	/	pink	-	30	-	S, F	few	18 May
65	Kongo E	nil	moderate: B	D	/	/	/	brown/ grey mud	gentle	300	-	S, F	few	18 May
66	Kongo village	nil	intense: V, B	/	/	/	150	-	-	400	-	-	no	18 May
67	Kongo W I	nil	moderate: P, A	/	/	/	75	pink	moderate	75	-	S	yes	18 May
68	Kongo W II	nil	rare	C	+	beach	30	pink	moderate	50	-	S, F	yes	18 May
69	Trevani E	nil	little: P	C	/	beach	50	pink	-	75	-	S, F	yes	18 May
70	Trevani village	nil	intense: V, B	D	/	/	100	black	gentle	200	-	S, F	few	18 May
71	Trevani W I	nil	moderate: P	C	/	/	/	brown	moderate	200	-	S, F	yes	18 May

Table 4 (cont.)

Beach N°	Locality	Turtle spoor**	Human dist.	Carn. spoor	Crab	Rocks	Beach					Veg	More nests poss?	Date obs. (1972)
							Erosion (cm)	Sand	Slope	Length (m)	Width (m)			
72	Trevani W II	nil	moderate: P	/	/	/	100	black	-	40	0	F, S	no	18 May
73	Kangani	nil	moderate: P	/	+	/	30	brown grey	-	150	-	S, F	yes	18 May
74	M'Gombani	nil	moderate: P	/	+	beach	/	brown	gentle	60	-	S, F	some	19 May
75	Pointe de Longoni E	nil	rare	D	/	/	100	brown red	gentle	50	0	S, F	no	19 May
76	P. de Longoni	nil	rare	D	+	/	/	brown	gentle	40	-	S, F	yes	19 May
77	P. de Longoni W I	nil	rare	D	+	/	/	brown	gentle	30	4	S, F	yes	20 May
78	P. de Longoni W II	bone	moderate: B	D	/	/	/	pink	-	200	5	S, F	no	20 May
79	Tririni	nil	moderate: B, P	D	/	beach	/	red pink	-	75	-	S, F	some	20 May
Z	West of Ile Vert	-	-	/	/	/	/	-	-	-	-	-	-	20 May
80	Bandaboi	nil	intense: V, B	/	/	/	100	dark brown	-	600	-	M, S, F	no	20 May
81	Chissioi Andréma	nil	rare	/	/	/	/	white	gentle	40	-	S, F	few	20 May
82	M'Tsangamboi	nil	intense: V, B	/	/	/	/	brown	gentle	175	-	S, F	no	20 May
83	Andréma	nil	intense: V	/	/	/	150	course mud	-	300	-	M, S	few	21 May
84	Hamro (Amagouizi)	nil	rare	C	+	/	/	red pink	-	100	-	S, F	some	21 May
85	Magi Mioni	nil	moderate: B, A	/	+	/	/	brown	-	150	-	S, F	few	21 May
86	Douamougno S	nil	rare	C	/	beach	/	pink	-	80	-	S, F	few	21 May

Table 4 (cont.)

Beach N°	Locality	Turtle spoor**	Human dist.	Carn. spoor	Crab	Rocks	Beach				Veg	More nests poss?	Date obs. (1972)	
							Erosion (cm)	Sand	Slope	Length (m)				Width (m)
87	Douamougno centre	Ei?	rare	/	/	/	/	pink shells	-	20	-	S, F	few	21 May
88	Douamougno N	nil	rare	/	+	/	/	pink shells	-	35	-	S, F	no	21 May
89	Kadijou W	nil	rare	/	+	/	/	white	-	200	-	S, F	no	21 May
90	Chissioi M'Zamboro NE I	nil	intense: V, B	/	/	/	/	grey	-	400	-	S, F	few	22 May
91	Ch. M'Zamboro NE II	nil	intense V, B	/	/	/	/	grey	-	60	-	S	few	22 May
92	Ch. M'Zamboro W	nil	moderate: B	/	/	/	/	grey white	-	75	-	S, F	some	22 May
93	Ch. M'Zamboro SW	nil	intense: V	/	+	beach	/	white	-	200	4	S, F	yes	22 May
94	M'Tsahara N	nil	intense: V, B	/	/	/	/	grey	gentle	60	5	S, F	yes	22 May
95	M'Tsahara S	Ei bones	intense: V, B, A	/	/	/	/	grey brown	moderate	450	-	S	few	22 May
96	M'Jago N	nil	intense: P	/	/	/	/	grey brown	gentle	300	-	C	few	22 May
97	M'Jago S	nil	moderate: P	/	/	/	/	grey brown	gentle	400	-	S, F	few	22 May
98	M'Zamboro N	nil	moderate: V, B, A	/	/	/	/	brown grey	moderate	300	-	C	few	22 May
99	M'Zamboro S	nil	moderate: A, P	/	/	/	/	brown	-	125	-	S, F	yes	22 May
100	M'Zamboro SW	nil	rare	/	/	/	/	brown	moderate	60	-	S, F	yes	22 May
101	M'Tsangadoi N	nil	intense: V, B	/	/	/	/	-	-	100	-	C	no	22 May
102	M'Tsangadoi S	nil	rare	C, D	/	beach	/	pink	moderate	120	5	S, F	yes	24 May

Table 4 (cont.)

Beach N°	Locality	Turtle spoor**	Human dist.	Carn. spoor	Crab	Rocks	Beach					Veg	More nests poss?	Date obs. (1972)
							Erosion (cm)	Sand	Slope	Length (m)	Width (m)			
103	Accua	nil	intense: V, B	/	/	/	75	bown	moderate	400	-	S, F	yes	24 May
104	Apondra	Cm bones	moderate: A	D	+	/	/	pink	moderate	120	-	S, F	few	24 May
105	Mutsumbatsu	nil	intense: V, A	/	/	/	/	pink	moderate	75	-	S, F	yes	24 May
106	M'Liha W	nil	intense: V	/	/	/	/	brown	gentle	220	-	S, F	yes	24 May
107	M'Liha E I	nil	intense: B, P	/	/	/	/	brown	gentle	250	-	S, F	some	24 May
108	M'Liha E II	nil	intense: A, P	D	/	/	/	pink	-	40	3	S, F	few	24 May
109	M'Liha E III	nil	little: P	C	/	/	/	pink	-	30	0	S, F	no	24 May
110	Tanaraki W	nil	intense: V	D	/	/	/	brown	gentle	300	-	S, F	no	24 May
111	Tanaraki E	nil	little: P	/	/	/	/	brown	-	30	0	S, F	no	24 May
112	Chembénioumba W	nil	intense: V, B, A	/	/	/	/	-	-	150	-	-	some	24 May
113	Chembénioumba E	nil	little	/	/	/	/	-	-	-	0	-	no	24 May
114	M'Tsangamouji N	nil	intense: V, B	D	/	/	/	grey	gentle	600	-	S, F	yes	24 May
115	M'Tsangamouji S	nil	intense: B	/	/	/	40	brown	moderate	500	-	S, F	yes	24 May
116	Soulou	bones	little: A, H	D	/	beach	/	pink	-	150	0	S, F	no	24 May
117	Chissimani I	nil	little: H	/	+	/	/	grey	-	30	3	S, F	few	24 May
118	Chissimani II	nil	rare	D	+	/	/	red	moderate	30	0	S, F	no	24 May
119	Chissimani III	nil	rare	C	/	/	/	pink	-	40	0	S, F	no	24 May

Table 4 (cont.)

Beach N°	Locality	Turtle spoor**	Human dist.	Carn. spoor	Crab	Rocks	Beach					Veg	More nests poss?	Date obs. (1972)
							Erosion (cm)	Sand	Slope	Length (m)	Width (m)			
120	Dindioni	nil	moderate: B, H	D	/	/	100	brown	-	175	10	M, S, F	yes	25 May
121	M'Tsanga Nyamba	Cm	rare	C	/	/	/	pink	moderate	50	5	S, F	some	25 May
122	Ochoungui S	nil	little: B	D	+	/	/	brown	-	300	-	S, F	some	25 May
123	Sohoa	nil	intense: V	/	/	/	/	grey	moderate	150	-	-	some	25 May
124	Sada	nil	intense: V, B	/	/	/	/	grey	-	500	-	S, F	some	25 May
125	Papani	Cm, Ei	intense: P	/	/	/	/	-	-	-	-	-	some	7 June
126	Moya N	Cm	intense: P	/	/	/	/	grey	gentle	150	5	M, S, F	some	10 June
127	Moya S	Cm, Ei	intense: P	C	500	/	/	pink	moderate	300	10	S, F	some	10 June

** See Tables 10-12 for details of turtle spoor.

Abbreviations at end of Table 1.

Table 5. Sightings of *Chelonia mydas* at Mohéli, Comores

N°	Date	Locality	Time	Dist (1)	Pair (2)	E (3)	Remarks (4)
1972							
1	26 Feb	Ch. Ouénéfou northeast	c. 1830	500	+	-	
2	27 Feb	Ch. Ouénéfou northeast	0630-0700	500	-	-	numerous individuals breathing
3	27 Feb	Ch. Ouénéfou west	c. 1100	200	+	?	at least 8 individuals, probably 10 to 15
4	27 Feb	Itsamia, 2 km northeast	0700	1,000	+	-	**
5	27 Feb	Itsamia, 1 km southeast	0800	700	+	-	**
6	27 Feb	Itsamia, 3 km southwest	0900	500	+	-	**
7	27 Feb	Itsamia, 3 to 4 km east	before 1200	4,000	-	-	6 sightings of individuals **
8	27 Feb	Mbwamaji	after 1200	?	-	-	1 sighting **
9	10 March	M'Samouheo	1700	200	+	-	
10	27 March	Moihani	0800	400	+	1	
11	27 March	Moihani	0900	400	-	-	3 individuals, probably those seen at 0800 hrs.
12	29 March	Ch. Ouénéfou/Nioumachoua	0800	1,000	-	-	1 individual breathes
13	29 March	Ch. Ouénéfou northwest	0830	75	-	-	individual at surface, breathes 5 or 6 times, dives as I approach
14	29 March	Ch. Ouénéfou northwest	0830	300	+	-	
15	29 March	Ch. Ouénéfou northeast	0930	400	+	1	couple breathes 2 times in 5 min., dives after each breath
16	29 March	Ch. Ouénéfou northeast	0930	100	-	-	turtle in 50 cm of water, swims off trashing water as I approach
17	29 March	Ch. Ouénéfou/Ch. Chandzi	0930	500	+	-	couple at surface for c. 30 min.
18	29 March	Ch. Chandzi northeast	1130	400	+	-	couple at surface
19	29 March	Ch. Chandzi northeast	1200	300	-	-	immature
20	29 March	Ch. Chandzi northwest	1200	500	?	?	group of 6, possibly escorts with a copulating pair
21	30 March	Ch. Ouénéfou southeast	0630	25	+	-	by rocks that are awash
22	30 March	Ch. Ouénéfou southeast	0730	50	+	1	couple "still" at surface, same couple as that seen at 0630

Table 5 (cont.)

N°	Date	Locality	Time	Dist (1)	Pair (2)	E (3)	Remarks (4)
23	30 March	Ch. Ouénéfou west	0900	500	+	6	one escort definitely male, one male circles my boat, they all dive
24	30 March	Ch. Ouénéfou west	0915	500	+	-	100 m from previous sighting, probably the same pair
25	30 March	Ch. Dzaha south	afternoon	500	-	-	one surfaces
26	31 March	Ch. Mbouzi south	0900	700	+	-	at surface
27	31 March	Ch. Ouénéfou west	1000	500	?	?	possibly one copulation, at least 4 individuals, possibly 8
28	31 March	Ch. Ouénéfou west	1800	50-75	+	-	
29	31 March	Ch. Ouénéfou west	1800	50-75	+	-	
30	1 April	Ch. Ouénéfou west	0600	50	+	2	
31	1 April	Ch. Ouénéfou west	0600	50	+	6	
32	1 April	Ch. Ouénéfou west	0645	100	+	-	one pair still at surface
33	1 April	Ch. Ouénéfou west	0645	100	+	-	one pair surfaces, probably the same as that seen at 0600
34	1 April	Ch. Ouénéfou west	0800	100	+	-	still at surface, probably a previous pair
35	1 April	Ch. Ouénéfou east	1300	400	+	4-6	at surface, not tightly grouped, one circles the boat
1973							
36	10 June	Ch. Ouénéfou east	1800	50	-	-	at least 8 individuals in the shallows

"c." = circa;

(1) "Dist" = distance offshore (m);

(2) "Pair" = pair in copula;

(3) "E" = escort males;

(4) ** = data from Dr. F. Malandain, pers. com.

Table 6. Measurements and observations on *Chelonia mydas* at Comores

JFCm N°	Sex/ Age	Date	Locality	Measurements				Scalation							Coloration			Obs	
				CCL	CCW	PL	HW	Po l/r	Cp	Pl	Ig	Ax l/r	Ing l/r	Im l/r	Pa	Scutes concs	Conc ches		Rays
785	? Imm.	23 March 1972	Fomboni, Mohéli	45.0	43.0	-	6.8	4/4	N	N	N	2/2	1/1	4/4	med	all	all	90% C-R	(1)
786	? Imm.	30 June 1969 (30 June 1972)	Mirontsi, Anjouan	81.0	69.5	-	-	-	N	-	-	-	-	-	-	all	all?	- C-R	(2)
787	? Imm.	Sept. 1971 (1 July 1972)	Mitsamiouli, Grande Comore	40.5	39.0	32	6.1	4/4	(3) N	N	-	1/1	4/4	abs	all	all	80% C-R	(3)	
797	Male? Ad.	14 March 1972	Ouallah, Mohéli	102.0	89.0	-	-	-	-	-	-	-	-	-	-	-	-	-	(4)
862	Male Ad.	2 July 1972	Choua- Chandroudé, Grande Comore	98.5	88.5	73	-	-	-	-	-	-	-	-	-	-	-	-	(5)
863	Female Ad.	1969 (30 June 1972)	Mirontsi, Anjouan	111.0	99.0	-	-	-	N	-	-	-	-	-	-	all	all?	-	

(1) probably caught in fishermen's nets; tagged ZZ 224, photographed and released;

(2) shot with speargun and collected by Mr. Chevalier;

(3) Carapace normal except one small square scale between 4th and 6th vertebrae; probably caught in fishermen's nets; prepared by hotelier; collected (USNM 231560);

(4) found dead and rotting on beach; reported to have washed up 10 days before; much marine plant material in body cavity; black spotted, presumed male;

(5) found dead and desiccated on beach of coral rubble; body intact, definitely male; collected (USNM 231561).

Abbreviations to Tables 6, 7, 8, 10, 11, 12 & 33; measurements and observations on marine turtles in the Comoro Archipelago.

Date: date handled or collected (date measured in parentheses if different from date handled or collected); the date the animal was killed is either indicated in footnotes or unknown.

Measurements: CCL = Curved carapace length; CCW = Curved carapace width; PL = Plastron length; HW = Head width; all measurements in cm to the nearest $\frac{1}{2}$ cm except head width to the nearest mm; not all measurements are reported in each table.

Scalation: Po l/r = Postoculars, left/right;
Cp = Carapace ("N" = normal = 5 vertebrals, 4 left/4 right pleurals, 11 left/11 right marginals + 1 pair of supracaudals);
Pl = plastron ("N" = normal = 1 pair each of gulars, humerals, pectorals, abdominals, femorals and anals);
Ig = Intergular ("N" = normal = large and single; "abs" = absent);
Ax l/r = Axillaries, left/right; Ing l/r = Inguinals, left/right;
Im l/r = Inframarginals, left/right; Pa = Postanal ("abs" = absent; "vsm" = very small; "sm" = small; "med" = medium; "lg" = large);
X.5 = X scales, one of which is partially divided;
other conditions are described case by case;
not all scale characters are reported in each table.

Coloration: Scutes concs = carapace scutes (pleurals) that have concentrations of dark pigment;
Conc ches = carapace scutes (pleurals) that have concentrations of chestnut-red pigment inside dark concentrations;
1-3 = condition present in 1st, 2nd, & 3rd pleurals;
Rays = percent of dark pigment distributed in rays ("C-R" = chestnut-red is the dominant pigment);
not all colour characters are reported in each table; none of the above are reported in Table 33.

Cop not: copulation notches, in increasing order of size: "nil" = no marks, "ir" = irritations only, "vsm" = very small, "sm" = small, "med" = medium, "lg" = large; reported only in Tables 7, 8, 10 & 11.

Limbs: condition of limbs: fr = front, hn = hind; reported regularly only in Tables 7 & 10.

Epizoa: Barn = barnacles; Alg = algae; reported regularly only in Tables 7 & 10.

Clutch size: number of eggs laid in a nest; reported regularly only in Tables 7 & 10.

Tag N^o: front flipper tagged with monel cattle ear tag "Return to Zurich Zoo"; reported only in Tables 7 & 10.

P: photo with J. Frazier; reported only in Tables 7, 8 & 10.

Col: collections, see Appendix II for those deposited in USNM; reported only in Tables 7, 8 & 11.

Obs: other observations, listed case by case.

General symbols: + present; / = no observation, but category probably absent; - = no data.

Table 7. Measurements and observations on nesting female *Chelonia mydas* at Mohéli, Comores in 1972

JFCm N°	Beach N°	Date	Measurements			Scalation							
			CCL	CCW	PL	Po l/r	Cp	Pl	Ig	Ax l/r	Ing l/r	Im l/r	Pa
702	67	1 March	114.5	109.0	-	4/4	N	-	-	-	-	-	-
703	67	2 March	107.0	102.5	-	4/4	N	N	N	3/4	1/1	4/4	abs
704	67	2 March	111.0	103.0	-	4/4	N	N	N	3/3	1/1	4/4	sm
705	67	2 March	-	-	-	-	-	-	-	-	-	-	-
706	67	2 March	-	-	-	-	-	-	-	-	-	-	-
707	67	2 March	-	-	-	-	-	-	-	-	-	-	-
708	12	10 March	112.5	98.0	90.5	4/4	N	N	N	3/3	1/1	4/4	abs
709	12	10 March	107.0	99.5	83.0	4/4	N	N	N	2/2	1/1	4/4	abs
710	12	10 March	116.0	108.0	88.0	4/4	(2)	N	N	3/3	1.5/1.5	4/4	abs
711	12	10 March	110.0	101.0	89.0	4/4	N	N	N	2/3	1/1	4/4	sm
712	12	11 March	109.0	98.0	84.5	4/4	N	N	N	2/2	1/1	4.5/3	med
864	12	11 March	-	-	-	-	-	-	-	-	-	-	-
713	45	1 April	106.0	95.5	-	4/4	N	-	-	-	-	-	-
721	67	23 June	122.0	107.5	-	5/5	N	-	-	-	-	-	-
722	67	23 June	105.0	99.0	-	4/4	N	-	-	-	-	-	-
723	67	23 June	119.5	115.0	-	4/4	N	-	-	-	-	-	-
724	67	23 June	111.0	102.5	86.0	4/4	N	N	-	3/3	1/1	4/4	med
725	67	23 June	117.0	111.5	-	4/4	N	-	-	-	-	-	-
726	67	23 June	102.5	99.0	83.0	4/4	(5)	N	N	4/3	1/1	4/4	med
727	67	23 June	112.0	105.0	88.0	4/4	N	N	N	3/4	1/1	4/4	lg
728	67	23 June	114.0	105.0	93.0	3.5/4	N	N	N	3/3	1/1	4/4	sm
729	67	23 June	103.0	102.0	79.0	4/5	N	N	N	2/3	1/1	4/4	sm
730	67	23 June	114.0(6)	108.0	89.0	4/4	N	N	N	3/3	1/1	4/5	vsm
731	67	23 June	105.0	99.0	85.0	4/4	N	N	N	3/3	1/1	4/4	vsm
732	67	23 June	108.0	101.5	86.0	4/4	N	N	N	3/3	1/1	4/4	vsm

Table 7 (cont.)

Coloration			Cop not	Limbs		Epizoa		Clutch size	Tag N°	P	Col	JFCm N°
Scutes concs	Conc ches	Rays		fr	hn	Barn	Alg					
-	-	-	med	ok	ok	-	-	-	206	-	-	702
all	some	25%	nil	ok	(1)	many	-	101	208	+	-	703
all	all	50%	nil	ok	ok	few	-	158	210	+	-	704
-	-	-	-	-	-	-	-	-	212	-	+	705
-	-	-	-	-	-	-	-	-	215/217	-	+	706
-	-	-	-	-	-	-	-	-	218	-	+	707
some	some	30%	nil	ok	ok	+	+	-	219	+	-	708
some	some	50%	nil	ok	ok	+	+	86	220	+	-	709
all	all	60%	nil	ok	ok	+	+	-	221	+	-	710
all	all	75%	nil	ok	ok	+	+	109	222	+	-	711
all	all	75%	ir	(3)	ok	+	+	-	223	+	-	712
-	-	-	-	-	-	-	-	120	-	-	-	864
-	-	-	ir	ok	ok	-	-	128	225	+	-	713
all	-	-	ir	-	-	+	-	-	236	-	-	721
all	all	-	ir	-	-	-	-	85	237	-	-	722
all	all	-	sm	-	-	-	-	-	238	-	-	723
all	all	95%	vsm	-	-	-	-	-	239	-	-	724
some	some	-	(4)	-	-	-	-	-	241	-	-	725
some	some	-	nil	ok	ok	-	-	-	242	-	-	726
none	none	-	sm	ok	ok	-	-	-	244	-	-	727
all	all	-	med	ok	ok	-	-	-	245	-	-	728
all	all	-	sm	ok	ok	-	-	-	246	-	-	729
all	all	-	sm	ok	ok	-	-	-	247	-	-	730
all	all	-	ir	ok	ok	+	-	-	248	-	-	731
all	all	-	sm	ok	ok	-	-	-	249	-	-	732

(1) right hind limb stumped;

(2) carapace scalation normal except anterior marginals indented;

(3) right distal manus missing;

(4) copulation notches asymmetric - left large, right small;

(5) carapace scalation normal except pleurals 5 left/4 right;

(6) curved carapace length estimated because supracaudals broken.

Abbreviations at end of Table 6.

Table 8. Measurements and observations on specimens of *Chelonia mydas* from nesting beaches on Mohéli, Comores in 1972

JFCm N°	Beach N°	Date	Measurements			Scalation					Coloration			Cop not	P	Obs	
			CCL	CCW	PL	Po l/r	Cp	Pl	Im l/r	Pa	Scutes concs	Conc ches	Rays				
788	67	2 March	117.5	105.0	87.0	-	N	-	-	-	-	-	-	-	+	(1)	
789	67	3 March	119.5	106.5	-	-	N	-	-	-	-	all	some	30%	-	+	-
790	67	3 March	114.5	100.5	-	-	-	-	-	-	-	all	none	5%	-	+	-
791	67	3 March	118.0	106.0	-	-	N	-	-	-	-	-	-	-	-	-	-
792	67	3 March	118.0	100.5	-	-	-	-	-	-	-	-	-	-	-	-	-
793	67	3 March	117.0	101.0	-	-	N	-	-	-	-	-	-	-	-	-	-
794	67	3 March	117.5	108.0	-	-	-	-	-	-	-	-	-	-	-	-	-
829	70	3 March	110.0	98.5	-	-	N	-	-	-	-	all	some	40%	lg	+	-
795	12	10 March	108.0	98.0	-	-	(2)	-	-	-	-	all	some	5%	-	+	(1)
796	12	10 March	113.0	103.0	-	-	N	-	-	-	-	all	all	75%	med	+	(1)
798	47	1 April	-	-	-	-	-	-	-	-	-	-	-	-	-	-	(3)
839	67	24 June	120.0	102.0	-	-	-	-	-	-	-	-	-	-	-	-	-
840	67	24 June	116.0	108.0	-	-	-	-	-	-	-	-	-	-	-	-	-
841	67	24 June	116.5	104.0	90.0	4/4	N	N	4/4	-	-	all	none	-	med	-	-
842	67	24 June	107.0	102.0	-	-	N	-	-	-	-	all	all	-	-	-	-
843	67	24 June	113.0	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-
844	67	24 June	107.0	105.5	91.0	-	N	N	4/4	-	-	all	none	-	-	-	-
845	67	24 June	106.5	98.0	-	-	N	-	-	-	-	all	none	-	-	-	-
846	67	24 June	114.0	102.0	86.0	-	-	N	-	-	-	all	all	-	med	-	-
847	67	24 June	117.0	107.0	-	-	-	-	-	-	-	-	-	-	-	-	-
848	68	24 June	109.5	100.5	-	-	N	-	-	-	-	all	all	-	med	-	-
849	12	27 June	111.5	105.0	86.0	4/4	N	N	4/4	med	-	all	none	-	med	-	-
850	12	27 June	117.0	101.0	-	-	-	-	-	-	-	all	all	-	lg	-	-
851	12	27 June	118.0	110.0	-	-	N	-	-	-	-	none	none	-	lg	-	(4)

Table 8 (cont.)

JFCm N°	Beach N°	Date	Measurements			Scalation					Coloration			Cop not	P	Obs
			CCL	CCW	PL	Po l/r	Cp	Pl	Im l/r	Pa	Scutes concs	Conc ches	Rays			
852	12	27 June	108.0	105.0	88.0	4/4	(5)	N	4/4	sm	none	none	-	vsm	-	(6)
853	12	27 June	111.0	100.5	-	-	N	-	-	-	all	-	-	vsm	-	-
854	12	27 June	107.0	106.0	84.5	3/4	N	N	4/4	sm	all	none	-	-	-	(7)
855	12	27 June	-	-	-	-	-	-	-	-	-	-	-	-	+	(3)
856	11A	27 June	-	-	-	-	-	-	-	-	-	-	-	-	+	(3)
857	8	27 June	111.0	95.0	86.0	5/4	N	N	5/4	-	all	all	-	vsm	-	(8)
858	8	27 June	106.5	97.5	84.0	-	-	N	4/4	vsm	all	all	-	lg	-	(9)
859	4	27 June	121.0	108.5	94.0	-	(10)	N	4/4	lg	all	all	-	-	-	-
860	4	27 June	112.5	107.0	89.0	-	N	N	4/4	-	all	all	-	sm	-	-
861	8	27 June	-	-	-	-	-	-	-	-	-	-	-	-	+	(3)

(1) condition of back limbs ok;

(2) carapace scalation normal except pleurals 4 left/5 right;

(3) collections;

(4) hole in first vertebral (harpoon wound?);

(5) carapace scalation normal except 6 vertebrales;

(6) many small *Chelonibia testudinaria* barnacles;

(7) killed night of 26 June, ovaries contain many large (c. 2 cm diameter) follicles;

(8) killed night of 26 June, oviducts contain 157 shelled eggs and ovaries, many follicles;

(9) killed night of 26 June, oviducts contain 158 shelled eggs and ovaries, many follicles of two distinct sizes;

(10) carapace scalation normal except pleurals 5 left/4 right.

Abbreviations at end of Table 6.

Table 9. Spoor and annual estimates of *Chelonia mydas* on 40 beaches, at Mohéli, Comores (see Table 2 and Figure 3B for details of beaches and their spoor)

Beach N°	Nest pits				Sets of tracks	Nests emerged	Sites of egg shells	Slaugh- tered turtles	Sites of bones	Annual estimate		Date of observation	
	+	?	-	T						nests	fems		
4	31	8	14	53	nil	nil	1	5	1	90	30	27 June 1972	
6	0	2	10	12	nil	nil	nil	nil	nil	6	2	27 June 1972	
**8	11	0	9	20	c. 10	nil	nil	nil	nil	**	**	24 February 1972	
**8	24	2	37	63	43	1	5	c. 10(2)	several	**	**	27 June 1972	
**8	32	6	31	69	13(15)	nil	12	1	nil	**	**	12 June 1973	
9	25	0	25	50	(1)	nil	3	nil	1	90	30	27 June 1972	
10	9	2	12	23	2(1)	nil	4	1	nil	45	15	27 June 1972	
11A	1	0	1	2	nil	nil	nil	nil	nil	6	2	27 June 1972	
11B	1	0	1	2	1	nil	nil	nil	nil	3	1	27 June 1972	
**12	15	7	4	26	c. 10	nil	nil	c. 10	nil	**	**	24 February 1972	
**12	seven beachings; four females tagged						nil	nil	nil	nil	**	**	9 March 1972
**12	two beachings; one female tagged						nil	2	nil	nil	**	**	10 March 1972
**12	30	1	23	54	8(3)	nil	3	7	nil	**	**	27 June 1972	
**12	18	0	28	46	23	nil	1	3	nil	**	**	11 June 1973	
13	0	0	0	0	nil	nil	nil	nil	1	0	0	23 February 1972	
19	3	0	0	3	1?	nil	nil	nil	nil	15	5	14 March 1972	
22	0	0	0	0	nil	nil	nil	JFCm 797	nil	0	0	14 March 1972	
24	-	-	-	-	nil	nil	nil	nil	2	-	-	23 February 1972	
24	2	1	2	5	nil	nil	nil	nil	2	15	5	14 & 15 March 1972	
24	4	0	0	4	nil	nil	nil	nil	2	15	5	26 June 1972	
26	3	1	0	4	nil	nil	2	nil	nil	15	5	15 March 1972	
28	1	0	0	1	nil	nil	nil	nil	nil	3	1	15 March 1972	
31	12	1	3	16	nil	nil	nil	nil	nil	39	13	15 March 1972	
34	nesting reported; no spoor seen					/	/	/	/	0	0	22 February 1972	

Table 9 (cont.)

Beach N°	Nest pits				Sets of tracks	Nests emerged	Sites of egg shells	Slaugh- tered turtles	Sites of bones	Annual estimate		Date of observation
	+	?	-	T						nests	fems	
37	one reported beaching March 1972; another animal reported slaughtered										16 March 1972	
38	0	0	0	0	nil	nil	nil	2	nil	0	0	19 February 1972
41	0	5	0	5	nil	/	/	/	/	15	5	30 March 1972
42	9	4	6	19	2	nil	nil	nil	nil	36	12	30 March 1972
43A	1	0	0	1	nil	nil	nil	nil	nil	3	1	30 March 1972
43B	0	2	0	2?	6	/	/	/	/	3	1	8 June 1973 no detail
**45	19	4	17	40	/	/	/	/	/	**	**	27 February 1972
**45	34	11	15	60	2(2)	(2)	nil	nil	nil	**	**	1 April 1972
**45	19	3	17	39	25(5)	(2)	4	nil	nil	**	**	25 June 1972
**45	20	2	21	43	28	nil	8	nil	nil	**	**	10 June 1973
**46	-	-	-	-	2	-	-	-	-	**	**	27 February 1972
**46	-	-	-	-	1	-	-	-	-	**	**	29 March 1972
**46	9	3	8	20	1	nil	nil	1	nil	**	**	1 April 1972
**46	34	2	31	67	33(6)	nil	nil	nil	nil	**	**	25 June 1972
**46	21	13	58	92	20	nil	6	1	nil	**	**	11 June 1973
**47	7	9	15	31++	2	/	/	/	/	**	**	27 February 1972
**47	60	22	26	108	(1)	nil	nil	1	nil	**	**	1 April 1972
**47	82	3	29	114	20(6)	4	4	/	/	**	**	25 June 1972
**47	53	8	78	139	45	nil	2	nil	nil	**	**	10 June 1973
48	17	16	21	54	2(2)	1	nil	nil	nil	150	50	29 March 1972
49	1	1	0	2	1	nil	nil	nil	nil	6	2	29 March 1972
50	18	5	1	24!	1	nil	nil	nil	nil	60	20	1 April 1972
59	0	0	0	0	nil	nil	nil	1	nil	0	0	2 March 1972
60	0	0	0	0	nil	nil	nil	1	nil	0	0	2 March 1972

Table 9 (cont.)

Beach N°	Nest pits				Sets of tracks	Nests emerged	Sites of egg shells	Slaugh- tered turtles	Sites of bones	Annual estimate		Date of observation
	+	?	-	T						nests	fems	
62B	0	3	0	3?	nil	nil	nil	nil	nil	9	3	2 March 1972
64	0	1	0	1?	nil	nil	nil	nil	nil	3	1	2 March 1972
65	11	6	9	26	/	nil	2d	1	1	-	-	2 March 1972
65	26	2	42	70	1(1)	nil	5	nil	nil	120	40	24 June 1972
66	0	0	0	0	nil	nil	nil	nil	nil	-	-	2 March 1972
66	0	0	5	5	(8)	nil	nil	nil	nil	3	1	24 June 1972
**67	99	32	34	165	7(7)	nil	9d	22(2)	/	**	**	4 March 1972
**67	131	49	90	270	1(14)	17(7)	7(1d)	13	nil	**	**	24 June 1972
68	2	0	1	3	(1)	nil	nil	nil	nil	-	-	3 March 1972
68	30	3	25	58	(1)	1(1)	nil	1	nil	150	50	24 June 1972
70	6	1	4	11	nil	nil	2(4d)	1	nil	30	10	3 March 1972
71	13	1	4	18	nil	nil	nil	1	1	45	15	3 March 1972
73	1	0	0	1	nil	nil	nil	1	nil	3	1	3 March 1972
84	15	3	0	18	10	nil	nil	nil	nil	60	20	8 March 1972

** for details see text Section on Population Size and Structure and Appendix I.

! = the majority of the nest pits are several months old.

? = species of turtle that made the spoor is not certain.

d or (d) = sites of eggshells exposed from dogs digging up nests.

Abbreviations for Tables 9, 13 & 34; spoor of nesting turtles in the Comoro Archipelago.

Nest pits: + = with eggs; ? = uncertain to have eggs; - = without eggs; T = total.

** = the numbers of nest pits recorded represent only about 1/10th of the beach.

Sets of tracks and Nests emerged are spoor usually discovered the morning after the night during which they were made or emerged; numbers in parentheses are various spoor from two nights before the date of observation.

Annual estimate: nests = 4 x the number of nest pits with eggs and uncertain; nesting spoor is assumed to represent a 3-month period of nesting activity.

fems = females, is calculated from 1/3 of the annual number of nest pits; the average female is assumed to nest 3 times in a season.

General symbols: - = no data; / = no data, but category probably absent.

Table 10. Measurements and observations on nesting female *Chelonia mydas* tagged and released on Mayotte, Comores, in 1972

JFCm N°	Beach N°	Date	Measurements			Scalation							Coloration		Cop not	Limbs		Epizoa		Clutch size	Tag N°	P	
			CCL	CCW	PL	Po l/r	Cp	Pl	Ig	Ax l/r	Ing l/r	Im l/r	Pa	Scutes conc		Conc ches	fr	hn	Barn				Alg
714	35	13 May	116.0	106.0	92.0	4/4	N	-	-	3/3	1/1	4/4	lg	all	-	med	-	-	+	+	-	226	-
715	127	1 June	112.0	99.5	88.0	4/4	N	N	N	3/3	1/1	4/4	sm	all	-	med	ok	ok	+	+	-	228	-
716	127	1 June	108.0	97.0	79.0	4/4	N	N	N	3/3	1/1	4/4	sm	all	-	ir	-	-	+	-	104	229	-
717	127	3 June	118.5	109.5	92.5	5/3.5	N	N	N	3/3	1/1	4/4	med	1-3	-	vsm	-	-	+	+	-	230	-
718	127	4 June	111.0	101.5	89.0	4/4	N	N	N	3/3	1/1	4/4	sm	all	-	sm	-	-	+	-	139	231	-
719	127	8 June	113.0	105.0	90.0	4/4	-	-	-	2/3	1/1	4/4	sm	all	all	lg	-	-	+	-	-	232	+
720	126	9 June	121.0	114.0	89.0	4/4	(1)	(2)	N	3/3	1/1	4/4	abs	all	none	lg	ok	(3)	+	+	119	233	+

(1) carapace normal except 6 vertebrales;

(2) plastron normal except anals asymmetric;

(3) left hind limb stumped.

Abbreviations at end of Table 6.

Table 11. Measurements and observations on carcasses of *Chelonia mydas* from nesting beaches on Pamanzi Island, Mayotte, Comores, in 1972

JFCm N°	Beach N°	Date	Measurements			Scalation						Coloration			Cop not	Col	Obs
			CCL	CCW	PL	Po l/r	Cp	Pl	Ig	Im l/r	Pa	Scutes concs	Conc ches	Rays			
800	127	7 April	108.0	102.0	-	-	N	N	-	-	-	some	-	-	-	-	-
802	127	7 April	-	97.0	-	-	N	N	-	-	-	-	-	-	-	+	-
805	125	28 May	116.0	109.0	-	-	-	-	-	-	-	all	-	75	-	-	-
806	125	28 May	110.0	105.0	83.0	-	N	N	(1)	-	-	-	-	60	-	+	-
807	125	28 May	106.5	103.5	-	-	-	-	-	-	-	-	-	-	-	-	-
808	125	28 May	114.0	94.0	-	-	-	-	-	-	-	-	-	-	-	+	-
809	125	28 May	105.0	95.5	82.0	-	N	N	abs	-	-	-	-	-	-	+	-
820	127	3 June	116.0	107.0	86.0	-	(2)	N	N	4/4	sm	1-3	-	-	-	+	(3)
821	127	6 June	112.0	100.5	-	3.5/3.5	N	-	-	4/4	sm	all	all	-	lg	+	(4)
822	125	8 June	108.0	100.5	86.0	-	N	N	N	4/4	sm	all	all	-	-	+	-
823	125	8 June	114.0	100.5	86.0	-	N	N	-	4/4	sm	all	all	-	-	+	-
824	125	8 June	112.0	98.0	85.0	-	N	N	-	4/4	sm	all	some	-	-	+	(5)
825	125	8 June	108.0	104.0	88.0	3/3	-	-	-	4/4	abs	1-3	all	-	lg	+	-
826	125	8 June	107.0	100.0	79.0	-	-	-	-	-	-	all	all	-	lg	-	(6)
827	126	10 June	115.0	102.0	-	-	-	-	-	-	-	all	-	-	lg	+	-
999	125	10 June	103.0	95.0	-	-	-	-	-	-	-	1-3	all	-	-	+	-
830	127	10 June	107.0	101.0	-	-	N	N	-	-	-	all	all	-	lg	+	-
831	127	10 June	112.0	100.0	-	-	N	-	-	-	-	all	all	-	nil	-	-
832	127	10 June	106.0	98.0	-	-	-	-	-	-	-	all	all	-	-	-	-
833	127	10 June	108.0	98.0	-	-	-	-	-	-	-	all	all	-	lg	+	-
837	125	10 June	116.5	107.5	86.0	4/3	-	N	-	-	-	all	all	-	lg	+	-

(1) intergular divided asymmetrically;

(2) humpbacked;

(3) axillaries = 4 left/4 right, barnacles and algae on carapace, 138 shelled eggs in oviducts;

Abbreviations at end of Table 6.

(4) inguinals = 1 left/1 right, photos with J. Frazier;

(5) barnacles on carapace;

(6) 108 shelled eggs in oviducts.

Table 12. Measurements and observations on carcasses of *Chelonia mydas* from nesting beaches on Pamanzi Island, Mayotte, Comores, June 1973

JFCm N°	Beach N°	Measurements		Scapes	Coloration	
		CCL	CCW	Cp	Scutes concs	Conc ches
903	127	109.0	101.5	N	all	all
904	127	102.5	93.5	N	all	all
905(a)	127	115.5	103.5	N	all	all
906	127	111.0	102.0	N	all	all
907	127	108.0	95.0	N	all	all
908	127	112.0	109.0	N	all	all
909	127	107.5	102.5	N	1-3	1-3
910	127	108.0	96.0	N	all	all
911	127	111.0	107.5	N	all	all
912	127	111.0	97.0	N	all	all
913	127	100.5	109.5(b)	N	all	all
914	127	117.5	104.5	N	-	-
915	127	106.5	96.0	N	all	all
916(c)	126	108.0	97.5	N	all	all
917(c)	126	110.5	105.0	N	all	nil
918	126	110.5	103.5	(d)	all	all

(a) JFCm 905: Postoculars 3 left/3 right;

(b) JFCm 913: Width > length, thus questionable and excluded from calculations;

(c) JFCm 916 & 917: Postoculars 4 left/4 right;

(d) JFCm 918: carapace normal except 6 vertebrales.

Abbreviations at end of Table 6.

Table 13. Nesting spoor and annual estimates of *Chelonia mydas* on 14 beaches, at Mayotte, Comores (see Table 4 and Figure 5 for details)

Beach N°	Nest Pits				Annual estimate	
	+	?	-	T	nests	fems
2	0	0	3	3	3	1
25	1	1	0	2	3	1
28	17	0	3	20	69	23
29	4	3	1	8	27	9
30	18	3	5	26	84	28
31	3	0	2	5	12	4
34	11	6	0	17	69	23
35	44	18	7	69	249	83
36	12	17	2	31	117	39
37	8	3	0	11	42	14
38	2	4	0	6	24	8
39	5	0	0	5	21	7
40	14	0	0	14	57	19
121	12	0	3	15	48	16
Total	151	55	26	232	825	275

Abbreviations at end of Table 9.

Table 14. Number of nests and slaughters of *Chelonia mydas* made over a two-month period, 7 April until 10 June, 1972, and annual estimates, at two beaches on Pamanzi Island, Mayotte, Comores.

Beach N°	7 April					10 June					Made over a 2- month period		Estimates for one year #				
	C*	Nest Pits †				New C*	Nest Pits †				C*	nests	C*	nests	nesting females	total females	% total killed
		+	?	-	T		+	?	-	T							
126	1	4	3	3	10	3	6	0	11	17	3	6	18	36	12	30	60%
127	11	12	8	4	24	6	27	12	25	64	6	33	36	198	66	102	35%
Total	12	16	11	7	34	9	33	12	36	81	9	39	54	234	78	132	41%

* "C" = number of turtle carcasses found on the beach.

† Nest Pits:

"+" = with eggs;

"?" = uncertain to have eggs;

"-" = without eggs;

"T" = total.

Estimates for one year:

carcasses and nests = 6 x values from two-month period;

nesting females = 1/3 of annual number of nests;

total females = sum of carcasses + nesting females;

% total killed = number of carcasses/total number of females.

Table 15. Number of nests and slaughters of *Chelonia mydas* made over a two-week period, 28 May until 10 June, 1972, and annual estimates, at three beaches on Pamanzi Island, Mayotte, Comores

Beach N°	Made over a 2- week period		Estimates for one year #				
	S*	nests	S*	nests	nesting females	total females	% total killed
125	5+	3	130	78	26	156	83%
126	0	3	10	78	26	36	28%
127	2	5	52	130	43	95	55%
Total	7+	11	192	286	95	287	67%

* "S" = number of turtles slaughtered.

Estimates for one year:

slaughters and nests = 26 x values from two-week period;

nesting females = 1/3 of annual number of nests;

total females = sum of slaughtered females + nesting females;

% total killed = number of slaughtered females/total number of females.

Table 16. Summary of morphometric data for nesting females of *Chelonia mydas* on Mohéli and Mayotte Islands, Comores

Measurement [cm]	Mohéli			Mayotte			Statistic	
	n	\bar{x}	st. er.	n	\bar{x}	st. er.	F*	t*
Curved carapace length	51	112.32	0.704	42	110.76	0.648	1.43	1.61
Curved carapace width	51	103.14	0.603	43	101.50	0.724	1.22	1.76
Plastron length	24	87.05	0.689	16	86.28	1.006	1.42	0.67

* All values are $p > 0.05$

Table 17. Measurements of hatchling *Chelonia mydas* from five clutches on Mohéli, Comores

Clutch N°	Stat- istics [†]	Sample size	Beach N°	Date 1972		Weight (g)	Measurements*			
				emerged	measured		SCL	SCW	PL	HW
1		1	47	26 Feb	27 Feb‡	21.5	50.0	41.0	41.0	16.0
2	\bar{x} st. er. range	8	45	31 March (evening)	2 April (morning)	21.65 0.4338 19.0-22.6	48.63 0.4199 47.0-50.5	38.69 0.5972 35.0-40.5	41.31 0.3265 40.0-43.0	15.13 0.1567 14.5-16.0
3	\bar{x} st. er. range	10	67	24 June (night)	25 June (morning)	- - -	50.40 0.2333 49.0-51.5	40.10 0.1944 39.0-41.0	42.45 0.2930 41.0-44.0	15.80 0.0817 15.5-16.0
4	\bar{x} st. er. range	10	67	24 June (night)	25 June (morning)	- - -	49.25 0.5124 47.0-52.0	38.65 0.2986 37.0-40.0	39.80 0.4096 38.0-42.0	15.30 0.1106 15.0-16.0
5	\bar{x} st. er. range	8	67	24 June (night)	25 June (morning)	- - -	48.13 0.2950 47.0-49.0	39.31 0.3772 37.5-40.0	39.19 0.2100 38.0-40.0	15.56 0.1133 15.0-16.0
Total ⁺	\bar{x} st. er. range	36	-	-	-	-	49.18 0.2350 47.0-52.0	39.21 0.2045 35.0-41.0	40.74 0.2691 38.0-44.0	15.46 0.0701 14.0-16.0

† Statistics: \bar{x} = average; st. er = standard error; range = minimum-maximum.

* Measurements: "SCL" = Straight carapace length; "SCW" = Straight carapace width; "PL" = Plastron length; "HW" = Head width; in mm to the nearest $\frac{1}{2}$ mm.

‡ Hatchling dug out of nest; the date is not certain, and, hence, has not been referred to elsewhere.

+ Excluding Clutch 1; mean = weighted average.

Table 18. Tests for homogeneity of variance and analysis of variance in measurements of 36 hatchling *Chelonia mydas* from four clutches on Mohéli, Comores

Test		Carapace length	Carapace width	Plastron length	Head width
Homogeneity of variances					
Bartlett-Box:	F	2.083	2.595	1.388	0.753
	p	0.099	0.150	0.243	0.524
Analysis of variance (d.f. = 3,32):					
	F	6.483	3.611	20.465	6.730
	p	0.002	0.023	<0.001	0.001
Multiple Range Tests (Least Significant Difference, $p \leq 0.05$):					
		4 > 5	3 > 4, 2	2 > 5, 4	5 > 2
		3 > 5, 2, 4	-	3 > 5, 4, 2	3 > 2, 4
Student-Newman Keuls ($p \leq 0.05$):					
	Subset 1	5, 2, 4	4, 2, 5	5, 4	2, 4
	Subset 2	3	5, 3	2	4, 5
	Subset 3	-	-	3	5, 3

Table 19. Variance ratio (F) and t tests comparing hatchling *Chelonia mydas* on Mohéli with other island populations in the western Indian Ocean

Parameter	Statistic [†]	Mohéli [‡]	Populations compared with Mohéli		
			Aldabra [⊖]	Europa ⁺	Tromelin ⁺
Weight	$\bar{X} \pm \text{st. er. (n)}$	21.65 ± 0.4338 (8)	28.22 ± 0.1298 (63)	22.85 ± 0.2560 (50)	23.96 ± 0.3649 (50)
	F (d.f.), p		1.42 (7,32), > 0.05	2.18 (49,7), > 0.05	4.42 (49,7), > 0.05
	t (d.f.), p		26.32 (69), < 0.001***	2.61 (56), < 0.05*	4.07 (19), < 0.001***
Carapace length	$\bar{X} \pm \text{st. er. (n)}$	49.18 ± 0.2350 (36)	50.07 ± 0.0887 (185)	48.49 ± 0.1937 (50)	48.62 ± 0.2291 (50)
	F (d.f.), p		1.37 (35,184), > 0.05	1.06 (35,49), > 0.05	1.32 (49,35), > 0.05
	t (d.f.), p		5.33 (219), < 0.001***	2.31 (84), < 0.05*	1.69 (84), > 0.05
Carapace width	$\bar{X} \pm \text{st. er. (n)}$	39.21 ± 0.2045 (36)	40.60 ± 0.1002 (185)	39.86 ± 0.2758 (50)	40.18 ± 0.2828 (50)
	F (d.f.), p		1.23 (184,35), > 0.05	2.53 (49,35), < 0.01**	2.66 (49,35), < 0.01**
	t (d.f.), p		7.71 (219), < 0.001***	1.90 (83), > 0.05	2.78 (82), < 0.01**
Plastron length	$\bar{X} \pm \text{st. er. (n)}$	40.74 ± 0.2691 (36)	40.73 ± 0.1023 (74)		
	F (d.f.), p		3.37 (35,73), < 0.001***		
	t (d.f.), p		0.02 (45), > 0.05		
Head width	$\bar{X} \pm \text{st. er. (n)}$	15.46 ± 0.0701 (36)	16.29 ± 0.1320 (49)	15.92 ± 0.0509 (50)	16.13 ± 0.0948 (50)
	F (d.f.), p		4.83 (48,35), < 0.001***	1.36 (35,49), > 0.05	2.54 (49,35), < 0.01**
	t (d.f.), p		5.57 (71), < 0.001***	5.54 (84), < 0.001***	5.70 (83), < 0.001***

† the calculation of t and its degrees of freedom, "d.f.", depends on the significance of the F test (see Nie *et al.*, 1970: 269);

‡ see Table 17;

⊖ raw data from Frazier, 1971: Table 3;

+ raw data from Hughes, 1974a: Table 5;

*, ** and *** = significant p values.

Table 20. Changes in various morphometric values with increasing carapace length in *Chelonia mydas*, Comores

Data set	<i>Changes with increasing carapace length</i>			
	Carapace width	Plastron length	Head width	Body weight
Hatchling: individual growth	>	<	<	n.d.
Hatchling: interindividual comparisons	<	<?	<	nil
Female: interindividual comparisons	<	<	n.d.	n.d.
All data	>, <	<	<	n.d.

> = allometric increase;

< = allometric decrease;

>, < = allometric increase followed by decrease;

nil = no obvious allometric change;

n.d. = no data.

Table 21. Scalation of female *Chelonia mydas* at Comores

Scale(s)	Condition or Numer ‡	<i>Mohéli</i>		<i>Mayotte</i>		<i>Total</i>	
		Fre- quency	Percent Fre- quency	Fre- quency	Percent Fre- quency	Fre- quency	Percent Fre- quency
Cervical	1	41	100.0	33	100.0	74	100.0
Vertebrales	5	40	97.6	31	93.9	71	95.9
	6	1	2.4	2	6.1	3	4.1
Supracaudals	1 pair	41	100.0	33	100.0	74	100.0
Pleurals	4 lf/4 rt	38	92.7	33	100.0	71	95.9
	5 lf/4 rt	2	4.9	0	0.0	2	2.7
	4 lf/5 rt	1	2.4	0	0.0	1	1.4
Marginals	11 lf/11 rt	41	100.0	33	100.0	74	100.0
Infra- marginals*	4 lf/4 rt	21	87.5	13	100.0	34	91.9
	4.5 lf/3 rt	1	4.2	0	0.0	1	2.7
	4 lf/5 rt	1	4.2	0	0.0	1	2.7
	5 lf/4 rt	1	4.2	0	0.0	1	2.7
Intergular	one large	14	100.0	6	75.0	20	90.9
	divided asy [†]	0	0.0	1	12.5	1	4.5
	absent	0	0.0	1	12.5	1	4.5
Plastron [⊖]	6 pairs	25	100.0	13	100.0	38	100.0
Postanal	large	2	10.0	1	7.9	3	9.1
	medium	4	20.0	1	7.9	5	15.2
	small	6	30.0	9	69.2	15	45.5
	very small	4	20.0	0	0.0	4	12.1
	absent	4	20.0	2	15.4	6	18.2
Axillaries	3 lf/3 rt	8	53.3	6	75.0	14	60.9
	2 lf/3 rt	2	13.3	1	12.5	3	13.0
	2 lf/2 rt	2	13.3	0	0.0	2	8.7
	3 lf/4 rt	2	13.3	0	0.0	2	8.7
	4 lf/3 rt	1	6.7	0	0.0	1	4.3
	4 lf/4 rt	0	0.0	1	12.5	1	4.3
Inguinals*	1 lf/1 rt	14	93.3	8	100.0	22	95.7
	1.5 lf/1.5 rt	1	6.7	0	0.0	1	4.3
Postoculars*	4 lf/4 rt	21	80.8	8	61.5	29	74.4
	4 lf/5 rt	1	3.8	0	0.0	1	2.6
	4 lf/3 rt	0	0.0	1	7.7	1	2.6
	3.5 lf/4 rt	1	3.8	0	0.0	1	2.6
	3 lf/4 rt	1	3.8	0	0.0	1	2.6
	3.5 lf/3.5 rt	0	0.0	1	7.7	1	2.6
	3 lf/3 rt	0	0.0	2	15.4	2	5.1
	5 lf/5 rt	1	3.8	0	0.0	1	2.6
	5 lf/4 rt	1	3.8	0	0.0	1	2.6
	5 lf/3.5 rt	0	0.0	1	7.7	1	2.6

‡ "lf" = left; "rt" = right.

⊖ 1 pair each of: Gulars, Humerals, Pectorals, Abdominals, Femorals and Anals.

* 1.5 or 3.5 or 4.5 = 1 of 1 or 3 or 4 scales was partially divided.

† "asy" = asymmetrically.

Table 22. Scalation and coloration of hatchling *Chelonia mydas* from 5 clutches on Mohéli, Comores*

Scale(s)	Condition or Number@	Clutch 1		Clutch 2		Clutch 3		Clutch 4		Clutch 5		Total	
		F	%F	F	%F	F	%F	F	%F	F	%F	F	%F
Cervical	single	1	100.0	8	100.0	10	100.0	10	100.0	8	100.0	37	100.0
Vertebrales	5	1	100.0	8	100.0	7	70.00	9	90.0	7	87.5	32	86.5
	6	0	0.0	0	0.0	3	30.0	1	10.0	1	12.5	5	13.5
Supracaudals	one pair	1	100.0	8	100.0	10	100.0	10	100.0	8	100.0	37	100.0
Pleurals	4 lf/4 rt	1	100.0	8	100.0	10	100.0	9	90.0	8	100.0	36	97.3
	5 lf/5 rt	0	0.0	0	0.0	0	0.0	1	10.0	0	0.0	1	2.7
Marginals	11 lf/11 rt	1	100.0	8	100.0	6	60.0	10	100.0	8	100.0	33	89.2
	11 lf/12 rt	0	0.0	0	0.0	2	20.0	0	0.0	0	0.0	2	5.4
	12 lf/11 rt	0	0.0	0	0.0	1	10.0	0	0.0	0	0.0	1	2.7
	12 lf/12 rt	0	0.0	0	0.0	1	10.0	0	0.0	0	0.0	1	2.7
Infra- marginals	4 lf/4 rt	1	100.0	8	100.0	10	100.0	10	100.0	7	87.5	35	94.6
	4 lf/3 rt	0	0.0	0	0.0	0	0.0	0	0.0	1	12.5	2	5.4
Intergular	one large	1	100.0	8	100.0	10	100.0	10	100.0	8	100.0	37	100.0
Plastron †	single	1	100.0	8	100.0	10	100.0	10	100.0	8	100.0	37	100.0
Postanal	large	1	100.0	0	0.0	1	10.0	1	10.0	0	0.0	3	8.1
	medium	0	0.0	1	12.5	2	20.0	0	0.0	2	25.0	5	13.5
	small	0	0.0	6	75.0	0	0.0	5	50.0	5	62.5	16	43.2
	very small	0	0.0	1	12.5	6	60.0	4	40.0	0	0.0	11	29.7
	absent	0	0.0	0	0.0	1	10.0	0	0.0	1	12.5	2	5.4
Axillaries	2 lf/2 rt	0	0.0	0	0.0	0	0.0	1	10.0	0	0.0	1	2.7
	4 lf/2 rt	0	0.0	0	0.0	0	0.0	0	0.0	1	12.5	1	2.7
	3 lf/3 rt	1	100.0	3	37.5	10	100.0	6	60.0	4	50.0	24	64.9
	3 lf/4 rt	0	0.0	1	12.5	0	0.0	1	10.0	0	0.0	2	5.4
	4 lf/3 rt	0	0.0	2	25.0	0	0.0	1	10.0	1	12.5	4	10.8
	4 lf/4 rt	0	0.0	2	25.0	0	0.0	1	10.0	2	25.0	5	13.5
Inguinals #	1 lf/1 rt	0	0.0	4	50.0	7	70.0	5	50.0	4	50.0	20	54.1
	1 lf/1.5 rt	0	0.0	1	12.5	0	0.0	0	0.0	0	0.0	1	2.7
	1 lf/2 rt	0	0.0	0	0.0	0	0.0	1	10.0	0	0.0	1	2.7
	1.5 lf/1.5 rt	0	0.0	1	12.5	0	0.0	0	0.0	0	0.0	1	2.7
	1.5 lf/2 rt	0	0.0	1	12.5	0	0.0	0	0.0	0	0.0	1	2.7
	2 lf/1 rt	1	100.0	1	12.5	1	10.0	1	10.0	2	25.0	6	16.2
	2 lf/2 rt	0	0.0	0	0.0	2	20.0	3	30.0	2	25.0	7	18.9

Table 22 (cont.)

Scale(s)	Condition or Number@	Clutch 1		Clutch 2		Clutch 3		Clutch 4		Clutch 5		Total	
		F	%F	F	%F	F	%F	F	%F	F	%F	F	%F
Postoculars	4 lf/4 rt	1	100.0	8	100.0	4	40.0	6	60.0	8	100.0	27	73.0
	4 lf/3 rt	0	0.0	0	0.0	4	40.0	2	20.0	0	0.0	6	16.2
	3 lf/4 rt	0	0.0	0	0.0	0	0.0	2	20.0	0	0.0	2	5.4
	4 lf/5 rt	0	0.0	0	0.0	1	10.0	0	0.0	0	0.0	1	2.7
	5 lf/4 rt	0	0.0	0	0.0	1	10.0	0	0.0	0	0.0	1	2.7
White marginal border begins	middle 2nd	0	0.0	0	0.0	0	0.0	2	20.0	0	0.0	2	5.4
	post. 2nd	0	0.0	0	0.0	1	10.0	0	0.0	1	12.5	2	5.4
	ant. 3rd	0	0.0	1	12.5	0	0.0	0	0.0	1	12.5	2	5.4
	middle 3rd	0	0.0	0	0.0	2	20.0	1	10.0	3	37.5	6	16.2
	post. 3rd	1	100.0	5	62.5	6	60.0	7	70.0	3	37.5	22	59.5
	ant. 4th	0	0.0	2	25.0	1	10.0	0	0.0	0	0.0	3	8.1

* "F" = Frequency; "%F" = percent frequency.

@ "lf" = left; "rt" = right.

+ 1 pair each of: Gulars, Humerals, Pectorals, Abdominals, Femorals and Anals.

"1.5" = scale partially divided.

Table 23. Coloration of female *Chelonia mydas* at Comores: number of carapace scutes (pleurals) that have concentrations of dark pigment

Sample		All		1st to 3rd		Some		All or some		None		Total	
		N°	%	N°	%	N°	%	N°	%	N°	%	N°	%
Mohéli	Live	14	74.0	/	/	4	21.0	18	95.0	1	5.0	19	100.0
	Dead	19	90.5	/	/	0	0.0	19	90.5	2	9.5	21	100.0
	Total Mohéli	33	82.5	/	/	4	10.0	37	92.5	3	7.5	40	100.0
Mayotte	1972*	18	78.0	4	17.0	1	4.0	23	100.0	0	0.0	23	100.0
	1973*	14	93.0	1	7.0	0	0.0	15	100.0	0	0.0	15	100.0
	Total Mayotte	32	84.0	5	13.0	1	3.0	38	100.0	0	0.0	38	100.0
Grand total		65	83.3	5	6.4	5	6.4	75	96.2	3	3.8	78	100.0

* Nearly all Mayotte specimens were observed when recently dead.

Table 24. Coloration of female *Chelonia mydas* at Comores: number of carapace scutes (pleurals) that have concentrations of chestnut-red pigment inside dark concentrations

Sample		All		1st to 3rd		Some		All or some		None		Total	
		N°	%	N°	%	N°	%	N°	%	N°	%	N°	%
Mohéli	Live	12	66.7	/	/	5	27.8	17	94.4	1	5.6	18	100.0
	Dead	9	45.0	/	/	3	15.0	12	60.0	8	40.0	20	100.0
	Total Mohéli	21	55.0	/	/	8	21.0	29	76.0	9	24.0	38	100.0
Mayotte	1972*	12	86.0	0	0.0	1	7.0	13	93.0	1	7.0	14	100.0
	1973*	13	87.0	1	7.0	0	0.0	14	93.0	1	7.0	15	100.0
	Total Mayotte	25	86.0	1	3.0	1	3.0	27	93.0	2	7.0	29	100.0
Grand total		46	68.7	1	1.5	9	13.4	56	83.6	11	16.4	67	100.0

* Nearly all Mayotte specimens were observed when recently dead.

Table 25. Stomach contents of three nesting female *Chelonia mydas* at Mohéli, Comores; indicated by estimated percent wet volumetric occurrence ("t" = trace); identifications by J. Norris and S. Fredericq; specimens deposited in U.S. National Herbarium, Smithsonian Institution

	JFCm Number		
	854	857	858
Chlorophyta			
<i>Caulerpa mexicana</i> (Sonder) J. Agardh			1
<i>Chaetomorpha</i> sp.			t
<i>Cladophora</i> sp.			1
<i>Enteromorpha flexuosa</i> (Wulfen) J. Agardh	t	t	t
<i>Halimeda gracilis</i> Harvey ex. J. Agardh	20		1
<i>Halimeda tuna</i> (Ellis & Solander) Lamouroux		2	t
<i>Ulva lactuca</i> L.			t
Phaeophyta			
<i>Dictyopteris delicatula</i> Lamouroux			t
<i>Giffordia mitchellae</i> (Harvey) Hamel			t
Rhodophyta			
<i>Amansia glomerata</i> C. Agardh	t	t	t
<i>Centroceras clavulatum</i> (C. Agardh) Montagne			t
<i>Champia parvula</i> (C. Agardh) Harvey			t
<i>Coelothrix indica</i> Borg.	t		t
<i>Galaxaura veprecula</i> Kjellman	t		t
<i>Jania</i> sp.			t
<i>Polysiphonia denudata</i> (Dillwyn) Kutzing			t
? <i>Hypnea</i> sp.			t
Unknown	t	t	t
Angiospermae (Seagrasses)			
<i>Thalassodendron ciliatum</i> (Forsk.) den Hartog: leaves	1	2	7
<i>Thalassodendron ciliatum</i> (Forsk.) den Hartog: stems		1	7
? <i>Cymodocea</i> or <i>Thalassia</i> : leaves	t	1	1
? <i>Cymodocea</i> or <i>Thalassia</i> : stems		1	
Unknown, macerated fibrous material:			
? <i>Thalassodendron</i> leaves	75	50	80
? <i>Cymodocea</i> / <i>Thalassia</i> leaves		30	
Unknown	t		
Eggs, small encrusting			t
Pebbles, calcareous			t

Table 26. Nesting behaviour of *Chelonia mydas* on Mohéli, Comores

JFCm N°	Date 1972	Beach N°	Tide cycle	Time of behaviour										N° Eggs	Time between high tide and beaching
				time high	first sighted	beached	at crest beach	start front flip. dig	begin egg hole	end egg hole	first egg	last egg	start hind limb cover		
702	1 March	67	spring	17:24	19:45	c.19:45	20:00	<20:10	c.20:25	20:50	+	/	/	/	+2:21
703	2 March	67	spring	17:48	20:38	c.20:00	/	/	/	c.20:58	/	/	<21:05	158	+2:12
704	2 March	67	spring	17:48	c.21:30	c.20:30	/	/	/	/	21:40	21:55	/	101	+2:42
709	9 March*	12	neap	01:22	01:00	c.00:30	/	/	/	/	/	/	/	86	-0.52
711	9 March*	12	neap	01:22	01:30	c.01:30	/	/	/	/	02:40	03:05	/	109	+0.08
713	1 April	45	spring	05:31	06:00#	/	/	/	/	/	06:12	06:38	/	128	bef. sun
722	24 June	67	neap	02:57	<01:30	/	/	/	/	/	/	/	/	85	bef. sun

+ Female JFCm 702 abandoned the nest pit, possibly from disturbance by observers.

* Because females JFCm 790 and 711 nested early in the morning of 10 March (before sunrise), they were scored for 9 March.

Female JFCm 713 had already dug 2 abortive nest pits when she was first sighted.

Table 27. Beaching times of nesting *Chelonia mydas* on beach N° 67, Mohéli, Comores, 24 June 1972.

Time when beached	Time before high tide (02:57)
01:00	1:57
01:00	1:57
01:15	1:42
01:30	1:27
01:45	1:12
02:00	:57
02:00	:57
02:15	:42
02:45	:12

Table 28. Egg measurements of *Chelonia mydas* at Comores: Mohéli samples from beach N° 8, 27 June 1972; Mayotte samples from beaches N°s 126 & 127, June 1972

Female N° JFCm Locality	857 Mohéli	858 Mohéli	717 Mayotte	720 Mayotte	820 Mayotte	821 Mayotte
a. Clutch size	157	158	31+	119	138	?
sample size	10	10	10	10	10	10
b. Maximum diameter [mm]						
median	/	/	47.500	36.750	44.500	44.929
average \pm st. er.	44.25 \pm 0.186	43.35 \pm 0.198	47.400 \pm 0.221	36.300 \pm 0.490	44.700 \pm 0.260	44.900 \pm 0.180
range	43.5 - 45.0	42.0 - 44.0	46.0 - 48.0	34.0 - 38.0	44.0 - 46.0	44.0 - 46.0
c. Middle diameter [mm]						
median	/	/	46.500	35.250	44.333	43.900
average \pm st. er.	43.40 \pm 0.233	42.95 \pm 0.138	46.600 \pm 0.306	35.700 \pm 0.429	44.400 \pm 0.163	43.900 \pm 0.233
range	42.5 - 45.0	42.0 - 43.5	45.0 - 48.0	33.5 - 38.0	44.0 - 45.0	43.0 - 45.0
d. Minimum diameter [mm]						
median	/	/	46.071	35.000	43.929	43.083
average \pm st. er.	42.60 \pm 0.277	42.85 \pm 0.130	46.000 \pm 0.258	35.350 \pm 0.511	43.900 \pm 0.180	43.350 \pm 0.236
range	41.0 - 44.0	42.0 - 43.5	44.0 - 47.0	33.0 - 38.0	43.0 - 45.0	42.5 - 45.0
e. Egg weight [g]						
median	/	/	57.167	26.167	51.833	50.167
average \pm st. er.	/	/	56.800 \pm 0.646	26.600 \pm 1.087	51.800 \pm 0.512	50.200 \pm 0.416
range	/	/	53.0 - 60.0	21.0 - 32.0	50.0 - 55.0	48.0 - 52.0
f. Calculated egg volume						
$\frac{\pi}{(6000 \text{ b.c.d})} [\text{cm}^3]$						
median	/	/	53.193	23.418	44.614	44.575
average \pm st. er.	42.84	41.77	53.232 \pm 0.787	24.091 \pm 0.934	45.634 \pm 0.531	44.754 \pm 0.540
range	39.69 - 46.65	38.79 - 43.59	47.689 - 56.699	19.681 - 28.731	43.589 - 48.773	42.598 - 47.713
g. Calculated clutch weight (a.e) [g]	/	/	/	3,165.40	7,148.40	/
h. Calculated clutch volume (a.f) [cm ³]	6,725.88	6,599.66	/	2,866.83	6,297.49	/

Measurements to the nearest $\frac{1}{2}$ mm or nearest $\frac{1}{2}$ g; diameter measured while applying gentle pressure with thumb and forefinger along a perpendicular axis.

Table 29. Observations on the emergence of a *Chelonia mydas* nest on beach N° 45, Chissioua Ouénéfou, Mohéli, Comores, 31 May 1972

Time	Beach temperature (°C)	HE#	OC+	P*	Comments
12:00	47.0° surface, bulb half covered 48.0° surface, bulb totally covered 38.0° 12 cm deep at nest site	1	-	-	hatchling gets c. 6 m down beach towards sea and drops dead; internal body temperature 49.5°C.
13:30		1	+	-	hatchling heads down beach towards sea; collected.
14:30		1	+	-	hatchling heads down beach towards sea; collected.
15:00		1	-	-	hatchling gets to sea.
15:30		1	+	-	hatchling gets to sea.
16:25		1	+	+	taken on beach by <i>Milvus migrans</i> .
16:35		1	-	-	gets to sea.
16:38		1	-	-	gets to sea.
16:45		1	-	+	taken on beach by <i>Corvus albus</i> .
17:00		1	+	+	taken on beach by <i>Milvus migrans</i> .
17:05		1	+	+	taken on beach by <i>Corvus albus</i> .
17:20	36.5° surface 38.0° 12 cm deep at nest site	-	-	-	2 hatchlings have been exposed on the surface of the sand for nearly 30 min.; 2 kinds of diptera appear at the emergence site.
18:10		-	-	+	2 <i>Ocypode ceratophthalmus</i> move towards emergence site, one takes a hatchling.
18:15		c. 50	?	+	mass emergence, all are in the sea by 18:20; <i>O. ceratophthalmus</i> catch 3 or 4.
18:40	30.5° surface, bulb totally covered 36.0° 12 cm deep at nest site				

"HE" = Hatchling(s) emerged;

+ "OC" = Orientation circle made by hatchling(s);

* "P" = Predation on hatchling(s).

Table 30. Number of sites of *Chelonia mydas* egg shells assumed to have been dug out by nesting female *Chelonia* on beaches of Mohéli, Comores

Beach N°	First visit†		Second visit		Third visit		Changes between visits	
	Date 1972	Sites	Date 1972	Sites	Date 1973	Sites	1 st to 2 nd	2 nd to 3 rd
8	24 Feb	0	27 June	5	12 June	>12	increase	increase
12	24 Feb	0	27 June	3	11 June	1	increase	decrease
24	14 March	0	27 June	0	/	/	nil	/
45	27 Feb 29 March	0 0	25 June	4	10 June	8	increase	increase
46	29 March	0	25 June	0	11 June	6	nil	increase
47	27 Feb 1 April	0 0	25 June	5	10 June	2	increase	decrease
65	2 March	0	24 June	3	/	/	increase	/
67	3 March	9*	24 June	8**	/	/	increase***	/
68	3 March	0	24 June	0	/	/	nil	/

† = two beaches each have 2 dates for the first visit, both of which are early in the nesting season;

"/" = no data;

* = all 9 sites were dug out by dogs;

** = 1 of 8 sites was dug out by dogs;

*** = therefore there had been an increase in sites dug out by nesting *Chelonia* between the first and second visits.

Table 31. Seasonal changes in distance to beach crest distributions of *Chelonia mydas* nest pits on Mohéli, Comores; summary of positions of the major mode in February/March/April and June 1972; the occurrence of a seaward shift in the major mode; and the presence of a mode seaward of the beach crest

Beach N°	Nest pits	Major mode(s)			Seaward mode	
		Month(s)		seaward shift?	Month(s)	
		Feb-April	June		Feb-April	June
8	with eggs	0, 2, 4	3	nil	0	0
	total	2	1	yes	0	nil
12	with eggs	1, 2	3	no	nil	0
	total	2	0, 3	nil	nil	0
24	with eggs	1	-1	yes	nil	-1
	total	1	-1	yes	nil	-1
45	with eggs	4	2	yes	0	-2
	total	3	2	yes	0	-2
46	with eggs	2	0	yes	nil	0
	total	0	0	nil	0	0
47	with eggs	2, 4	3	nil	nil	nil
	total	2, 4	2	yes	nil	nil
65	with eggs	3, 4	0	yes	nil	0
	total	5	0	yes	nil	0
67	with eggs	4	2	yes	0	0
	total	4	2	yes	0	0

All numbers refer to distance from beach crest in metres.

Table 32. Sightings of *Eretmochelys imbricata* at Comores

Island	Date	Locality	Time of the day	Distance offshore	Remarks
Grande Comore:	28 May 1973	Iconi	c. noon	700 m	small animal (c. 30 cm long) at surface several minutes, lifts head breathing; N. Cornfield, pers. com.
Mohéli:	27 Feb	Ch. Ouénéfou northeast	morning	400 m	large individual seen under- water; T. Laurette, pers. com.
	30 Mar 1972	Ch. Ouénéfou southeast	c. 08:00	50 m	at surface.
	31 Mar 1972	Ch. Canzoni	c. 08:00	500 m	at surface breathing for a few minutes, takes 4 to 6 breaths then dives.
	8 June 1973	Ch. Canzoni	after- noon	50 m	large animal (c. 1 m long) at surface for 5 minutes, lifts head a few times a minute, breathing.

Table 33. Measurements (in cm) and observations on *Eretmochelys imbricata* at Comores

JFEi N°	Date 1972	Locality	Measurements				Scales								
			CCL	CCW	PL	HW	Po l/r	Cp	Pl	Ig	Ax l/r	Ing l/r	Im l/r	Pa	
<i>Grande Comore</i>															
20	2 January (7 January)	Itsandra	39.0	35.0	28.0	6.0	3/3	N	N	N	2/2	1/2	4/4	med	
25	29 June (1 July)	Mitsamiouli	36.5	33.5	27.0	5.2	3/3	N	N	N	3/3	1/1	4/4	sm	
26	? (1 July)	Mitsamiouli	40.0	36.5	28.0	5.5	3/3	N	N	N	2/3	1/1	4/4	sm	
27	January (1 July)	Mitsamiouli	47.0	38.5	34.5	6.6	3/3	N	N	N	3/2	0/1	4/4	sm	
28	Sept 1971 (2 July)	Mitsamiouli	34.0	29.5	25.5	-	-	N	N	N	3/2	1/1	4/4	sm	
29	Sept 1971 (2 July)	Mitsamiouli	47.0	44.0	36.5	6.5	3/3	N	N	N	3/3	1/1	4/4	sm	
*136	17 July	Moroni	67.0	58.0	50.0	9.0	-	-	-	-	-	-	-	-	
*137	9 December	north of Moroni	57.0	48.5	43.5	7.5	-	N	-	-	-	-	-	-	
156	27 June (2 July)	south of Choua- Chandroudé	39.0	35.5	28.0	-	3/3	N	N	-	2/2	1/1	4/4	med	
<i>Mohéli</i>															
21	19 Dec 1971 (25 Feb)	Moihani	37.5	33.0	-	-	-	N	-	-	-	-	-	-	
22	3 March	Itsamia	51.5	43.0	38.5	-	3/3	N	N	N	2/2	1/1	4/4	-	
23	16 March (17 March)	Fomboni	37.5	34.0	-	-	3.5/3.5	N	N	N	2/3	1/1	4/4	sm	
<i>Anjouan</i>															
24	June 1969 (30 June 1972)	Mirontsi	39.0	36.0	28.0	5.3	3/3	N	N	N	3/3	1/1	4/4	med	

Table 33. (cont.)

Keels			1 st Dent	Coloration				Epizoa		Tag N ^o	Col	P	Original Collector	JFEi N ^o
Vert	Pleurals	Pl		Dors Appen	Ig	Ax & Ing	Pl	Barn	Alg					
<i>Grande Comore</i>														
2-5! V	2-4!	H-A	5	B	BC	BC	Y	many	fil & enc	-	+	+	Pichard**	20
1-5	1-4	H-A	4	B	BC	BC	Y	few	+	235	-	-	Hotel Maluga	25
2-5	2-4	H-A	5	B	BC	BC	Y	-	-	-	+	-	Hotel Maluga	26
2-5	2-4	Ab-A	8	B	BC	BC	Y	pit	-	-	+	-	Hotel Maluga	27
1-5	2-4!	H-A	4	B	BC	BC	Y	few	enc	-	+	-	Hotel Maluga	28
2-5	4	Ab-A	5	B	BC	BC	Y	-	enc	-	+	-	Hotel Maluga	29
-	-	-	-	-	-	-	-	-	-	213	-	-	Richeaux	136*
-	-	-	-	-	-	-	-	-	-	234	-	-	Richeaux	137*
1-5	3-4	-	5	B	-	-	Y	-	-	-	-	-	Richeaux**	156
<i>Mohéli</i>														
1, 2-5!	3-4!	-	5	-	-	-	-	many	enc	-	+	+	Malandain**	21
-	-	-	-	B	2BS	-	Y	-	-	211	-	-	Frazier	22
1-2, 3-5! V	2-3, 4!	H-A	5	B	BC	BC	Y	many small	fil & enc	-	-	+	Doushang**	23
<i>Anjouan</i>														
1-3 4-5!	4!	H-A	-	B	-	BC	Y	many small	+	-	-	-	Chevalier**	24

Table 33 (cont.)

Keels: Vert = vertebrals, Pleurals, Pl = plastron; indicates scutes on which keels are present; ! if very strong, and V if V-shaped.

1st Dent = first, most anterior, denticulate marginal.

Coloration: Dors Appen = dorsal surface of appendages, Ig = intergular, Ax & Ing = axillaries & inguinals, Pl = plastron; B = black, BC = black centres, 2BS = 2 black spots, Y = yellow.

Epizoa: Barn = barnacles, pit = burrowing barnacle; Alg = algae, fil = filamentous, enc = encrusting.

** Specimen kept by original collector.

Abbreviations at end of Table 6.

Table 34. Spoor of *Eretmochelys imbricata* on 17 beaches at Mohéli, Comores (see Table 2 and Figure 3B for details of the beaches and their spoor)

Beach N ^o	Nest Pits ⁺				Sets of tracks	Nests emerged	Bones	Date of observation
	+	?	-	T				
24	2	0	0	2	1	nil	nil	14 March 1972
24	1	1	1	3	nil	nil	nil	26 June 1972
26	0	1	0	1	nil	nil	nil	15 March 1972
28	1	0	0	1	1	nil	nil	15 March 1972
30	1	0	0	1	nil	nil	nil	15 March 1972
43A	1	0	0	1	nil	nil	nil	31 March 1972
43B	-	-	-	2?	6	-	-	8 June 1973
46	1	0	1	2	nil	nil	nil	1 April 1972
47	3	1	0	4++	nil	(1)	nil	27 Feb 1972
47	10	4	1	15	(1)	nil	nil	1 April 1972
48	2	0	0	2	2	nil	nil	29 March 1972
62B	-	-	-	3?	nil	nil	nil	2 March 1972
63	-	-	-	2	nil	nil	1	2 March 1972
64	-	-	-	1?	nil	nil	nil	2 March 1972
67	1	0	0	1	1	nil	nil	3 March 1972
69	0	0	0	0	1	nil	nil	3 March 1972
70	1	0	0	1	nil	nil	nil	3 March 1972
73	2	0	0	2	nil	nil	nil	3 March 1972
84	2	0	0	2	nil	nil	nil	8 March 1972

Abbreviations at end of Table 9.

Table 35. Estimated rate of human predation on *Chelonia mydas* at Mohéli, Comores

Beach N°	First visit		Second visit		Third visit		Fourth visit		Estimated predation rate			Estimated nesting population	Percent of population taken yearly
	Date	# corpses old new	Date	# corpses old new	Date	# corpses old new	Date	# corpses old new	peak season +	off season	annual rate		
4	27 Jun	2 2	-	- -	-	- -	-	- -	2-3/mo	0	7	30	23%
8	24 Feb	0 0	27 Jun	10 2	12 Jun	0 1	-	- -	1-2/wk	0	20	200	10%
10	27 Feb	0 1	-	- -	-	- -	-	- -	1/mo	0	3	15	20%
12	24 Feb	0 0	9/10 Mar	0 2	27 Jun*	2 7	11 Jun*	0 3	2/wk	1/wk	70	200	35%
24	23 Feb	0 0	14 Mar	0 0	26 Jun	- 0	-	- -	1/yr	0	1	5	20%
46	27 Feb	- 0	1 April	0 1	25 Jun	0 0	11 Jun*	0 1	1/mo	0	3	150	2%
47	27 Feb	- 0	1 April	1 0	25 Jun	0 0	10 Jun*	0 0	1/yr	0	1	150	1%
65	2 Mar	1 1	24 Jun	0 0	-	- -	-	- -	1/mo	0	3	40	8%
67	3 Mar	0 25	24 Jun	0 13	-	- -	-	- -	2/wk	1/wk	70	600	12%
68	3 Mar	0 0	24 Jun	0 1	-	- -	-	- -	1/yr	0	1	50	2%
70	3 Mar	1 0	-	- -	-	- -	-	- -	1/mo	0	3	10	33%
71	3 Mar	2 0	-	- -	-	- -	-	- -	1/mo	0	3	15	20%
Total	all beaches with human predation										185	1,465	12.6%
	all Mohéli beaches										185	1,800	10.3%

all dates are 1972 unless indicated *, otherwise they are 1973;

+ peak season is assumed to last 3 months;

"-" no data;

The occurrence of bones (see Table 9) was not applicable to corpses unless a large number of bones was included.

Beaches with little evidence of human predation are not included (i.e., N°s 9, 13, 22, 38, 59, 60 and 73).

Table 36. Tortoise-shell imports into Zanzibar from territories including Comores

Import from	Date	Weight		Value			Source
		originally recorded	kg equivalent	originally recorded	equivalent Pounds Sterling	equivalent Dollars	
South†	16 Oct 1890 to 17 Aug 1891	62 packages	4,921.5	Rs 92,225*	6,567.5	43,400.00	Great Britain, 1892
Southern ports‡	1892	49 packages	3,839.6	Rs 11,816	844.0	5,560.47	Great Britain, 1893
nil	1893	/	/	/	/	/	Great Britain, 1894
Southern ports‡	1894	55 packages	4,365.9	Rs 14,613	1,044.0	6,876.71	Great Britain, 1895
French South Africa	1914	392 pounds	177.8	£ 320	320.0	1,557.28	Zanzibar, 1915
Madagascar & Comores	1916	3,052 pounds	1,384.4	£ 2,386	2,386.0	11,611.47	Zanzibar, 1917
Madagascar & Comores	1917	413 pounds	187.3	£ 202	202.0	983.03	Zanzibar, 1918

† South = "Ibo, Mozambique, Zambesi, Comoro and other Portuguese and French Possessions to the south".

‡ Southern ports = "Southern ports and islands, including Madagascar".

* Average export value for 62 packages.

PLATES

Plate Captions

- Plate I Fig 1 Chindini beach (N° 2) at the south end of Grande Comore, looking southwest, 12 January 1972; showing supralittoral platform of recent lava in foreground and sand beach on the southwest side of the bay (centre).
 Fig 2 Booni crater, about 8 km south of Mitsamiouli, on the northwest of Grande Comore, looking south, 25 May 1973; showing stark coastal features with recent volcanic rock.
- Plate II Fig 1 Coastal cliffs north of N'Gouni crater, about 2 km southwest of Moroni, on the west of Grande Comore, looking south, 10 January 1972; showing 2 to 3 m cliffs of recent lava.
 Fig 2 Iconi village, about 4 km south of Moroni, on the west coast of Grande Comore, looking south from the top of N'Gouni crater, 10 January 1972; showing coast dominated by recent lava, with small perched beaches, and village and paved road crowding the coast.
- Plate III Fig 1 M'Sanga Nyamba beach (N° 8), northwest coast of Mohéli, looking north from cliffs above the beach, 24 February 1972; showing dense strand and forest vegetation on the beach platform and turtle tracks on the beach.
 Fig 2 M'Sanga Nyamba beach (N° 8), northwest coast of Mohéli, looking northwest from the southern end of the beach, 24 February 1972; showing dense strand vegetation (especially *Hibiscus tiliaceus*) crowding the beach crest and turtle tracks on the beach.
- Plate IV Fig 1 M'Samouheo beach (N° 12), northwest coast of Mohéli, looking northwest from cliffs above the beach, 24 February 1972; showing dense strand and forest vegetation on the beach platform.
 Fig 2 M'Samouheo beach (N° 12), northwest coast of Mohéli, looking south from the northern end of the beach, 24 February 1972; showing small grove of coconuts, dense strand vegetation (especially *Hibiscus tiliaceus* with *Ipomoea pes-caprae* below it) crowding the beach crest, and turtle tracks.
- Plate V Fig 1 Chissioua Ouénéfou beach (N° 45), west side of Mohéli, looking south, 1 April 1972; showing narrow beach crowded by cliffs and dense strand vegetation; the main nesting area is left of centre, and most of the sand is in the intertidal zone.
 Fig 2 Chissioua Ouénéfou beach (N° 47), northeast side of Mohéli, looking north from cliffs above the beach, 10 Juni 1973; showing beach crest crowded by dense strand and forest vegetation.

- Plate VI Fig 1 M'Sanga Nyamba beach (N° 67), southeast coast of Mohéli, from the south end of the beach looking north, 3 March 1972; showing long but narrow beach with dense strand and forest vegetation on the beach platform.
- Fig 2 Chigoni Bay, west side of Mayotte, 15 June 1973; showing gentle and densely vegetated slopes.
- Plate VII Fig 1 Moya South beach (N° 127), west side of Pamanzi Island, Mayotte, looking south, 18 June 1973; showing 'C'-shaped beach with dense strand (especially *Colubrina asiatica*) and forest vegetation on the beach platform, main nesting area is in the centre of the beach, at the right.
- Fig 2 Moya South beach (N° 127), west side of Pamanzi Island, Mayotte, looking inland at the centre of the beach, 18 June 1973; showing dense strand vegetation (especially *Colubrina asiatica* and *Hibiscus tiliaceus*) on beach platform; the remains (shell and flippers) of slaughtered turtles are in front of the bushes.
- Plate VIII Fig 1 Dorsal aspect of immature *Chelonia mydas* JFCm 785, 23 March 1972, Fomboni, Mohéli; showing predominance of chestnut-red colour and dark pigment distributed mainly in rays.
- Fig 2 Dorsal aspect of the head of immature *Chelonia mydas* JFCm 785, 23 March 1972, Fomboni, Mohéli; showing predominance of chestnut-red colour.
- Plate IX Fig 1 Nesting female *Chelonia mydas* JFCm 710, M'Samouheo beach (N° 12), Mohéli, 10 March 1972; showing conspicuous chestnut-red 'bull's-eyes' with emanating rays.
- Fig 2 Nesting female *Chelonia mydas* JFCm 712, M'Samouheo beach (N° 12), Mohéli, 10 March 1972; showing conspicuous chestnut-red 'bull's-eyes' and dark pigment concentrated in rays.
- Plate X Fig 1 Nesting female *Chelonia mydas* JFCm 708, M'Samouheo beach (N° 12), Mohéli, 10 March 1972; showing concentrations of chestnut-red pigment in posterior-medial corners of pleural scutes.
- Fig 2 Nesting female *Chelonia mydas* JFCm 711, M'Samouheo beach (N° 12), Mohéli, 10 March 1972; showing concentrations of chestnut-red pigment with emanating rays.
- Plate XI Fig 1 Dead nesting female *Chelonia mydas* JFCm 794, M'Samouheo beach (N° 12), Mohéli, 10 March 1972; showing dark pigment dispersed in dark spots.
- Fig 2 Dead nesting female *Chelonia mydas* JFCm 795, M'Samouheo beach (N° 12), Mohéli, 10 March 1972; showing conspicuous chestnut-red 'bull's-eyes' with emanating dark rays, but colours less vivid than in live animals.
- Plate XII Fig 1 Dead female (?) *Chelonia mydas* JFCm 789, M'Sanga Nyamba beach (N° 67), Mohéli, 3 March 1972; showing concentrations of dark pigment in posterior-medial corners of pleural scutes, and bleached less vivid colours.
- Fig 2 Dead female (?) *Chelonia mydas* JFCm 790, M'Sanga Nyamba beach (N° 67), Mohéli, 3 March 1972; showing bleached less vivid colours.
- Plate XIII Fig 1 Nesting female *Chelonia mydas* JFCm 719, Moya South beach (N° 126), Mayotte, 9 June 1972; showing concentrations of chestnut-red pigment and emanating rays (photo by Dr. R. Von Hentig).
- Fig 2 Nesting female *Chelonia mydas* JFCm 720, Moya North beach (N° 127), Mayotte, 9 June 1972; showing large concentrations of chestnut-red pigment, and many light coloured circles on the posterior, probably old attachment sites of the barnacle *Chelonibia testudinaria* (photo by Dr. R. Von Hentig).

- Plate XIV Fig 1 Ventral aspect of nesting female *Chelonia mydas* JFCm 720, Moya North beach (N° 126), west side of Pamanzi Island, Mayotte, 9 June 1972; showing stumped left hind limb and asymmetric anal scutes of plastron (photo by Dr. R. von Hentig).
- Fig 2 Female *Chelonia mydas* JFCm 713, nesting on beach 45, west side of Chissioua Ouénéfou, Mohéli, 1 April 1972; showing covering of the nest by sweeping sand backwards; note deep body pit, tag at base of left front flipper and large copulation notch in the shell to the right of the tag.
- Plate XV Fig 1 Hatchling *Chelonia mydas* emerging from a nest on beach 45, west side of Chissioua Ouénéfou in late afternoon, 31 March 1972; showing covering behaviour in which the turtle flips sand onto its body.
- Fig 2 Hatchling *Chelonia mydas* emerged from a nest on beach 45, west side of Chissioua Ouénéfou in late afternoon, 31 March 1972; showing the body covered with sand and the turtle lifting its hind feet from the sand, reducing body contact with the substrate.
- Plate XVI Fig 1 Dorsal aspect of immature *Eretmochelys imbricata* JFEi 20, captured at Itsandra, west side of Grande Comore, 2 January 1972; showing keels on all but the most anterior pleurals and on all vertebrae.
- Fig 2 Ventral aspect of immature *Eretmochelys imbricata* JFEi 20, captured at Itsandra, west side of Grande Comore, 2 January 1972; showing moderately strong keels on each side of the plastron and black centres to many ventral scales.
- Plate XVII Fig 1 Dorsal aspect of the carapace of immature *Eretmochelys imbricata* JFEi 21, captured at Moihani, southeast side of Mohéli, 19 December 1972; showing keels on all but most anterior pleurals and vertebrae (the shell is varnished).
- Fig 2 Dorsal aspect of the head of immature *Eretmochelys imbricata* JFEi 20, captured at Itsandra, west side of Grande Comore, 2 January 1972; showing black scales outlined in yellow and an extra asymmetric prefrontal scale.
- Plate XVIII Fig 1 Female *Chelonia mydas* JFCm 713 nesting on beach 45, west side of Chissioua Ouénéfou, Mohéli, 1 April 1972; showing carapace scutes covered with scratches and copulation notch above right front flipper.
- Fig 2 Carapace of dead *Eretmochelys imbricata* (nesting female ?) on beach 127 Moya South, west side of Pamanzi Island, Mayotte, November 1972; showing heavy infestations of barnacles *Chelonibia testudinaria* and encrusting algae (photo by A. Birtles).

PLATE I



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2

PLATE II



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PLATE III



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2

PLATE IV



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PLATE V



1



2

PLATE VI



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2

PLATE VII



1

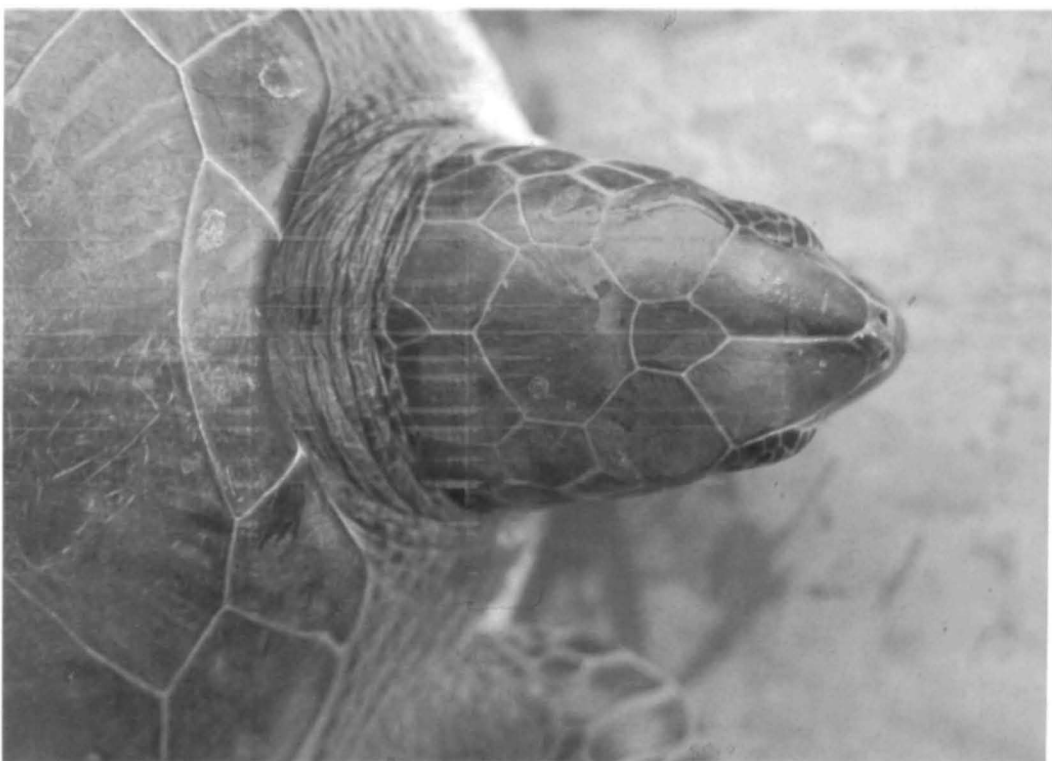


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PLATE VIII



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PLATE IX



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PLATE X



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PLATE XI

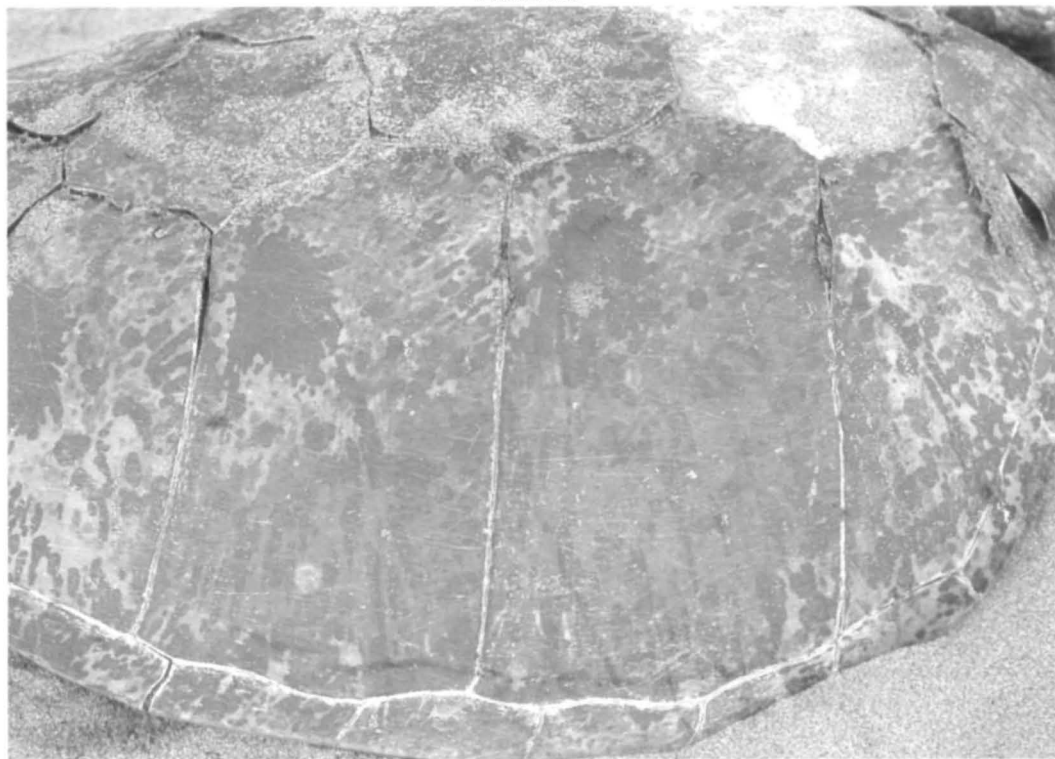


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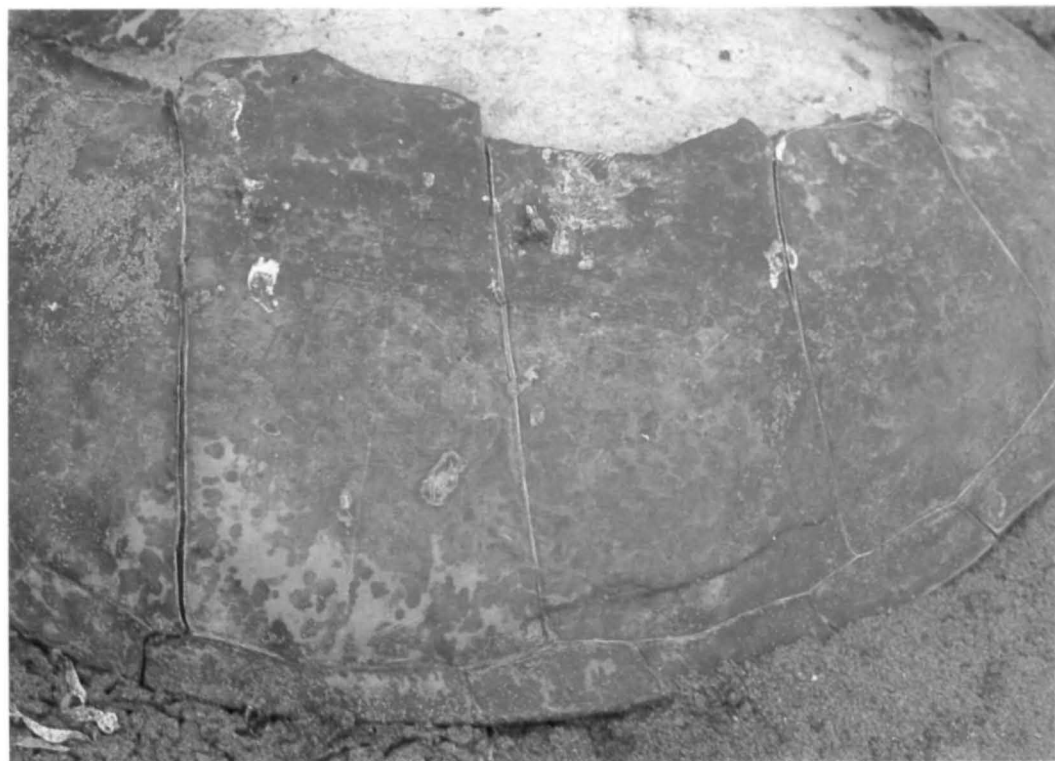


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PLATE XII

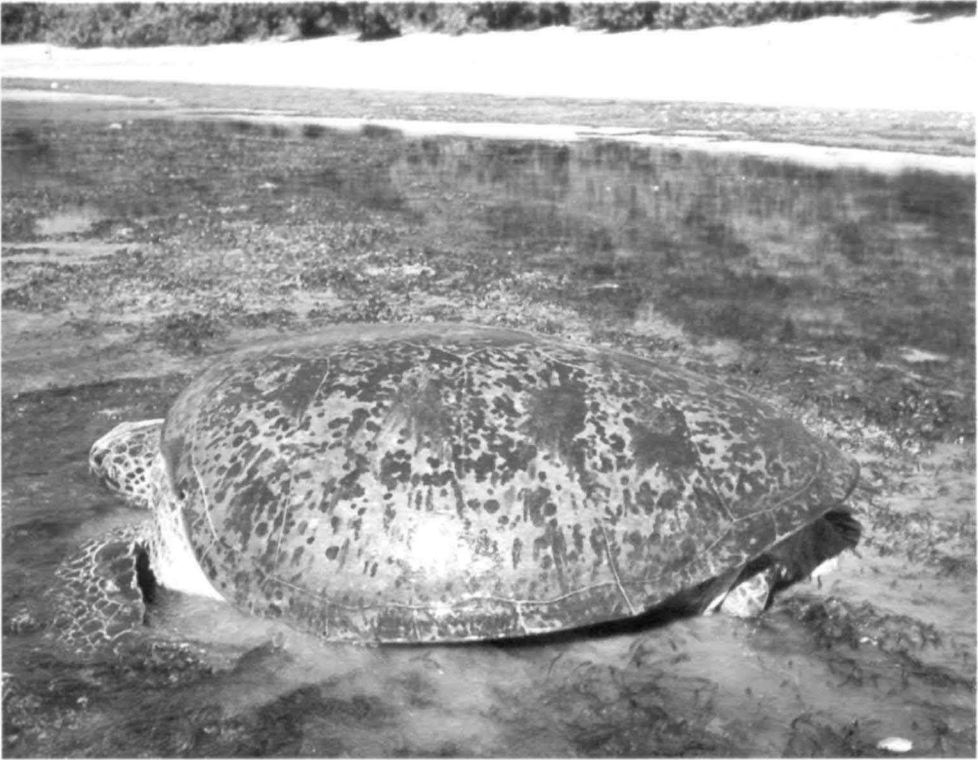


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PLATE XIII



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PLATE XIV

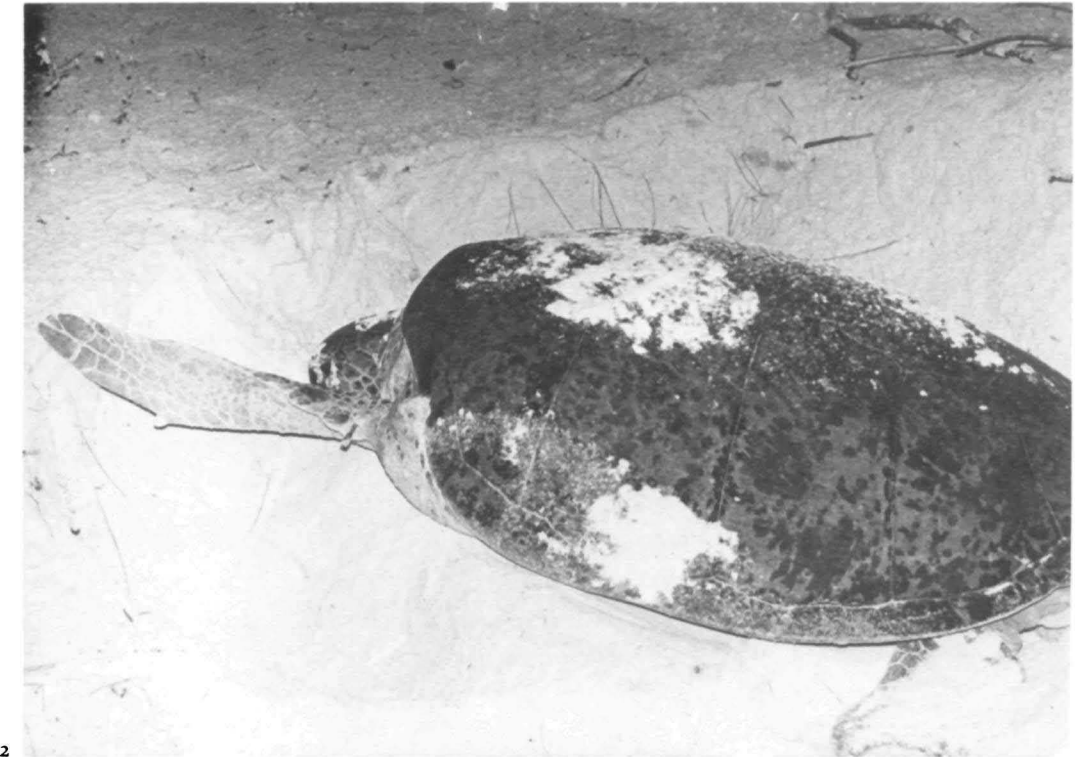


PLATE XV

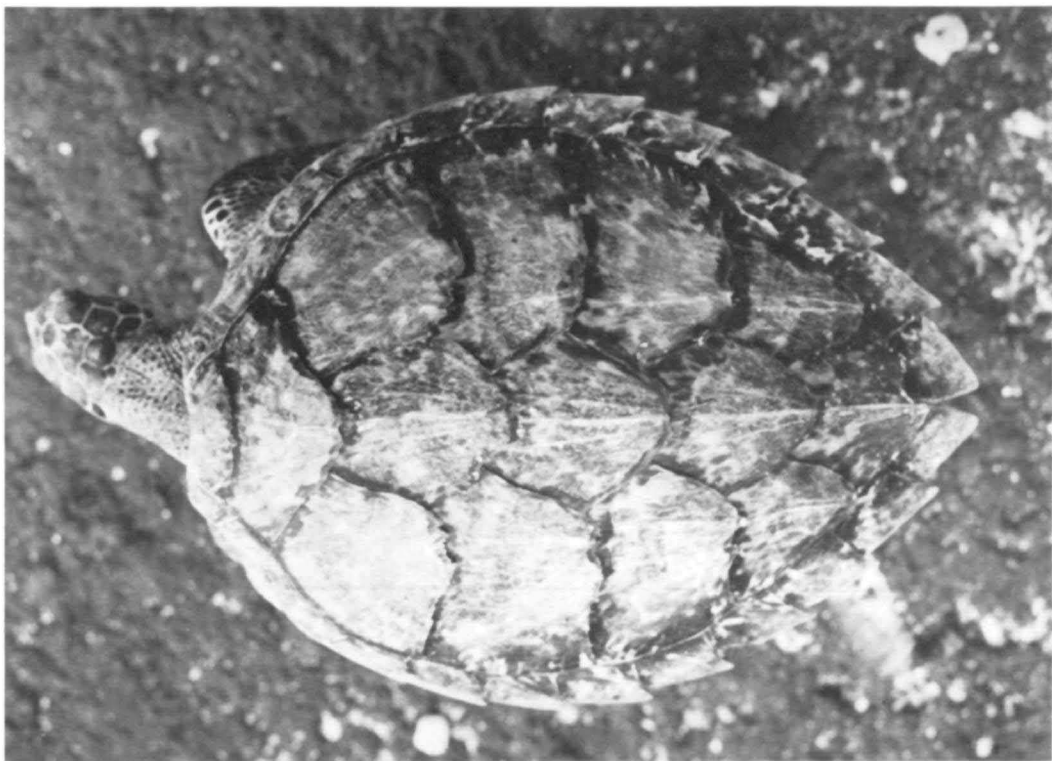


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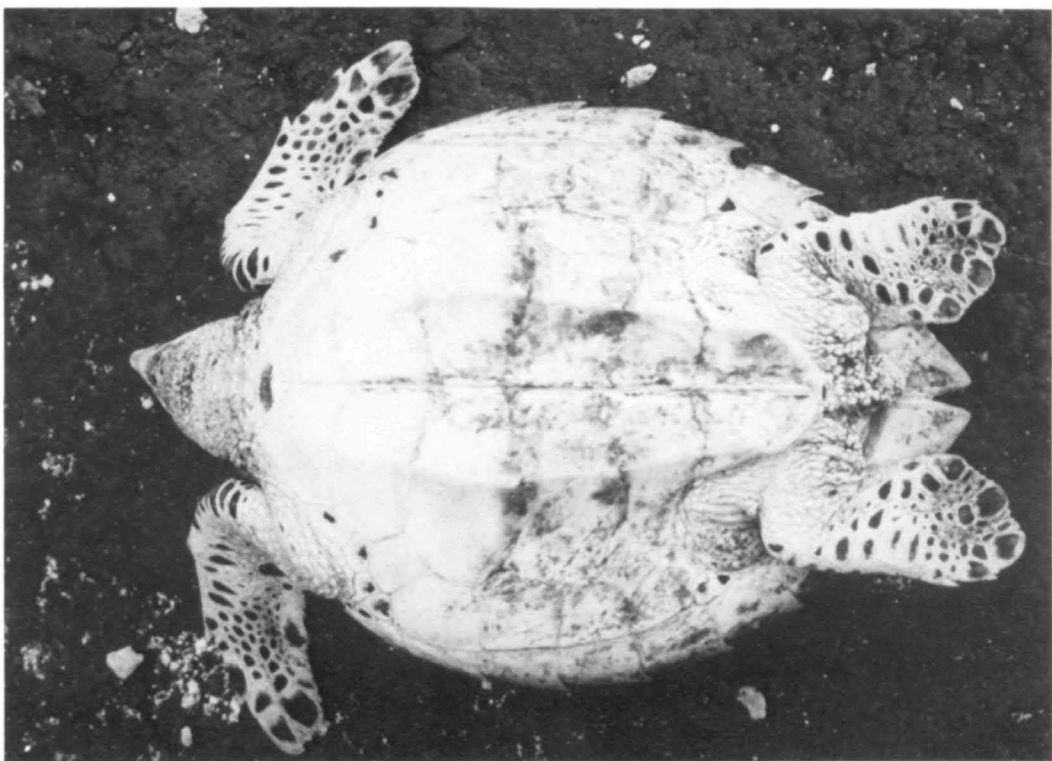


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PLATE XVI

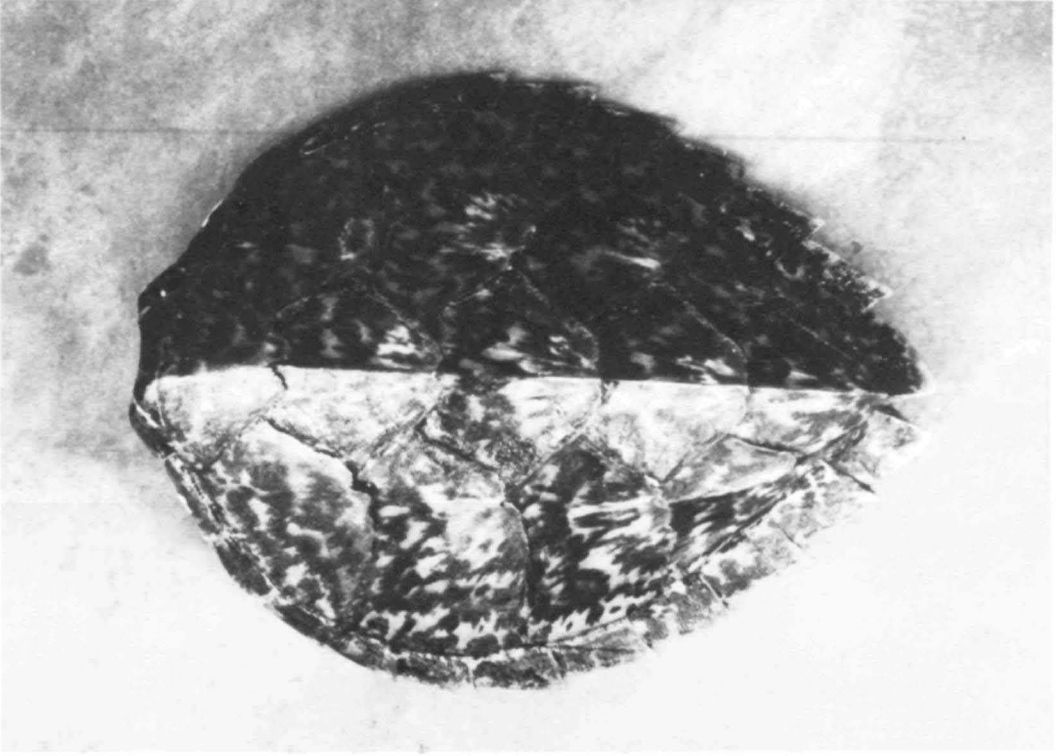


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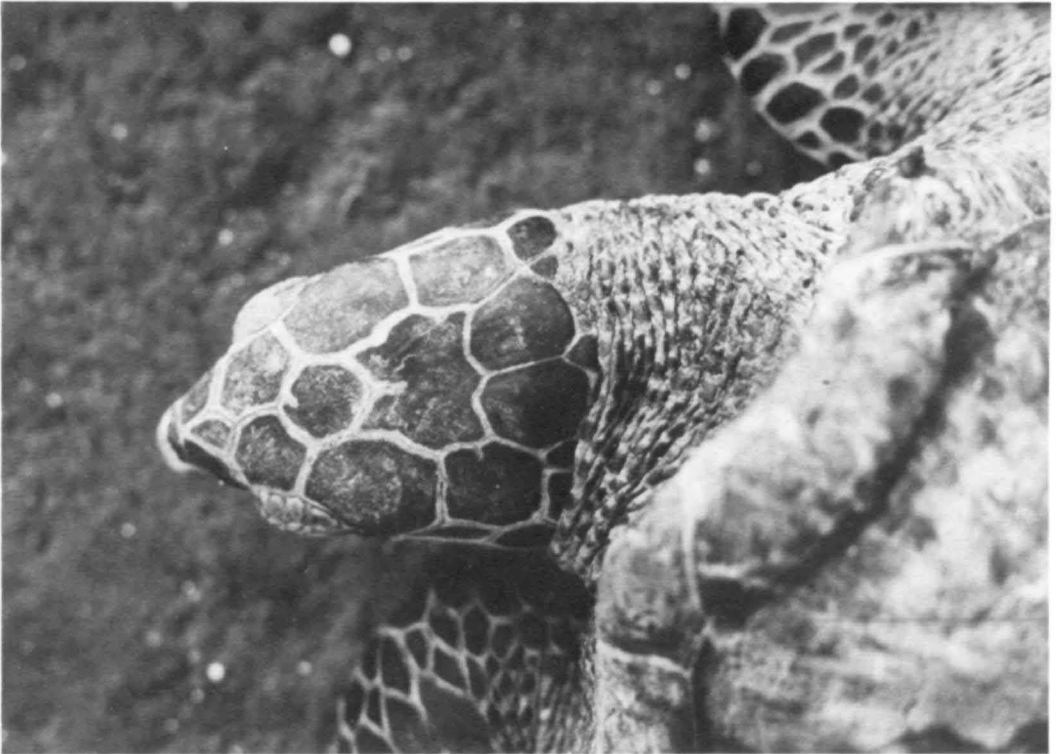


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PLATE XVII

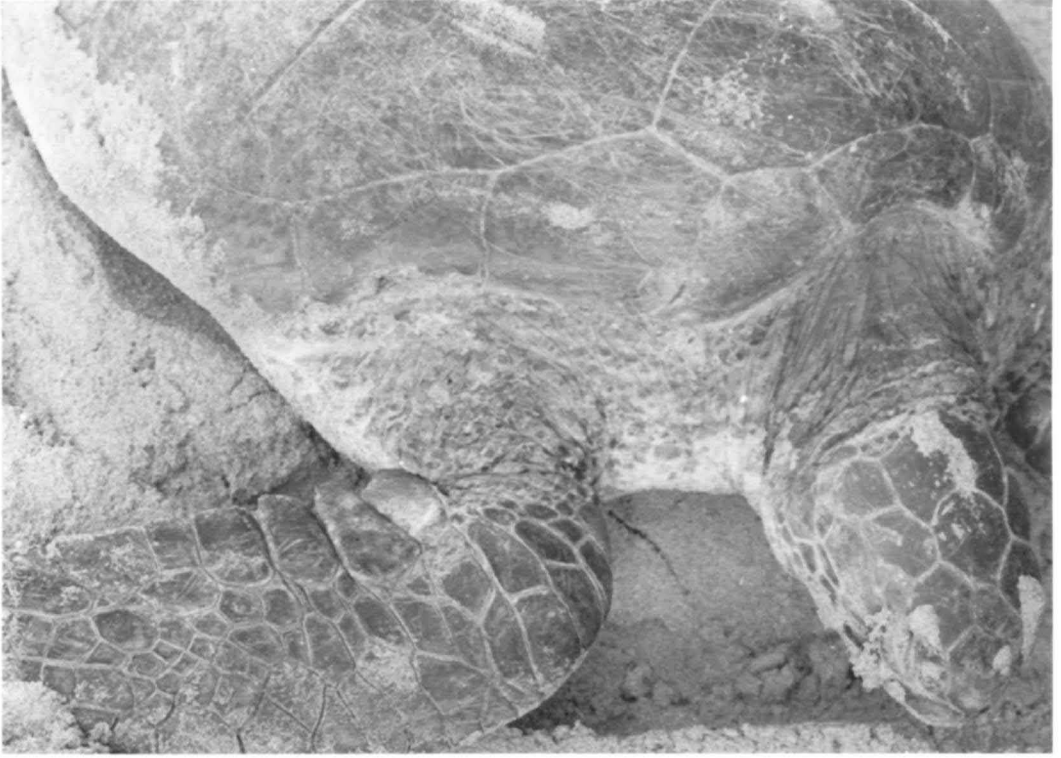


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PLATE XVIII



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