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Subsistence Hunting of Turtles in the Western Pacific: The Caroline Islands

ABSTRACT

The Caroline Islands comprise numerous low coral atolls and islands as well as high volcanic islands. Some of the remote coral islands are used by sea turtles, mostly the green turtle, *Chelonia mydas*, as nesting areas during the season which generally lasts from March to September. Green turtles, and to a lesser extent hawksbills, *Eretmochelys imbricata*, are found year-round in the lagoons of the high islands. The inhabitants of the coral atolls, the "outer islanders" have, for the most part, developed methods of capture and utilization exceeding those of the islanders residing in the administrative centers of Truk, Ponape, Yap, and Kosrae. However, population pressures, the emergence of a "money economy," and other factors have increased the pressures on turtles throughout the region. The decline in importance of traditional tabus and the preference for modern boats and motors over traditional canoes have led to the disappearance of the protective buffer these customs once provided. Turtles face increased harvesting, and there is a need for a conservation system to replace the original tabus. Any such system must be designed with the people in mind and worked out in partnership with them.

Stretching from 131° East to 163° East Longitude, the Caroline Islands comprise a series of both high volcanic and low coral islands and atolls placed in a rough line totaling 3,200 km in length. On the easternmost limit is the high volcanic island of Kosrae; the west is bounded by the small coral island of Tobi. The total land area does not exceed 1,193 km² of dry land. The lagoon area, on the other hand, encompasses 8,546 km² and a total of about 950 islands and islets. The ocean area inside the present political boundaries of the Federated States of Micronesia (Yap, Truk, Ponape, and Kosrae) and Palau exceeds 3.4 million km².

Within this vast expanse of ocean, sprinkled among

the island chain are a few uninhabited atolls and single islands, all coralline in structure, which serve as nesting beaches for green and, to a lesser extent, hawksbill turtles. These islands are sometimes visited by islanders in canoes from nearby inhabited islands, or by the crew from a passing fishing vessel. Little is known of the nesting turtle populations or of their capacity to withstand exploitation.

The inhabitants of the Carolines arrived many centuries before the first Europeans. They had already developed cultures allowing exploration of remote parts of the Pacific. Whether voyaging for discovery or due to social pressures, they inhabited the islands and were well established by the arrival of the first Spaniards in the sixteenth century. Serious colonization by Europeans did not take place until the Germans discovered how valuable the islands were for copra and other commodities, including turtle shell. There are, however, no reports in the literature of the early explorers or commercial entrepreneurs that would suggest that the resource ever existed on the scale reported for the Caribbean. While turtles were most certainly seen and occasionally eaten by early visitors and inhabitants alike, we can only speculate on their numbers.

The Carolines had a series of various colonial masters interested in different goals. First the Spanish arrived with soul-saving religion, and guns to back them up. They met with less than resounding success. Two notable events were the slaying of the Spanish Governor and troops in Ponape during the late 1800s, and the supposed eating by natives of a priest and his followers left on Ulithi atoll about the same period. The Germans administered the area from their western Pacific headquarters in Rabaul, but only for a relatively brief time. Their rule was cut short by the first world war and the almost immediate occupation of the major islands by the Japanese in 1914. The area was given to Japan as a mandated area under the League of Nations and remained so until 1945, when the United States occupied the main islands. The United Nations then gave the United States control over the area known as Micronesia as a Strategic Trusteeship, and today it remains the last trusteeship under U.N. control. Political talks are progressing with the United States on the one hand, and the separate delegations from the Marshalls, Palau, and the Federated States of Micronesia on the other.

Turtles are occasionally seen around the main islands of Yap, Koror, Truk, Ponape, and Kosrae, usually in the water, and never for very long. The turtles, mostly *Chelonia mydas*, are to be found in the uninhabited islands far from the dusty streets, bars, and tin shacks of the administrative and population centers. The turtles concentrate their nesting activities on small islands such as Oroluk, Pikelot, West Fayu, Gaferut, and Helens Reef.

Oroluk atoll is located midway between Truk and Ponape. Until the late 1960s it was uninhabited, but today a small band of Polynesians from Kapingamaringi occupy the island with government consent and cause disruption to what once was regarded as one of the largest turtle nesting areas in the Eastern Carolines.

The island of Gaferut, containing 0.111 km², has been used as a resource island for many years by the people of Faraulep, and to a lesser extent by those from Woleai and Ifaluk. Gaferut is now seldom visited, due to the decline in the use of voyaging canoes by those islanders. Another factor was the tragic loss of most of the able-bodied men of Faraulep in their canoes during a typhoon in the 1950s. The island is sometimes visited by the government field-trip ship from Yap, and occasionally passengers from Faraulep, Ifaluk, and Woleai take turtles to be carried to their home islands. The ship's visit is short, and the evening's take is usually never more than 8 or 10 green turtles. The island is visited in this manner perhaps 2 or 3 times a year. A unique feature of Gaferut is a reef extension on the northwest side of the island which contains a large, deep hole big enough to accommodate many large turtles. Turtles often stay in this natural hole during the day or days before nesting. The standard method of capture is to move silently to this depression and capture the turtles resting there. The island itself is heavily wooded and has a large population of sea birds, only 1 coconut tree, and no fresh water. This makes a rather inhospitable place for humans.

One recent visit to Gaferut was made by islanders in a canoe from Satawal who were returning home on a long sea voyage from Saipan in June 1979. The navigator of the canoe reported that the island was covered with tracks and nests. The canoe was heavily laden, and able to carry only 2 or 3 turtles on the continuation of its voyage. This points out the limitations placed on the taking of turtles by the traditional mode of conveyance: the voyaging sailing canoe. These canoes are capable of extended voyages of many hundreds of miles with capable navigators from the islands of Satawal, Puluwat, Pulap, Tamatam, and Elato. But the number of turtles taken is limited by the size of canoe (usually not exceeding 8.2 m in length) and by the winds encountered. This is in stark contrast to the government ship or stray Japanese or Taiwanese fishing vessel, which happen upon an island, with a capacity far exceeding that of the canoes.

The other important nesting areas in the central and western Carolines are the islands of Ulithi atoll. Traditional customs are still strong within the atoll, and the turtles are considered the property of the chiefs of Mogmog, the highest caste island in the atoll. Information about turtles from Ulithi is not readily available, but the relatively large numbers of nesting turtles reported on 2 small islands just outside the atoll war-

rant a close study. A program sponsored jointly by the Peace Corps and the Micronesian Mariculture Center in Palau failed dismally in Ulithi during 1973 due to a number of factors, not the least of which was the personality of the Peace Corps volunteer assigned to the project. The resultant bad feelings have probably lessened the chances for serious investigators to do any work at Ulithi for some time.

Thus, except for the relatively few outer islanders who still possess the skills of their ancestors in bulding and sailing the large voyaging canoes, the great majority of the Micronesian population in the Carolines does not have access to turtle nesting sites. From a conservationist's standpoint this may be desirable, because the number of people exploiting turtles is reduced to manageable numbers (3,000 vs 90,000). Nevertheless, the remoteness of the islands makes the work more difficult than one would first imagine.

The inhabitants of the Caroline Islands are essentially of 1 Micronesian stock. Like other inhabitants of the Pacific, they can be grouped generally into 2 distinct groups: those that inhabit the low coral islands and atolls, and those who farm the higher volcanic islands of the chain. The languages are different from island to island, with the western Yapese and Palauan languages being distinct from the Carolinian dialects spoken from Ulithi to Kosrae. Ethnically and linguistically the outer islands of Palau are linked to Ulithi and the central Carolines, although administratively they are under the control of the administrative center in Koror, Palau. The rest of the islands' inhabitants live within 1 of the 4 states of the Federated States of Micronesia: Yap, Truk, Ponape or Kosrae. In Ponape, 2 outer islands, Kapingamarangi and Nukuoro, are inhabited by Polynesians rather than Micronesians, and make up the only distinctly different ethnic group in the Carolines.

It is important to note the basic differences between the coral atoll inhabitants and those living on volcanic islands. The former are mostly fishermen and "people of the sea," while the latter tend to concentrate their activities in farming and gathering crops on the more fertile high islands. As would be expected, the level of knowledge of the sea and its fauna is greatest in the coral islands.

The people of the coral islands, for the most part referred to as "outer islanders" by expatriates, have the greatest knowledge of turtle behavior, except for the inhabitants of Palau. Palau, in the western Carolines, is unique for many reasons; this uniqueness extends to knowledge of turtles and fishing activities in general. The Palauans have developed relatively exacting bodies of knowledge for much of the reef fauna, turtles included. Scientists studying there have remarked on the level of general knowledge and abilities of Palauans around the reefs of their home islands. But on the

other high islands of Yap, Truk, Ponape, and Kosrae the knowledge of the sea is not on a par with the "outer islanders" of those states.

In the outer islands, knowledge of turtle behavior is wrapped up in traditional beliefs, altered somewhat by the advent of western schooling, the outboard motor, and other introductions. Population pressures in these islands have forced migrations to the administrative centers and, in some instances, colonization of atoll islands not usually used for habitation. In general, however, population pressures are not as extreme today as in the Gilbert Islands during the 1930s when the British Administration forced migrations and resettlement from traditionally inhabited islands to previously uninhabited ones.

These pressures will increase, particularly in the outer islands; and it appears that neither government nor local institutions are aware of or concerned with the problem. For example, the island of Satawal in the central Carolines had approximately 275 inhabitants at the end of the second world war. In 1968 the population of this 350-acre island was about 390. By 1978 it had risen to over 550, or a density of over 1,000 people per square mile. Marriage on other islands, employment in the administrative center and other factors tend to conceal the real growth, but an average of 22 births and only 3 deaths a year is quickly moving the island towards dangerous overpopulation.

These increasing pressures, in the case of Satawal, put increased pressure on traditional sources of protein, including turtles. Voyages in the traditional canoes will be made more often in search of turtles and fish on the nearby nesting islands, and perhaps the not-too-distant future will see the introduction of larger motorboats for this purpose. Indeed, on Lamotrek Island, 64 km west of Satawal, an 8.2 m diesel-powered skiff was recently purchased with funds granted by the District Legislature. The vessel reportedly travels to the atoll of Olimarao in search of turtles, and occasionally to Satawal for trading and social visits.

Turtles have suffered and will continue to suffer under such pressures. The atoll of Oroluk, located in western Ponape and already briefly described, was uninhabited until the late 1960s. When the Kapingamarangi people petitioned the government to allow colonization, a stable population resulted on Oroluk. While the numbers are not great, from 10 to 20 persons at any one time, the effects have been startling. The island itself is the only one in a large atoll enclosing 419 km² of lagoon area. The island has been known as a nesting ground for years during the season from March to September. The inhabitants have built a stone holding-pen, and turtles are placed within the pen to await the government field trip ship which calls about 6 times per year. Until recently turtles were loaded aboard the field trip vessel for return to Ponape, where they were

either sold or eaten in the Polynesian village there. The enforcement of the Endangered Species Act has put a stop to commercialization, but subsistence use is still allowed under Federal law.

While there are no figures available on the numbers of nesting turtles at Oroluk, the inhabitants complain of a decline in numbers, and estimates of nesting females per year range from 40 to 100 individuals. This is not a great number, considering that, at least by reputation, Oroluk is considered one of the better "turtle islands" in the Carolines.

Because the physical environment of the outer islanders consists of coral atolls, and since the turtles prefer the beaches of the atolls and low islands to those found on the higher volcanic islands, they have the most contact with nesting turtles. They also develop the skills necessary for catching turtles in the lagoons and from boats and canoes. In the past 30 to 40 years, outer islanders in the administrative centers on the high volcanic islands, principally Truk, Ponape and Yap, often have shared these skills with friends and relatives there. Thus, techniques for catching turtles have been developed in the high islands which were absent in the past. As travel between islands is made easier by government-subsidized shipping, the chance for such minor technology-transfer increases.

In addition to sharing their own techniques and knowledge of turtles, the Micronesians learned much from the Okinawans who were brought to the islands prior to the second world war. The Okinawans came as laborers in the sea-oriented enterprises run by the Japanese, and many were excellent divers. They showed the Micronesians how to dive for turtles resting under the coral ledges, and how to gaff them with hooks embedded in long lengths of bamboo. The hooks were released from the gaff but remained tied to a long length of fishing line which was in turn tied to a floating log or other float. Some turtles were undoubtedly lost as they struggled to drag the float, and lines became entangled in the coral. But for the most part the method became an effective and successful way to catch green turtles, particularly in Yap.

The knowledge of turtle behavior possessed by outer islanders is limited, however. For example, in 1972 I inquired of the elders of an island their determination of periods between nesting. Some swore that females nest only once a season, others that she nests up to 10 times. Because they captured every nesting female they saw, there was no way for them to be sure. In another instance, a turtle was spotted nesting on a remote atoll away from the inhabited island. I asked the men how long they thought it would take for the eggs to hatch, assuming we left them in the ground. Some ventured 10 days, others 25. Nobody really knew, however, for they always dug up every nest they encountered and had no means of determining the time required. It was

not until work at the West Fayu turtle hatchery showed the local crew that 58 to 60 days were required, that they began to understand some of the basics of turtle behavior.

Pressures on the turtles of the Carolines have been rising at an accelerated pace during the past 10 years. The main reasons for this seem to be the furtherance of the "money economy" in Micronesia, and the relative ease with which fishermen are now able to procure outboard motors, boats, and the gear required to hunt turtles. Amazingly, tangle nets such as are used in some places in the Caribbean are not used in Micronesia, and for that reason I have always hesitated to show the classic movie on the Miskito Indians produced a few years ago. Clarity of the water might be one of the reasons why people have never used nets, but the unavailability of materials might be another. Since most materials are now available, I felt it better not to show the movie and introduce the concept, rather than trust to *Chelonia's* eyesight.

Other factors have combined to increase the pressures on turtles. In the case of West Fayu, it was the island's flora. Until after the second world war, there were no coconuts on the island, which limited the amount of time voyagers could remain to await the turtles. Shortly after the war, a major infestation of an unidentified insect killed many of the bushy trees on the island which had prevented coconuts from receiving enough sunlight to survive. People from Satawal then transported copra nuts to the island and planted much of the island in coconuts. The coconuts have been the single most important change on the island (not counting a wrecked 9,000 ton freighter full of Toyotas in 1971). Man can now increase the length of a stay to hunt turtles.

Another factor that has increased the number of voyages is the improvement in materials used in the manufacture of the traditional canoes. Until the middle 1950s pandanus sails were used exclusively on all canoes on Satawal Island in the central Carolines. The introduction of cotton canvas sails greatly increased the speed and performance of the canoes. Recently, the introduction of dacron sailcloth has lessened the voyage time even more. Other improvements and introductions, such as the magnetic compass, have meant a greater confidence in voyaging and a strong probability that many more voyages are undertaken now than in the past.

Many of these improvements, including introduction of motor boats on other islands, have occurred during the years since 1965. They have greatly increased the pressure on the turtle populations in all of the areas visited by inhabitants of the central Carolines, with the possible exception of Gaferut.

The motorboats, usually under 6.7 m in length and powered by 25 to 40 horsepower outboard motors,

are used mostly in the administrative centers (the high islands). In Truk, for example, motorboats are used to chase the turtles on moonlit nights across the shallows, and harpoons are used to spear and retrieve them. Turtles captured in the higher islands, where varieties of seagrasses are found, tend to be smaller and more variable in size than those in the nesting areas of the outer islands.

In the outer islands, the turtles are most often captured while mating or on the nesting beaches. The people of Satawal Island, and to a lesser extent those of the westernmost islands of Truk, Puluwat, Pulap, Tamatam, and Pulusuk, go to West Fayu to capture turtles. During the day a close watch is kept for mating turtles within the lagoon. If mating turtles are spotted, a canoe races to the position. The men affix large hooks to strong lines and then place the hook in a notch in the end of a piece of bamboo or stick approximately 2-m long. The ends of the lines are then tied to a large boom carried on the canoes, or to the canoe itself. Two men are given the responsibility of swimming up silently behind the mating turtles with the hooks. They then swim under the mating turtles, and each man places a hook into the skin on the turtle's neck. A sharp watch must be kept for sharks which occasionally cruise around mating turtles and take nips out of their flippers. For the most part, the mating turtles are oblivious to what is taking place around them. The swimmers are usually successful in their attempts. Once the turtle is hooked it immediately sounds and a tug-of-war ensues, with the turtle usually losing. Often the equipment for this type of capture is not available when islanders on fishing voyages sight mating turtles. In this case, the men swim up to the unsuspecting turtles and grab them in a "full nelson" hold from the underside. The man's hands are then placed under the chin of the turtle and force its head back, minimizing the chances of being bitten. Other men then jump off the canoes with whatever ropes and lines are available, and attempt to tie the front flippers in a manner that will allow them to drag the turtle aboard. This is obviously a much more dangerous and less successful operation than the hook and bamboo pole method.

During moonlit nights on West Fayu, it is also possible to tether a previously captured female to a tree, and allow her to swim in the shallows around the island. The nesting beach is not more than 15 m wide, and the tether is fairly short. Men then climb into the trees near the water's edge and wait for her to attract males. Once the males are attracted, the men chase them down.

Pikelot Island is perhaps one of the best known and most visited turtle islands in the central Carolines. Canoes from Puluwat, Tamatam, Pulap and Pulusuk in the western part of Truk visit the island during the summer months to capture turtles to take to their home islands for consumption.

Canoes from Satawal also visit Pikelot, as it is traditionally owned by them, and administratively it is the easternmost island in Yap State. In 1978 canoes journeying to Pikelot returned to Satawal carrying 18, 10, and 11 green turtles on 9 March, 8 May, and 16 June, respectively. Another trip by 4 canoes to West Fayu returned on 31 May the same year and brought with them 11 captured turtles from that island. This number of turtles is considered average to good. The yearly fluctuations in the total number harvested varies considerably. These excursions usually last from 1 to 3 weeks, depending upon the winds, weather, and food supply. An important consideration for the voyaging canoes is the weather, for the turtle nesting season coincides with the typhoon season in the central Carolines, and is also the time of the most variable and fickle winds.

Reports from Pikelot in 1977 showed canoes from Puluwat averaging 4 turtles a night (all nesting females) during a week's stay in May of that year. The report, published in Guam, further noted that because of the number of tracks on the beach, the 28 individuals taken could have represented only a portion of the population. What was not understood, however, was that during the good weather experienced on the island, the tracks and nests could have been made over a 1- to 2-month period by a relatively small number of turtles.

The total number of nesting females on the beaches at West Fayu and Pikelot is probably not very large, but their presence provides the incentive for inhabitants of the nearby islands to continue making the large sailing canoes primarily for the purpose of transporting live turtles back to the inhabited islands. There is a good chance that without adequate stocks of turtles, the canoe voyaging tradition would suffer, and with it an important component of local society. Thus, while actual numbers of turtles harvested may not be large, perhaps averaging 30 to 70 a year per island for the 6 major islands involved (Satawal, Puluwat, Pulap, Tamatam, Pulusuk, and Lamotrek-Elato), the turtles contribute much to their overall cultural stability, reinforcing their independence from the outside. The estimated maximum contribution to the protein, perhaps 18 kg a person a year, is not nearly as important as this cultural role.

An important buffer provided for the turtles were the past tabus and ceremonies surrounding the taking and consumption of turtles. Canoe travel provided an additional buffer, and has continued in the face of the lifting of traditional religious tabus. While it cannot be shown quantitatively that many of the tabus formed such a buffer, it is my opinion that a substitute is required to restore the balance and to enable the relationships to continue to exist.

The taking of turtle eggs was not traditionally covered by tabus. The exploitation of this resource has

continued unchecked on almost all islands where there is nesting in the Carolines. The comparison of 25 g of protein to a possible 150 kg needs no elaboration here. However, the local inhabitants' belief must be remembered that the sea has been, and always will be, an adequate provider for all things. In my discussions with various inhabitants, none expressed great concern over the taking of eggs or, when concern was expressed, it was always countered by a bird-in-the-hand philosophy.

In the population centers such as Truk and Yap, the taking of marine turtles is an occurrence best equated with deer hunting in the United States. Often the hunting of turtles is undertaken with a form of sport in mind and, although the turtle is eventually consumed, it does not figure as prominently in the lives of the inhabitants as it does in the outer islands.

It has been my continued belief that efforts at conservation should be made with the people of the area firmly in mind and that assistance should be given to enable them to better understand the resource. This is not an easy task for scientists and others who themselves know so little of the behavior of turtles in the Carolines. Yet, the challenge presented must be met in the very near future if turtles are to remain a viable part of the island ecosystem.

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Subsistence Hunting of Marine Turtles in Papua New Guinea

ABSTRACT

In Papua New Guinea marine turtles are heavily utilized by coastal and island villagers as a source of food, for traditional feasts and exchanges, and for sale in local markets.

In general there are many traditional rules and regulations concerning the hunting and use of turtles, but these are dependent on respect for traditional authority. In most areas this authority is eroding as a result of the younger generation's exposure to the western economies and way of life. Young people are taking advantage of modern equipment to catch turtles for everyday use and for sale in the markets. Village elders, beginning to notice the subsequent decline in turtle numbers, attribute it to the disregard of old traditions.

This paper summarizes the findings of surveys on the subsistence and cultural significance of marine turtles in Papua New Guinea (PNG). These surveys include a postal questionnaire, and village and market surveys.

Methods

In 1977 the postal questionnaire was prepared in the 3 main languages of Papua New Guinea: English, Motu, and Pidgin and was distributed to various schools, colleges, missions and government organizations around the PNG coast. The information received in these questionnaires was carefully assessed and used as background information for village surveys. Village surveys are a valuable source of data on traditions. Interviews are conducted informally, with village elders, councilors and turtle hunters participating. Information is collected on traditions such as hunting methods and their associated rituals, the use of turtles in the village, and legends. Village leaders are advised of a visit by a *tok save*, a message sent over the local radio so that villagers will be present when the interviewers arrive.

Daily market surveys are currently being conducted in Daru and Port Moresby.

Results

Around the coast and islands of Papua New Guinea people rely on the sea as a major source of protein. Fish, turtles, and shellfish provide the main wealth of the village. Often gardens are very poor, and so the people traditionally exchange their fish and turtles for garden produce such as sac-sac (sago), taro, and greens from the mainland or island villages.

The major source of protein is fish which is eaten daily. Second in importance are turtles. The most heavily utilized turtle is the green turtle (*Chelonia mydas*). However hawksbills (*Eretmochelys imbricata*) are also widely eaten, usually with little ill effect (Spring, this volume).

In most parts of PNG, turtles are highly valued for traditional use and for their cash value. However, in the Trobriand Islands, they have no special significance for the people who cultivate and prize yams far beyond their nutritional worth. Turtles are eaten when found but are not a sought-after food and certainly not used on important occasions such as feasts.

In all other coastal areas, however, turtles are or were traditionally eaten in feasts, for example bride-price repayments, funerals, the building of a new canoe, the opening of a new *haus boi*, the birth of a first child. Today, feasts are also held for nontraditional special occasions relating to business, political and religious activities such as Christmas, Independence Day celebrations, the opening of a new church or business group. When turtles are required for a feast, the chief or leader organizes the hunters and canoes to go out and get turtles, up to 60 for a big feast. Turtles are either kept on their backs in the shade in the village or in *banis* in the sea. While they are in *banis* they are fed sea-grasses, chopped clams and fish to ensure that they do not get too skinny in the meantime. When all preparations have been made for the feast, the turtles are killed. If guests from other villages are invited, they bring exchange presents such as sac-sac (sago), and other items of wealth (for example, *tambu*, dogs teeth), according to the number of turtles which are provided by the host village. Turtles are usually given a quick roast and then cut up and boiled in a pot with a few greens. All of the turtle is eaten including parts of the shell, bones, blood, and internal organs. When a hawksbill with a particularly beautiful shell is caught and eaten, the shell is saved for making into combs or preserved as a decoration for the house or sold to tourists. In the past, the hawksbill shell was used to make a number of everyday items such as spoons and knives, but these are now supplied by trade stores. Hawksbill shell was also used to make some items of traditional *bilas* such as belts, bracelets, earrings, lime-sticks and brideprice items but these are rarely seen today.

In areas close to town centers, turtles are being hunted with little restraint, for daily consumption and for sale in the town markets. A large green turtle will fetch between US \$90 and US \$115 in the Port Moresby market, for example. Shells are also sold to tourists at between US \$15 and US \$30 for a good size shell.

However, there are other areas where turtles are no longer hunted at all; these are the Seventh Day Adventist villages, where the people do not eat meat. Of the areas I have surveyed, there are only a few locations where turtles are still abundant; two of these are Seventh Day Adventist areas, Massau Island in the New Ireland Province and the Hermit Islands in the Manus Province.

Turtles also contribute to the oral history of the village. There are many legends and stories to explain the origin of turtles, why they entered the sea, how they got their shells, and so on. Some clans believe they are descended from turtles, and stories describe this relationship. Some magic men claim to possess powers over turtles. There are 4 such men, to my knowledge, in the widely separated provinces of East Sepik, Western, Manus, and Milne Bay. Each of these men is highly respected within his village and only uses his magic for very important occasions. For example, at Ponam Island in the Manus Province, the traditional net is only used in association with magic. It was last used in 1975 when there were several important occasions occurring together—Independence, the ordination of a local priest, and the opening of a church.

Methods of Hunting

In Papua New Guinea turtle hunting methods have been traditionally passed down from generation to generation, with a few modifications along the way. Hunting techniques and their associated rituals differ from area to area, but they can be roughly grouped as follows.

Netting

The traditional net is rarely used today, but it was rather widely used in the *taim bilong tambuna*, the olden days. The net is made from bush fibers. The art of making the *kapet*, the traditional net, belongs to certain families and is passed down from generation to generation. Most nets have disintegrated today. However, in the Manus Province several are left and are used for very special occasions. The one on Ponam is considered a sacred object and is stored in its own house and looked after by an elder who possesses magic powers and who is highly respected in the community.

When turtles are needed, the people concerned see the 2 leaders of the turtle net and discuss their requirements. The leaders then confer and set a date for

the hunt. Twenty-four men are needed to cast the net, 12 on each side (each leader is responsible for his own side). The leaders pass the message among the 12 men that a hunt is on and to prepare according to the rules. On the day of the hunt the canoes gather together and leave at dawn. The net, weighted with stones, is carried across 2 large canoes. There are 10 canoes altogether, 4 small ones on each side. The canoes halt at a passage and wait until a turtle is seen. Then the net is cast and some hunters jump into the sea with it. When the turtle is caught in the net the men call to the large canoers who converge. The small canoes duck in and pick up the turtles. Up to 7 or 8 large turtles can be caught in 1 channel. The whole process is carried out according to strict ritual, and so the turtle hunt becomes quite an occasion in the village.

Harpooning

This, the most widely practiced technique, is traditional in some areas and introduced in others.

FIXED-SPEAR TIP

This consists of a wood or bamboo harpoon with a fixed iron tip. This is used in the East Sepik Province, Madang Province and the Trobriand Islands. Two or three men in a small canoe hunt turtles, usually at night, using a lantern. When the turtle is speared, 1 or 2 men jump in the water and pull the turtle on to the canoe. Only a few turtles are caught on these hunting expeditions as there is limited space on the canoes.

DETACHABLE SPEAR TIP

In the Manus Province this widely practiced method was taught to the villagers by Japanese fishermen prior to the second world war. It consists of a wooden harpoon with a detachable spear tip made from a 3-cornered file connected to a *perei*, a wooden float, by a nylon cord. When the turtle is speared either from the canoe or by a swimmer in the water, the harpoon detaches, and the turtle is allowed to swim until it is exhausted. Then it is picked up by the canoe. This technique is also used in the Western Province, where villagers have magnificent sailing outriggers. A spotter on the mast directs the harpoonist at the prow of the boat.

PLATFORM

This was the traditional way of spearing turtles and dugongs in the Western Province. It is no longer practiced, but was 40 or 50 years ago. Turtle hunters would build a platform made of bush materials over the reef and wait for turtles and dugongs to swim past. When

one did, it was promptly speared. The turtle was allowed to run and was pulled in when tired.

By Hand

In the St. Matthias Group in the New Ireland Province, turtles were traditionally caught by hand. Today the people are Seventh Day Adventists and do not eat turtle meat. The village elders believed that drinking turtle blood would increase their swimming and diving powers so turtles had to be caught without spilling a drop of blood. Canoes would chase a turtle until it tired. A hunter would then leap into the water, wedge a wooden pole in the soft skin of the neck under the shell, and flip the turtle onto its back. The turtle was then lifted onto the canoe alive and unharmed.

In Bipi Island, turtles were also traditionally caught by hand for feasts. The village chief would call all the hunters and tell them to prepare their canoes to go and catch turtles. Each hunter would prepare his canoe and take along his supplies (some food, tobacco, and betel nut). On reaching the turtle islands the hunters would prepare all the food in one pot and offer it to the spirits of the reefs and beaches. Next morning all the canoes would go to sea in a line and look for turtles. When a turtle was spotted a competition would ensue to see who could catch the first turtle. Each canoe would average 4 or 5 turtles, depending on the skill of the hunters. Turtles are also traditionally caught by hand in the Western Islands, the Trobriands, and Woodlark Islands. In the Woodlarks turtles are hunted on a dark night with calm water full of phosphorescence. Canoes follow the turtle's phosphorescent trail, then hunters leap on the animal.

Nesting Females

Taking nesting females is a rather widespread practice today. In the Manus Province it is a tradition with associated rules. In other areas it is nontraditional with little or no regulation. In Manus, there is a practice of calculating when nesting females will return to lay a second clutch of eggs. When an individual needs a turtle for a household occasion, he asks the village elder if he can catch a nesting female using this method. If fresh tracks are seen on the beach, the nest is dug up and the number of eggs inside counted. According to a formula which varies from one location to another, a number of small sticks or *yakets* are planted in the ground, each stick representing 1 day. When 2 or 3 sticks are left, the hunter returns to the site of the original nest and awaits the female turtle. This technique, though still current, is practiced less often, as nesting females are more scarce than in the past.

The Tulu village in the Manus Province maintains a strong traditional tie between 2 clans and the leathery

(leatherback) turtle. The people believe that the leatherback turtle belongs to these 2 clans and that the turtle will not return to nest if this ownership is not recognized. Only members of the 2 clans can use divining methods to predict the return of the nesting female. Every female coming ashore to lay its eggs is eaten, if found. When the turtle is killed, it is cut up and divided according to tradition. The front end and the head go to one clan and the back to the other. The pieces in between are divided among the rest of the village. All the turtle is eaten and oil is collected from the shell and used for wick lanterns. In 1978 1 leatherback was eaten out of 5 that were nesting. Three of these nests were dug up (Pritchard 1979). In 1979 2 nesting females came ashore. Both were eaten and their eggs dug up. When I visited Tulu recently, the people were worried about the decreasing numbers of nesting females. There are usually between 12 and 14 nesting females in a good year.

Other Methods

Turtles are also incidentally caught in fishing nets and by hook. A few are also shot by speargun, but in general this practice is frowned upon by the village elders. At Kitava village in the Trobriand Islands, mating pairs are caught with ropes during the breeding season.

Turtle-Hunting Ritual

Ritual still surrounds turtles where they are caught for feasts, and strict rules are associated with their capture and consumption. In areas where traditional authority and respect is breaking down, especially around city centers beset by a need for money, traditional restraints on taking turtles (and other wildlife) are becoming less effective.

Missionary activity has also resulted in a breakdown of traditional rituals, but not always to the detriment of turtle populations. In the Western Province, turtles, once hunted only for feasts, are now eaten as a daily food. On the other hand, where the Seventh Day Adventist Church is influential, the people no longer eat turtle meat, and the turtle populations are increasing. In the more remote provinces, traditional ways are still respected and practiced.

Traditional Ownership of Reefs and Beaches

In most places the right to fish certain reefs and beaches is controlled by individuals or by clans. This enables some measure of control over exploitation of turtles in these areas. However, this system relies heavily on traditional authority and respect within the village. Also, in the old days, traditional laws were defended effectively by force.

Today this is no longer possible. The Wildlife Management Area system of the Wildlife Division enables traditional owners to legally take any offenders to court, thereby enforcing traditional rules, and placing the onus for enforcement on the villagers themselves.

Social Restrictions

These restrictions while not primarily of a conservative nature often have a side benefit of conservation.

Hunting rituals are usually designed to discipline the hunting party into a well-organized and efficient hunt. To prepare for the hunt, hunters usually cannot sleep with their wives during the preparatory period. They must organize their personal effects and dress neatly and not indulge in any gossip or bad thoughts or pry into other peoples belongings. Silence is usually observed during the hunt, only the leader giving orders. If a man's wife is pregnant, he cannot participate in the hunt, or go near the hunting party.

Village restrictions are usually based on the superstition that unless these rules are observed the hunt will be poor or the hunters may have an accident. There are many restrictions on the hunters' wives. For example, they cannot sweep or work until the men return; they must sit down in their houses and not walk about. Children cannot play or make a noise until the hunt is over.

People or clans who believe themselves related to turtles cannot eat turtle meat (East Sepik, Trobriand Islands). All villagers are also prohibited from eating turtle meat during the yam planting season in the East Sepik. In the Trobriands, if a person has eaten turtle meat, he or she cannot go near the yam gardens for 3 days, or else the garden magic will be affected. Magic men who have powers over turtles do not eat turtle meat for fear of losing their magic powers (Manus, East Sepik, Western and Milne Bay Provinces).

Conclusions

Marine turtles play a significant role in the lives of coastal village people as an important source of food. The rules and rituals associated with turtle hunting and the legends explaining their origin also contribute to the cultural heritage of the people.

The greatest threat to turtle populations today is the breakdown of traditional restraints on catching turtles, the incentive to catch more turtles than was previously required, for sale in markets, and the use of modern fishing gear. An old man from Bipi Island said: "Before, in the old days, there were plenty of turtles; we used to hunt them only when our elders said so. Today the young people are following new ways, shooting turtles with spears from canoes with outboards and spearfishing with diving masks. In my opinion, if we

still follow the old traditions, turtles will still be plentiful, but the new generation are killing them indiscriminately and turtles are getting scarce.”

Acknowledgments

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Subsistence Hunting of Sea Turtles in Australia

ABSTRACT

Information sources included the results of a questionnaire survey, the biological and anthropological literature, and personal observations made in Torres Strait. The main findings were:

1. Hunting of turtles in Australia occurred north of 21°S on the east and west coasts by Aboriginal and Torres Strait Islander people for subsistence purposes.
2. The green turtle (*Chelonia mydas*) was the most preferred and most commonly taken species.
3. There were some regional differences in the sex and size composition of the catches, and in the seasonality of turtle hunting.
4. There was also regional variation in the apparent importance of turtles to the hunters, both from nutritional and cultural aspects.
5. The number of turtles caught seemed to depend on the extent of the desire of people to be involved in this activity.
6. An estimate of the total annual catch by Aboriginal and Torres Strait Islander people in Australian waters came to between 7,500 and 10,500 turtles.
7. Relative to turtle hunting, turtle egg collecting has insignificant impact on wild turtle stocks.
8. The hunting pressure on turtles before the time of white settlement was probably as great, if not greater, than at present.
9. Future levels of hunting pressure will depend more on changing socio-economic goals of Aboriginal people than on present trends of population increases.

Introduction

Australia's coastline north of the Tropic of Capricorn stretches for over 7,500 km through 3 major political

subdivisions: Queensland, Northern Territory, and Western Australia (Figure 1). Australian territorial waters include a zone of 3 international nautical miles from low water mark; in addition there is an Australian Fishing Zone of 200 international nautical miles from low water mark, defined by the Fisheries Amendment Act 1978. Several changes are pending with respect to delineation of sea borders (Appendix A).

The extant indigenous population of Australia can broadly be divided into 2 groups, the Aborigines and the Torres Strait Islanders, the latter people being defined in anthropological literature as having lived within the area bounded by latitudes 9°20' and 10°45'S and longitudes 142° and 144°E (Beckett 1972). In 1971 there were approximately equal numbers of Aborigines in Queensland, the Northern Territory, and Western Australia; however, about 95 percent of the total number of Torres Strait Islanders in these 3 political subdivisions lived in Queensland (1971 census of Population and Housing).

Legislation pertaining to the taking of sea turtles in Australian waters varies between political subdivisions (Appendix B). In summary, in both Queensland and Western Australia, noncommercial taking of turtles is permitted for Aborigines and Torres Strait Islanders, with the additional qualification of living on a reserve applying to those people in Queensland. In the Northern Territory, the taking of green turtles is permitted only within specified areas adjacent to some settlements. At the federal level, the taking of turtles in proclaimed waters (that is, outside the 3-mile territorial limit) is prohibited; there is apparently no provision made at present for noncommercial taking of turtles by Aborigines or Torres Strait Islanders, but in practice this is permitted.

General accounts of aspects of subsistence hunting of turtles in Australian waters can be found in the biological and anthropological literature (for example, Beckett 1972; Cogger and Lindner 1969; Duncan 1974; Kowarsky 1978; McCarthy 1955; Moore 1972; Nietschmann, in press; Turner 1974); most of this information deals with the Torres Strait region. I have been privileged to have access to an unpublished manuscript on subsistence hunting of turtles in the north of Western Australia (Capelle 1979).

This investigation had 3 main aims: 1) collect and summarize information on subsistence hunting of turtles throughout Australia; 2) to assess the importance of turtles to those people who have traditionally hunted them; and 3) to provide information which, with data on the status of sea turtle populations in Australian and adjacent waters (documented elsewhere in these proceedings), might enable an assessment of the present, and future, impact of turtle hunting on sea turtles in the region.

Methods

A questionnaire (Appendix C) was distributed to persons and communities in coastal northern Australia. At the time of writing, 31 completed questionnaires had been returned. The areas of coastline of which respondents indicated knowledge are shown in Figure 1 (note: some respondents indicated familiarity with more than 1 region). Replies were from the following sources:

<i>Source</i>	<i>Number of respondents</i>
Aboriginal and/or islander community resident or administrator	9
Department of Aboriginal Affairs (federal)	3
Department of Aboriginal and Islanders Advancement (Queensland)	4
National Parks and Wildlife Service (Queensland)	4
Western Australian Department of Fisheries and Wildlife	4
Other	7
Total	31

Results

Turtle Hunters

All sources of information indicate that among Australians, turtle hunting is virtually the exclusive domain of Aboriginal and Islander people (with the proximity of the border to Papua New Guinea, residents of that country certainly would hunt turtles in Australian waters, but I have not documented these activities here). I have attempted to estimate the number of people living in reasonable proximity to the tropical coast who could legally, or who would traditionally, use turtles for subsistence (Appendix D).

Figures obtained from the above are certainly overestimates of numbers actually using turtles at present. In the Northern Territory, for example, most turtle hunting would be carried out by the 13 major coastal settlements of Aboriginal people; their numbers would be far lower than the figure estimated for that division. In Western Australia, the total number of persons who might hunt turtles between Pt. Hedland and Wyndham would not exceed 600 (Capelle 1979), yet over 10 times that figure is obtained by summing numbers of Aborigines and Torres Strait Islanders living in coastal Local Government Areas along the same coastline.

Two factors could be advanced to explain these discrepancies. Firstly, the basic census unit, the Local Government Area, was too large and would have included many people living away from the coast. This would apply particularly to Western Australia and the

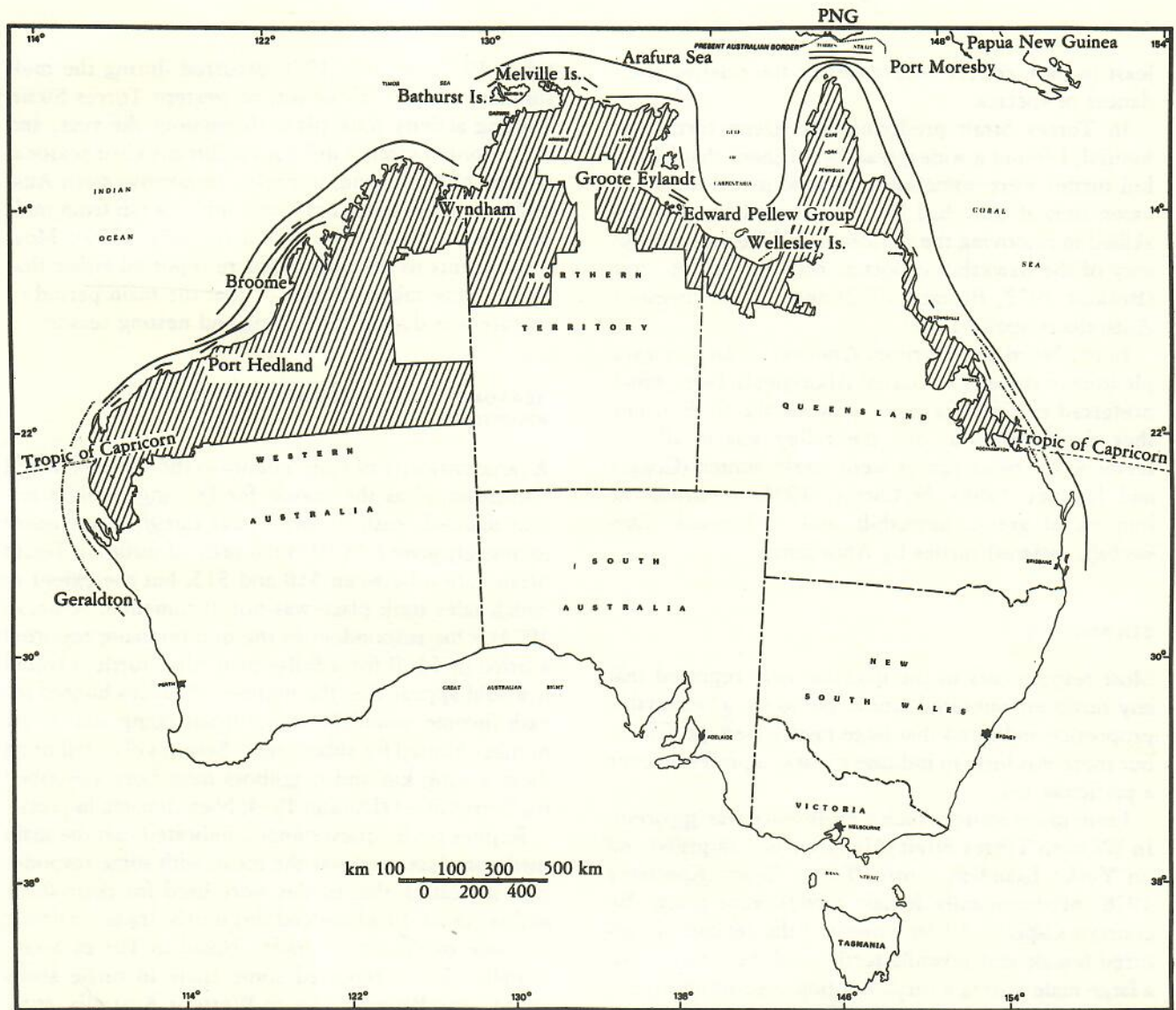


Figure 1. Map of Australia showing: 1) major political subdivisions; 2) regions of coastline about which respondents to the questionnaire indicated knowledge: continuous lines =

turtle hunting reported, broken lines = no turtle hunting known; 3) local government areas north of the Tropic of Capricorn with a coastal border = shaded areas.

Northern Territory. Secondly, as will be discussed later, many Aboriginals and Torres Strait Islanders would now no longer hunt turtles.

Geographical Extent of Turtle Hunting

The survey indicated that turtle hunting was limited to north of about latitude 21° S on the east and west coasts of Australia (Figure 1). This distribution is very similar to that described by McCarthy (1955).

Hunting Methods

According to the survey, the most common method of capturing turtles is by use of a spear or harpoon from a boat. Less commonly, turtles are taken by hand, either in pools on the reef, while basking in very shallow water, or after chasing by boat. Turtles are also sometimes taken while nesting. Descriptions of hunt-

ing techniques can be found in McCarthy (1955), Turner (1974) and Capelle (1979). Today there is widespread use of aluminium dinghys, powered by outboard motors, as fishing platforms (Duncan 1974, Capelle 1979) as opposed to the traditional dugout canoes powered by sail or paddles (McCarthy 1955, Beckett 1972, Moore 1972).

Composition of the Catch

SPECIES

The survey indicated that green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), flatback (*Chelonia depressa*), loggerhead (*Caretta caretta*), and ridley (*Lepidochelys olivacea*) turtles were hunted, in order of decreasing frequency. There are apparently regional differences in the composition of catch, which may, at

least in part, reflect differences in the relative abundances of species.

In Torres Strait predominantly green turtles are hunted; I found a widespread belief there that hawksbill turtles were sometimes poisonous and would be eaten only if they had been butchered by someone skilled in removing the poison parts. The reputed toxicity of the hawksbill is documented for Torres Strait (Beckett 1972, Bustard 1972) and for northwestern Australia (Capelle 1979).

In the Northern Territory *Chelonia mydas* was a staple item in the diet of coastal Aboriginals, being much preferred to *Chelonia depressa*, while the flesh of neither the loggerhead nor the ridley was locally esteemed, and these turtles were rarely hunted (Cogger and Lindner 1969). McCarthy (1955) reported the hunting of green, hawksbill, and leatherback (*Dermochelys coriacea*) turtles by Aboriginals.

SEX AND SIZE

Most respondents to the questionnaire reported that any turtle encountered would be taken; a reasonable proportion indicated that large turtles were preferred, but there was little to indicate a marked preference for a particular sex.

From other sources such a preference was apparent. In Western Torres Strait (Nietschmann, in press) and on Yorke Island in central Torres Strait (Kowarsky 1978) predominantly female turtles were taken. By contrast Capelle (1979) witnessed the release of captured female and juvenile turtles and the retention of a large male during a turtle hunting expedition by Aboriginals in the northwest of Western Australia.

A marked regional variation in size composition of the catch occurs in Torres Strait. On Yorke Island turtles taken were below reproductive size (Kowarsky 1978), while in western Torres Strait mature turtles, as adjudged by the presence of eggs in females, and by their carapace measurements, were commonly taken (Nietschmann, in press).

In western Torres Strait, Islanders distinguish between 2 general types of turtles, the more esteemed fat turtles and the poorer condition turtles; they claim that the former feed on seagrasses while the latter eat more algae (Nietschmann, in press). A similar distinction is reported by Pritchard (1976).

SEASONAL VARIATION IN CATCHES

In Torres Strait there appear to be regional differences in the seasonality of catches. In the eastern islands, turtles were taken only during their mating and egg-laying season (Duncan 1974). My records indicate that peak catches of turtles on Yorke Island between Oc-

tober 1975 and July 1976 occurred during the mid-summer months. However, in western Torres Strait, hunting activity took place throughout the year, and the recorded catches did not exhibit any clear seasonal trends (Nietschmann, in press). In northwestern Australia the main period of turtle hunting ran from mid-November through to March (Capelle 1979). Most respondents to the questionnaire reported either that turtles were taken all year or that the main period of capture was during the mating and nesting season.

REASONS FOR HUNTING AND USE OF TURTLE PRODUCTS

A large majority of respondents to the survey marked "subsistence" as the reason for hunting, while a few also marked "cash income" (this category was never exclusively given). In 1973 the price of turtles in Torres Strait varied between \$10 and \$15, but the extent to which sales took place was not documented (Duncan 1974). One respondent to the questionnaire reported a price of \$160 for a full-grown adult turtle. Overall it would appear that the number of turtles hunted for cash income would be insignificant compared to the number hunted for subsistence. Systems of distributing meat among kin and neighbors have been described for Torres Strait (Duncan 1974; Nietschmann, in press).

Replies to the questionnaire indicated that the main turtle product used was the meat, with some respondents indicating that turtles were used for their shells and as curios. I had noticed this tourist trade occurring to some extent on Thursday Island in Torres Strait. Capelle (1979) reported some trade in turtle shells around the Broome area in Western Australia, stimulated by the increasing number of tourists visiting the region.

Most respondents did not regard turtle meat as a main source of protein in their diet, and most did not regard it as a very important food for traditional occasions. There were however, exceptions to these generalizations, with emphasis mainly on the cultural importance of turtles. In Torres Strait Nietschmann (in press) considered hunting (turtles and dugongs) to be important both culturally and nutritionally.

A different situation may apply to some turtle hunters living on mainland Australia or on some of the larger offshore islands. For example, along the Western Australian coast from Pt. Hedland to Wyndham there are permanent reserves of freshwater, easily obtainable vegetable foods, abundant game, available shellfish, clams, mussels, oysters and fish, and food from community stores which make turtles only one of a number of food resources (Capelle 1979). An account of subsistence hunting on Bickerton and surrounding islands in the Northern Territory (Turner 1974) presents a similar picture to that apparent in Western Australia,

with turtles being but one component in a diet of fish, birds, lizards, small marsupials, dugong and various vegetable foods like yams and berries.

FACTORS LIMITING THE CATCH

Almost all respondents to the questionnaire marked "lack of inclination by local people" as the major factor limiting the number of turtles caught; some added the comment that turtles were taken only in accordance with community needs. In Torres Strait, lack of access to boats and working outboard motors was not considered a limiting factor in the development of subsistence fishing (Duncan 1974). Nietschmann (in press) lists several factors influencing the frequency of hunting including money available to buy fuel, desire for fresh meat, occurrence of feast days, and environmental variation.

ESTIMATING THE ANNUAL CATCH

Most respondents indicated that fewer than 20 turtles a week are taken; some gave figures as low as 1 per fortnight or per month. The highest estimate was one for the Cape York Peninsula and Torres Strait of 50 to 100 turtles a week, 2,500 to 5,000 a year.

Some regional estimates of annual turtle catches are available. Nietschmann (in press) made a "very rough estimate" of the average annual catch of green turtles in Torres Strait as being just over 2,000 turtles. By extrapolating from catch records from one community in Torres Strait, an estimate of over 2,500 turtles annually for Torres Strait was obtained (Kowarsky 1978). Recently, Dr. John Parmenter, of Applied Ecology Pty. Ltd., made a similar extrapolation and arrived at a figure of about 4,000 turtles slaughtered annually by Torres Strait Islanders. He and I are aware of the number of untested assumptions implicit in such calculations, but nevertheless I consider such estimates useful in indicating the order of magnitude of the depletion of turtle populations by people of the region.

I have made estimates of the turtle catch per capita per year for 4 communities in Torres Strait using population figures from Duncan (1974) and turtle catch records from Kowarsky (1978) and Nietschmann (in press):

<i>Community</i>	<i>Number turtles per capita per year</i>
Yorke	0.55
Mabuiag	1.28
Kubin	1.99
Badu	0.80

In Queensland, excluding Torres Strait, the number of people living on reserves and former reserves near the coast within the area of turtle hunting as indicated by data in Figure 1 was taken to be about 6,500. Using the lowest estimate above of turtles taken per capita per year, a projected figure of about 3,500 turtles per year is obtained. Thus for the whole of Queensland, including Torres Strait, a broad estimate of the total annual catch could range between about 5,000 and 8,000 turtles.

To obtain an estimate of the extent of turtle hunting in the Northern Territory it has been necessary again to extrapolate from data of one community. At South Goulburn Island, the Aboriginal population of about 200 take about 3 turtles a week (D.L. Grey, personal communication 1979). In the Northern Territory there are about 13 major coastal settlements of such people. A projected total catch for the region of about 2,000 turtles a year can thus be obtained.

Capelle (1979) has made the following estimate of annual turtle catch on the coast of Western Australia between Pt. Hedland and Wyndham:

<i>Locality</i>	<i>Annual catch</i>
One Arm Point	48
Kalumburu	40
Other isolated communities (3)	10
Towns (4)	6
Total	104

Outside the area defined above, little turtle hunting would be expected on the basis of replies from the questionnaire survey (Figure 1).

The above estimates taken together would suggest that between about 7,500 and 10,500 turtles are taken annually by Aboriginal and Torres Strait Islander people in Australian waters. Assuming an average weight per turtle of 100 kg, between 750 and 1,050 tonnes of turtle would be taken.

EGG COLLECTING

Most respondents to the questionnaire reported that few, if any, eggs were taken during the nesting season. Weekly egg collections were commonly estimated at 20 or less, but 2 respondents gave estimates of about 1,000 per week. It would appear that green, hawksbill, loggerhead, and flatback eggs were eaten. Compared to exploitation of turtles by hunting, the collection of eggs in Australia would appear to have insignificant impact on the wild turtle populations.

Discussion

For many Aboriginals and Torres Strait Islanders to-

day, sea turtles have little or no significance. Among those people still engaged in turtle hunting activities there appears to be a broad spectrum of attitudes. For some a captured turtle is a bonus food item; for others turtles are an integral part of their socioeconomic and cultural organization.

It would be useful to compare past hunting pressures with those of the present as one means of assessing the potential impact of such activities on the wild turtle populations. The absence of quantitative records of past hunting make such a direct comparison impossible; as an alternative, one can consider technological, population and socioeconomic changes which may have influenced the extent of hunting which takes place.

Modern technology, plus a cash income from employment opportunities and widespread social security payments, have provided the present day turtle hunter with a fast and efficient means of traveling over long distances at sea. This apparent increase in hunting power may be offset to some extent by dependence on factors such as fuel supplies and motor maintenance. Other developments such as increasing use of domestic refrigerators and increasing availability of fresh, frozen, and canned foods at community stores could act to remove some pressure on turtles as a food resource.

Australia's Aboriginal population at the time of arrival of white settlers is thought to have been about 300,000; since that time it drastically declined until in 1954 the total number of "full-blood" Aboriginals was about 40,000 (Anonymous 1965). The Torres Strait Islander population in Torres Strait apparently did not follow the same decline, with numbers in that region in the nineteenth century being estimated between 3,000 and 4,000 (Beckett 1972).

White settlement in Australia, as well as resulting in a decline in population, also brought profound socioeconomic changes to Aboriginal society, with a breakdown in tribal organization and religion, and often a forced movement from traditional homelands (Anonymous 1965, Brokensha and McGuigan 1977). In fairly recent times there has been a voluntary movement of Torres Strait Islanders from their home islands to the Australian mainland, and a decline in numbers in Torres Strait of about 5 percent in 5 years (Caldwell 1975).

On the basis of the above, and particularly since one of the main regions of Aboriginal settlement before the arrival of whites was the northern tropical coast (Brokensha and McGuigan 1977), it would be reasonable to presume that hunting pressures on turtles in the past were at least as great, if not greater, than those existing today.

Since the 1950s the Aboriginal population of Australia has been increasing. The total number of Torres Strait Islanders is also increasing, but this is due to increasing numbers on mainland Australia. In Torres Strait the Islander population will probably decline to

under 3,000 by the end of the century (Caldwell 1975). A study of mainland Torres Strait Islanders found that their lifestyle changed markedly from that on reserves in Torres Strait and that they seemed to have a general lack of attachment for that region (Fisk, Duncan, and Kehl 1974).

If the projections of numbers of Torres Strait Islanders in Torres Strait are accurate, no significant increase would be predicted in hunting pressure on turtles in that region in the future. The extent to which increasing numbers of Aboriginals place additional hunting pressure on turtles would depend upon the proportion of those people maintaining a traditional lifestyle in future years.

This leads to a factor which is perhaps more likely to result in a rapid change in the pressure of hunting on turtles, and that is a change in the socioeconomic aims of Aboriginals. It is clear that in the general regions where turtles are hunted, there are far more Aboriginals than those now involved in hunting activities. Fairly recently, there has been a trend of movement away from settlements (established by government or missions) toward traditional clan territories which has been termed the "outstation" or "homelands" movement (Coombs 1974, Brokensha and McGuigan 1977, Anonymous 1979a). An example of this was the formations of 10 homeland centers by people formerly living at a mission (established in 1938) in northeastern Arnhem Land in the Northern Territory (Brokensha and McGuigan 1977). Such a movement, if widespread, could be expected to result in an increase of hunter-gatherer activities, including the subsistence hunting of sea turtles.

Appendix A. Changes in Present Australian Sea Borders

Recently the Commonwealth (federal), State, and Northern Territory governments agreed to changes in the division of responsibility in offshore areas, but the relevant legislation has not yet been passed. The present situation with regard to fisheries is that within the 3-mile territorial area, fisheries are subject to State or Northern Territory legislation, while outside this area they are subject to Commonwealth legislation.

Borders with Indonesia and Papua New Guinea present special problems and are yet to be settled (Prescott 1978). That with the latter country is of particular relevance to turtle biologists as the region in between, Torres Strait, includes significant nesting beaches and extensive reef systems and shallow waters which are apparently important feeding areas for turtles (Bustard 1972; Kowarsky 1978; Nietschmann, in press). The Torres Strait Treaty (summarized by Stanford, 1978) between Australia and Papua New Guinea was signed in December 1978 but is yet to be ratified. Among

other provisions, it delineates a Seabed Jurisdiction Line, a Fisheries Jurisdiction Line and a Protected Zone within the Torres Strait region; the combined area enclosed by these 3 lines does not differ markedly from the position of the present border (shown in Figure 1).

Appendix B. Legislation Related to the Taking of Sea Turtles in Australian Waters

Queensland

All species of the families of Cheloniidae and Dermochelyidae [sic] are "protected species" under the Fisheries Act 1976. This act does not, however, apply to "... the taking, otherwise than by the use of any noxious substance or explosive and for purposes other than commercial purposes, ... by any Aborigine or Torres Strait Islander who at the material time is resident on a reserve ..."

The terms Aborigine and Torres Strait Islander are defined in the Aborigine Act 1971 and the Torres Strait Islander Act 1971.

Northern Territory

The Fisheries Ordinance 1965-66 declares all waters of the Territory closed against the taking of green turtle except specified areas which correspond to the local people's more important traditional turtle hunting areas. Although commercial exploitation of turtles is not prohibited, this practice is discouraged by the fisheries authorities in the Northern Territory.

Western Australia

Under the Fauna Conservation Act 1950-70 turtles are wholly protected throughout the entire State at all times; however a person who is a native according to the definition in the Native Welfare Act 1963 may take turtles "... sufficient only for food for himself and his family, but not for sale" on land other than that of a sanctuary.

Commonwealth (Federal) Legislation

The Fisheries Act 1952-74, through Fisheries Notice No. 48, prohibits the taking of turtles from proclaimed waters. This Act makes an exception for "traditional fishing," defined as "fishing by indigenous inhabitants of an external Territory" if the fish are taken in a traditional manner and landed in that Territory. It would thus appear that traditional fishing by Australian residents (Aboriginals or Torres Strait Islanders) is not excepted from the provisions of this Act. However, discussions I have had with Federal authorities indicate that a wider definition of traditional fishing than that

in the Act has been applied in practice, so that, effectively, the noncommercial taking of turtles by Aboriginals and Torres Strait Islanders would be permitted in proclaimed waters.

Appendix C. Turtle Hunting Questionnaire

1. Name
2. Organisation
3. Coastal region (including islands) of which you have knowledge (indicate, as far as possible, the extent of the region on the attached map).
4. Does turtle hunting take place in the above region? If yes, go straight on. If no, go to question 14.
5. Which people go turtle hunting? Aboriginal, Islander, Other (give details).
6. Reason for hunting: Subsistence, Cash Income
7. What species of sea turtles are caught? Green, flat-back, hawksbill, loggerhead, ridley
8. What species are used for: meat, shells and curios, leather products, soup?
9. How are turtles caught? On beach while nesting, from boat with spear or harpoon, by rope after chasing by boat, other (give details)
10. What number of turtles are captured per week in the region? (If possible, make a guesstimate). Less than 20, 20-50, 50-100, more than 100
11. How important are turtles as: a main protein source in diet, a main source of cash income, a traditional food for important occasions?
12. Is there a preference for particular types of turtle? small, large, male, female, any turtle
13. What are reasons given for the preference above?
14. What is the major factor limiting the number of turtles caught? scarcity of turtles, lack of boats and equipment, lack of inclination by local people
15. Where in your region are the most significant aggregations of turtles, and what species are they?
16. What species' eggs are eaten by people within your region? (If possible make a guesstimate of number of eggs eaten per week). Green, hawksbill, loggerhead, other (give details)
17. Are there seasonal trends in the quantities of turtles/eggs collected by people in your region?

Note: Spaces for answers have been deleted to conserve space.

Appendix D. Population Statistics for Aboriginals and Torres Strait Islanders

The most recent comprehensive data in this regard is the 1976 Census of Population and Housing by the Australian Bureau of Statistics. Explanation of the question in that census relating to racial origin is given in Anonymous (1979b). The basic unit of area used in the census was the Local Government Area (LGA).

To gain an idea of the number of Aboriginals and Torres Strait Islanders who could be potential users of turtles, I extracted their numbers in each LGA north of the Tropic of Capricorn with a maritime border (shaded area, Figure 1) from the 1976 Census Data: Queensland, 19,300; Northern Territory, 12,931; Western Australia, 8,736; total, 40,427.

In Queensland, because of present legislation, more apposite in the present context would be the number of people resident on reserves near the coast. Excluding the Torres Strait region, for which recent data were not separately available, the number of persons resident on such reserves (either government or church) under the auspices of the Queensland Government Department of Aboriginal and Islanders Advancement was 7,552 in March 1978 (Anonymous 1978).

A special situation is found in Torres Strait itself. Here are 14 reserve islands with a total resident population of about 2,500 and some 2,000 Islanders living on Thursday Island, the region's Administrative center (Nietschmann, in press). From a stay of 4 months on Thursday Island, I gained a strong impression that turtle meat was available locally irrespective of the reserve-residency status of the Islander. It would probably be more realistic, therefore, to use the total number of Aborigines and Islanders in the region as the number of potential users of turtle products than to restrict the number to those actually resident on reserves in Torres Strait.

In Queensland, the total number of people who potentially could use turtle products would thus be $7,552 + 4,500 = 12,052$, approximately 62 percent of Aboriginal and Islander people living in the LGA's already defined.

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**Subsistence Hunting
in the Indian Ocean**

ABSTRACT

Sea turtles are exploited by subsistence hunters throughout the Indian Ocean. All 5 species are involved, but *Chelonia* is commonly killed for meat, *Eretmochelys* for tortoiseshell, and *Dermochelys* for oil. Nests of all species are excavated for eggs. International trade in tortoiseshell was well established two millenia ago. Present day coastal populations often lack animal protein, and subsistence-level exploitation concentrates so heavily on reproducing animals and nests that reproduction in many turtle populations has been severely reduced.

Introduction

Subsistence hunting is a difficult topic to describe for various reasons. The term defies unambiguous definition but often connotes traditional forms of exploitation for no monetary reward. Today, the wholly traditional hunter, without concern for money, is a rarity. Noncommercial, subsistence-level hunting is of little importance to governments and so is rarely discussed and almost never documented in detail. Finally, an area as vast as the Indian Ocean (Figure 1) can hardly be treated in a few pages, and it is symptomatic of its isolation and neglect that the situation on over one-seventh of the planet is to be considered in the same space available to a single country. This report is thus a summary of a more thorough study (Frazier, 1980; in prep.).

Sea Turtles Available for Hunting

Five of the 7 species of sea turtle are recorded from the Indian Ocean. Within the region, each species has its areas of abundance, but the most common species in general are green turtles, *Chelonia mydas*, and hawksbills, *Eretmochelys imbricata*. They occur and are hunted in most territories. Loggerheads, *Caretta caretta*, are

Note: Revised April 1980.

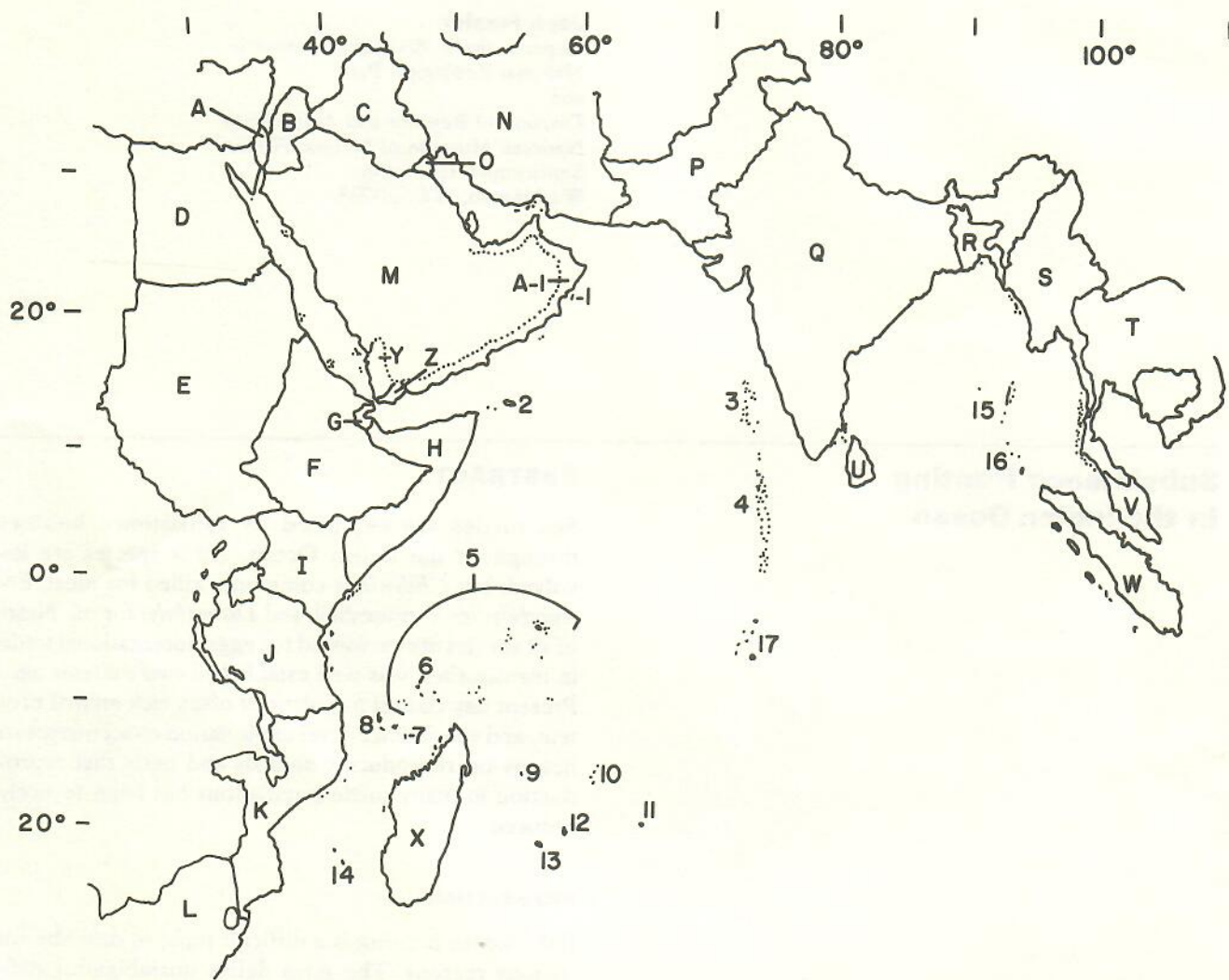


Figure 1. The Indian Ocean. Mainland countries: A) Israel; B) Jordan; C) Iraq; D) Egypt; E) Sudan; F) Ethiopia; G) Djibouti; H) Somalia; I) Kenya; J) Tanzania; K) Mozambique; L) South Africa; M) Saudi Arabia; N) Iran; O) Kuwait; P) Pakistan; Q) India; R) Bangladesh; S) Burma; T) Thailand; V) Malaya; 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) Rodriguez (Mauritius); 12) Mauritius; 13) Reunion (France); 14) Europa (Reunion, France); 15) Andamans; 16) Nicobars; 17) BIOT (Chagos).

generally uncommon but abundant on Masirah Island, Oman, and are common in South Africa, Mozambique, and Madagascar. Olive ridleys, *Lepidochelys olivacea*, are abundant in the Bay of Bengal and evidently Pakistan. Leathery turtles, *Dermochelys coriacea*, are nowhere common, although one of the largest nesting areas in the world is on the eastern Malaysian peninsula. The only major nesting areas, where they occur regularly in the Indian Ocean, are South Africa, Mozambique, and Sri Lanka. Details of the status of sea turtles in the Indian Ocean region are in Kar and Bhaskar (this volume); Frazier (in press, this volume, in prep.); Hughes (this volume); Ross and Barwani (this volume); and Sella (this volume).

Coastal Peoples that Hunt Turtles

People have occupied the coastal areas of the Indian Ocean basin for hundreds of generations, and many depend on marine resources for food and trade materials. The tortoiseshell trade was well established by the first century A.D. (Freeman-Grenville 1962; Parsons 1972). However, coastal peoples differ tremendously in their expertise as sailors and fishermen. The most adept turtle hunters are the Seychellois, of Seychelles, St. Brandon, and Chagos Islands; Vezo of southwest Madagascar; Bajun of northern Kenya and southern Somalia; Tamils from southern India and northern Sri Lanka; and Selung from the islands of

Burma and Thailand. Exploitation by these peoples often fits the "subsistence hunter" paradigm, and sea turtles are important in their cultures. However these animals are exploited for nonmonetary reasons throughout the Indian Ocean, although to varying degrees.

General Patterns of Exploitation and Consumption

Meat and eggs are generally consumed, except in some Islamic areas where turtle meat is not allowed for religious reasons. Nutritive products of sea turtles are used by subsistence hunters and are also marketed within the country of origin. *Chelonia* is consumed widely, but other species may also be eaten depending on the area; eggs of all species are commonly eaten. Whole *Chelonia* have been exported for foreign consumption from many countries: Seychelles, Kenya, Somalia, People's Democratic Republic of Yeman (PDRY), and India. In all but PDRY, it has been traditional turtle hunters, using traditional hunting methods, that have provided the turtles for this export trade.

Likewise, *Eretmochelys* is killed by fishermen living at subsistence levels throughout the Indian Ocean region, and the tortoiseshell is exported to oriental and occidental capitals. Turtle oil is produced for medicinal or culinary purposes where *Chelonia* is killed in numbers, and it is popularly used in local communities. This product was also exported in the past.

Trade in turtle leather, or skins, has seen only 2 main centers of development in the region: Pakistan and eastern India. This is neither a traditional activity, nor is it carried out by traditional turtle fishermen. Begun in the last decade, it is one of the fastest growing fisheries of marine turtles and accounts for tremendous numbers, especially of *Lepidochelys*. In other parts of the world, enormous populations of this turtle are being threatened by this type of exploitation (Frazier, ms.) *Lepidochelys* meat, and eggs, have been eaten by local peoples: there is a long-standing trade in eggs from Orissa to Bangladesh (Singh, *in litt.*, 20 July 1976).

Caretta is occasionally killed for meat, but *Dermochelys* is rarely slaughtered, except in certain areas. The oil from the latter is used in boat preservation.

Even in those territories where large numbers of turtles occur and turtle hunters are expert, the main source of protein is fish. Details are not available, but the greatest per capita consumption of turtle was probably in the Aldabra Islands earlier in this century, during the heyday of the *Chelonia* fishery; turtle meat may have been eaten as often as 3 or 4 times a week. This contrasts with the situation in eastern Nicaragua where *Chelonia* traditionally provided 70 percent of the animal protein for Miskito Indians (Nietschmann 1972).

Specific Patterns of Exploitation for Each Territory

South African natives did not traditionally catch turtles (McAllister, Bass, and Van Schoor 1965). Strict laws and efficient enforcement inhibit killing, and no significant exploitation of sea turtles occurs in this territory (Hughes, this volume).

Coastal peoples in Mozambique eat eggs and meat of most sea turtles, even *Dermochelys*. Some turtle products have been marketed locally, but subsistence-level exploitation has been widespread. In the south, women patrol beaches for eggs and nesting turtles; though unorganized, this exploitation has reduced reproduction. Because of the impact of subsistence-level beach predation, the populations of *Dermochelys* and *Caretta* nesting in this territory are thought to be doomed (Hughes 1973). *Eretmochelys* has been exploited for tortoiseshell for at least a century, but this is a small fishery (Frazier, unpubl. data; Hughes 1973).

Madagascar has subsistence hunters all around the coast, but the Vezo and Sakalava in the west are the most experienced as marine exploiters. The latter capture turtles by a variety of techniques, but turning nesting females is not as important as in other territories. This is one of the most important countries for traditional, noncommercial turtle hunting, and turtles are an important part of the culture. However, stuffed turtles and tortoiseshell are prepared for sale to expatriates or for export, and this may account for more turtles than are consumed locally. Annual catches have been estimated to include thousands of each of the 4 species, excluding *Dermochelys* (Hughes 1971).

Reunion has few turtles, hence, little hunting, but its dependencies, Europa and Tromelin Islands in particular, are major nesting areas for *Chelonia*. Because of their remoteness, they have had little concerted exploitation. Passing sailors and temporary inhabitants have caught nesting turtles, but there is no significant hunting today, and the main rookeries are nature reserves (Hughes, this volume).

Turtles on Mauritius were exterminated along with the dodo, but the St. Brandon Islands still have nesting *Chelonia*. Most exploitation here is for export to Mauritius, but the islanders (mainly Seychellois) catch and eat turtle regularly. As the fishing population is transient and small, *Chelonia* exploitation for local consumption is minimal, about 30 per year (Hughes 1975).

The British Indian Ocean Territory (BIOT) now consists of only the Chagos Archipelago, and the Créole des Isles inhabitants, of Mauritian and Seychellois origin, have been evacuated. They hunted turtle, the catch was commonly bought by an island's lessee, and *Chelonia* meat was divided among the islanders. Minimal export occurred (Frazier 1977). Fish was the main source of protein.

The Republic of Seychelles, dispersed over a vast area of the western Indian ocean, is famous for turtles and turtlemen. Harpooning mating animals and turning nesting females are the main techniques of capture. Since its inception, the Seychelles turtle fishery has been geared for export, but turtle products are an important part of the culture. Eating *Chelonia* is presumed to be an inalienable right, and restraint in killing turtles is uncommon. Many gourmet dishes and specialty items have been prepared from turtle products. Some tortoiseshell is crafted locally, but most has been exported (Frazier, in press).

Mayotte, a dependency of France, but geographically one of the Comoro Islands, has no organized turtle fishery. Nesting *Chelonia* are exploited regularly at Pamanzi Island and, although the numbers taken are but several a week, the impact on the nesting population is great. Hunters often cook meat on the beach right after capture and take some choice cuts home in the morning. Waste of eggs and the less choice pieces is tremendous. There may be some local sale of meat, but this is uncommon (Frazier 1972).

Comores are over populated and few turtles occur at the 2 main islands of Ngazidia (Grand Comore) and Anjouan. Before the islands' independence from France, most turtles that were caught at these islands were netted and sold to expatriates and tourists. Moroni Island has thousands of *Chelonia* nesting annually, dispersed over a dozen important beaches. Small numbers are killed while nesting, and occasionally meat is taken to large villages for sale. Most exploitation is for local consumption (Frazier 1977). Although nowadays the people are inexperienced in turtle biology or lore, the fishermen from these islands were once reported to have complicated ceremonies and techniques for hunting turtles and dugongs (Petit 1930).

Tanzania's most able sailors and fishermen are on Zanzibar and Pemba Islands. They catch nesting *Chelonia* happened upon, but, except for sorties to Maziwi Island and other small cays around Mafia Island, turtles are encountered sporadically. Only a few persons are involved with the net fishery in the south. Total catches for local consumption are probably less than 100 per year. *Chelonia* was exported for a few years in the 1960s. Tortoiseshell is, as usual, collected when possible and sold to merchants for export.

Zanzibar was a major clearing house for tortoiseshell from the late 1800s until recently. Subsistence-level fishermen from countries all around the western Indian Ocean supplied the product which was exported to both Europe and the East (Frazier, unpubl. data).

Kenya has few nesting turtles, but the Bajun of the north coast are expert at netting and catching turtles with grapnels and sucker fish. Although *Chelonia* meat and oil are relished, turtle seems less important to their culture than it is to the Vezo. Most coastal people eat

meat and eggs if available, but exploitation is sporadic, and now illegal. Bajun fishermen supplied an exporting company from 1952 to 1964. For thousands of years, tortoiseshell has been collected for sale to merchant exporters (Freeman-Grenville 1962).

Somalia's south coast is inhabited by Bajun who are culturally related to Bajun in Kenya, and their relationship with marine turtles is the same. Somalis, although also Moslems, will not eat turtle or other animals from the sea for religious reasons, so exploitation has been concentrated in the south. It has not all been for local consumption; an exporting company was active here about the same time as in Kenya (Travis 1967). The original turtle canning concern was taken over by Russians, but has evidently ceased production with their exodus.

Little is recorded from Djibouti.

Eritrea is Ethiopia's only coastal province. The Islamic people inhabiting the coastal strip occasionally sail to and among the Dahlak Islands where *Chelonia* may be butchered if encountered. What little exploitation occurs is for subsistence (Minot, n.d.).

In Sudan there is also little involvement with turtles. Yemeni fishermen may visit the Suakin Archipelago and catch any nesting animals that they find. There may once have been a large number of turtles slaughtered by passing sailors. *Eretmochelys* is thought to occur in large numbers in the Archipelago (Moore and Balzarotti 1977).

Egypt probably has some nesting turtles, which may be occasionally exploited, but little is known from this territory.

Bedouins traveling along the coast of Sinai may dig up nests and eat eggs. This, the epitome of subsistence hunting, occurs infrequently (Sella, this volume).

Israeli law does not allow exploitation of sea turtles; its tiny coastal strip makes much fishing activity unlikely (Sella, this volume).

Jordan's situation is not known, but the small coastal strip precludes much of a fishery.

Saudi Arabia's Red Sea coast may support sizable turtle populations particularly on the Farasan Islands, but little is known of the situation. Exploitation is likely to be mainly for subsistence, but predation by foreign-owned turtle exporting companies have been rumored.

Fishermen of the Yemen Arab Republic patrol beaches for nests. Male turtles are also eaten, but the numbers killed are small. Nesting beaches on the volcanic offshore islands are less likely to be disturbed than mainland beaches (Walczak 1979).

Yemenis from the People's Democratic Republic of Yemen (PDRY) eat turtle if food is scarce, and some islanders, as on Socotra, eat turtles regularly. Their catching techniques are varied, including the use of sucker fish. *Chelonia* is netted on pastures at Khor Umaira, and a major nesting area has been exploited

for export, but this is a nontraditional, commercial fishery (FAO 1973).

Omani Arabs catch *Chelonia* around Kuria Muria and Masirah Islands and dig up nests of any of the 4 nesting species on Masirah. There is some exploitation of nesting *Chelonia* at Ras al Hadd for export, but only a few hundred are caught annually at this major rookery (Ross and Barwani, this volume).

The Persian Gulf states have little documented about their turtle populations. *Chelonia* is imported into Abu Dhabi for consumption. In Qatar both *Eretmochelys* and *Chelonia* are eaten. Turtles are probably not consumed in other states for religious reasons (Ross and Barwani, this volume).

Iran has a large and poorly surveyed coast. Turtle meat is not eaten for religious reasons, but eggs are collected throughout the territory. On Larak Island, oil from *Dermochelys* is prepared for boat preservation (Kinunen and Walczak 1971).

Pakistan has no traditional turtle fishery of significance, but at a recently developed enterprise in the west large numbers are slaughtered and their skins exported (Salm 1976). These may be *Chelonia* or *Lepidochelys*. Eggs and meat may once have been eaten in Karachi (Murray 1884).

India has the largest coastline and the greatest population in the region and turtles are traditionally hunted in many areas. However, the net fishery in the Gulf of Mannar is most developed. Eggs and meat of most species are eaten and sold in local markets. *Chelonia* has been exported to Sri Lanka and elsewhere. Eggs of *Lepidochelys*, and recently whole animals, are taken in large numbers in Orissa and exported to Bangladesh. Possibly many of these turtles are also taken for leather. Oil from *Dermochelys*, and occasionally other species, is used in boat maintenance, and sometimes for medicinal purposes. India has both imported and exported large numbers of turtles and turtle products, but it also has the greatest amount of subsistence hunting in the region (Frazier, 1980).

The Republic of Maldives includes hundreds of islands. Tortoiseshell has been exported for centuries, but as the populace is Moslem, consumption of eggs and meat was banned until recently. In the last decade most exploitation provided stuffed animals for tourists, and subsistence hunters were able to realize the equivalent of a month's income with the sale of 1 turtle (Didi, *in litt.*, 15 June 1976; Colton 1977).

Sri Lanka is also a rich area for sea turtles and turtle culture. According to one estimate, 50,000 people depend on the turtle fishery (Salm 1975), many of them around Jaffna, where there is a net fishery. Formerly artisans of tortoiseshell worked in the south, but *Eretmochelys* there has been extirpated. In the past only *Chelonia* was eaten, and other species were released if caught accidentally. Now all species are eaten, and there

is tremendous pressure on nesting turtles. Protective legislation has been ineffective because of pressures on food resources (Deraniyagala 1939; Hoffmann, *in litt.*, 21 April 1975).

Bangladesh has not been studied, but may support large numbers of *Lepidochelys*. "Hundreds" of eggs are collected from an (?) island off the Sundarban (Choudhury 1968). *Lepidochelys* and eggs are imported from Orissa, India.

Burma is also poorly known, but millions of eggs are reported to have been collected in a year on Diamond Island (Maxwell 1911). Moslems do not eat turtle meat, but most turtles are eaten in the eastern part of the territory. *Lepidochelys* is evidently the main species involved, although *Chelonia* is also exploited (Theobald 1868). The Selung are expert sailors and fishermen, and they hunt turtles for their own consumption (Anderson 1889).

Summary and Conclusions

Marine turtles are hunted by subsistence fishermen throughout the Indian Ocean. Meat, eggs, and oil are valued foods in most territories. These, together with tortoiseshell, have been exploited for millennia.

One of the myths about subsistence hunting, along with the belief that it is completely divorced from monetary considerations, is that it is sustainable and does not damage a resource. However, there are numerous examples in the Indian Ocean where human populations are dense and lacking in protein sources, and their exploitation, concentrated on breeding turtles, has all but stopped the animals' reproduction. The most threatening forms of exploitation are those stemming from commercial enterprises and involve intense, organized exploitation for export. The leather and skin trade is a recent example (Frazier, *ms.*). In the past, tortoiseshell was collected in a desultory way, but with present-day prices (Mack, Duplaix, and Wells, this volume), *Eretmochelys* is now under tremendous pressure.

Ideally, subsistence exploitation should be uninhibited, but the present situation over much of the Indian Ocean indicates that this is untenable and that unless strict breeding and feeding reserves are established and management policies implemented, it is unlikely that marine turtles will continue to be a significant part of the subsistence hunter's diet.

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**The Cultural Context
of Sea Turtle
Subsistence Hunting
in the Caribbean
and Problems Caused by
Commercial Exploitation**

Changing Patterns

In the Caribbean, the diverse cultural patterns that once linked many indigenous coastal and island societies to sea turtles are mostly gone now, having declined with the demise of the turtles and with the catastrophic loss of human population that occurred after the coming of the Europeans. The varied indigenous patterns of local subsistence use of sea turtles were replaced largely with intensive methods introduced and organized principally by the English and other north Europeans to feed their mariners, colonists, and slaves, and later to supply an export commodity for markets abroad. Yet in spite of almost five centuries of intensive pressure on sea turtles and indigenous peoples, vestiges and amalgams of former patterns persist. Here and there, in isolated backwaters, in corners of the Caribbean too far or too poor or too formidable to attract large-scale foreign colonization, indigenous societies survived as did reduced populations of the formerly abundant green turtles. These patterns, among the last of their kind, are now changing due to internal and external pressures and constraints.

In the big and small islands of the Caribbean, where so much was lost long ago but where also some of the old and introduced cultural traits and lifeways have been maintained in peasant fishing-communities, highly specialized livelihoods are threatened by marine resource depletion and demographic and economic change.

And on the horizon, pressures build for another pattern of change; this one guided by the desire to protect and conserve vanishing species. But what will happen to the indigenous peoples whose cultures are adapted in part to those animals? And what of the peasant peoples whose fishing skills have long provided a measure of economic and social independence and an important means of subsistence? What do these peoples stand to lose if sea turtles are lost through intensive exploitation or if they are protected by prohibitive legislation?

Ecological and Cultural Transformations

The intrusion and spread of European colonization in the Caribbean area meant rapid and widespread changes in biota and environments, the displacement and loss of native peoples and cultures, and the introduction of new peoples, lifeways and approaches to resource use. The decline of native societies in the West Indies was quick and final. Disease, slavery, loss of food supply, and cultural dislocation reduced populations estimated to have numbered several million to a few hundred surviving Amerindians on Dominica and St. Vincent by the end of the 1600s. Along with much of the native island fauna, green turtle populations were severely reduced.

The Island Arawaks and Caribs were skilled in obtaining resources from their marine environment, including sea turtles (Breton 1665; Dutertre 1667, II; Labat 1742, I; Price 1962). Unlike the Island Arawak, the Island Carib were never enslaved on a large scale and resisted European intrusions. They survived for a longer period than did the Island Arawak and "the prolonged and intimate interaction between these Island Carib fishermen and the French settlers played a major role in shaping future local fishing habits" (Price 1962:1370). In the Lesser Antilles French traders introduced large-meshed turtle nets and metal harpoon points to the Island Carib—as did the English in other parts of the Caribbean—and later these materials were sold and traded to African fishing slaves and to communities of freed and runaway slaves (Moreau de Saint-Méry 1797:873; Price 1962:1374, 1376). On the edge of the plantation system, a distinct and continuing fishing subculture evolved based first on African slaves, who provided food for the plantation staff and guests. Although some slaves from the Gold and Ivory Coasts may already have been experienced fishermen, "most slaves clearly learned to fish in their new home, and the techniques they practiced indicate that both the French and the Island Caribs served as teachers" (Price 1962:1371). These people and freed and runaway slaves served as the nucleus around which developed the unique and self-perpetuating fishing subculture in many parts of the Caribbean. "It should be clear that an early synthesis of Island Carib, French and Negro techniques, completed by the mid-eighteenth century, appears almost totally unchanged in fishing villages throughout the islands today" (Price 1962: 1376–77).

Thus, even though populations of Caribbean Amerindians were lost, much of their fishing technology and knowledge was maintained within the economic and later emerging cultural amalgam of African and European influences. The independent and distinctive means of livelihood in West Indian fishing communities are based in large measure on the persistence of Amerindian fishing knowledge and technology and

continuing access to marine resources. Although I know of no West Indian society or community that is heavily dependent on sea turtles for subsistence or livelihood—other than the Cayman Islanders, on many islands these animals do contribute a significant source of food and small but important amounts of money.

Uninhabited at the time of European discovery, the Cayman Islands later became an important turtling ground. As the early settlers' dependency on turtles and the sea grew, socioeconomic patterns developed which relied heavily on the commercial and subsistence exploitation of green and hawksbill turtles. After 200 years of intensive turtling in local and foreign waters, large-scale exploitation came to an end when the Nicaraguan government closed the turtle grounds to the Cayman Islanders in the 1960s and markets were lost in the United States and Europe as the result of national and international legislation (Hirst 1910; Lewis 1940; Carr 1956; Parsons 1962; Nietschmann 1979b).

On the mainland margins of the Caribbean, several indigenous societies are culturally and nutritionally dependent upon green turtles whose survival has been threatened by commercial overexploitation.

Types and Scale of Exploitation

As a result of antecedent and introduced cultural and

Table 1. Types of sea turtle exploitation

Subsistence

1. exploitation, exchange and consumption are socially and nutritionally important and part of an indigenous culture complex
2. exploitation and consumption primarily by individual households in peasant fishing communities
3. opportunistic catches by subsistence fishermen
4. exchange and socially-based sale of meat within communities provide meat and small sums of money

Market

5. sale of live turtles, meat and eggs to regional markets
6. sale of live turtles to packing companies for export
7. sale of turtle products (calipee, shell, skins, oil) for export
8. opportunistic catches (primarily of hawksbill) by lobster divers and fishermen for market sale

Incidental

9. incidental catches by shrimp trawlers

economic systems, there exists in the Caribbean region a variety of contexts within which sea turtles have been and are being exploited.

In general, exploitation of sea turtles for subsistence is less of a threat to sea turtle survival than is market exploitation. Subsistence-related activities are dependent on the size of local human populations, their degree of reliance on the animals, and the society's cultural needs and exploitation controls. Exploitation for market, both regional and export, is much more open-ended, dependent on large, external populations with the power to purchase more than can be obtained; hence, the drain on sea turtles that provide meat and luxury by-products would rapidly escalate without legislative controls.

The Cultural Context of Turtling and Turtles

Among the traditional indigenous peoples who still make their own living rather than earning it and who still rely on turtling and turtles for part of their subsistence, the procurement, distribution and consumption of green turtles remain important to their culture. More than any other Amerindian society, the coastal Miskito Indians of Nicaragua and Honduras are culturally dependent on green turtles, as will be seen in the following material. Although other coastal Amerindians are less reliant upon sea turtles, the cultural and social context of resource acquisition and distribution are generally similar in structure and content.

Subsistence provisioning involves production for immediate use, distribution within a discrete social unit and area, and consumption by the producers and their dependents. In subsistence, resource exploitation is organized and internally regulated within kin-based networks to satisfy biological and cultural needs.

Turtling is more than a means to get meat, turtles are more than simply a source of meat, and turtle meat is more than just another meat. For several surviving coastal Caribbean Amerindian societies, turtling and turtles are part of a way of life, not merely a means of livelihood. The activity and the product are not elements that can be simply lost or substituted without consequent deep change in cultural patterns.

Turtling is part of a cultural complex that links people, society, environment, and biota. Rooted in cultural history and followed for generations, it is one of the principal means through which knowledge of the sea and marine life is passed on, technological patterns are maintained, and sea and resource procurement skills are socially rewarded. For many males it is an important if not a major activity and it supplies significant often substantial amounts of protein.

Chelonia mydas is the most important sea turtle exploited for meat by Amerindian peoples. Green turtle meat constitutes a significant source of protein and

item for social exchange. In coastal Miskito villages subsistence turtling supplied up to 70 percent of animal protein in the diet prior to intensive commercial exploitation (Nietschmann 1973). Among these people turtle meat transcends all other food in esteem and social significance.

Miskito society is structured by kinship relationships and all subsistence activities have a social context. Individuals are obliged to freely share subsistence resources, especially if it is turtle meat. Socially based exchanges of resources between kin honor consanguineal and affinal relationships, spread meat distribution through the community, and insure that differential procurement is evened out so that many households share the results of an individual's skills. The giving of meat is as important as its receipt. Without these exchanges, social relationships and the quality of diet in the communities would decline.

But turtle meat also has a symbolic as well as social and nutritional value. Between the sea and the table turtle meat moves along a chain of cultural levels where each transformation increases its symbolic value. Males obtain and butcher the turtles, whose meat is distributed by women to kin and friends. As the meat moves from animals to hunter, from males to females, from individuals to kin and to the larger society, it is increasingly imbued with symbolic significance. In the end, the item is no longer simply meat but a cumulative symbolic record of relationships between nature and people, men and women, and the individual and society.

Thus, turtling and turtle meat are for the Miskito a means by which part of the structure and organization of society is maintained and their place in their world is defined.

Surviving Traditional Societies and Turtles

Because of the worldwide demise of green turtles¹ and traditional turtling societies, few situations remain where native peoples depend on *Chelonia*. In recent and contemporary times, the most important traditional turtling people have been the Seri in Mexico, the Marshall Islanders in Micronesia, the Torres Strait Islanders in Australia, the Andaman, Nicobar and Maldivian Islanders of the Indian Ocean, the Vezo and Sakalava of Madagascar, the Bajuni of Kenya and Somalia, and the Miskito of Nicaragua and Honduras.

In the Caribbean, the Miskito are the foremost Amerindian turtling society. Other native groups that still exploit turtles are the Rama of Nicaragua (Nietschmann and Nietschmann 1974); Guaymí (Gordon 1969)

1. A survey of subsistence hunting of sea turtles is beyond the range of this short paper and my personal field experience. I thank Bill Rainey for sharing this information on sea turtle distributions and exploitation in the Caribbean.

Table 2. International recoveries of tags placed on nesting green turtles at Tortuguero and Aves Island

<i>From turtles tagged at Tortuguero, 1956-76</i>			<i>From turtles tagged at Aves Island, 1971-76</i>		
<i>Place</i>	<i>Number</i>	<i>Percentage</i>	<i>Place</i>	<i>Number</i>	<i>Percentage</i>
Nicaragua	957	86.2	Lesser Antilles	5	50
Colombia	45	4.1	Dominican Republic	2	20
Panama	28	2.5	Mexico	1	10
Mexico	28	2.5	Nicaragua	1	10
Venezuela	24	2.1	Venezuela	<u>1</u>	10
Cuba	13	1.2		10	
All others	<u>15</u>	1.4			
	1,110				

Source: Carr, Carr, and Meylan 1978:9

and San Blas Cuna (Stier 1976:45-46) of Panama; some Guajiro in Colombia (Kaufmann 1971:76; Rebel 1974:136); Maya along the northeastern coast of Yucatán; and Black Carib (Garifuna) in the Honduras coast-Bay Island area.

Many other peoples elsewhere in the Caribbean also exploit turtles for subsistence and small-scale market sales: for example, the Cayman Islanders; Creoles in Bluefields, San Juan del Norte (Greytown), Limón, Bocas del Toro area and Colón; Colombians in the Golfo de Urabá and waters off Cartagena, Barranquilla and Ríohacha; Venezuelans in the Golfo de Venezuela and off the Los Roques Islands and on Aves Island;² various groups throughout the Lesser Antilles; American and British Virgin Islanders; Dominicans in the Cabo Samaná and Puerto Plata areas; Cubans along the southern coast; Jamaicans, especially off the Morant and Pedro Cays; and people from San Andrés and Providence Islands who journey to Serrana Bank, Roncador Cay, and the Albuquerque Cays.

Hawksbills have scattered distributions yet are heavily exploited for their valuable shell. Hawksbill meat is also eaten by some peoples. Areas where hawksbill exploitation is heavy include the Gulf of Honduras (Cabo de Tres Puntas); Bay Islands; Miskito and Set Net Cays, Corn Islands and Cocal Beach in Nicaragua; Almirante Bay, Chiriquí Beach, and San Blas Islands in Panama; Roncador Cay and Serrana Bank in Colombian waters; Los Roques Islands in Venezuela; Huevos Island off Trinidad; the British Virgin Islands; Isla Mona off Puerto Rico; the Pedro Cays; and Cayman Brac, BWI.

The areas where green turtles are most heavily exploited in the Caribbean can be located by using the tag return data compiled by Archie Carr and Bill Rainey (Table 2).

2. Aves Island is the major nesting beach for green turtles in the eastern Caribbean. In 1978 the Venezuelan government established a military outpost there.

The overwhelming number of tags returned from Nicaraguan waters reflects the localized concentration of green turtles and highly focused exploitation for subsistence and market by the Miskito Indians. All other relationships between a native society and sea turtles in the Caribbean fade when compared with the Miskito's dependence on green turtles and the scale of subsistence and recent commercial exploitation.

The Cultural Impact of Commercialized Turtling on the Miskito and Nicaraguan Green Turtle Population

In 1969, on the heels of Nicaragua's failure to accept the Conferencia Tripartita agreement with Costa Rica and Panama for a three-year moratorium on green turtle exploitation, the first of three turtle processing companies began purchasing and exporting turtle meat and calipee. The Miskito had long been involved in a series of export market resource exploitation cycles (rubber, lumber, gold, bananas), each one of which made them increasingly dependent upon purchased goods and wage labor. Economic conditions were depressed in Miskito communities when the turtle companies started up.

The Miskito were the world's best turtle hunters, and the last large green turtle population in the western Caribbean inhabited the nearby shallow waters off eastern Nicaragua. The new companies provided a year-round connective link between local supply and distant demand. The Miskito started to sell large numbers of green turtles to the companies that exported the meat, oil, and calipee to foreign countries. Whereas they were once the central focus of the Miskito's subsistence system, green turtles now became the primary means to secure money to purchase, and the only surviving green turtle refuge came under severe exploitation pressure. From 1969 through 1976, up to 10,000 green turtles were exported every year. Already depleted by Cayman Island turtlers on the feeding ground at Miskito Bank and by Costa Ricans on the nesting beach at Tortuguero, the most

significant West Caribbean green turtle population was subjected to a sudden and intensive rise in human predation. The resulting reduction of the population soon became evident. The average amount of time it took to capture one turtle went up from two man-days in 1971 to six man-days in 1975. Even though hunting was less efficient, more turtles were taken from the depleted herds because more Miskito were hunting and were doing so almost year-round. Furthermore, tags placed on nesting turtles at Tortuguero to study migration and life cycle patterns began to be returned from Nicaraguan waters in unprecedented numbers, indicating a massive upward change in the scale of exploitation (Nietschmann 1979a:8-9).

For the Miskito the commercialization of turtling was different from previous economic booms in that it threatened the internal core of their subsistence and associated social relationships. Economic entanglement led to social quicksand as they became overly dependent on intensive exploitation for sale, rather than their former moderate exploitation for provisioning and social exchanges. Miskito society became as threatened as the species they hunted and netted for market sales. Decline of the turtle populations created the need to further intensify and both resource decline and intensification of turtling led to shortages of meat and agricultural foods and to social conflicts in Miskito communities.

The turtle companies extended credit and advanced foodstuffs to the Miskito so that they could stay on the turtle grounds for long periods, year-round rather than their normal pattern of short, seasonal trips. Simply to pay off the credit extended by the companies and to purchase food for families to live on while the turtlemen were away from the villages meant intensive exploitation. Labor had to be further diverted from subsistence activities to commercial turtling as the resource declined. The quality and variety of the diet fell as money obtained from the export of protein was used to purchase imported white flour, rice, beans and sugar that replaced traditional foods. As the resource further dwindled, and as labor was further overextended, sufficient yields could be maintained only by diverting turtles from subsistence consumption and social distribution to market sale. By 1972, the downward spiraling pattern of market exploitation had already passed the economic threshold where money earned from turtling could not buy the equivalent amount of food formerly produced in subsistence. During a year period between 1972-73, 913 turtles were obtained by Little Sandy Bay Miskito. Of these, 743 (81 percent) were sold to the companies and only 170 consumed in the village (Weiss 1977). By 1975, the resource and subsistence drain hit social rockbottom. Rather than incur the wrath of disgruntled kin by returning to the villages with only a turtle or two, many turtlemen pre-

ferred to sell all to the companies as there were no social pressures to distribute money. Social relationships became strained, turtlemen and their families were accused of selfish interests and denial of Miskito traditions, and members of the many households which were without turtlemen became nutritionally impoverished and felt socially abandoned.

In traditional subsistence, the risk of failure was ameliorated by access to a wide range of plants and animals and by generalized sharing of the yields between kin. Differential procurement was common but differential receipt was rare. As the Miskito became further involved in market activities by channeling more and more labor to acquire the culturally most important item to sell, economic risk was added to subsistence risk and magnified through the individualization of production efforts. Where all households once operated within a social network that saved them from a possible economic mistake or plain bad luck, some individual households began to have to secure resources, income, and food and run the risk of possible economic shortfall.

As the economy became increasingly monetized, a few households in every village became financially better off than the majority. Alterations in the focus of production and the individualization of production created economic differences between individuals and households. In order to secure a surplus to sell rather than to share, labor and materials that once helped support the less able, the elderly, widows, widowers, the sick, and the injured were diverted to market.

Until the Miskito began to sell a subsistence resource, they were able to keep distinct the two economic systems: one based on generosity and sharing between kin without expectation of return, and the other based on individual receipt of goods and materials with no expectation to share. But when labor and materials that were once exchanged between kin were channeled into market sales, social devaluation resulted. To sell a subsistence resource is a social contradiction. If a household produces food, it is obliged to share; if it purchases food, its members are under no such social obligation; if they sell what should be shared, they bring into conflict the opposing rules in the two economic systems (Nietschmann 1979a:12-13).

Between 1969 and 1977 intensive commercial turtle exploitation for export markets began to erode the ecological and social heart of Miskito subsistence and culture. Many other factors also contributed: increasing inflation in the price of purchased goods, depletion of other resources, wage labor migration from villages, and the younger Miskito's increasing dissatisfaction with the nonmaterial rewards of a subsistence-based way of life. In many other areas of the Caribbean migration, inflation, and changing lifestyles are reducing the at-

tractiveness of turtling whether for subsistence or for small-scale market sales.

National and international conservation led to the closing of many foreign markets that trafficked in endangered and threatened species. The 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and U.S. endangered species legislation (1973) were the two most important of many conservation measures enacted that included the protection of sea turtles. In addition, the West Caribbean population of green turtles received a reprieve from impending disaster when the Tortuguero nesting beach was declared a National Park by the Costa Rican government in 1975, and when the Nicaraguan government closed the turtle companies in early 1977 (the Miskito were permitted to continue subsistence turtling).

The loss of the market for green turtles created economic stress in Miskito communities but the decline of the resource would have led to the same result. Their response was to expand once again subsistence agriculture and hunting and fishing which had an immediate benefit in 1978 when the shipment and distribution of food supplies and goods to the east coast were interrupted by the Nicaraguan Revolution. The Miskito still have sufficient land and a relatively rich resource base and stock of green turtles which will provide for both subsistence and social well-being. Yet because of long exposure to outside goods and markets they will continue to feel economically deprived.

The new Nicaraguan government has major problems of economic and social reconstruction in ravaged western Nicaragua. When the government turns its attention to eastern Nicaragua, they may find that some of the social and ecological wounds caused from bleeding resources away from local societies have already begun to heal. May they be sensitive and wise.

If the Tortuguero nesting beach continues to be protected as a National Park and if the Nicaraguan green turtle population and those of other countries can be protected from commercial exploitation, I see no reason why subsistence turtling by local peoples should not continue, especially by Amerindian peoples such as the Miskito, Rama, Guaymí, and San Blas Cuna.

Elsewhere in the Caribbean, curtailment of market exploitation of sea turtles might cause economic hardship but I know of no island or mainland society whose culture is dependent on tortoiseshell; turtle calipee, meat, eggs, oil, skin; or stuffed turtle curios and shell-lacked carapaces.

Effective management and restocking of Caribbean sea turtle populations can be achieved by national and international programs to protect nesting beaches and marine habitats, and to prohibit commercial exploitation, export and import of sea turtle products (meat, eggs, oil, calipee, leather, shell, and curios). Just as

Miskito society was not saved by selling a subsistence resource, endangered and threatened species cannot be saved by selling them.

There is a possibility that the Nicaraguan government will establish a marine reserve or park in the Miskito Cays area. This zone contains some of the best seagrass and reef habitat and largest number of green turtles to be found anywhere in the Caribbean. Hawksbills may still be fairly abundant. If within a large enough area both sea turtles and the marine habitat were to be protected from disturbance by turtlers, fishermen, lobster divers, and shrimp trawlers then these species would have an optimum chance for increasing their populations. The Miskito Cays-Miskito Bank region is large enough so that subsistence turtling could still be done in areas well outside a designated reserve.

The exploitation of sea turtles for subsistence by Caribbean mainland and island peoples often provides an important source of meat in local diets subject to nutritional decline caused by high-priced purchased foods. Furthermore, the cultural context of turtling and turtle meat in Amerindian societies must not be threatened by market exploitation or by overly prohibitive legislation. If Caribbean peoples once more have use of sea turtle populations, then management and conservation efforts will be well rewarded.

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