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Exploitation of Marine Turtles in the Indian Ocean

J. Frazier[1]

Marine turtles long have been of great value to peoples of the Indian Ocean, nutritionally, economically, and culturally. Once directed primarily toward subsistence, the hunting of marine turtles for international trade has increased; today their populations are often so depleted that they are not only insignificant as resources, but are endangered. An understanding of exploitation is imperative to guarantee future populations, yet available information is sketchy. "Subsistence hunting" is an ambiguous term, since the most intense exploitation is for export. Historically this has involved Chelonia *and* Eretmochelys, *whose populations are now much reduced. Yet, newly "discovered" populations (*Lepidochelys *especially) are being exploited, under the stimulus of new foreign markets (e.g., leather), and their fates seem even less hopeful than those of long-exploited populations. Moreover "subsistence hunting" for immediate local consumption has led to depletion of nesting and feeding populations of turtles in areas where protein sources are in great demand and human population densities high. Neither the future nor the solution to this dilemma is clear, but it is obvious that economic considerations must be carefully considered, and ecological arguments alone are insufficient to manage these resources.*

KEY WORDS: marine turtles; Indian Ocean; subsistence hunting; exploitation.

INTRODUCTION

Marine turtles are valuable resources to many peoples of the Indian Ocean, having contributed to the nutritional, economic, and cultural fabric of the region. Indeed, the Indian Ocean has been famous for its sea turtles for millennia.

[1] Department of Zoological Research, National Zoological Park, Smithsonian Institution, Washington, D.C.

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Chronicles, such as the *Periplus of the Erythrean Sea* from the first century A. D., repeatedly discuss the quantities and values of tortoise shell available for trade (Freeman-Grenville, 1962: 1 ff.). Numerous territories, such as Seychelles and Zanzibar, are world renowned for the turtles and turtle products that they have produced and marketed.

However, despite the long-standing value of this resource, its future is in jeopardy. Many turtle populations have declined to the point where they are no longer significant resources, either materially or culturally. The classic case is Seychelles, where a once invaluable food and trade item was, in the course of a century, reduced to little more than a political football (Frazier, 1979). An example of cultural loss is in Kenya where, during the last decade, traditional Bajun fishermen have been banned from practicing their specialized techniques for turtle hunting because of restrictions to protect depleted populations. In some areas the reptiles are not just diminished in numbers, they are endangered.

The plight of marine turtles has received attention from all parts of the planet, including countries large and small, rich and poor, and many states around the Indian Ocean. International restrictions have been established, through the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), to reduce international trade and exploitation in these animals. A recent World Conference on Sea Turtle Conservation highlighted the problems and pointed out again and again what little basic information exists, especially for the Indian Ocean (Bjorndal, in press).

There is an unrelenting urgency to understand the status of marine turtles and the pressures to which they are being subjected. Exploitation is one of the most direct and easily identified of problems. In some cases it causes tremendous strains on a population, especially where commercial ventures are involved (see Frazier, in press-a), but also under intense levels of noncommercial utilization.

If these natural resources are to be available and significant in the future they must be managed, and management problems must therefore be identified. This paper draws together information on sea turtle exploitation in the Indian Ocean, and describes how this relates to local human populations. A synopsis of this material is in the *Proceedings of the World Conference on Sea Turtle Conservation* (Frazier, in press-b).

TURTLES AND TURTLE HUNTERS

Marine Turtles of the Indian Ocean

Of the world's seven species of sea turtles, five are known from the Indian Ocean. Only Kemp's Ridley, *Lepidochelys kempii* (Garman) and the Australian Flatback, *Chelonia depressa* (Garman), both of which have restricted ranges, are

missing. The most widely occurring species in the Indian Ocean is the Green Turtle, *Chelonia mydas* (Linnaeus), which is probably also most numerous. The Hawksbill, *Eretmochelys imbricata* (Linnaeus), is likewise common throughout the region. Loggerheads, *Caretta caretta* (Linnaeus), are not generally common, but the largest rookery in the world is on Masirah Island, at the mouth of the Persian Gulf. This turtle also nests in the southwest Indian Ocean, in Madagascar, Mozambique, and South Africa. The Olive Ridley, *Lepidochelys olivacea* (Eschscholtz), is abundant in the Bay of Bengal and evidently in Pakistan as well. *Dermochelys coriacea* (Linnaeus), the Leathery Turtle, is unique and the largest of turtles. It is the rarest species in this ocean. A major world nesting area is on the east side of the Malayasian peninsula, but the only areas of concentrated nesting in the Indian Ocean are in Sri Lanka, Mozambique, and South Africa. Details on the status of marine turtles in the Indian Ocean are found Bhaskar (in press); Frazier (in press-c; in press-d; in prep.); Hughes (in press); Ross and Barwani (in press).

TRADITIONAL HUNTERS OF THE INDIAN OCEAN

The Indian Ocean hosts a wide variety of beachcombers, fishermen, sailors, and turtle hunters, and these different peoples vary greatly in their proficiency in hunting and processing marine turtles. Many traditional peoples in the region have not only developed specialized tools and techniques for capturing and preparing turtles, but have interwoven distinctive turtle myths and customs within their cultures. The Vezo of southwest Madascar have some of the richest cultural relationships with turtles (see Petit, 1930), and these marine reptiles are also of great importance in the cultures of Comorians, Bajun from Kenya and Somalia, Seychellois, Socotra Islanders, Tamils from Sri Lanka and southern India, Onge from the Andamans, and Selung from the archipelagos of Burma and Thailand.

An extraordinary technique of catching turtles with remora sucker fish has been practiced by Comorians, Bajuni, and Socotra Islanders (Holmwood, 1884; Petit, 1930; Parsons, 1962; FAO, 1968). Harpooning, netting, and hooking turtles with grapnels are other specialized techniques used by a variety of cultures. Less developed methods of capture, practiced widely, include: grabbing or noosing mating animals while they are immobile at the surface; catching incidentally in fish nets and traps; catching underwater by hand: spearing underwater with spear guns; chasing and catching in shallow water; and "turning" females upside-down while they are on nesting beaches.

In those peoples with sophisticated traditional techniques, as well as in others where the relationships with turtles have been more casual, there has been a long history of subsistence-level exploitation, utilizing meat, eggs, oil, and other turtle products. The age-old tortoise-shell fishery was dependent on

subsistence-level hunters for the capture of turtles and production of raw material for trade.

Turtle eggs of all species are relished throughout the region. Meat is also eaten in most places, except where local Islamic (or other religious) traditions forbid the food. However, there is no universal prohibition in Islam; some of the keenest turtle hunters in the world are Moslems, for example the Bajun. Meat of *Chelonia* is especially favored, and entrails, even blood of this species, are highly esteemed. *Lepidochelys* is also eaten, and *Caretta* may be consumed in some places. *Demochelys* is rarely eaten, and *Eretmochelys* is regarded as poisonous in many territories. Nowhere in the Indian Ocean is turtle a primary source of protein, as it has been with the Miskito Indians (Nietschmann, 1972).

Turtle oil is used to season and preserve wood of local boats, and *Dermochelys* is the most important source of this product. Oil from *Chelonia,* and occasionally other species, may also be used for boat maintenance, but it is used medicinally and for food preparation as well. More localized and incidental uses of turtle products include making crude sandals of the flipper skin and using the bowl-shaped carapaces as vessels.

Eretmochelys have been captured for millennia to supply a world market with tortoise shell (Parsons, 1972), the wold's first plastic. Traditional fishermen have also supplied turtles for more recent markets: Calipee, the cartilagenous part of the belly, was processed mainly from *Chelonia* and exported in great quantities to Europe over the last century. *Chelonia* have been exported whole (alive or frozen) also during the last century. Most recently turtles, especially *Lepidochelys,* have been caught for leather, which is popular in Europe and Japan.

The quantities of animals taken for these export ventures are great, and the commercial values considerable. Raw, unworked tortoiseshell is now worth almost $100/kg in Japan, where nearly 100,00 kg have been imported yearly. Imports of turtle leather into Japan alone are also worth more than a million dollars annually. These intensely commericalized fisheries have developed in the last century, and the last decade has seen the most dramatic surge in prices and volumes traded (Mack *et al.,* 1979). It is not surprising that large international enterprises have become major exploiters of marine turtles.

THE PROBLEM WITH "SUBSISTENCE HUNTING"

Despite the multitudes of subsistence hunters that line the shores of the Indian Ocean, a great amount of turtle exploitation carried out by them today is directed toward a money economy.

"Subsistence hunting" is not easily defined. The goal of hunting is to provide food for personal use, and it is commonly assumed that the hunter will catch only what he can consume. "Commercial" hunting is the antithesis of this

approach, and here the hunter uses "modern technology" to catch as much as possible for sale to a buyer or market. The two stereotypes are differentiated morally as well; in the paradigm of the "noble savage" the traditional hunter is naive, innocent, and praised, the commercial one is tainted and denounced (although the majority of writers and critics participate eagerly – if unwittingly – in commercialized society). This dichotomy between "subsistence" and "commercial" hunting is in such common usage that it affects legal regulations. Aboriginal rights in salmon fishing or Bowhead whaling are examples in which ethnic groups, because of traditional practices, are allowed to catch animals that their neighbors are prohibited from exploiting.

However, rather than two mutually exclusive options, there seems to be a spectrum of conditions ranging from the self-sufficient hunter who consumes what he catches to the community in which different individuals with specific roles hunt, process, and distribute the catch, all based on a money economy. The extreme condition of market dependence is when the hunter will not eat his catch because it is "too valuable" when sold (Fig. 1). Hunting for monetary returns could be excluded from the definition of subsistence hunting, but as long as an action provides means for supporting life, it is a form of subsistence. Hence, population dependence and market dependence are not mutually exclusive (cf. Neitschmann, 1979).

An example of subsistence hunting, dependent on a market, is an incidental fishery for tortoise shell; the product is not edible and is useful only in the hands of an artisan. Yet, income from the sale of tortoise shell could provide the fisherman with funds to buy nets, boats, cloth, or grain – all necessary for subsistence.

To avoid having to decide arbitrarily where "subsistence hunting" ends and "commercial hunting" begins, I will instead deal with exploitation in general, and make arbitrary categories as to the degree of commercialization and the amount of movement of the product. This provides a rough index of the size and complexity of the exploitation system. Exploitation can be for local consumption or for export; export may be intranational or international; distant consumers may be nationals or foreigners.

Another problem in describing subsistence-level hunting is that by its nature it is rarely documented in detail. Usually it is carried out in remote areas where there are no facilities and no interest in recording hunting techniques, hunting effort, catch, or other vital statistics. The less commercialized an activity is, the less likely governments are to expend resources on monitoring it. To understand and document the situation, it is usually necessary to gather information firsthand, from detailed studies (see as a prime example Neitschmann, 1979).

The vastness and diversity of the region involved increases the difficulty in obtaining detailed information. The Indian Ocean is the third largest ocean, and comprises one-seventh of the earth's surface. Despite its size and importance,

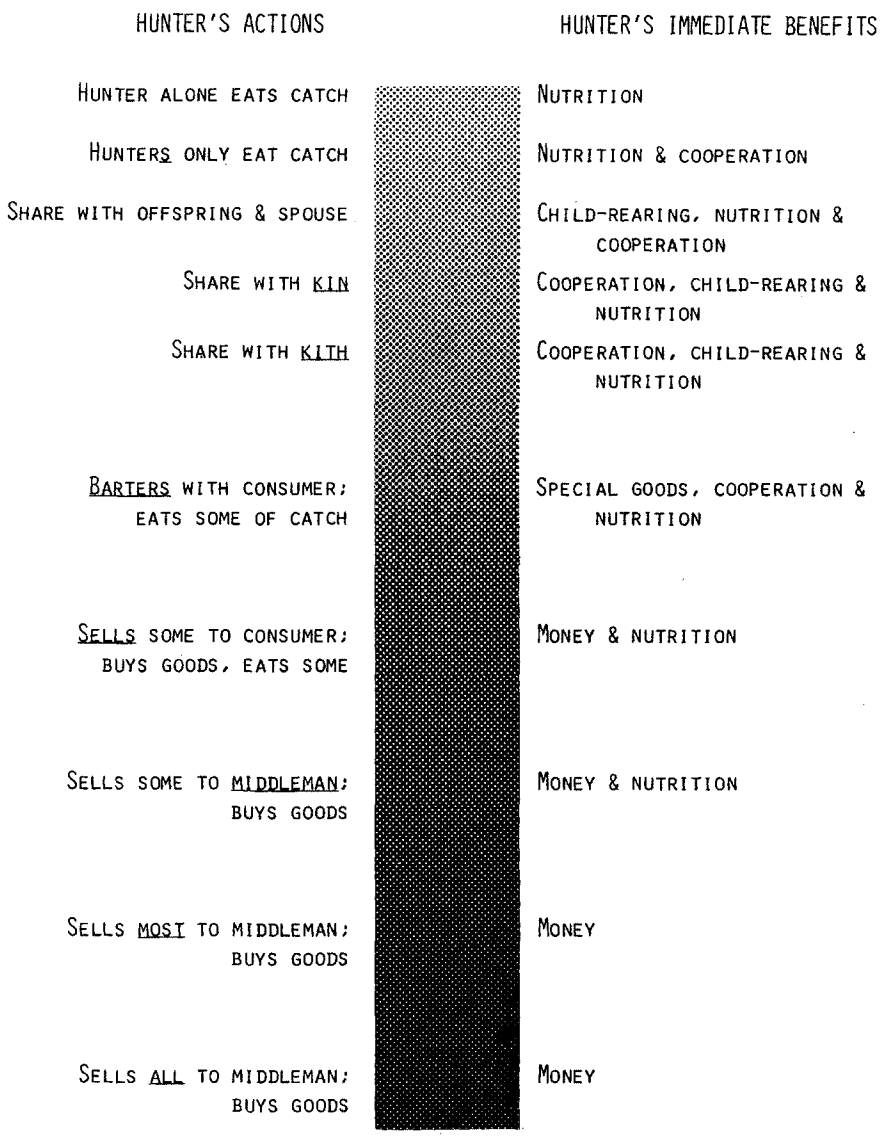

Fig. 1. Schematic of various conditions of exploitation, ranging from the hunter who eats what he catches to the hunter who sells all of his catch.

it has been neglected by scientists and is one of the most poorly known of oceans. Some 40 sovereign territories form its shores (Fig. 2). [Thailand, Indonesia, and other countries of Australasia will not be discussed here, but Polunin (in press) treats some of these.] It would be ambitious indeed to document the exploitation that occurs over this area, and there is little hope that it could be

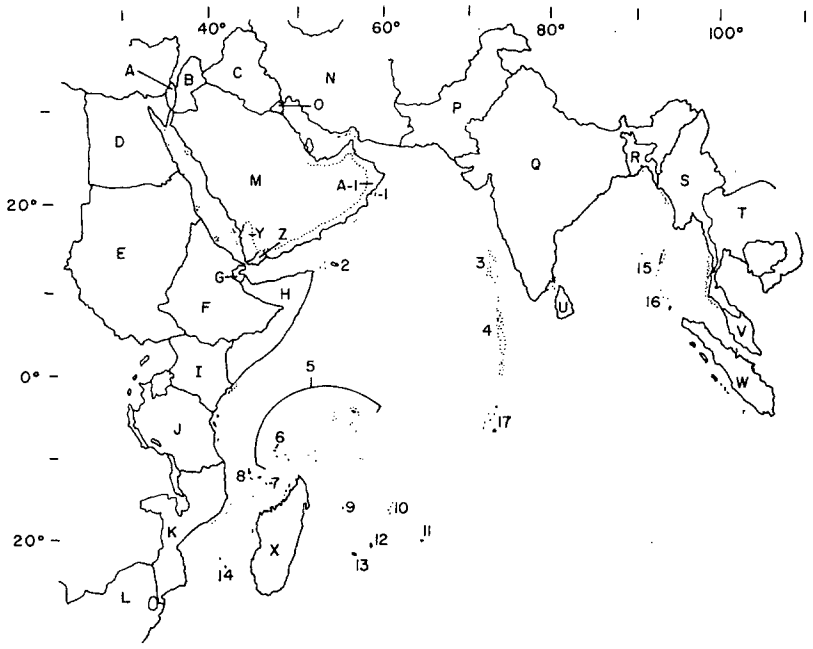

Fig. 2. The Indian Ocean. Mainland countries: A = Israel, B = Jordan, C = Iraq, D = Egypt, E = Sudan, F = Ethiopia, G = Djibouti, H = Somalia, I = Kenya, J = Tanzania, K = Mozambique, L = South Africa, M = Saudi Arabia, N = Iran, O = Kuwait, P = Pakistan, Q = India, R = Bangladesh, S = Burma, T = Thailand, U = Ceylon, V = Malaya, W = Indonesia, X = Madagascar, Y = Yemen Arab Republic, Z = People's Democratic Republic of Yemen, A-1 = Oman. Islands: 1 = Masirah (Oman), 2 = Socotra (PDRY), 3 = Laccadives (India), 4 = Maldives, 5 = Seychelles, 6 = Aldabra (Seychelles), 7 = Mayotte (France), 8 = Comores, 9 = Tromelin (Reunion, France), 10 = St. Brandon (Mauritius), 11 = Rodrigues (Mauritius), 12 = Mauritius, 13 = Reunion (France), 14 = Europa (Reunion, France), 15 = Andamans, 16 = Nicobars, 17 = BIOT (Chagos).

given the same detailed treatment Neitschmann (1979) has applied over the past decade to the turtle-hunting Miskito Indians of eastern Nicaragua. Hence much of the information available here is general, or speculative, at best.

ACCOUNT BY COUNTRIES

In the present treatment, each sovereign territory is examined separately, for it is each nation that must respond to its own specific problems. Because subsistence hunting and exploitation deal with the relationship between resources and exploiters, a brief sketch of the latter in each country is given, if for no other reason than to characterize their abilities as fishers and sailors and use this as an index of potential impact on turtle stocks. Local regulations relevant to

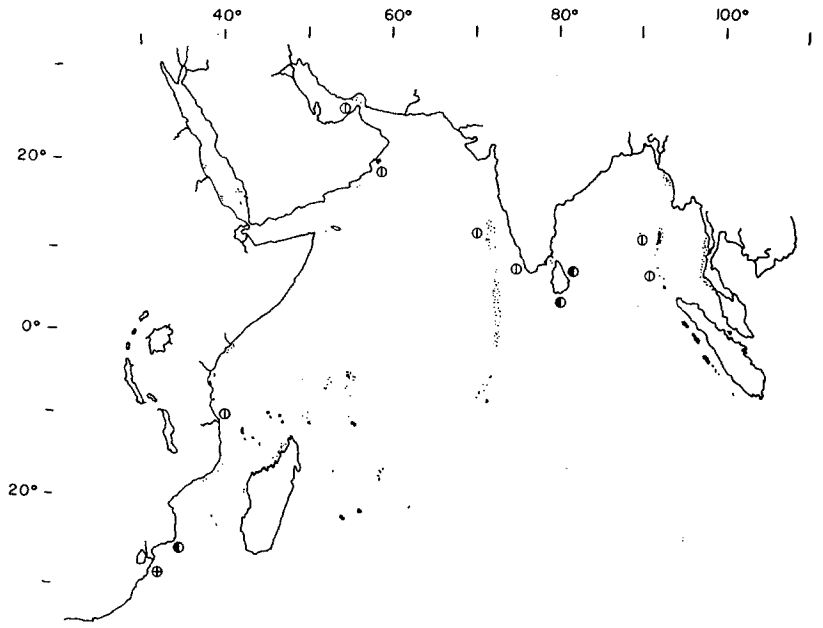

Fig. 3. Exploitation of *Dermochelys coriacea* in the Indian Ocean. Symbols: Impact: Disturbance to reproduction/recruitment (left half of circle): (◐) little, (●) great. Major utilization (right half of circle): (◑) local consumption; (◑) intranational export, national consumption; (◑) intranational export, expatriate consumption; (●) international export. (⊕) No significant exploitation. (?) Exploitation situation not known. (○, ○) Situation before 1950, after 1950 *if* a major change has occurred (otherwise past and present situations are assumed to be unchanged). No symbol indicates there are no significant turtle populations.

turtle exploitation are also mentioned. For comparison and consistency, all monetary units are reported in local currencies and converted to U.S. dollars. Graphic summaries of exploitation of the five species of marine turtles in the Indian Ocean are given in Fig. 3-7.

1. Republic of South Africa. Thonga and Zulu tribesmen have inhabited the coastal area of northern Natal for centuries, although the Zulu have expanded their territory considerably in historic times. Both of these peoples are accomplished hunters and have catholic tastes; however, neither ventured out to sea, and neither seems to have exploited the near shore regularly, as do the Xhosa farther south. Large middens from "strandlopers" testify to intense exploitation of the littoral, or intertidal, zone by pre-Bantu (Hottentot?) peoples. Europeans, Boers and British mainly, colonized in the 1800s but have not been involved significantly in subsistence hunting for turtles.

Until 1963, turtles that nested in Thongaland were killed and eggs dug up and eaten. *Caretta*, and to a lesser extent *Dermochelys*, were exploited. Both species were evidently coming under increasing exploitation, although turtles

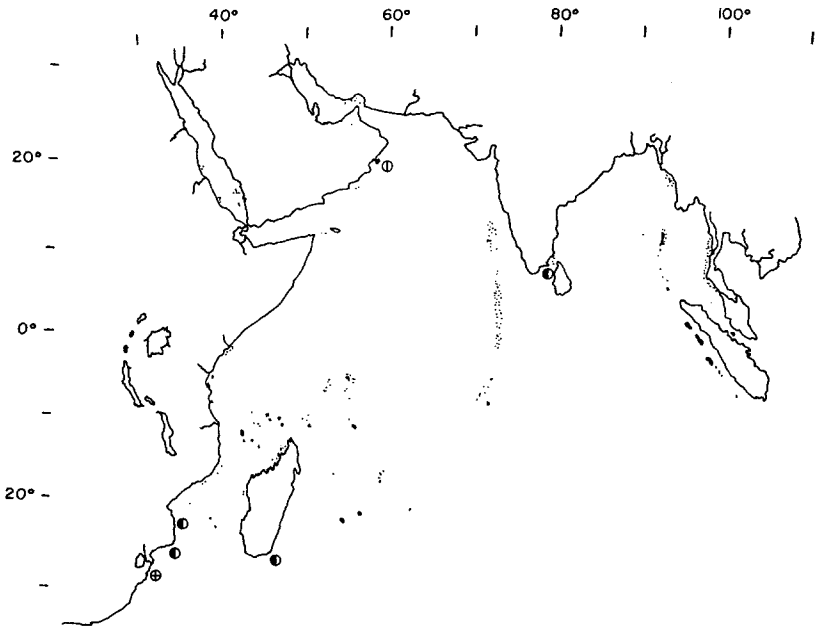

Fig. 4. Exploitation of *Caretta caretta* in the Indian Ocean (symbols as in Fig. 3).

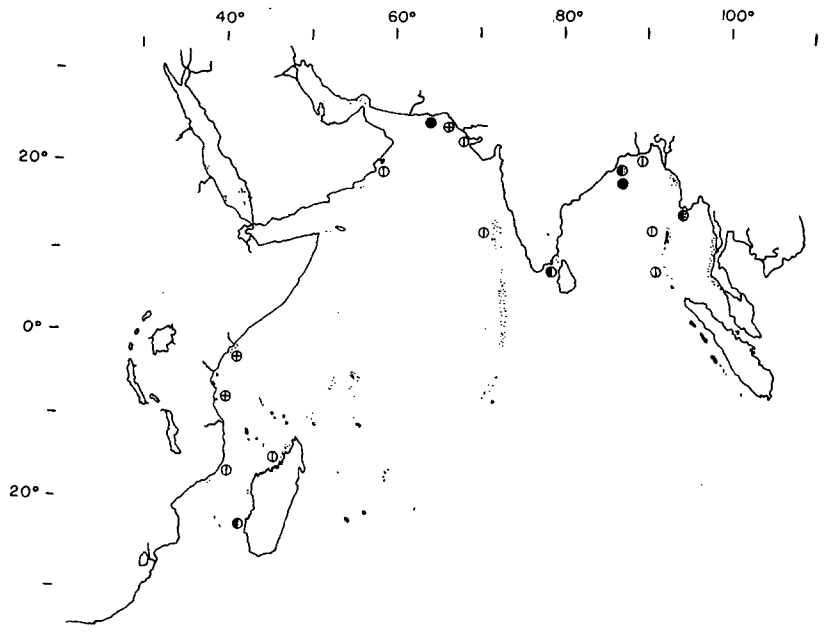

Fig. 5. Exploitation of *Lepidochelys olivacea* in the Indian Ocean (symbols as in Fig. 3).

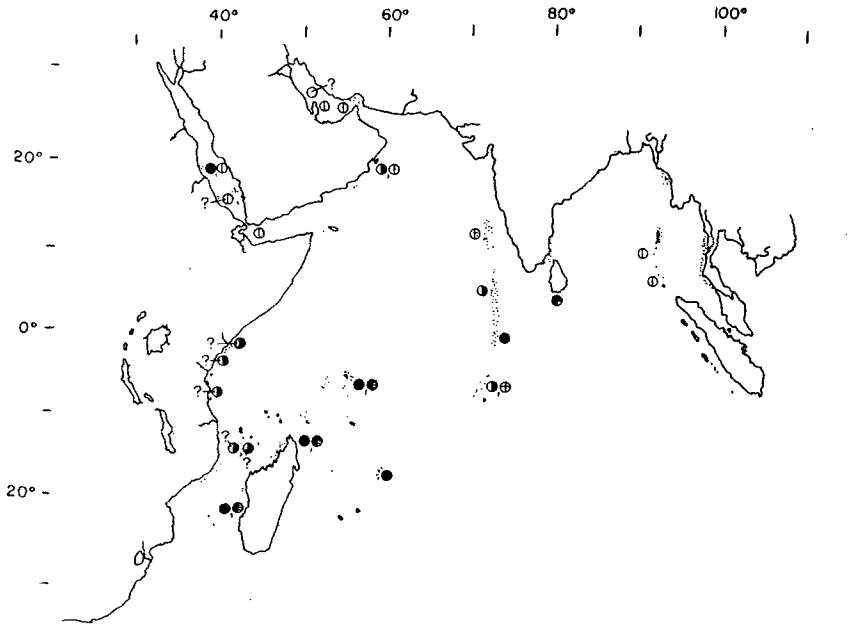

Fig. 6. Exploitation of *Eretmochelys imbricata* in the Indian Ocean (symbols as in Fig. 3).

were protected under Natal Fisheries Ordinance. Curiously, elder tribesmen said that their people had previously been afraid of turtles and did not kill them (McAllister *et al.*, 1965; Hughes, 1971b). Hence, turtles may have been exploited by Thongas for only a score of years. Other species occur as vagrants or immatures, are less frequent and thus seldom exploited (Hughes, 1974). There has never been any commercialized turtle exploitation in South Africa.

The main nesting area in Thongaland came under Natal Parks Board protection in 1963 when an intensive research program began (McAllister *et al.*, 1965; Hughes, 1971a). Since then, guards and researchers have patrolled the beach and there has been no significant exploitation. Populations of both *Caretta* and *Dermochelys* seem to have increased (Hughes, 1975b). A small-scale, scientifically managed, native-run exploitation program has been considered for years, but as yet this has not begun (Hughes, personal communication, 1973). A marine reserve from Cape Vidal to Sodwana Bay (80 km) has recently been created and an additional reserve from Mozambique south (61 km) is expected to be approved (Hughes, in press).

2. Mozambique (including Primieras, Segundas, Paradise, and Bazaruto Islands). Many Bantu tribes live along the coast; they include Thonga, Sangane, Sisonga, Xuabo, Chiamani, and Makua. Some of these peoples venture onto

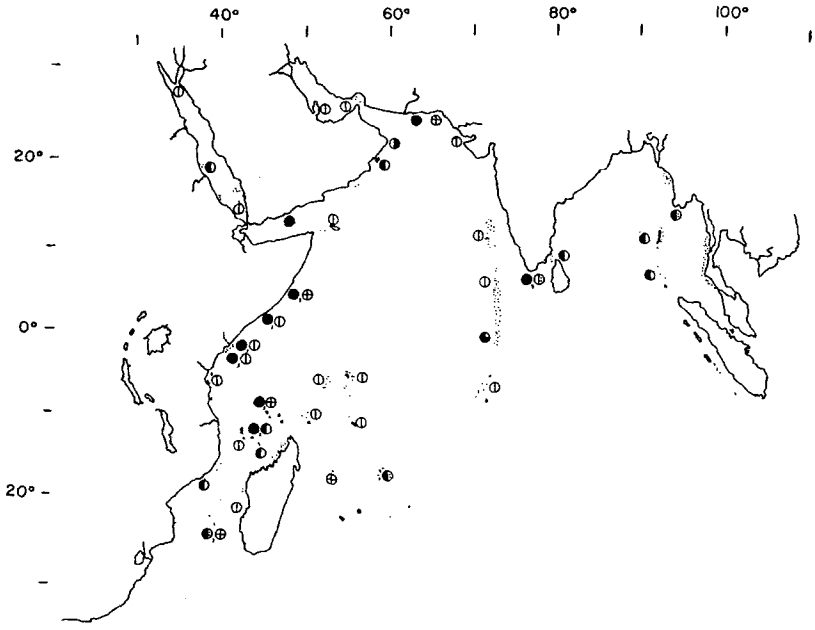

Fig. 7. Exploitation of *Chelonia mydas* in the Indian Ocean (symbols as in Fig. 3).

near shore waters with small boats, but none are seafaring. At least the six tribes listed above have names for various sea turtles (Hughes, 1973a), showing that these animals have been important in their cultures. Arabs, and later Portuguese and Indians, settled along the coast and they have marketed tortoise shell.

All five species of turtles occur, some in sizable feeding populations, and all five nest, *Chelonia* and *Eretmochelys* especially on island beaches. Nesting females are killed and eaten when encountered, and eggs are dug up. The distant islands (Primieras) are less exploited than the near islands or the mainland. There is some netting, particularly of subadult *Chelonia*, but in 1972 the catch was incidental and small. Although small amounts of meat, either *Chelonia* or *Eretmochelys*, were sold locally, for about $.34/kg; there was no significant market. Juvenile *Chelonia* were stuffed and sold to tourists (Hughes, 1973a). Tortoise shell was sold by fishermen for $1.30 to $4.30/kg and sold to European importers for about $9.00/kg (Hughes, 1972, 1973a). Zanzibar imported tortoise shell from Mozambique as early as 1890, and traded regularly from 1920 to 1964; this was a small operation, averaging about 300 kg/year over the half century (Frazier, unpublished data). Perhaps twice this annual quantity was exported directly to France and Italy after the trade with Zanzibar stopped

(Hughes, 1973a) and about 300 kg were imported by Japan in 1976 and 1977 (Japan, Ōkurasho, 1977, 1978).

Article No. 2627 of 7 August 1965, Hunting Law (Designation No. 7/78 of 18 April 1978) and Decree No. 117/78 of 18 May 1978 protected turtles and eggs of all species, but these are rarely enforced. Most (island) nesting populations of *Chelonia* are small, evidently from heavy past exploitation. Mainland nesting populations of *Caretta* and *Dermochelys* are small and exploitation on them heavy; along the south coast few females are thought to survive a nesting season. These populations have been labeled "doomed" (Hughes, 1973a). Marine reserves proposed in the 1960s included: Paradise Islands Region (200 km of coast plus islands, etc.); António Enes region (Primieras and Segundas Islands); and Maputo (coast). There are presently reserves at Maputo, Inhaca Island, Bazaruto, and Marromeu (Hughes, 1971a, 1971b, 1973a, 1976, in press).

3. Madagascar (including offshore islands). Numerous tribes live along the coast: Antalaotra, Sakalava, Vezo, Mahafaly, Antandroy, Antanosy, Antaifasina, Antaisaka, Antaimoro, Tanala, Betsimisaraka, Betaninema, Antankarana (Petit, 1930). The Sakalava and Vezo are accomplished sailors and fishermen, and turtles figure importantly in their culture. Arabs, French, Chinese and Indians colonized in the last few centuries, and they exported turtle products. All five species of turtle occur and all but *Dermochelys* are common. Nesting females are captured, but there is little concentrated nesting. Along the west coast, Vezo harpoon turtles, and in the northeast turtles are caught by netting and grappling. Estimated annual catches of turtles are thousands of each species, except *Dermochelys* (Table I).

Estimated values of turtle meat, for local consumption, are hundreds of thousands of dollars, involving thousands of tons yearly. Annual value of tortoise shell and stuffed Hawksbill turtle sales has been estimated to be $100,000 (Table II). Tortoise shell was exported as early as 1613 and annual figures have been over 4000 kg (Petit, 1930; Decary, 1950; Hughes, 1973b). Exports to Zanzibar were regular but not large; from 1920 to 1964 they averaged about 330 kg (Frazier, unpublished data). During the present decade approximately 100 kg have been exported yearly (Wells, ms). On the basis of diminishing export figures, it is thought that *Eretmochelys* in Madagascar has declined (Decary, 1950; Hughes, 1971b, 1973b), but it is not clear if annual catches have decreased or if they are being marketed locally rather than being exported outright (cf. Hughes, 1973b).

Legislation protects laying females and turtles smaller than 50 cm carapace width (J.O. 17/11/23 of 24 October 1923); and various islands have been listed as turtle nesting reserves (J.O. 9/6/23 of 23 May 1923). A reserve has been suggested for *Caretta* nesting near Fort Dauphin, and closed seasons and other fishing restrictions have also been put forward (Hughes, 1971a, 1971b, 1973b).

4. La Reunion (France) (including Europa, Glorieuse, and Tromelin Islands). The main island was colonized by the French in the 1700s and its

Table I. Estimated Quantities and Values of the Marine Turtle Fishery in Madagascar[a]

Species	Region	Estimated annual catch[b] Size class[c] Juveniles	Subadults	Adults	Total	Total weight kg	Total value[e] U.S. dollars
Chelonia mydas	South and Southwest	2,245 (15)	1,166 (100)	3,411 (170)	6,822	730,145	156,022
Caretta caretta	South and Southwest	–	402 (50)	1,612 (100)	2,014[d]	181,300	38,741
Lepidochelys olivacea	South and Southwest	–	–	2,400 (45)	2,400	108,000	22,680
Eretmochelys imbricata	South and Southwest	1,206[d] (10)	402[d] (20)	402[d] (45)	2,010[d]	38,190	8,161
	Diego Suarez	400 (10)	?	40 (45)	440 +	5,800 +	1,247 +
	Northwest	?	?	130	130 +	5,850 +	1,258 +
	Tamatave	40	?	?	40 +	400 +	86 +
	Total	1,646 +	402 +	572 +	2,620 +	50,240 +	10,752 +[f]
Total		3,891 +	2,372 +	7,995 +	13,856 +	1,069,685 +	228,195 +

[a]Based on Hughes (1971a, 1971b, 1973b).
[b]These estimates appeared in Hughes (1971a, 1971b, 1973b, etc.) without explanation of how they were derived.
[c]Figures in (parentheses) indicate the gross weight of an individual of an age class for a species.
[d]These figures were reported as slightly larger or smaller by Hughes in various of his papers.
[e]Estimated at $.43/kg, and 50% of gross weight is consumable.
[f]*Eretmochelys* is generally not eaten in Madagascar, so this value may not by relevant.

Table II. Estimated Quantities and Values of the Tortoise-Shell Fishery in Madagascar

Commodity	Quantity[b]		Value	
	Weight (kg)	Individuals	Per unit[c]	Total
Unworked tortoise shell	250	100[d]	$29.92/kg	$7,479
Worked tortoise shell	1,175	940[e]	$62.50/kg	$73,438
Stuffed and polished turtles	–	1,000	$25.64/one	$25,641
Total	1,425 +	2,040	–	$106,558

[a] Based on Hughes (1973b).
[b] These estimates appeared in Hughes (1973b) without explanation of how they were derived.
[c] The values of tortoise shell cited by Hughes (1973b) seem exaggerated, but in the absence of other information, they have been repeated here.
[d] Based on 2.5 kg/turtle
[e] Based on 2.5 kg/turtle, and 50% wastage.

dependencies represent the vestige of a vast French presence in the western Indian Ocean that lasted until a few decades ago. The people are Creole, of mixed French, Bantu, and Malagasy ancestry. They are not renowned as seafarers.

Chelonia is the most common and dominant species, although *Eretmochelys* nests in small numbers. The main island has few turtles, but this territory has the largest rookeries in the southwest Indian Ocean. The dependent islands are nature reserves, inhabited by only a few meterologists. Occasionally a *Chelonia* is killed for the pot, but present-day exploitation is negligible.

Organized turtle exploitation on Europa may have begun as early as 1860, but it was probably not regular until 1903, with the first settlement. The island was deserted in 1923, and protective legislation for turtles was passed on 13 May 1933 (Paulian, 1950) so there were probably only two or three decades of organized slaughter. Given the remoteness of the island and its small human population, exploitation was probably not very effective. However, the north of the island has a large number of turtle bones, testimony to a large slaughtering program (Paulian, 1950). The exploitation was mainly to supply other French colonies in the western Indian Ocean region. Thanks to this half century of protection, the nesting population seems to have recovered fully, and is now limited by population-dependent parameters (availability of nesting habitat) (Hughes, 1971a, 1971b; Servan, 1976). Recently some thousands of hatchlings have been collected (from daylight emergencies that would have otherwise been doomed by heavy predation) and transported to a rearing facility in Reunion (Hughes, in press).

5. Mauritius (including Rodrigues and St. Brandon Islands). Inhabited by Indians, Europeans (French and British), Chinese, Malagasy, and Bantu, the

islands are a melting pot, but the people are not especially seafaring. Due to overpopulation, many resources have been overexploited, and turtles have long since been insignificant around the two main islands (Wright, 1974). *Chelonia* nests in St. Brandon, but exploitation is increasing. Regular habitation and exploitation began in the early 19th century. The Mauritius Fishing Development Company began in 1927, but not until the early 1960s were there regular shipments from the islands.

About 30 *Chelonia* are killed annually for local consumption. From 1937 to 1971 the annual export has averaged 304, and it has not exceeded 575. The annual crop shows no sign of decline, but the fishing effort has greatly increased. Harpooning breeding animals and "turning" nesting females are the main methods of capture, although spear-gunning has recently begun. In 1972 the Company bought turtles for about $3.00 and sold them in Port Louis for about $29.00 each; they were exported for $72.00. Meat sold for about $.53/kg and eggs for $.04 each. An insignificant amount of tortoise shell is exported from St. Brandon, rarely more than 100 kg/year (Frazier, unpublished data). It was sold to the Company for about $1.00/kg. *Eretmochelys* is regarded as poisonous in Mauritius, and it is unlawful to sell the meat. Recommendations have included closed seasons and reserves on Pearl and Frigate Islands (St. Brandon) (Hughes, 1975a).

6. British Indian Ocean Territory. This territory consists solely of the Chagos Archipelago, previously a dependency of Mauritius. Until 1972, when a naval base was established, the Archipelago was inhabited by Creole des Isles who came from Mauritius and Seychelles. It is now uninhabited except for the naval base. Despite small boats, the Creole des Isles were accomplished sailors, and visited many of the islands. Turtles were taken by turning nesting females and harpooning. *Chelonia* has fed locals and been sold to the Leasee for export to Mauritius. Tortoise shell has also been sold for export to Mauritius. From 1904 to 1915 annual exports of tortoise shell from Chagos varied from 146 to 588 kg and values ranged from 0.057 to 0.244 kg/$1.00. Diego Garcia was the main source. Annual exports included up to a few dozen live turtles and 80 liters of oil. Hence, annual crops have generally been less than two hundred *Eretmochelys* and less than a hundred *Chelonia*, but most of the exploitation was geared for consumption on the islands. Present-day exploitation if there is any is insignificant (Frazier, 1977).

7. Seychelles (including Aldabras, Amirantes, Farquhars, and other outer islands). The islands were inhabited in the mid-18th century by French, with Bantu and Malagasy slaves. British colonists settled in the early 19th century, after which freed slaves and indentured Indian laborers immigrated. Non-Caucasians make up the bulk of the population (Lionnet, 1972).

Chelonia and *Eretmochelys* have occurred in large populations and the exploitation of these, together with giant land tortoises, was a primary attraction in colonization. Ever since discovery, testudines have been exported in large

numbers. Seychellois are expert sailors and fishermen, and hunting and eating turtle are culturally important. Harpooning and turning nesting females are the traditional means of capture, but spear-gunning, now banned, was practiced with much success. Turtles are not netted. *Chelonia* has been an important source of red meat for islanders, and a variety of products have been prepared: oil, heart oil, calipee and calapash, quitouz (dried salted meat), lime (from bones), shell, meat in oil, etc.

The Aldabras were the main producing islands but had small human populations, so exploitation was in part for export, either national or international. Oil sold for $.10/liter in 1938 (Wheeler, 1948). Prices in Mahé at the end of the 1960s were $22 to $36 per adult turtle and about $.50/kg for meat. Eggs were not sold, and nests were rarely dug up, but eggs from slaughtered females were readily consumed. At the beginning of the century, thousands of *Chelonia* were slaughtered annually (Frazier, in press-c). From 1968 to 1976 *Chelonia* was totally protected, but poaching was widespread. Since legal exploitation resumed, no turtles have been exported to the main islands (Frazier, 1979).

Eretmochelys has been taken for shell for export to Europe and Asia, although there has been some local crafting of tortoise shell. In 1973 a stuffed, polished turtle sold for $60 to $100 and raw tortoise shell was sold for about $6/kg, but prices have reputedly increased to $100/kg (Wilson, *in lit.*, 10 september 1979). Exports to Japan have risen sharply from 106 kg in 1976 to 577 in 1977 and 1076 in 1978 (Wells, ms.).

The history of *Chelonia* exploitation in Seychelles is a classic example of overexploitation; the territory has gone from the most famous and productive area in the Indian Ocean to insignificance (Fig. 8). There is now great concern over *Eretmochelys* (Frazier, 1979). A variety of laws have been passed in an effort to manage or rehabilitate turtles. There are several Marine Parks, but the most important reserves for turtles are Aldabra for *Chelonia,* and Cousin for *Eretmochelys* (Frazier, 1979; in press-c).

8. Mayotte (France). Although a part of the Comoro Archipelago, Mayotte is a French Department. The "Maori" are similar to Comorians, but have more Malagasy (Sakalava) ancestry. They are excellent sailors. *Chelonia* is common, and *Eretmochelys* nests in small numbers. Exploitation is heavy (and wasteful), although meat is rarely distributed to anyone but the hunters and their immediate family and friends. Occasionally whole turtles are sold to French expatriates. *Eretmochelys* is killed for tortoise shell when encountered but this is entirely opportunistic. Tortoise shell sold to Indian merchants in 1972 for $1.50/kg and a whole animal sold for $15.00 (Frazier, 1972). Despite a low level of exploitation by individual hunters, the number of people killing turtles is relatively great and the populations seem smaller than would be expected, given the feeding and nesting habitats available. There are no regulations on turtle exploitation and these are badly needed.

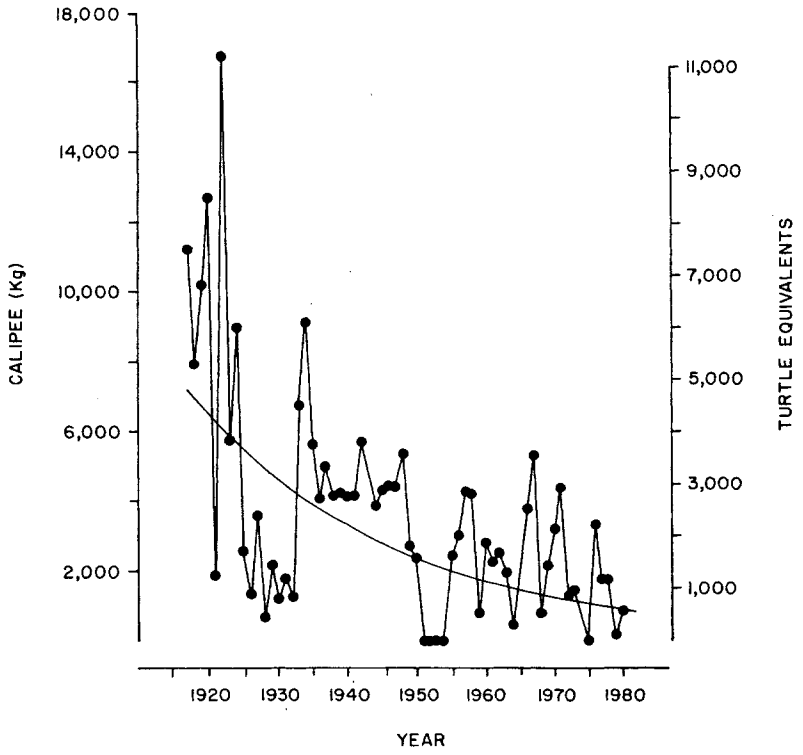

Fig. 8. Annual exports of calipee from the Seychelles from 1907 to 1970, with estimated turtle equivalents shown (based on the assumption that one turtle contributes 1.5 kg of calipee). Regression equation: $\log_{10} Y = (-0.01459)(X - 1900) + 3.95974$; $r = 0.4753$; standard error of estimate = 0.5233, $F_{(1,58)} = 16.9222$. (Data from the *Seychelles Blue Books* for the appropriate year, cited by Stoddart, 1976).

9. Comores (Ngazidia, Moheli, and Anjouan). Comorians derive from Arabs, Bantu slaves, and Malagasy; they strongly resemble the "Swahili" of the East African Coast. There are few French colonists left since independence in 1975. Despite small dugout outriggers, some fishermen venture well out to sea, but most fishing is coastal.

Turtles are few at Ngazidia or Anjouan, but *Chelonia* nests in the thousands on Moheli and satellite islands. *Eretmochelys* is not abundant. Exploitation of both species fits a classical "subsistence hunter's" paradigm. *Chelonia* are killed for the pot; occasionally a few are sold locally. *Eretmochelys* is captured when encountered; whole turtles and scutes are sold to merchants who export them or sell preserved dry turtles to tourists. A fisherman may sell a small turtle of either species for $3.75 to a merchant; and a tourist will buy a preserved turtle

for $10 to $25. However, where there is no significant market (e.g., Moheli), a whole small turtle may sell for only $.75. Tortoise shell was $2.50/kg in 1972. There are no regulations or reserves for turtles (Frazier, 1977).

10. Tanzania (including Mafia and satellites, Zanzibar, and Pemba Islands). Many Bantu tribes inhabit the coast of the mainland. From south to north they include: Matambwe, Makonde, Nigindo, Machinga, Mwera, Matumbi, Rufiji, Ndengereko, Zaramo, Kwere, Doe, Zigua, Bondei, and Segeju. Hadimu and Tumbatu are on Zanzibar and Tumbatu are also on Pemba, together with "Shirazi" (Gulliver, 1959; Goldthorpe and Wilson, 1960). Shirazis and Arabs colonized several centuries ago, followed by Europeans, Germans and British, and then Indians in the last century. The latest colonists are especially involved in commercial exploitation. People of Zanzibar and Pemba are excellent sailors and fishmen.

All five species of turtle occur, but neither *Caretta* nor *Dermochelys* is known to nest. Nesting occurs on mainland beaches, but more importantly on small coraline islands. Nesting *Chelonia* are killed and eaten, but apparently eggs are not dug up. There is some netting of turtles in the extreme south, but the fishery is small. *Chelonia* meat is sold in Zanzibar at about $.50/kg, but probably only a few a week are landed on average. The annual crop in the Republic probably does not exceed 500. A Kenya-based turtle exporter exploited this population for a few years in the early 1960s and this evidently failed, although details are not available (Frazier, ms).

There is a long history of exploitation of tortoise shell dating back to the first century A.D. (Freeman-Grenville, 1962). Zanzibar was one of the world's major clearing houses for tortoise shell. Records beginning with the British in 1891 show annual imports averaged about 2300 kg, while annual exports averaged about 2600 kg. The mainland has regularly sent the majority of its tortoise shell to Zanzibar, and from 1920 to 1963 this has averaged about 540 kg per year. Recent exports to Japan are at about the same level: 2152 kg in 1976; 1474 in 1977; 1410 in 1978; and at least 3621 in 1979 (Wells, ms.). There are still substantial shipments to Hong Kong also (Frazier, unpublished data).

Legal exploitation requires the purchase of a license, but this is rarely enforced. Marine Reserves include Maziwi Island, East Africa's most important rookey, and other islands near Mafia (Tanzania, 1970, 1975), but these are not patrolled. Some turtles are killed by dynamite "fishing," which is illegal (Bryceson, 1978).

11. Kenya (including Lamu, Manda, and other offshore islands). Bantu peoples: Segeju, Digo, Rabai, Giriama, and Bajun inhabit the coast along with "Swahilis," Arabs, Europeans (British mainly), and Indians (Goldthorpe and Wilson, 1960; Kenya, 1970). Bajun are seafaring and have highly developed techniques for turtle fishing. Non-Africans are most active in export.

All five species occur; *Chelonia* and *Eretmochelys* nest. Tortoise shell has been exploited for millennia (Freeman-Grenville, 1962), although Kenya is not a major producer. Rarely has the annual export been greater than a few hundred kilograms (Frazier, unpublished data). However, recent exports to Japan are considerable: 2712 kg in 1976, 2655 kg in 1977, and 2850 kg in 1978 (Wells, ms). Nesting *Chelonia,* and possibly *Eretmochelys* in some areas, are eaten when encountered. They are occasionally killed on remote shores. Incidental catches in nets are insignificant, except in the north where Bajun skillfully set nets for many animals. They also have highly developed techniques using special grapnels and also remora "sucker" fish (Holmwood, 1884; Copley, 1956; Frazier, ms). However, their total catches were probably a few hundred yearly.

From 1952 to 1964, D. G. and R. B. Whitehead exported *Chelonia* from Kenya, although some were caught in southern Somalia. Department of Fisheries statistics indicate that less than 1000 were taken annually, and in most years it was well below 500. The accuracy of the figures is questionable, for Travis (in Goodwin, 1971) estimated that annual takes were at best 2400 to 2800. A whole turtle was sold by fishermen for about $8.00 and exported for about $30.00 (Frazier, ms). The fishery came under Government controls with the beginning of commercial exploitation when catcher's and dealer's permits were required and quarterly returns on catches were to be filed. *Chelonia* was "totally protected" in 1962 and *Eretmochelys* in 1971 (Kenya, 1962, 1971). Poaching is widespread, but probably accounts for less than a few hundred turtles yearly.

12. Somalia (including Bajun Islands). Bajun fishermen live along the southern coast and they are accomplished seamen and fishermen. Somalis, who inhabit most of the country and its coast, generally consider the sea and its products unclean. Bajun catch turtles for meat and tortoise shell and have done so for generations, having a developed "turtle culture" (Grottanelli, 1955). Meat is sold, but the local market is poorly developed. Tortoise shell is exported to Europe; formerly it was shipped to Zanzibar, but rarely more than 100 kg/year (Frazier, unpublished data). In 1976, 5099 kg were exported (Wells, ms), but this is exceptional.

Exploitation of *Chelonia* by expatriate concerns – Italian, British, and Russian – has been intense, although short-lived, but few details are available (Travis, 1967; Goodwin, 1971). A canning plant was operational at Chisimaio in the early 1960s for a short period. During the 1967-1968 fishing season, A.C.T.S., a company based in Mogadiscio, processed approximately 6800 turtles from the northwest coast and produced oil, dried flippers, and calippe (Losse, 1968). While operating a turtle cannery in Chisimaio, Travis took an estimated 3800 turtles from the Bajun Islands in 1 year. Also during 1 year, six camps between Bur Gavo and Merca (400 km of coast) took 8436 turtles, 3243 of which were females. Most (79%) were caught by net; 14% were taken

by remora fishing; 4% by "turning" on beaches; and 3% by other means (Travis, in Goodwin, 1971). Travis was deported, evidently to clear the way for Russian concerns, and despite endless rumors, no details have been released. There is evidently no restrictive legislation or reserves protecting turtles.

13. Djibouti. After many years as a French colony, the territory has been well "francocized." *Eretmochelys* were probably caught and prepared for a large tourist trade, but little is recorded.

14. Ethiopia (Eretria) (including the Dahlak Archipelago). The coast of Ethiopia has had an involved history, with waves of invasions across the Red Sea. At present Arabs are common, but a dozen tribes of "semitized cushitics" are also along the coast; some of these peoples are experienced seamen. The Dahlak Archipelago, with over 100 islands, may support 2000 to 3000 fishermen (Ullendorff, 1965).

The Archipelago is the main area for turtles, where *Chelonia* and *Eretmochelys* are captured. The former is thought to be heavily exploited (Minot, n.d.), but there are no figures for either species. There seems to have been an important tortoise-shell fishery in the Dahlak area (Bruce, 1813; Bloss, 1936). Moslem beliefs may protect turtles from local consumption. Accidental catches in nets and "turning" nesting females are probably the main methods of capture. Parks and Reserves have been proposed for the Archipelago, but it is unlikely that these will be established or managed with the present political unrest.

15. Sudan [including Suakin Archipelago, Makawwar (Mohammed Qol) and Siyal Islands]. The coast is inhabited by Arab, Beja, and Beni Amer peoples (Barbour, 1961), and fishermen, mainly of Yemeni origin, ply the islands. The Suakin Archipelago, some 30 islands, is the main turtle nesting area, and *Eretmochelys* is the dominant species. Past exploitation was massive, and possibly done by passing European sailors; the Suakin area was an important trading center for centuries and the tortoise-shell fishery was evidently very important (Bruce, 1813; Bloss, 1936). There is little present-day exploitation, and this may be due to Moslem beliefs. Nesting females may be "turned" on beaches if they are encountered, but there is no specific turtle fishery and no market. Curiously, tortoise shell is not collected or sold, only meat is taken, and even eggs are rarely collected. A Marine Fisheries Ordinance forbids capturing turtles without a license, but this is rarely enforced. Reserves have been proposed (Moore and Balzarotti, 1977).

16. Egypt. Two turtles are recorded, *Chelonia* and *Eretmochelys* (Marx, 1968), but numbers seem to be small and exploitation light. Historically this may have been an important source, or consumer, of tortoise shell (Parsons, 1972).

17. Sinai. Bedouin occasionally inhabit coastal areas and may dig up eggs, presumably of *Chelonia.* There is little exploitation; perhaps only a dozen or so turtles are killed in a year, and these mainly accidentally in fishing nets

or by underwater bombings (Sella, *in lit.*, January 1976, 20 August 1976, in press).

18. Israel (Eilat). There is only about 12 km of coast, and the town of Eilat is the site of a Marine Laboratory. Yet there is no information available on marine turtles, and the area is reputed to be badly polluted with crude oil (Mendelssohn, *in lit.*, 17 March 1975). Given that turtles are protected in Israel (Yoffe, *in lit.*, 20 December 1977), there is little chance that exploitation is significant (see also Sella, in press).

19. Jordan (Al Aqabah). This coast, of some 12 km, is reputed to be badly polluted with oil (R. Fitter, *in lit.*, 2 October 1975). Probably few turtles exist here and few are exploited.

20. Saudi Arabia (Red Sea) (including Farasan and other offshore islands). Little is recorded, but Yemeni fishermen probably catch and eat what nesting turtles they chance upon. There are reports of a foreign company exploiting turtles for export (Walczak, *in lit.*, 1974).

21. Yemen Arab Republic (including offshore islands). Yemeni fishermen, who are accomplished sailors, not only visit their own islands and coast, but also other localities in the Red Sea as far north as Sudan. Turtles, probably *Chelonia,* are eaten, but they are evidently not much sought after and females are not eaten. Eggs are greatly relished, but there seems to be no market of significance. There is no protective legislation and no reserves (Walczak, 1975, 1979).

22. People's Democratic Republic of Yemen (including Socotra, Abd al Kuri (Kuria Muria), Perim, and Jabal Aziz Islands). South Arabians live and move along most of the coast; however, for religious reasons few eat turtle meat or eggs, and then only when fish is in short supply. Fishermen of Scotra, however, eat eggs and meat, preferring females, and they catch *Chelonia* with remora and by diving. On Kuria Muria they also eat meat and eggs. *Eretmochelys* meat and eggs are eaten on Jabal Aziz and Perim Islands (FAO, 1968, 1973). On the mainland, *Chelonia* have been netted on pastures for selling to exporters, but "turning" nesting females was reported to be uncommon in the early 1960s (Hinds, 1965: 57). By the late 1960s turtles were still netted on pastures at Khor Umaira and turned on nesting beaches in Quaiti State. There was some local consumption and a local, but small, market. In 1966 eggs sold for $.14 to $.28/dozen in Aden, and poorly cured shells sold to tourists for about $5.00. In 1972 all the crop in Quaiti, and most of it in Khor Umaira, was sold to an exporter, Turtle Produce Company of Kenya, and this business began shipping *Chelonia* to Europe in 1963. The Cooperative and Marketing Department began the export business in 1961. In 1972, the company involved was Caltex. The exporter bought turtles for $6.00 each from fishermen in 1972. From 1964 to 1977, annual landings have been as great as 500 metric tons, and averaged 193 mt (Table III). Most of the catch has been nesting females, and it was recom-

Table III. The Marine Turtle Fisherey in the People's Democratic Republic of Yemen

Year	Landings reported,[a] metric tons	Turtle equivalents[b]	Turtles exported[c]
1961	–	–	–
1962	–	–	–
1963	–	–	–
1964	300	2632	–
1965	200	1754	–
1966	200	1754	–
1967	100	877	–
1968	200	1754	–
1969	300	2632	2017
1970	500	4386	4000
1971	0	0	0
1972	0	0	200
1973	0	0	–
1974	0	0	–
1975	300	2632	–
1976	300	2632	–
1977	300	2632	–

[a]Data from FAO (1974, 1976, 1978); species not identified.
[b]Based on the assumption that the average turtle (*Chelonia*) weighs 114 kg (cf. FAO, 1973).
[c]Data from Public Corporation for Fish Wealth, cited in FAO (1973).

mended that they and their beaches be protected, and that exploitation be concentrated on feeding grounds (FAO, 1968, 1973).

23. Oman (including Masirah and Kuria Muria Islands). Omani Arabs inhabit Masirah and much of the coast, and they are accomplished sailors. Large nesting populations of *Chelonia* and *Caretta* occur, and *Eretmochelys* and *Lepidochelys* also nest. Exploitation has traditionally been at a low, "subsistence" level, although small amounts of tortoise shell were exported in the last century. Small numbers of *Dermochelys* are slaughtered annually for oil. Eggs of most species are eaten, but turtle meat is not commonly consumed. At least 1000 *Chelonia* are estimated captured annually from feeding pastures, where they are harpooned. The value of this crop is more than $30.000, although there is no significant commerce. Nesting females were captured and there was considerable concern about the impact of this exploitation, but this is now banned (Anonymous, 1978; Ross and Barwani, in press). In 1972 it was though that exploita-

tion of *Caretta* eggs was not excessive (FAO, 1973), but by 1976 there were indications that the advent of motor bikes and material affluence facilitated and stimulated egg collection (Garvey, 1976).

24. United Arab Emirates. *Chelonia* are trucked from Ras al Hadd to Abu Dhabi; the annual take may be only 100. The meat fetches about $6.00/kg. Although this trade is only recent, it bodes ill for the turtles (Ross and Barwani, in press).

25. Qatar. *Eretmochelys* meat and eggs are commonly eaten and *Chelonia* may be sold in markets, but the annual crop is probably less than a few hundred (Ross and Barwani, in press).

26. Bahrain, Saudi Arabia, Kuwait, and Iraq. Exploitation, if it occurs, must be minimal. Turtle meat at least is probably not consumed, for religious reasons.

27. Iran (including Hormuz, Larak, Lavan, Qeshm, Shitvar, and other islands). Persian fishermen inhabit or visit most of the coastal areas and they are excellent sailors. Turtle populations may be large on some offshore islands, e.g., Lavan and Shitvar, and *Eretmochelys* may be the most numerous species. Egg collecting is done throughout the territory, but turtles are not eaten, again for religious reasons. In the last decade they have been killed to sell carapaces to people in oil companies. *Eretmochelys* or *Chelonia* are captured while nesting or occasionally in nets, and in 1971 a dried carapace sold for $3.00 to $7.00. A *Dermochelys* fishery on Larak Island takes and estimated 10 to 15 animals yearly; these are rendered to oil for use in boat preservation (Kinunen and Walczak, 1971).

28. Pakistan. Baluchi and Sind tribesmen visit most of the coast in their respective territories, but few people are truly seafaring. Large nesting populations of *Chelonia* and *Lepidochelys* nest at Ormara and Hawks Bay, but, for religious reasons, turtles have generally not been molested (Hatt, 1957; Shockley, 1949; Minton and Minton, 1973). However, eggs might be dug up by inquisitive children in populated areas (Burton, 1918), and at the end of the last century it was claimed that large numbers of eggs were sold in the Karachi area and meat was also eaten (Murray, 1884). *Eretmochelys* has evidently been little exploited; 745 kg of tortoise shell were exported to Japan in 1976 (Wells, ms).

A Karachi businessman recently began a business exporting flippers, for leather, from Baluchistan to Japan; many thousand turtles (*Chelonia*?) were slaughtered in 1975 (Telford, *in lit.*, to H. Campbell, 1976). Exports of turtle skins were 4648 kg in 1976; 1016 kg in 1977; and 5360 kg in 1978 (Japan, Ōkurasho, 1977-1979). One order from France was worth $10,000 (Salm, 1976). It was thought that these were *Chelonia,* but it is likely that large numbers of *Lepidochelys* are also taken. A Sind Wildlife Ordinance of 1972 protects all turtles and eggs in Sind and dictates steep fines for killing turtles (Salm, 1975a, 1975b; Mohiuddin, 1975), and export of turtle was also banned at this time

(Siddiqi, *in lit.*, 9 February 1976). However, this legislation, which is laudable in Sind, has been ineffective in Baluchistan. At Hawks Bay, nest habitat destruction by beach houses is critical, and there are no reserves for turtles in Pakistan (Salm, 1975a, 1975b; 1976).

29. India (including Laccadives, Andaman and Nicobar Islands). Turtles and eggs are traditionally exploited along the entire coast, but the only specialist fishery, using special tangle nets (see Kuriyan, 1950), is in the Gulf of Mannar and Palk Bay, where about three-fourths of the catch is *Chelonia.* The take evidently increased over the first half of this century, for the total reported catch from Madras in 1928 was 49, of which 36 came from Krusadai (Sundara Raj, 1933). By 1950 an estimated 800 to 1000 were caught annually around Krusadai Island alone (Kuriyan, 1950). In the 1960s the estimated catch in the Gulf of Mannar was 3000 to 4000 per year; an additional 1000 were estimated to have been taken from Palk Bay in this highly seasonal fishery (Jones and Fernando, 1968). Average annual value of this fishery from 1963 to 1966 was $6,440, and 4,700 was from exports to Sri Lanka (Jacob, 1976). After exports to Sri Lanka were stopped, turtle merchants in the Tuticorin area began selling to visiting ships from the United States and West Germany. This lasted a few years only, but dealers, who invested in large holding tanks, etc., are keen to stimulate trade with Japanese ships. In 1973, the annual catch in this area was estimated to be 1500, but in recent years it has probably been several thousand. Between 1966 and 1974 exports of turtle meat (mainly *Chelonia*?) went to nine countries and ranged from 2651 to 1095 kg annually (India, 1974; Murthy and Menon, 1976), representing but a few hundred turtles a year. The desire to develop a turtle industry in this area is shared by merchants and high-ranking officials (Shanmugasundaram, 1968).

There is a small local fishery in the Gulf of Kutch, where meat is rarely eaten, but *Chelonia* and *Lepidochelys* are occasionally killed for oil. Eggs of either species are eagerly sought and sell for 25 piase (about U.S. $.03) each. Flippers are occasionally hacked off and used by Wagir fishermen as rough shoes for walking on coral. Turtles are caught incidentally in fishing nets (Bhaskar, 1978d, 1979e). Exploitation along the west coast is mainly for local use, and although both eggs and meat may be consumed, this is a small fishery.

The Laccadives (Lakshadweep) were reputed to have a significant *Chelonia* fishery where oil production was important (Ayyangar, 1922). Nowadays, eggs are occasionally taken, and meat is rarely eaten, but *Chelonia, Eretmochelys, Lepidochelys,* and, when available, *Dermochelys,* are actively hunted for oil, which is used for boat maintenance. Twenty liters of oil sells for Rs 60 (U.S. $7.50). Harpooning, foul-hooking, netting, and catching by hand are the techniques used for catching. Tortoise shell is collected for export to the mainland, and sells for Rs 118 to Rs 160/kg (U.S. $14.75 to $20.00) (Bhaskar, 1978a, 1978b, 1978c, 1978e, 1979b).

As mentioned above, the only specialist turtle fishery is in the Gulf of Mannar, where exploitation has been for export as well as local consumption. The market at Tuticorin slaughters 20 to 30 turtles every Sunday and although most Indians are thought not to eat animals, there is great demand for turtle meat, and virtually every part of the animal is consumed (Table IV; Valliappan, 1973); blood is thought to be an elixir (Murthy and Menon, 1976). In the south of India *Dermochelys* is used in the preparation of oil for boat maintenance and medicinal purposes (Kuriyan, 1950); in 1922 an entire animal sold for $5.00 and perhaps a dozen were caught in a year (Cameron, 1923). Formely *Chelonia* was the main species eaten, at least around Krusaidai Island (Kuriyan, 1950), but now most turtles are eaten and the eggs of all species are eaten. Even hatchlings are collected and stuffed for curios (Murthy and Menon, 1976). In Madras 90% of nests are robbed, mainly by people. Fishers do not take eggs, but professional egg collectors from the interior do. Eggs sell for 5 to 10 paise each (about U.S. $.01) (Whitaker, 1977).

Exploitation of *Lepidochelys* eggs in Orissa is long-standing, although traditional fishers do not kill turtles, and collect eggs only when there is no other food (Valliappan and Whitaker, 1974). The former King of Kanika claimed a Rs 15 (U.S. $1.64) royalty on each boatload of eggs removed from the coast. This system was still maintained until recently, when Bengalis from Calcutta came down to harvest. In 1973, 15 boatloads were taken, representing some 1,500,000 eggs. There has been large-scale exploitation of nesting and mating *Lepidochelys*

Table IV. Prices of Turtle Products Sold in the Tuticorin Market, Madras, India[a]

Species	Item	Price	
		Rupees	U.S. dollars
Chelonia	Glass of blood (250 ml)	1	.12
	Meat (1 kg)	4	.48
	Carapace	50	6.00
	Turtle: 45-55 cm long	10 to 15	1.20 to 1.80
	60-70	25 to 30	3.00 to 3.60
	90-100	45 to 60	5.40 to 7.20
	over 115 cm	65 to 75	7.80 to 9.00
	Shell: carapace (1 kg)	20	2.40
	plastron (1 kg)	40	4.80
Eretmochelys	Tortoise shell (1 kg)	100 to 150	12.00 to 18.00
	Carapace[b]	12	10.00

[a]Data from Valliappan (1973).
[b]Data from Acharji (1950).

recently, with an estimated annual catch of 10,000 for the mid-1970s. Turtles were sold by fishers for $1.89 to $7.69 and the majority were sent by rail to Calcutta (Singh, *in lit.*, 20 July 1976). It is not clear how long this trade has been going on, but early accounts claimed that this species was rarely eaten (Theobald, 1868a).

There have been recent reports of mass strandings of dead *Lepidochelys* along the Orissa coast – the result of intense turtle fishing activities on mating grounds (Davis, 1977; Davis and Bedi, 1978; Davis *et al.*, 1978). Efforts are being made to reduce exploitation on this population, and egg poaching is said to have practically stopped (Kar, 1980).

At the beginning of the century there was a regular trade in *Chelonia* from the Andaman Islands to Calcutta (Maxwell, 1911a). There is presently an active fishery in the Andamans and Nicobars, where *Chelonia, Eretmochelys, Lepidochelys,* and *Dermochelys* are harpooned, netted, and caught on nesting beaches. Most consumption is local, but some turtles and eggs may be transported to Port Blair for sale. Eggs are eagerly sought and may sell for 10 piase each (U.S. $.015). Meat is also relished and may sell for Rs 3 to 4 per kg (about U.S. $.50). Tortoise shell is used locally and little is exported. It sells locally for Rs 32/kg (U.S. $4.00). *Dermochelys* are used for oil. Skulls and shells of turtles may be used by indigenous islanders to adorn their huts (Bhaskar, 1978d 1979a, 1979c, 1979d).

India was a regular importer of tortoise shell from Zanzibar from 1891 to 1957 with an average annual import of 300 kg (Frazier, unpublished data). From 1960 to 1974 tortoise-shell exports dropped from 101,772 kg to 63 kg (Jones, 1969; India, 1974; Murthy and Menon, 1976), but by 1976 they had risen to 24,079 kg, and 2424 kg in 1977 (Wells, ms). Export notice No. 91/75 of 5 January 1975 bans the export of turtle products (without the approaval of the Ministry of Agriculture and Irrigation) (Whitaker, *in lit.*, 8 July 1978). All five species have been totally protected since 1978, but enforcement is problematical (Ali, personal communication, 1979). Krusadai Island has been proposed as a reserve (Salm, 1975b).

30. Maldives. A territory of thousands of islands, peopled by expert fishers and sailors, the Maldives have figured as an important source in the world trade of tortoise shell for centuries. Exports from 1973 to 1975 were: 1.56, 5.57, and 3.58 metric tons (Haleem, *in lit.*, 14 August 1976). Exports to Japan from 1976 to 1979 were: 485, 317, 567, and 641 kg (Wells, ms). Oil, of *Chelonia* especially, was used for preserving boats. The population being Moslem, there was a religious ban on eating turtle meat until the late 1940s. This was lifted in the 1950s and since then *Chelonia* and *Eretmochelys* have been hunted for meat and eggs. Various products are sold (Table V). Also, children keep hatchlings as playthings (Didi, *in lit.*, 15 June 1976). Methods of capture include "turning" nesting females, catching mating animals, gaffing resting or feeding turtles, diving for resting animals, and chasing them in boats in shallow water (Didi, *in lit.*,

Table V. Prices of Turtle Products Sold in Male, Maldives

Species	Item	Price	
		Rupees	U.S. dollars
Chelonia	Oil (liter)[a]	3	.76
	Shell (kg)[a]	24	6.11
Eretmochelys	Shell (kg)[a]	160	40.71
	Carapace[a]	25	6.36
	Stuffed[a]	45 to 80	11.45 to 10.36
	Meat (kg)[b]	2	.51
Both species	Meat (kg)[b]	3 to 4	.76 to 1.02
	Eggs[b]	.10 to .15	
	Carapace[c]		60.00

[a] From Didi (*in lit.*, 16 October 1976).
[b] From Haleen (*in lit.*, 14 August 1976).
[c] From Colton (1977).

16 October 1976). In 1972 organized tourism began, and by 1977, 15,000 tourists, one for every citizen, visited the Republic (Didi, *in lit.*, 10 May 1978). This has had a tremendous impact, and turtles are under heavy exploitation for curio-hungry Europeans – Germans, French, and Italians especially (Colton, 1977, *in lit.*, 20 May 1977). Annual take of *Eretmochelys* for sale to tourists may be 2000 (Jonklass, *in lit.*, 25 February 1976). Recent legislation, on 6 February 1977, was enacted to ameliorate this: no turtles to be hunted at Male, the main island; no turtles less than 76 cm (2½ ft.) long to be taken; no spear guns, spears, or explosives to be used for turtles (Didi, *in lit.*, 2 August 1977; Colton, *in lit.*, 20 May 1977; Anonymous, 1977).

31. Sri Lanka. The northern and eastern coasts are inhabited mainly by Tamils while the rest of the island is generally Sinhalese, both expert sailors and fishermen. The densest areas of fishing are in the north, west, and south (Ceylon, Department of Fisheries, 1958; DeSilva, 1964), and the most accomplished turtle catchers are the Tamils in Jaffna, who specialize in netting (Deraniyagala, 1939). The turtle fishery here is many generations old and possibly 50,000 people depend on it for subsistence (Salm, 1975a).

In the first half of this century, people were selective in the use of turtle; *Chelonia* were eaten, *Dermochelys* were rendered to oil, and *Eretmochelys* taken for tortoise shell; eggs of all species were eaten (Deraniyagala, 1939). Now, all species, save *Eretmochelys,* are regularly eaten (Hoffman, *in lit.*, 21 April 1975), and although this species is regarded as poisonous it is sometimes eaten by poor people (Deraniyagala, 1939).

There are four or five major markets that handle turtle, and 200 to 300 animals are estimated sold yearly in each, with a grand total of some 2000 marketed locally (Hoffmann, *in lit.*, 15 May 1975). The total annual catch may be 3000 to 5000. In Jaffna two to three turtles may be landed daily with 1500 taken in a year (Hoffmann, *in lit.*, 16 March 1977). Eggs are collected all around the island, but in the west and south especially (Hoffmann, *in lit.*, 21 April 1975). They sell for about $.01 to $.02 per egg, and meat is about $.12/kg (Jonklass, *in lit.*, 26 May 1976; Hoffmann, *in lit.*, 16 March 1977). A century ago a large turtle sold for 6 pence, and it was said that a native ate 20 to 30 eggs at a meal (Kelaart, 1852).

The tortoise-shell fishery in the south was very large and world famous, but it evidently fished out the nesting *Eretmochelys*, and artisans, some of the finest in the world, now must import shell from the Maldives. From 1920 to 1926 imports were usually about 2 tons and exports rarely more than 400 kg (Deraniyagala, 1939). Sri Lanka had a small tortoise-shell trade with East Africa, and imported some *Chelonia* from southern India. With the sharp increase in tourism, there is an increase in the demand for tortoise-shell articles. All turtles and eggs were protected by an amendment to the Fauna and Flora Protection Ordinance on 22 June 1972, but this has not been enforced. Marine reserves have been recommended in Yala, Wilpattu, and Arippu (Hoffmann, *in lit.*, 21 April 1975, 15 May 1975; Salm, 1975b).

32. Bangladesh. As Moslems, the East Pakistanis might not be expected to molest turtles, but terrapins and tortoises of nine species are eaten in the hundreds of thousands yearly (Ahmad, 1955). Sea turtle eggs (*Lepidochelys*?) are reportedly collected "in hundreds" on an island off the Sundarban and sold in markets (Choudhury, 1968). Evidently 4960 kg of tortoise shell were exported in 1977 (Wells, ms), but this is an exceptional record for this country.

33. Burma (including Mergui Archipelago, Cocos, Diamond, and Cheduba Islands). Notable among the diverse peoples of Burma are the Selung, intrepid sailors who visit the islands and shores of the eastern part of the territory. They eat turtles and eggs (Anderson, 1889). People in the western provinces of Pegu, Martaban, and Tenasserin "eat all sorts (of testudines) indiscriminately"; turtles are caught accidentally in fishing traps or by "turning" females (Theobald, 1868a). Those mainlanders who are Moslem generally will not kill or eat turtles, but eggs are readily consumed and collected in vast numbers. Diamond Island reportedly produced 1.6 million *Chelonia* eggs and 1.5 "Loggerhead" (*Lepidochelys*?) eggs in 1911 (Maxwell, 1911b). These are consumed mainly in the Irrawaddy Division and by "well-to-do" people in the interior. The numbers of eggs have dwindled in recent history (Parsons, 1962). Theobald (1868a) claimed that *"Couana"* (= *Lepidochelys*) *"olivacea"* is the most common species in the west, but (1868b) felt "that even the Burmese do not greatly care for it," and he stated that *Lepidochelys* and *Dermochelys* are "unedible," and that *Chelonia* was reputed to be poisonous on occasion (1876). Very little else is documented.

TRENDS IN EXPLOITATION

The locations and intensities of hunting areas (Figs. 3-7) reflect the distributions and sizes of rookeries (see Bhaskar, in press; Frazier, in press-c, in press-d, in prep.; Hughes, in press; Ross and Barwani, in press). This indicates that the accessibility of nesting females is a major factor in the availability of turtles for hunting. Although traditional fishing techniques that used remoras or nets were able to capture feeding turtles efficiently, nesting females are simplest to catch, for they are on land and helpless. In addition, breeding turtles congregate around nesting beaches, presenting singularly high densities that are easier and more efficiently exploited. In general, it is the breeding females that bear the brunt of exploitation.

The result is that harvesting not only removes turtles, but severely limits reproduction. Catches are concentrated on that part of the turtle population which most needs protection; sorry proof is the histories of many fisheries which show declines – sometimes catastrophic. Another trend is clear: the farther the product is removed from the producing center, or the more commercialized the fishery, the greater impact the activity is likely to have on the stock of turtles being cropped (Table VI).

Large populations of *Chelonia* and *Eretmochelys* that became known were exploited for export, but no longer do they produce the same annual crops as recorded at the start of exploitation, e.g., *Chelonia* on Aldabra and Seychelles and *Eretmochelys* on the south coast of Sri Lanka. This reduced productivity is a sure sign of overexploitation. Exceptions, such as *Chelonia* at Europa and *Eretmochelys* in Maldives, have large populations despite export exploitation in the past, but these populations were culled for a short period of time and/or were harvested on a low level, not organized for maximum take.

Recently "discovered" populations (from the point of view of exporters), such as *Chelonia* in South Yemen and Pakistan, have come under heavy exploitation, but have not shown population decreases. However, exploitation has only lasted about a decade or less, and population trends may not yet be evident.

The overall pattern exemplified by *Chelonia* exploitation shows the classical "rape and run" syndrome: first, large, accessible populations were exploited for export; as their yields dwindled, commercialized exploitation moved elsewhere (Fig. 9). A similar pattern is seen in the historical exploitation of great whales (McHugh, 1974; McVay, 1974).

Eretmochelys exploitation, for world trade, is much older than that of any other turtle, and this, not *Chelonia mydas*, might be properly dubbed "the world's most valuable reptile." Yet, population trends from trade statistics are much less clear than with *Chelonia*. Tortoise shell, being a luxury item, is subject to the complexities of world economics, with wars, recessions, inflation, booms, technological advances, population increases, etc., and interpretation of

Table VI. Summary of Exploitation of Marine Turtles in the Indian Ocean[a]

Country	Seafaring peoples	Status					Exploitation									
							Past (before 1950)					Present (after 1950)				
		Dermochelys	*Chelonia*	*Eretmochelys*	*Caretta*	*Lepidochelys*	*Dermochelys*	*Chelonia*	*Eretmochelys*	*Caretta*	*Lepidochelys*	*Dermochelys*	*Chelonia*	*Eretmochelys*	*Caretta*	*Lepidochelys*
South Africa	.	b.	. v	. v	b F	. V	ne .	. . .	. . .	ne .	. . .	. . .	. . .	. . .	. . .	. . .
Mozambique	+	b.	b F	b f	b F	b f	ne .	net	net	net	net	ne .	net	net	ne .	net
Madagascar	+++	. v	b F	b F	b f	. f	. . .	net	net	net	. . t	. . .	N. T	n . T	ne T	T
Reunion	+	. v	B f	b f	. .	. .	. . .	Ne .	n . t	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Mauritius	++	. v	b f	b f	. .	. .	. . .	net	n . t	. . .	. . .	. . .	net	. t	. . .	. . .
BIOT	+++	. .	b f	b f	. .	. .	. . .	n . t	n . t	. . .	. . .	. . .	n . .	n . t	. . .	. . .
Seychelles	+++	. v	B f	b F	. v	. .	. . .	Net	n . t	. . .	. . .	. . .	n . t	n . T	. . .	. . .
Mayotte	+++	. .	b f	b F	. .	. .	. . .	n . t	n . t	. . .	. . .	. . .	n . t	n . t	. . .	. . .
Comores	++	. .	B f	b F	. .	. .	. . .	n . t	n . t	. . .	. . .	. . .	n . t	n . t	. . .	. . .
Tanzania	+++	. v	b F	b F	. f	b f	. . .	n . t	n . t	. . .	. . .	. . .	n . t	n . T	. . .	. . .
Kenya	+++	. v	b F	b f	. f	? f	. . .	net	n . t	. . .	. . .	. . .	net	n . T	. . .	. . .
Somalia	+++	. v	B F	? f	. f	. f	. . .	n . t	n . t	. . .	. . .	. . .	N. t	n . t	. . .	. . .
Djbouti (?)	.	. .	. .	. f	. .	. .	. . .	. . .	. . t	. . .	. . .	. . .	. . .	. . t	. . .	. . .

Ethiopia	+++	. .	b f	b F	. .	. f	. . .	n . .	n . .	. . .	. . .	. . .	n . .	n . .	. . .	. . .
Sudan	++	. .	? ?	b F	. .	? ?	. . .	n . .	N . .	. . .	. . .	. . .	n . .	n . .	. . .	. . .
Egypt	?	. .	? ?	? ?	. .	? ?	. . .	. . .	. . t	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Sinai	.	. .	b ?	? ?	. .	? ?	. . .	ne .	. . .	. . .	. . .	. . .	ne .	. . .	. . .	. . .
Israel	.	. .	. .	. .	. .	. .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Jordan	.	. .	. .	. .	. .	. .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Saudi Arabia (?)	++?	. .	? ?	? ?	. .	. .	. . .	n . .	n . .	. . .	. . .	. . .	N . .	n . .	. . .	. . .
Yemen A. Rep.	+++	. v	b f	b f	. .	. f	. . .	ne .	n . .	. . .	. . .	. . .	ne .	n . .	. . .	. . .
P. Dem. Rep. Yemen	+	. v	B f	b f	. .	. .	. . .	net	ne .	. . .	. . .	. . .	Net	ne .	. . .	. . .
Oman	+	. .	B f	b f	B f	b .	. . .	net	n . .	. e .	. e .	. . .	net	. e .	. e .	. e .
Qatar	?	. .	b f	b f	. .	. .	. . .	n . t	ne .	. . .	. . .	. . .	n . t	ne .	. . .	. . .
Other Persian Gulf States (?)																
Iran	+++	. f	b f	b f	. .	b f	. . t	. e .	. e .	. . .	. . .	. . t	net	net	. . .	. . .
Pakistan	+	. .	B f	. .	. .	B f	. . .	ne .	. . .	. . .	. e .	. . .	N . .	. . t	. . .	N . .
India	+++	. v	b f	b f	. .	B f	b . .	net	ne .	. . .	. E .	. . .	neT	. . T	. . .	NE .
Maldives	+++	. v	b f	b f	. .	. f	. . .	net	net	. . .	. . .	. . .	NeT	NeT	. . .	. . t
Sri Lanka	+++	b .	b f	b f	? f	b f	ne .	net	Net	. . .	. e .	. e .	nEt	nEt	. . t	nEt
Bangladesh	+	. .	. .	. .	. .	b f	. . .	. . .	. . .	. . .	. e .	. . .	. . .	. . t	. . .	. e .

[a] Symbols: . = none or none significant, + = people venture onto nearshore waters, ++ = people are seafaring, +++ = people are accomplished sailors, b = the species breeds in this territory, B = the species has a major rookery in this territory, f = the species feeds in this territory, F = the species has a major feeding ground in this territory, v = the species occurs as a vagrant in this territory, n = nesting females are exploited, N = thousands of nesting females are exploited annually, e = eggs are exploited, E = tens of thousands of eggs are exploited annually, t = nonbreeding turtles are exploited, T = thousands of nonbreeding turtles are exploited annually, ? = not known.

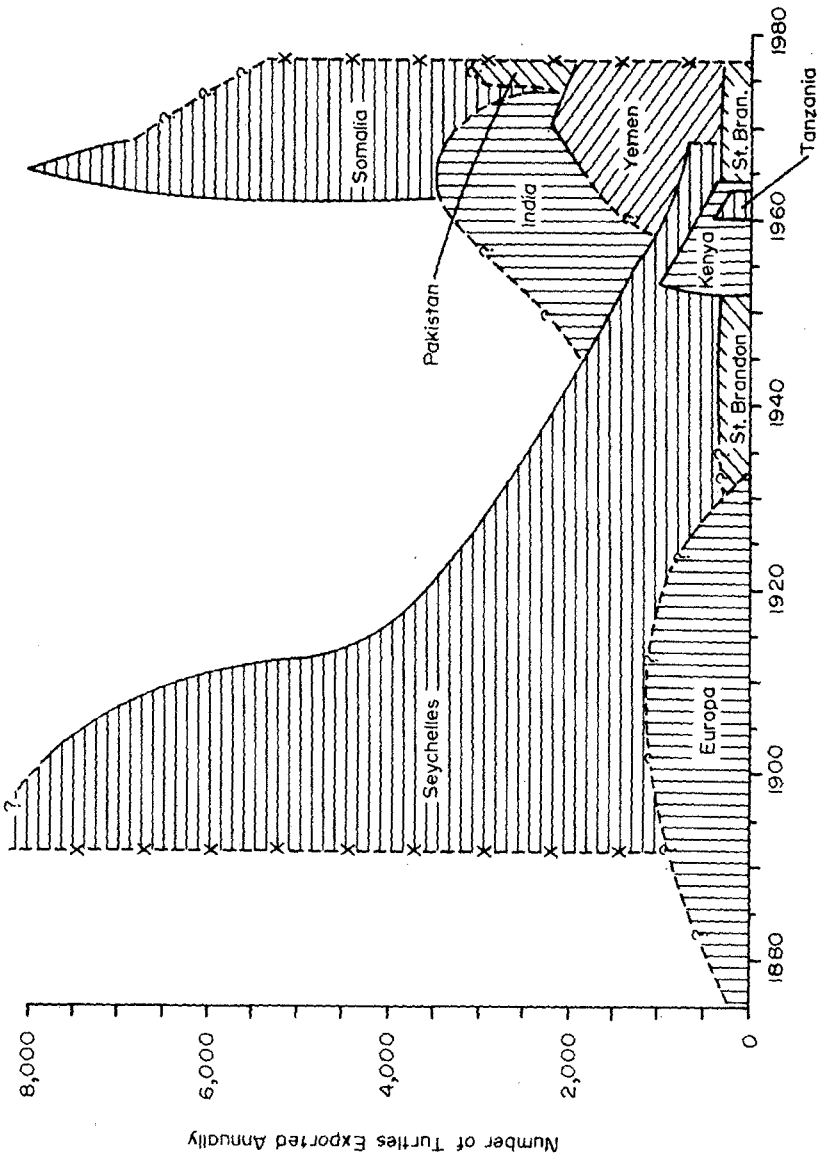

Fig. 9. Numbers of *Chelonia* taken annually from nine territories in the western Indian Ocean. Based on annual export statistics converted by an averaged turtle equivalent; each curve has been smoothed to show major trends. Dashed lines and question marks show parts of the curve that have been interpolated from very little information. Plots are not cumulative.

the statistics is complicated. Seychelles, a major historic supplier, does not show any marked decrease in export from 1893 to 1967 (Frazier, 1971). However, suppliers of tortoise shell, particularly to Japan, have recently appeared in all parts of the region, in places where formerly there were none. This reflects soaring prices and Japan's insatiable demand (Mack *et al.*, 1979), and shows what pressures the turtle may be under from this form of exploitation.

Large populations of species previously unexploited commercially are now culled in tremendous numbers, e.g., *Lepidochelys* in Pakistan and Orissa, India. This fishery is evidently providing leather for a luxury market. Although details of catches are not available, the numbers taken appear to be so great, and reproducing animals under such pressure, that the fishery is not likely to endure. A similar situation involving exploitation of *Lepidochelys* from the East Pacific for luxury markets is predicted to crash soon (Frazier, in press-a).

The soaring traffic in marine turtle hides came in the wake of a demolished trade in crocodile hides. The older industry died in the 1960s as the result of extirpated stocks of crocodilians and behindhand restrictions in trade. Turtle skins were an easy replacement, and it is simple to understand how this fishery has grown so rapidly, especially as turtle skins are valued at millions of dollars a year. This is yet another example of "rape and run."

Populations either too dispersed, too small, or of unsuitable species for export markets have escaped "commercial hunting," but intense exploitation may occur at a classical "subsistence," or nonexport, level. Hunting of nesting animals and nests can be so persistent that reproduction and recruitment are reduced intolerably. *Caretta* and *Dermochelys* in Mozambique, and all nesting species in Sri Lanka are evidently in this predicament. Hunting pressure on nonbreeding animals can also be severe, as illustrated by the situations in Madagascar and Sri Lanka involving most species.

Increases in human populations with limited protein sources or strong traditional habits are often followed by increased exploitation which is unsustainable – even though it is solely for "subsistence." This may have the same disastrous effect on reproduction and recruitment of turtle populations as does multinational commercial exploitation for export markets.

There is no simple "good and bad" relating to local subsistence consumption vs. export for luxury products. Exploitation is without morals; it is at one level a simple biological event, and at another level a complicated economical and sociological phenomenon.

Prices of consumable turtle products are comparable throughout the Indian Ocean region (Table VII). In many countries eggs sell for a few cents each and meat is about $.50/kg. Whole turtles, for national consumption, range from about $1 to nearly $40. Nonessential items, however, are quite variable in price; a carapace may be less than $1 or as much as $60. Tortoise shell varies from about $1 to $18/kg (although some of the prices quoted here may be out of

Table VII. Prices of Marine Turtle Products in the Indian Ocan Region; All Prices Given in U.S. Dollars[a]

Country	Local consumption		Intranational export								International export	
			National consumption			Expatriate consumption						
	Meat	Turtle	Eggs	Meat	Turtle	Turtle	Carapace	Raw tortoise shell	Worked tortoise shell	Stuffed turtle	Turtle	Tortoise shell
South Africa (nil)												
Mozambique	.09-.22			.34			.85	1.28-4.26				8.51-9.36
Madagascar				.43					62.50	25.64		29.92
Reunion												
Mauritius		3.25	.04	.53	29.00			1.13			75.00	
BIOT												
Seychelles				.50	22.00-36.00				60.00-100.00			6.00(100.00)
Mayotte						15.00		1.50				
Comores					.75-3.75			2.50		10.00-25.00		
Tanzania				.50								
Kenya					8.00						30.00	
Somalia												
Djbouti												

Ethiopia							
Sudan							
Sinai							
Israel							
Jordan							
Saudi Arabia							
Yemen A. Rep.							
P. Dem. Rep. Yemen	.01-.02			6.00	5.00	14.75-20.00	
Oman							
U.A.R.		6.00					
Iran					3.00-7.00		
Pakistan	.01-.03						
India		.48	1.20-9.00		6.00-10.00	12.00-18.00	
Maldives	.03-.04	.51-1.02			6.36-60.00		11.45-20.36
Sri Lanka	.01-.02	.12					
Bangladesh							
Burma							

[a]Data summarized from foregoing nation-by-nation accounts.

date), but when exported it may be five times more valuable. The fact that non-nutritive products are worth so much more than eggs and meat illustrates the "subsistence" hunter's paradox: an otherwise useless item when sold for export can earn many meals. While the lowly subsistence hunter does not eat tortoise shell or stuffed, polished turtles, these items can provide him with an invaluable means of subsistence.

The subsistence hunter is intimately related to the innumerable complexities of the market, for it is he who originally produces and sells the products. The lowly economic position of the hunter enhances the profit margin of the export commodity which must be processed, packaged, shipped, transshiped, distributed, etc., before being sold. This is important in maintaining the interest of the exporter.

PROBLEMS OF MANAGEMENT

The problems in managing marine turtle exploitation are compound, with interested parties at various socioeconomic levels, from the common "subsistence hunter" to the foreign importer. International demand for turtle products guarantees a tremendous stimulus for hunting and marketing. The economic incentives for exploiting fast, and to extinction if necessary, are far greater than those for harvesting on a sustained, long-term basis. This is particularly relevant with common resources (Clark, 1973), but economic considerations are all too often ignored by ecologists (Larkin, 1977).

Even if economic involvement could be kept secondary to ecological and management practices, the art of fisheries management is primitive, and its history is a list of cases of overexploitation and mismanagement. Moreover, for those species that are well studied, we rarely understand enough ecology to be able to apply it toward successful management (Larkin, 1978), and many central concepts in resource management are untenable, e.g., "maximum sustainable yield" (Larkin, 1977). With marine turtles even basic ecological facts are undocumented, adding that much more need for faith in management policy-making.

The socioeconomic effect of intense exploitation may be disastrous for the traditional hunter and his culture. There are many shocking cases of local "subsistence cultures," once dependent on local fisheries – or even specifically marine turtles – being transformed to market- and money-oriented economies, and such changes inevitably lead to degradation of traditional cultures with concomitant social, nutritional, and health problems (Johannes, 1978; Nietschmann, 1979).

We have set no admirable precedents in managing common marine turtle resources. Time will tell if we are able to correct this, or survive with the consequences.

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