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Marine Turtles of Micronesia

The islands of Micronesia comprise 1 of the 3 great groups of Pacific Oceanic Islands. They are almost all located north of the Equator, being situated east of the Philippines and southwest of the Hawaiian Islands. The boundaries of Micronesia are almost identical to those of the U.S. Trust Territory, with the exception that Guam, an unincorporated territory of the United States, is not part of the Trust Territory, while the Gilbert Islands (part of the independent Kiribati), and the independent Nauru are considered part of Micronesia. Nukuoro and Kapingamarangi Atoll, though included in the Trust Territory, are culturally considered to be part of Polynesia. Moreover, the northern Marianas Islands have recently achieved Commonwealth status with the United States. The islands are all small and distances between them are large. Micronesia occupies an area equal to that of the United States, yet the land area is only half that of Rhode Island. Bryan (1971) calculates the total number of islands in Micronesia as 2,203. The 1973 population was 114,973 (excluding Guam), with an annual growth rate of 3.6 percent. The total land area is only 1,851 km².

Geologically the islands are all of volcanic origin, but differing age and subsequent weathering, subsidence, and coral formation have given them a very varied physiognomy. As a first-order approximation, the eastern islands are typically low atolls, often composed of many dozens of small, narrow islands surrounding a large central lagoon. The westernmost islands contain much weathered limestone and reach much higher altitudes. The highest islands, such as Ponape, attract an exceedingly high rainfall, with consequently lush vegetation. Shoreline vegetation throughout the Territory shows certain dominant species, such as coconut palms (*Cocos*), *Pandanus*, *Messerschmidia*, *Portulaca*, *Sida*, and *Scaevola*.

Species Present

The hawksbill (*Eretmochelys imbricata*) and the green turtle (*Chelonia mydas*) are present throughout Micro-

nesia and are widely recognized animals among those familiar with marine life in all districts. Nearly everywhere the green turtle is the more plentiful species, although in the Palau Lagoon area the hawksbill appears to be more common.

Two other species have been recorded on rare occasions. The olive ridley (*Lepidochelys olivacea*) was first recorded in Micronesia by Falanruw, McCoy, and Namlug (1975), who observed a mating pair in M'il Channel, northwest of Yap, on 30 November 1973. These authors also recorded a small (29 cm) *L. olivacea* from Lamotrek, in the eastern Yap District. Cushing (1974) reported 5 *L. olivacea* that were caught accidentally by long lines and plankton nets between 13 and 20 September 1974, in the southern Palau District (0° to 4°N, 131° to 137°E). In addition, I saw an immature stuffed *L. olivacea* for sale in a souvenir shop on Saipan in April 1976 that was said to have been locally caught and preserved.

The leatherback (*Dermochelys coriacea*) is reported occasionally in Micronesia, although it appears to be encountered only in deep water and has never been reported nesting in Micronesia. McCoy (1974) mentioned a very young leatherback, 69.4 cm in carapace length, that was captured near Satawal, in the eastern Yap District, on 2 September 1972. The turtle was tagged and released. McCoy also mentioned a leatherback caught at Woleai in 1971 that was captured and consumed by local people. I also have an unidentified newspaper cutting describing a large leatherback (444 kg in weight, 2.167 m in total length) caught by 2 Kapingamarangi fishermen off Parem Reef, Ponape Island.

Conservation Laws and Jurisdictional Background

Three completely different legal systems prevail concurrently in the Trust Territory: traditional law, vested in the hereditary chiefs; Micronesian law, as elaborated by elected delegates to the Micronesian Legislature; and U. S. federal law. As far as turtles are concerned, traditional law reflects patterns of hereditary ownership of the turtle resource, and the need for permission to be sought from traditional owners before turtles can be exploited. Micronesian law, as reflected in the Trust Territory Code (Title 45, Section 2) prohibits the capture of hawksbills less than 27 inches (69 cm) long, or green turtles less than 34 inches (86 cm) long (although only recently has the code differentiated between the 2 species). In addition, turtles are totally protected by Trust Territory law during the months of 1 June to 31 August and 1 December to 31 January, inclusive. They may also not be captured on the nesting beaches.

Federal law at present offers total protection to the hawksbill turtle, which is listed as an endangered spe-

cies. The green turtle is listed as a threatened species, with certain populations, namely those of Florida and Pacific Mexico, being listed as endangered. The Department of the Interior Regulations recognize and permit the continuation of certain patterns of traditional subsistence use of turtles in the Trust Territory.

Traditional ownership patterns are still respected to a large extent in Micronesia, and flagrant violations of these rights may lead to protest or sanctions of one kind or another. The Trust Territory Code, however, is not widely respected; hawksbills, for example, tend to be chased and caught whenever seen, whatever their size or whatever the season of the year, and the nests too are frequently raided. The green turtle has traditionally been collected on nesting beaches in many parts of Micronesia, especially in the Yap District, and no attempts have been made to enforce that section of the Trust Territory Code that prohibits such activities.

Little attempt is made to enforce the Endangered Species Act in the Trust Territory, and the law is ignored throughout Micronesia. Indeed, some question exists as to whether provisions of the Endangered Species Act even apply in the Trust Territory, but most legal opinions now hold that it does; for purposes of import and export of listed wildlife, the Act specifically refers to the Trust Territory as having the status of a State of the Union. Reluctance to enforce federal endangered species law in the Trust Territory probably stems from several considerations:

1. The Trust Territory has for years had but a single American conservation officer, based in Palau, to whom local people have made clear that his life may be in danger if he insists on rigorous enforcement of turtle protection laws.
2. The United States has been sensitive to charges of colonialism in thrusting conservation laws passed in Washington, D.C. on peoples leading traditional subsistence life-styles in remote islands on the far side of the world.
3. The Trust Territory is not a permanent political entity, and in the years to come the various districts will be electing whether or not they wish to remain associated with the United States. The United States has not deemed it politic or appropriate to thrust unwelcome conservation obligations upon people who would be likely to reject them totally on reaching political independence.

A loophole that has resulted from the wording of the Endangered Species Act, which considers the Trust Territory to have the status of a state, is that products of the hawksbill turtle hand-carried by tourists entering Honolulu from the Trust Territory can no longer be confiscated. Such transportation of products is legally

simply a case of carrying personal effects across state lines, unless it can be proven that the material is post-Act in origin.

Palau District

The hawksbill is more abundant than the green turtle in the Palau District, or is at least more conspicuous in the more accessible areas such as the Palau Lagoon. Douglas Faulkner, the underwater photographer, reports that hawksbills may be seen virtually every day in the Palau Lagoon by a competent scuba diver, and immature hawksbills are also reported to be numerous in the Kayangel Lagoon at the northern end of the Palau system. However, Robert Owen, conservation officer for Micronesia from 1949 to 1978, reports a gradual but steady decline in abundance. Natural predators are relatively few, and no natural egg predators have been reported, but the turtles are eaten by crocodiles (*Crocodylus porosus*), and the human pressure on eggs is intense—estimated at 80 percent by Jim McVey, who conducted a head-starting program for hawksbills in Palau in the early 1970s. Adult turtles too are highly persecuted. Hawksbill meat is eaten locally, but the economic pressure on the species is definitely from the shell trade. Tourism in the islands increased about 300 percent with the advent of regular air service in the early 1970s; a large proportion of tourists in Palau are from Japan, which of course offers no legal impediments to the free importation of hawksbill products.

The hawksbill turtle nests on small beaches on limestone islands in the Palau Lagoon. The principal nesting months are July and August, but some nesting takes place in June and September, and a few may nest in any month of the year. Their nesting site fidelity is reported to be strong, and they nest at approximately 15-day intervals, 2 or 3 times in a season. Favored islands include Eomogan, where Jeff June of the Peace Corps saw 3 turtles nesting in 1 night in late August 1975, and Ngerugelbtang Island, where the turtles often walk the length of a long spit before reaching a nesting area safe from tidal inundation. Other islands sometimes used for nesting include Aulong, Ngeangas, Ngobadangel, Unkaseri, and Abappaomogan.

Green turtles are not often seen in the Palau Lagoon, but achieve substantial populations in the northern and southern extremes of the Palau District. Richard Howell, district fisheries officer on Truk, reported that about 10 years ago he found fully mature green turtles to be plentiful in the Ngaruangel Lagoon, at the northern tip of the Palau complex. Villagers from Kayangel could catch 5 in 30 to 60 minutes. The turtles were resident there year-round, feeding on the large strands of turtle grass present especially on the western edge of the reef. Howell reported seeing only 1 male turtle in the area. Nesting (probably by greens) takes place on the

barely exposed Ngaruangel Island, since natives of Kayangel returned from the lagoon with fresh eggs. Raids on the turtles were sporadic, and could be made only during calm weather. The turtles were only used by Kayangel people for special occasions, although they were also used for trade with villagers on northern Babelthaup.

Green turtles also nest in small numbers on Hon-eymoon Beach, Pelelieu Island, and, on 1 occasion, a female was seen inside the reef on Morei Island. However, the best green turtle beaches by far in the Palau System are on the southern islands of Merir and Helen Reef, located many kilometers to the south; coordinates are 4°19'N, 132°19'E for Merir, and 2°48' to 3°01'N, 131°44' to 131°51'E for Helen Reef. Merir now unfortunately has a small permanent settlement, numbering 7 people in 1976. Even such a small group of people can cause havoc to the turtle population on such a tiny island. Helen Reef, whose single emergent point of land, Helen Island, is too small for permanent settlement, still has heavy pressure on its marine resources, especially by pirates, the majority of whom come from Taiwan. When caught, they may be jailed in Palau for variable periods of time. Another serious problem for turtles in the outlying islands is that the crew of the government field trip vessel, far from being a positive force for law enforcement, take advantage of their subsidized trip to Helen Island, Merir, and other turtle islands to gather as many turtles as they can for themselves, which can be taken back to markets for personal profit.

There is an extensive folklore and legend regarding turtles in Palau. For example, the discovery of the approximately 2-week nesting cycle for both the green and the hawksbill turtles is attributed to a chance discovery described as follows:

"A young couple arranged to spend the night on a remote beach on Pelelieu Island. They used the girl's grass skirt as a pillow, and after making love, went to sleep. When they woke the next morning, there were turtle tracks on the beach and a nest right beside them but, to their great embarrassment, the grass skirt had disappeared. Nevertheless, they decided to repeat the rendezvous two weeks later, and, just before they fell asleep, noticed a large turtle crawling ashore with the remains of the grass skirt still attached to a front flipper."

This story is a favorite subject of Palauan story boards.

Yap District

Chief informant on sea turtles in the Yap District is Mike McCoy (this volume), formerly of the Peace Corps and now chief fisheries officer for Ponape and associate of the Yap Institute of Natural Sciences. McCoy's 1974 paper "Man and Turtles in the Central Carolines" is

Table 1. Summary of turtle sightings by aerial survey region, Guam, Fiscal Years 1975 through 1979

	Region												Total sightings	Number of months
	1	2	3	4	5	6	7	8	9	10	11	12		
FY 1979	4	1	1	1		1	6	2	43	31	18	77	185	12
FY 1978	6	3	1	9		6	14	3	10	1	15	15	83	12
FY 1977	0	3	1	1		4	1	5	10	0	8	8	41	2
FY 1976	7	5	6	6		35	8	14	44	10	12	42	189	9
FY 1975	14	5	18	3		23	11	9	37	16	6	143	285	6
Total	31	17	27	20		69	40	33	144	58	59	285	783	41
\bar{x} /Region	6	4	6	4		15	8	8	31	12	13	59	—	—

Source: Molina, unpublished report.

one of the most valuable sources available on human attitudes to turtles in Micronesia. To avoid duplication, reference is made to McCoy's paper herein for information on turtles in the Yap District.

Marianas District and Guam

Hendrickson (in manuscript) quoted the following information, received from Isaac I. Ikehara, chief of the Guam Division of Fish and Wildlife, regarding the available information on sea turtles in Guam in 1968:

Green turtles and hawksbills are reported to occur in Guam waters. They apparently nest on the island beaches, but only sporadically; eggs were harvested more commonly during the time before the second World War, in many areas of the island, especially on the northern and southern ends (Tarague, Ritidian, Uruno, Orote, Cocos Island, Asiga Beach, and other localities).

It appears from local residents that sea turtles are a rarity on the local market and the consultant found none on three of his visits. Skin divers occasionally bring them back but they are not considered a normal commercial item although red turtle meat is reputed to sell at \$0.75 (US) per pound. There is no export of turtle products from Guam. In 1968 there were reportedly two divers specializing in turtles each catching three or four turtles on a good day.

There is apparently no legislation protecting sea turtles or regulating the catch in any way, but there are some good catch statistics. All sizes from 15 lb. to 400 lb. are taken, but the informant estimates that the average size is around 60 lb. (the type most likely to be taken by divers). No special feeding grounds have been identified.

Harry Kami, enforcement officer for the Guam Fish and Wildlife Division, made a number of flights over the Guam coast during the last couple of years, and saw sea turtles—sometimes in concentrations of 40 or 50 individuals—off the northern coast of Guam, between Ritidian Point and Pati Point. Kami also sometimes saw 3 or 4 turtles off the coast near Inarajan Bay, on the southeast coast, and said that turtles formerly nested on Cocos Island, off the southwest coast, although the island was now too intensively visited for nesting to take place.

The north coast of Guam, near which the turtles were seen, was under Air Force control, and was rather little visited. However, despite the presence of a good beach, little nesting took place here. Factors that lessen the suitability of this beach for nesting may include the shallow reef (only 1 m submergence by high tide), and the presence of dense vegetation above the high tide line on the beach. Most of the turtles seen off Guam were of adult size, and indeed appeared to be very

Table 2. Summary of turtle sightings by month, Guam, Fiscal Years 1975 through 1979

	Month												Total sightings	Number of flights
	J	A	S	O	N	D	J	F	M	A	M	J		
FY 1979	12	3	6	6	7	12	18	52	24	14	20	11	185	24
FY 1978	7	6	10	4	16	17	7	5	0	3	4	4	83	24
FY 1977	23	—	—	18	—	—	—	—	—	—	—	—	41	4
FY 1976	—	20	28	24	20	42	16	10	7	22	—	—	189	18
	—	—	—	—	—	—	45	44	32	46	54	64	285	12
Total	42	29	44	52	43	71	86	111	63	85	78	79	783	82
\bar{x} /Month	14	12	15	13	14	24	22	28	16	21	26	26	—	—

Source: Molina, unpublished report.

large from an aircraft at 65 to 80-m altitude; but mating pairs had not been seen.

Kami found 1 green turtle nest on the east coast of Guam between Ylig Bay and Togcha in 1974. Because of the extensive human use of this beach, the eggs were moved and, while reburying them, several incomplete nests were found.

Dr. Lucius Eldredge informed me by letter (dated 12 July 1976) that Dick Randall of the University of Guam Marine Laboratory reported 6 recent turtle nests on June 26, 1976, at the north edge of Sella Bay on the southwest coast of Guam.

A recent unpublished report by Molina includes the results of 5 years of aerial surveys of turtles around Guam. The following section is extracted from this report:

The island of Guam was divided into 12 survey regions (Figure 1). Marine turtles have been sighted within every survey region (Table 1) and during all months of the year (Table 2). Region 5 has not been censused due to military restriction. Two flights were made each month in all cases. A total of 783 marine turtles have been sighted around Guam on 41 aerial surveys made during the past 5 years. Far more turtles were sighted within region 12 (Pati Pt.-Ritidian Pt.) than in any other (Table 1). Approximately 74 percent of the observed turtles were seen within regions 8 to 12. The most probable explanations for this distribution are the low levels of development and fishing pressure in these areas.

Marine turtle abundance appears to peak twice during the year (Table 2). In general, these peaks coincide with the winter (December to February) and late spring (May to June) months. This also loosely correlates with Guam's "dry," tradewind season which usually lasts from December to June. It is unclear at the present time whether or not the turtles are mating during the entire period, yet it seems likely. The time of nesting is also unclear. However, reports from local fishermen indicate that nesting occurs around June.

Reports have been made of larger than usual numbers of turtles visiting Guam about every 3 years. The last of these visits happened in 1976, and is reflected in our aerial survey data (Table 2). Another visit was expected this year. Again, our data show the winter increase in numbers.

*Since it is difficult to make positive species identifications on turtles from a moving airplane, we have no reliable estimate of the species composition of Guam's marine turtle community. However, it is generally regarded that *Chelonia mydas* is by far the major component.*

Human interference with nesting turtles is a serious problem at Tarague Beach. The majority of the problem lies with the friends and relatives of the Tarague landowners who use the beach for "4-wheeling" and who actively hunt for turtle eggs. Since Tarague Beach is privately owned and enjoys military isolation, there may be a good chance

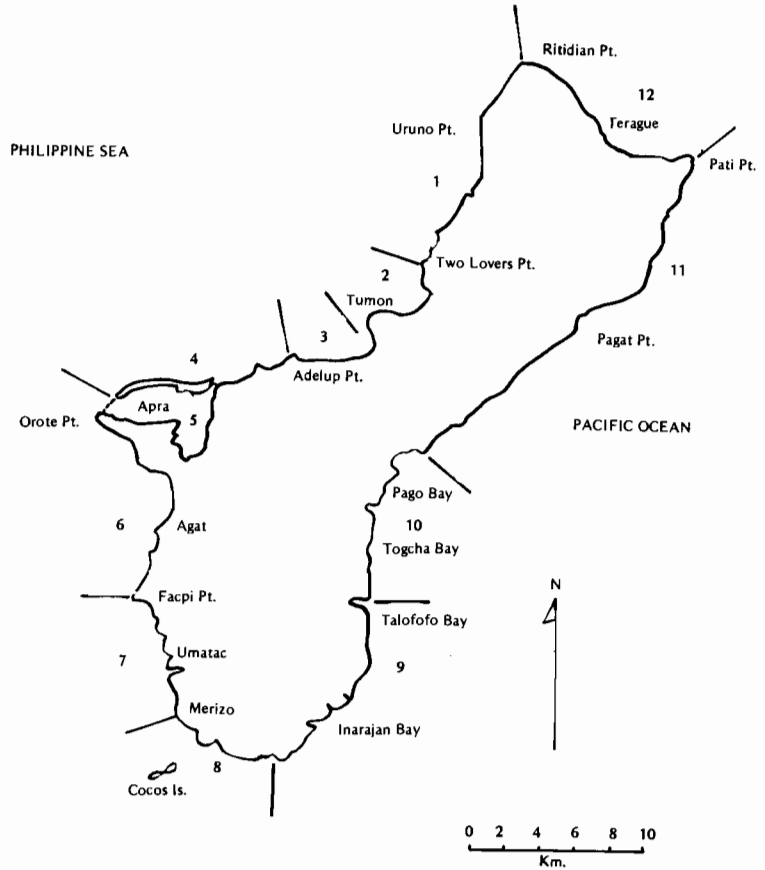


Figure 1. The island of Guam with its 12 aerial survey regions.

of controlling this problem, especially if the area could be designated as a marine turtle sanctuary. If it is not already too late, Tarague Beach may be Guam's only hope for such a valuable natural resource. Mr. Castro appears to be pro-turtle conservation and has offered to do what he can in cooperation with our office to help protect these animals.

Turtle meat is occasionally sold in Guam, but is very expensive—although it can on occasion be purchased with U.S. government food stamps at Perez Market. There are no laws protecting turtles in Guam at the present time, and some opposition to establishing local laws because turtles protected in Guam may well be caught in the Trust Territory. However, because Guam is an unincorporated territory of the United States, federal law unquestionably applies, and hawksbills should already have legal protection. The green turtle too should soon receive nominal protection.

Very few Guamanians are expert at spearing sea turtles, with the exception of a few old-timers, and nets are never used nowadays for catching turtles.

North of Guam, the Northern Marianas Islands stretch in a slightly curved elongated chain. Few turtles appear to nest anywhere in the Marianas; to a large extent this may reflect shortage of nesting beach, most of the uninhabited islands having no beach whatsoever. Saipan has several kilometers of beach on the west coast, but

the area is rather extensively developed with hotels and other beach facilities, and few if any turtles nest there. However, dense patches of turtle grass within a few meters of the beach suggest good feeding habitat for green turtles. Rota has several beaches, and Tinian 2 small, marginal ones, but I have no evidence that these are used by nesting turtles.

Stuffed turtles are for sale at several locations on Saipan. In a handcraft shop on Beach Road, 13 stuffed green turtles (half-grown to maturity) were for sale; also 3 hawksbills and 1 olive ridley. The turtles were reportedly all locally caught.

Turtles are being caught in increasing—and now rather large—numbers in the northern Marianas. The turtles were captured by divers for sale to hotels and gift shops, and 1 diver could easily catch 4 or 5 turtles in a day (Ben Sablan, personal communication).

Truk District

The islands of the Truk District lie to the east of the Yap District. Truk itself is composed of a large lagoon, roughly circular in shape, about 40 miles in diameter. The lagoon is fringed by a reef, broken in several places and reaching above sea level to form small, low islets, principally in the northern and southeastern sections. Most of the human inhabitants, who numbered 20,105 in 1970, however, do not live on the reef islands, but rather on several mountainous, large islands near the middle of the reef. The other islands of the Truk District—the Lower and Upper Mortlocks, to the southeast; the Hall Islands to the north; and the so-called Western Islands of Namonuito, Palap, Puluwat and Pulusuk—are low atolls.

Although only 2 days were spent on Truk during the survey reported here, I was able to learn a good deal regarding sea turtles in the District, through the kindness and efficiency of Mr. Richard Howell and Mr. Tawn Paul of the Fisheries Office. Informants for turtles in the outer islands were Mr. Casian Orik (Western Islands), Mr. Marion Henry (Mortlocks), and Mr. Appo Pius (Truk Lagoon).

Three species of sea turtles are recognized in the Truk District: the leatherback (locally called "mirang"); the green turtle ("winimon") and the hawksbill ("winichen"). The leatherback is seen only occasionally and always in deep water; there are no nesting records in the area. The other 2 species are both widespread, but the green turtle is generally more plentiful than the hawksbill.

The hawksbill is found principally in the Truk Lagoon and in the Mortlocks. On the northern fringe of the Truk Lagoon, hawksbills nest in small numbers on the islands of Holap, Tora, Ruac, Lap, Ushi, Onao, Tonelik, Pis, Alanenkobwe, Lemoil and Falalu. The largest of the islands, Pis, has human inhabitants, and

turtles nesting there are likely to get killed. Mr. Pius informed me that the casual nesting in this area (perhaps 1 or 2 turtles per night on each beach during May to October) had not diminished perceptibly during the last 50 years. In the Lower Mortlocks, Marion Henry reported casual hawksbill nesting in all 3 atolls (Etal, Lukunor, and Satawan), but not commonly on the inhabited islands (Kutu, Mor Satawan and Ta in Satawan atoll; Etal Islet; and Lukunor Islet).

The tiny island of East Fayu, about 100 km north-northwest of the Northeast Pass leading out of the Truk Lagoon, is an important one for green turtle nesting. About 6 or 7 turtles are reported to nest here each night during the season, which begins remarkably early (February), and lasts until about June. The island is elongate, less than 2-km long, and has a sandy beach with a deep water approach all around. The rights to the turtle resource are vested in the people of Nomwin Atoll, a few kilometers to the east. A few green turtles (1 to 3 per night) are also reported to nest on Fanang Islet, at the eastern end of Nomwin Atoll, and on a few tiny islets in adjacent Murilo atoll. A few also nest on northern Murilo Island.

Turtle nesting has not been reported in the Western Islands, all of which are inhabited. However, the people of Pulusuk, and also of Puluwat and Pulap (Tamam Islet) take advantage of the March-April trade-winds to travel to Pikelot, in eastern Yap District, to collect turtles. This journey may be made 3 or 4 times during the 2-month period, and a typical catch is about 20 turtles, which are collected on the beach during a stay of 1 or a few nights. The eggs are also collected. It was estimated that about 30 turtles nest each night at Pikelot; however, from data obtained in the Yap District, I believe this to be a distinct exaggeration. Turtles were reported to be diminishing in Pikelot, but holding their own in the Hall Island-East Fayu region.

In the Truk Lagoon both species of turtle are found (mostly adults) and are about equally common; however, only the hawksbill is known to nest. Rather few turtle fishermen are operating, and the turtles are obtained by spearing. A turtle can be obtained on demand within 24 hours by certain fishermen. Reportedly, the hawksbills are killed for use of their shell, which is sold in souvenir shops; however, I did not see any for sale at the time of my visit.

In the Truk District, it was reported to me that the green turtle often weighs 300 to 350 lbs. (136 to 159 kg), and occasionally 400 lbs. (181 kg), and usually laid 80 to 120 eggs. The hawksbill weighed 100 to 150 lbs. (45 to 68 kg) and laid 110 or more eggs (maximum observed: 152). There is no reason to question the accuracy of these figures. I was also informed that *both* species eat seagrass and algae. When I questioned an informant (Appo Pius, a fisherman of 50 years' standing) on this, he appeared absolutely certain that stom-

achs of the hawksbill as well as the green contained such plant material, even when I pointed out that in most parts of the world the hawksbill is carnivorous.

Ponape District

The Ponape District is situated to the east of the Truk District. Ponape, the District Headquarters, is a large (129.04 square-mile), centrally located island, which is highly elevated, reaching an altitude of over 2,500 feet. Rainfall is heavy, and vegetation lush. The island is roughly circular in shape and is surrounded by a barrier reef penetrated by about twenty entrances. There are some sizeable offshore islands, including Sokehs, Langer, Parem, Mwahnd Peidi, Mwahnd Peidak, Takaiu, Dehpehk, and Temwen. The population of the island was estimated to be 14,520 in 1970.

Kusaie is the second largest single island of the Ponape District; it has an area of 42 square miles, an altitude of 2,064 feet, and a 1970 population of 3,743. It is situated approximately 300 miles east-southeast of Ponape.

The other islands of the District are all atolls. Mokil (population 1970, 411) and Pingelap (population 849) lie between Ponape and Kusaie. The atolls of Ant and Pakin lie close to the west coast of Ponape; Pakin had a population of 36 in 1973; Ant had 10. Oroluk atoll, which had a population of 42 in 1935, none in 1948 or 1970, but since mid-1973 inhabited by about 18 people, lies west-northwest of Ponape. Southwest of Ponape are the atolls of Ngatik (population 442) and Nukuoro (population 420). Far to the southwest, nearly 500 miles from Ponape, is the atoll of Kapingamarangi, inhabited by 432 people in 1970, but with a permanent overflow population now living on Ponape, and a few others on Oroluk.

I spent 5 days on Ponape, where my chief informant was Ben Sablan of the Fisheries Department. Valuable information was also received from Alan Millikan, the District Fisheries Specialist, and David Fullaway, the chief Forestry Officer.

Populations of sea turtles around Ponape itself appear to be relatively insignificant and very little nesting, if any, takes place. Indeed, Ponape has very few sandy beaches. Turtles used to provide an important source of food to the people of Kapingamarangi, but they are now rarely seen in that area (Niering 1963). Nesting does not take place on Pingelap and Mokil, but Mokil has a shallow lagoon in which small green turtles (less than about 50 cm long) are easily seen and caught. Ben Sablan observed 5 such turtles on an underwater survey of the 15.5 km² Mokil Lagoon in 1974.

Around Kusaie, Sablan found 31 green turtles and 6 hawksbills during a 3-day underwater survey in August 1973; nesting, however, appears to be sparse at best.

No details are available for nesting on Ngatik, but Sablan reports some nesting on the eastern islets of Peina, Bigen Karakar, Jirup, Bigen Kelang, Piken Matagan, Dekehnman, and Wat. Two green turtles were seen in the water during an underwater survey in September 1973.

Green turtles have been seen around Ant Atoll and it is rumored that daytime nesting occurs; but this needs confirmation.

Green turtles appear to be rather plentiful around Nukuoro, where Sablan counted 52 (but no hawksbills) during an October 1973 underwater survey. Nearly all were of adult size and were relatively inactive. They probably nest on the island, but there is no evidence of high-density nesting. Sablan also saw 3 green turtles underwater in Pakin.

Apparently the only nesting ground of importance in the Ponape District is the atoll of Oroluk, which once boasted as many as 19 islets, but apparently all but Oroluk Islet itself, at the extreme northwest of the atoll, have now disappeared. The District Administrator of Truk reported to me that he had seen green turtles nesting by daylight on Oroluk, on the lagoon side of the island, during a helicopter visit in November 1964. The island was uninhabited at that time, and the turtles reportedly showed no fear of the observers. Turtles in Oroluk are considered to have a split nesting season (December to January and June to July), and this may have been the original rationale for the split closed season throughout the Trust Territory. It is estimated that between 9 and 15 turtles nest on Oroluk on the average night, with up to 20 on a very good night. The local people, about 18 in number and resident on the island since mid-1973, catch a substantial proportion of the nesting turtles.

In a memorandum dated February 3, 1976, Sablan described the findings of a July 1975 visit to Oroluk. The islanders reported that since they first settled on the island 2 years ago, the number of turtles nesting had dropped considerably. This may well have been due to excessive predation, although Sablan also recorded the following human disturbances to the nesting beach during the night he was on the beach: 1) very active human activities until the early morning; 2) several campfires maintained until midnight; 3) co-pira operation with outboard motor until 9:00 a.m.; 4) ship generator and lights on until morning. However, at West Fayu in the Yap District, the tagging and hatchery crew in 1972 found that the turtles continued to nest even though a wrecked cargo ship containing 300 Toyotas was being salvaged on the island with extensive lights, noise and other disturbance by the salvage crew every night. The ship had spilled 600 tons of oil and was not completely defueled until more than 6 months after the wrecking.

Marshall Islands District

The Marshall Islands comprise a widespread District at the eastern end of Micronesia. With the exception of a few small isolated reef islands, such as Jemo, the Marshalls are comprised exclusively of atolls, most of which are made up of a few to many dozens of islets. The atolls are roughly aligned along 2 parallel axes, the northeastern being the Ratak Chain and the south-western the Ralik Chain. None of the islands reaches a height of more than a few meters above sea level, and the total land area of the District is only 180.82 km². The human population, numbering 20,206 in 1970, is widely distributed, but only the atolls of Majuro, Kwajalein, and Ailinglapalap have more than a thousand people.

Bryan (1971) lists Taongi, Bikar, Taka, Jemo, and Erikub as the only atolls or islands that have never had human populations, while the people of Bikini and Enewetak were displaced after the second World War when these islands were used for atomic weapons testing. Rongerik is listed by Bryan as having 6 people in 1935 and 1948, but as being uninhabited in 1970; this island was used temporarily by the displaced people of Bikini, but proved unsatisfactory. The Marshall Islands are well described by Anonymous (1965), while excellent maps and directories to names of islands are provided by Bryan (1971).

Only Kwajalein and Majuro were visited during the present survey. However, much useful information on turtles elsewhere in the Marshalls was provided by Ben Sablan on Ponape, who was formerly resident in the Marshalls; by Major Ron Barnett and Rev. Elden Buck on Kwajalein; Jim Hiyane, the agricultural officer on Ponape; George Balazs in Hawaii; and Jobel Emos, a janitor at the Kwajalein Missile Range.

Bikar Atoll

The atoll of Bikar, one of the northernmost of the Marshalls, is generally thought to have the highest concentration of breeding green turtles in the District. The atoll is composed of several islets, the named ones being Jabwelo and Almani on the east, Bikar on the south, and the sandbank of Jaboero between Bikar and Almani. Bikar is the largest with an area of 0.063 miles².

Bikar has been thus described (Anonymous 1956): "Sea birds of many kinds are abundant, but the outstanding feature is the great number of turtles that come ashore to lay eggs on Bikar Islet." Fosberg (1969) recounted his experiences with the turtles of Bikar as follows:

On the night of August 6, a few baby black turtles were seen hurrying toward the sea. They were being attacked by large red hermit crabs (Coenobita perlata) and by rats (Rattus exulans). The hermit crabs bit through the car-

apace, the rats through the plastron. Almost all of the female turtles that visited Bikar Atoll, well over 300 in the seven nights, August 5–12, came ashore on Bikar Islet. One set of tracks and a pit were noted on Jaboero Islet, a few on the south part of Almeni Islet, but none on Jaliklik Islet, which is rocky and has no loose sand.

Judging by the numbers given in an earlier part of this paper, it is possible that the "over 300" turtles is a misprint for "over 30."

From the large numbers of tracks seen, the relatively light nesting observed and the observations on hatchlings, it appears that the season on Bikar reaches its peak probably around June and July.

In 1958 Bikar Atoll and Pokak (Taongi) Atoll, which lies to the north of it, were set aside as preserved natural areas by administrative decree by the then District Administrator, Maynard Neas. It is hoped that this protection may be strengthened, as clearly Bikar is the principal turtle nesting area in the Marshalls and should be kept as a stocking area for the rest of the archipelago.

Hendrickson (in manuscript) was able to visit Bikar on 2–3 July 1971 and made the following observations:

The consultant visited Bikar Atoll and all 3 of its islets judged suitable for green turtle nesting (Bikar, Arumeni and Jaboerukku). These are the only vegetated islets in the atoll, the remainder being barren bars and banks which are presumably swept by high wave action. The timing of the visit was particularly favorable, being at the end of a 7-day period of diminishing tides during calm weather. This left a series of high tide marks on the clear areas of beach where rocks had not confused the wave wash pattern and, for the most part, it was possible to identify the night on which recent beach ascents had been made by nesting turtles, by noting the particular high tide mark where the track ceased to be evident. It was possible to say with some confidence that 39 turtles had ascended the beaches during the preceding 6 days (78 tracks, half ascending, half descending). Thirty-five of the 39 turtles had used the beach on Bikar Islet, 1 had ascended the Arumeni and 2 had ascended Jaboerukku. One of the 35 tracks on Bikar was a hawksbill track (not ridley); all others were presumed made by green turtles (loggerheads have not been reported from the area).

Hendrickson made some calculations of the possible size of the nesting population on Bikar, concluding that the order of magnitude of the population was 711 sexually active adult female turtles in the Bikar breeding population. From these figures, he reasoned that "even the most favorable interpretation of the data available (granting the assumptions made) allows consideration of a population of only small size, not constituting an exploitable wild resource of any significant magnitude."

Jemo Island

Jemo is an isolated, tiny island situated at 10°8'N, 169°32'E, located between the atolls of Ailuk and Likiep. The land area of Jemo is only 1.55 km². The turtles on Jemo were described as follows (Anonymous 1956): "Many turtles visited Jemo to lay their eggs. Jemo was formerly tabu for most of the year, being regarded as a bird and turtle reservation. Only during one month in the year were these animals hunted and their eggs taken."

Fosberg (1969) visited Jemo from 18 to 22 December 1951 and observed tracks corresponding to the nesting of 22 turtles during the past several days.

The Rev. Elden Buck of Kwajalein informed me that a boat from Likiep sometimes brings 10 to 15 turtles for sale on Ebeye. These turtles were presumably caught on Jemo, which is the closest turtle island to Likiep. Likiep itself has few turtles, according to Ben Sablan on Ponape. Further confirmation of the presence of nesting turtles on Jemo was provided by several informants during my survey.

Arno Atoll

Green turtles nest occasionally on the sandy beaches of Arno Atoll, but they are scarce and of no commercial importance (Hiatt 1951). Ben Sablan reported that nesting on Arno takes place on the islet of Ine, in the south and southwest.

Erikub Atoll

Erikub is an uninhabited atoll composed of 16 islets lying just south of the inhabited atoll of Wotje. Jim Hiyane, the agricultural officer on Ponape, informed me that he had seen turtles nesting on Erikub, and estimated that 6 or 8 turtles nested nightly. He mentioned that people from Wotje go to Erikub for copra, coconut, crabs, etc., and often picked up turtles when there, but did not go specifically for turtles.

Jobel Emos on Kwajalein confirmed that turtles nested on Erikub and pinpointed the northwestern islets of Enogo and Loj as being the most favored for nesting. Emos claimed that nesting on Erikub was year-round, but that the turtles were usually exploited during summer months because of the prevailing calm water at that season. He said that the Wotje people, when they caught a female turtle on Erikub, would tether it in shallow water so that it would attract males, which were captured as they mounted her. Emos' estimate was that 3 or 4 turtles nest nightly on Erikub.

On Kwajalein, the Rev. Buck showed me a photograph of a boatload of over twenty turtles that had been brought in from Erikub and Bikar for sale on Ebeye, the islet where the Marshallese workers on the Kwajalein Missile Range reside.

Taka Atoll

Taka is an uninhabited atoll lying very close to, and southwest of, the inhabited atoll of Utirik. It has five islets, the largest of which is Taka itself (2.5795 km²). According to the Rev. Buck, people from Utirik collect turtles and turtle eggs on Taka, but further details are not available.

Ebon Atoll

Ebon is the southernmost of the Marshall Islands. It is a roughly circular atoll composed of 22 islets, by far the largest of which is Ebon itself, an elongate island that makes up the southern side of the atoll; it is about 10-km long and has an area of 2.804 km². Bryan (1971) lists the 1970 population of Ebon as 480—substantially reduced from the 1935 and 1948 censuses. Ebon has a reputation for abundance of food of all kinds, and although no definite information on turtle nesting is available, it is considered to be the best area for catching turtles in the water. The turtles are nearly all of adult size and are caught with nets. Each night 2 to 4 can be caught. Rev. Buck said that if a turtle on Ebon is captured in a certain place, the next night it is often found that another turtle has moved to the same spot.

Kwajalein Atoll

Kwajalein is the largest atoll in the Marshalls, and reputedly the largest in the world. Ninety-three islets are listed by Bryan (1971). The islets of Kwajalein (at the southern tip) and Roi and Namur (now connected by a runway and called Roi-Namur) are devoted exclusively to U.S. military uses. The Marshallese residents live on Ebeye, a small and highly overcrowded islet a short distance north of Kwajalein, on the eastern edge of the atoll. Most of the other islets are very small, and in some parts the bounding reef is without islets for distances of 15 to 25 km.

Major Ron Barnett on Kwajalein gave me considerable information on turtle observations on Kwajalein. Turtles are often seen around Kwajalein Islet, and between Kwajalein and Ebeye. A few turtles appear to be extraordinarily static in range; a certain green turtle is reported to have resided at a certain coral head (known as K5) off the lagoon shore of Kwajalein for 2 to 3 years, and is very familiar to skin divers. Green turtles are also seen on the ocean side of Kwajalein at the end of the runway, where they scavenge for the kitchen scraps that are thrown in each day. They are usually of less than mature size. One turtle that I saw feeding on the kitchen scraps of Kwajalein, however, appeared to be of adult size.

No records are available for turtle nesting on Kwajalein, and indeed there is a shortage of good beaches. However, much of the atoll is poorly studied and a

Marshallese informant on Kwajalein informed me that turtles do nest sometimes on the islands at the north-western end of the atoll.

Major Barnett, in a letter dated 16 July 1976, reported that on July 10 a green turtle had been found nesting on the ocean side of Bigej Island, about 19 km north of Kwajalein Islet.

Ujelang Atoll

Ujelang or Ujilang, is an elongate atoll about 20-km long located at the western extreme of the Marshalls, being closer to Ponape than to the population centers of the Marshalls. It had a small native population of about 40 people (plus 12 non-natives) in 1935. It was uninhabited in 1948 according to Bryan, but this is presumably in error, since Helfich (in manuscript) reports that the Enewetakese people displaced by atomic tests were settled on Ujelang in 1947. The 1970 population, according to Bryan (1971), was 281.

Ujelang is listed by Carr (1965) as a "minor nesting beach" for the green turtle. The source of this information was not quoted, but Carr informs me that he based this record on an observation made by the crew of a U.S. Naval vessel anchored off Ujelang one night in 1962. Baby green turtles were attracted to the lights of the ship in very large numbers—although at this point it is not possible to ascertain whether the numbers represented only 1 or 2 successful nests, or whether there were numerous nests erupting simultaneously. Two of these hatchlings were transmitted alive to Carr. Phil Helfich, in a brief manuscript, reports on an interview with Chief Johannes, chief of the exiled Enewetakese people on Ujelang: "Chief Johannes indicated that turtles nested all around the island Ujilang. Ujilang is the island which has been occupied by the Enewetakese since 1947, and it is difficult to visualize that they did not decimate the nesting turtle populations, because Ujilang is such a small island."

None of the informants on my survey had any information about turtles on Ujelang. The island is extremely remote and is not often visited. This would appear to be a priority for future studies.

Enewetak Atoll

Enewetak is a rather large, almost circular atoll in the western Marshalls. According to Bryan (1971), it is composed of 44 islets, has a land area of 2.26 miles² and had 128 people in 1948, but none in 1970. However, according to one writer (Anonymous 1972), 100 people, mostly civilians, live on Enewetak. Another report (Anonymous 1975) gives 1947 as the year in which the 136 Enewetakese residents were transferred to Ujelang; the island was used for nuclear tests between 1948 and 1958. Since 1954, the University of

Hawaii has operated the Mid-Pacific Marine Laboratory on Medren Island, Enewetak, which is financed almost completely by the U.S. Energy Research and Development Administration.

Helfich (in manuscript) quotes Chief Johannes of Enewetak, who lived on the atoll until 1946, as reporting turtle nesting (up to 1946) taking place from May through August on the islets of Alice, Bell, Runit (Yvonne), Glen through Keith, Leroy, Wilma, and Vero. The last 2 islands had the best nesting areas. Another islet by the name of "Vikai" was reported by Johannes to have abundant nesting turtles, but no island of this name is shown on available maps of Enewetak.

At the present time there appears to be little turtle nesting on Enewetak. However, George Balazs has prepared reporting sheets for observations of turtles by scientists at the Mid-Pacific Marine Laboratory and others, and valuable information may eventually be forthcoming from this program.

Majuro Atoll

Majuro, the District Headquarters, is an elongate atoll approximately 30-km long. The southern rim of Majuro was originally composed of a single extremely attenuated island, Majuro, and a series of much smaller islands to the west. However, these islands have now been connected in order to provide vehicular access between the principal town (known as D-U-D, from its constituent and now coalesced islets of Carrit, Uliga, and Dalap) and the airport; and the blockage of the former passages between islets, with no provision for bridges or culverts, has led to substantial pollution problems in the Majuro lagoon.

Turtle nesting has not been reported on Majuro, although turtles are spotted in the waters of Majuro relatively frequently. Ben Sablan informed me that large turtles are seen resting near the Windward Islands of Majuro, and on an afternoon dive one summer he had seen more than 15 turtles, all females.

Jaluit

Jaluit is a large, irregularly shaped atoll, about 30-miles long from north to south. It is composed of 91 islets. Bryan (1971) gives the 1970 population as 881, substantially reduced from former years. Ben Sablan informed me that turtles nest in small numbers on Lijeron Islet, near the northern end on the west side of the atoll.

Aur, Maloelap and Likiep Atolls

Ben Sablan reports that turtles may be found on each of these atolls, but that in no case were they plentiful.

Bikini and Taongi Atolls

Although my informants did not mention these atolls, both were recorded by Hendrickson (in manuscript) as being second in importance only to Bikar among the Marshall Island turtle nesting atolls. Hendrickson obtained his information about Bikini from Mr. Robert Ward, a heavy equipment maintenance supervisor for the Bikini Atoll Rehabilitation Project. Additionally, the popular movie *Mondo Cane* made several years ago showed rather large numbers of dead green turtles on Bikini, though the interpretation made that these had been disoriented by radiation damage and had wandered into the interior of the island to die is somewhat questionable. I have seen dozens of dead green turtles inland from the nesting beach on Baltra Island, Galapagos. This island appears to lack the normal sea-finding (or land-fleeing) cues that enable a turtle to identify the proper heading for the ocean.

Acknowledgments

I am most grateful to the World Wildlife Fund (United States National Appeal) for funding my field work in Micronesia; to R.M. (Chris) Christensen and *Chelonia* magazine for initial publication of the findings; and to Dr. Hal Coolidge for providing the initial impetus for my field work in Micronesia, as well as for vigorous support with all phases of the work.

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Biology and Conservation of Sea Turtles

Revised Edition

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Smithsonian Institution Press
Washington and London

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First edition published 1982 by the Smithsonian Institution Press.

Library of Congress Cataloging-in-Publication Data

World Conference on Sea Turtle Conservation (1979 :
Washington, D.C.)

Biology and conservation of sea turtles / edited by Karen A.
Bjorndal. — rev. ed.

p. cm.

“Proceedings of the World Conference on Sea Turtle
Conservation, Washington, D.C. 26–30 November 1979 with
contributions on Recent advances in sea turtle biology and
conservation, 1995.”

Includes bibliographical references.

ISBN 1-56098-619-0 (alk. paper)

1. Sea turtles—Congresses. 2. Wildlife conservation—Congresses.

I. Bjorndal, Karen A. II. Title.

QL666.C536W65 1979

597.92—dc20

95-18872

British Library Cataloguing-in-Publication Data is available.

Ⓢ The paper in this publication meets the minimum requirements
of the American National Standard for Permanence of Paper for
Printed Library Materials Z39.48-1984.

Manufactured in the United States of America.

02 01 00 99 98 97 96 95 5 4 3 2

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Front cover: Adult female green turtle, *Chelonia mydas*, at French
Frigate Shoals, the major migratory breeding site for this species in
the Hawaiian Islands. Photo by G. H. Balazs.