MARINE TURTLES OF U.S. TERRITORIES IN THE CENTRAL PACIFIC OCEAN AND THE U.S. TRUST TERRITORY OF THE PACIFIC ISLANDS

REPORTS BY

GEORGE H. BALAZS
HAWAII INSTITUTE OF MARINE BIOLOGY
P. O. Box 1346
KANEOHE, HAWAII 96744

AND

PETER C. H. PRITCHARD
FLORIDA AUDUBON SOCIETY
P. O. DRAWER 7
MAITLAND, FLORIDA 32751

SUBMITTED TO

RICHARD SHOMURA, DIRECTOR
HONOLULU LABORATORY
NATIONAL MARINE FISHERIES SERVICE

CONTRACT No. 79-ABA-02422
(AMENDED 23 AUGUST 1979)

MARINE TURTLES OF U.S. TERRITORIES IN THE CENTRAL PACIFIC OCEAN AND THE U.S. TRUST TERRITORY OF THE PACIFIC ISLANDS

Reports by

George H. Balazs
Hawaii Institute of Marine Biology
P. O. Box 1346
Kaneohe, Hawaii 96744

and

Peter C. H. Pritchard
Florida Audubon Society
P. O. Drawer 7
Maitland, Florida 32751

Submitted to

Richard Shomura, Director
Honolulu Laboratory
National Marine Fisheries Service

Contract No. 79-ABA-02422
(amended 28 August 1979)

MARINE TURTLES OF U. S. TERRITORIES IN THE CENTRAL PACIFIC OCEAN

by

George H. Balazs
Hawaii Institute of Marine Biology
P. O. Box 1346
Kaneohe, Hawaii 96744

Report
prepared for
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

Working Paper No. 12
Joint SPC-NMFS Workshop on Marine Turtles
in the Tropical Pacific Islands
Noumea, New Caledonia
11-14 December 1979

TABLE OF CONTENTS

Introduction

Except for the Hawaiian Islands which have been covered in a separate document, the marine turtles at areas under U. S. jurisdiction in the Central Pacific Ocean have not been systematically investigated and only limited, diffuse information exists on their occurrence and status (Balazs, 1978, 1979). The purpose of this report is to consolidate and review all of the available published and unpublished information in order to provide a basis for future investigations.

Of the Central Pacific areas covered in this report, only the islands of American Samoa have an indigenous human population. However, like most areas throughout Polynesia, the present cultural importance of marine turtles to these people has not been determined (see Johannes, 1978). While the other U. S. territories in the Central Pacific are either uninhabited or occupied only by military personnel, turtles that utilize these areas could very well be involved in migratory patterns that encompass inhabited Pacific islands outside of U. S. jurisdiction. It is therefore imperative that tagging studies eventually be carried out to determine the extent to which international movements are taking place.

Under provisions of the U. S. Endangered Species Act that became effective in September 1978,olive ridley (*Lepidochelys olivacea*) and loggerhead (*Caretta caretta*) turtles that occur at areas under U. S. jurisdiction are fully protected. Green turtles (*Chelonia mydas*) are also protected under this act, except for subsistence use in U. S. Trust Territory of the Pacific Islands. Three other species, the hawksbill (*Eretmochelys imbricata*), the leatherback (*Dermochelys coriacea*) and Kemp's ridley (*Lepidochelys kempi*) have received full protection since 1970 (U. S. Department of Commerce, 1978).

The work involved in preparing this report was funded by the National Oceanic and Atmospheric Administration, National Marine Fisheries Service, under

contract no. 79-ABA-02422 (as amended 28 August 1979). Some of the information presented was gathered by the author during the course of research projects supported by the University of Hawaii Sea Grant College Program, the State of Hawaii Office of the Marine Affairs Coordinator, the U. S. Fish and Wildlife Service, and the New York Zoological Society.

Status of Marine Turtles and Habitat

Johnston Atoll

Johnston Atoll is located at 16°45'N, 169°31'W and consists of four islands within a 170 km^2 submerged coral platform where ocean depths are less than 30 m. Two of the islands (Akau and Hikina) are completely man-made, while the other two (Johnston and Sand) are natural islands that have been artificially enlarged. These dredge and fill operations by military agencies have periodically taken place over the past 45 years, with a resulting increase in total land area from the original 23 ha to the present 343 ha. A 2750 m aircraft runway is located on Johnston Island. From the late 1950's until 1962 nuclear weapons testing took place in the atmosphere over the atoll. The area is still controlled by the Nuclear Defense Agency, but is now used principally as a storage site for chemical munitions. In addition, a Coast Guard Loran Station is located on Sand Island. A small human population resides at the atoll to maintain these facilities. In 1926 Johnston Atoll was designated as a federal bird refuge due to the presence of large colonies of nesting seabirds. The area is therefore concurrently managed by the U. S. Fish and Wildlife Service as part of the National Wildlife Refuge System (U. S. Department of the Interior, 1976a). The closest island to Johnston is French Frigate Shoals in the Northwestern Hawaiian Islands, a distance of 835 km to the north-northwest. Additional comprehensive

information on the biological and historical aspects of the atoll has been presented by Amerson and Shelton (1976).

Both immature and adult green turtles occur at Johnston Atoll, but nesting has never been documented. Courtship behavior and apparently sustained copulation have, however, been periodically observed by resident personnel. Most of the sightings of turtles are made in the shallow waters along the southern and western shores of Johnston Island where foraging regularly takes place. Numerous species of benthic algae occur within the atoll (Buggeln and Tsuda, 1966), including *Caulerpa racemosa*, *Codium arabicum* and *Gelidium pusillum* which are known to be food sources of green turtles in the Hawaiian Islands. From 10 to 12 turtles can be seen foraging near Johnston Island throughout the year. However, the daily exchange rates and total number of individuals involved are unknown.

In November of 1966 personnel of the Smithsonian Institution collected an adult green turtle "on the beach of Sand Island" for use as a museum specimen (Amerson and Shelton, 1976). It is unknown if this was a natural mortality that had been salvaged, or a live turtle that possibly was exhibiting the rare behavioral trait of basking ashore, such as occurs at undisturbed sites in the Northwestern Hawaiian Islands.

From 1962 to 1976 one of the residents of Johnston Island reported catching between 6 and 15 turtles a year, the largest of which weighed 138 kg. None of these turtles were found to have tags. This is significant in view of the large number of green turtles that have been tagged in the Hawaiian Islands, particularly at the colonial breeding site of French Frigate Shoals (Balazs, 1979). The method of capture involved snagging the turtles in the neck or flippers with a hook and line cast from shore. On one such occasion a large

shark, possibly a tiger shark (*Galeocerdo cuvier*), attacked and ate a struggling turtle before it could be retrieved. Several sharks were also seen feeding on a large turtle outside the fringing reef on the northwestern side of the atoll.

Since 1976 the capture of turtles at Johnston Atoll has been prohibited under refuge regulations issued by the U. S. Fish and Wildlife Service. Observations of turtles by resident personnel are being communicated to the author through the use of standardized sighting report forms.

Kingman Reef

Kingman Reef is located 1575 km to the southeast of Johnston Atoll at 6°23'N, 162°18'W. The area consists of an 8 by 15 km triangular reef sheltering a lagoon with depths to 82 m. A single small coral island is situated at the western end (Bryan, 1942, see also Krauss, 1970). Kingman Reef is administered by the U. S. Navy and entry is prohibited under its designation as a Naval Defensive Sea Area and Air Space Reservation. The area is apparently used for Navy training exercises involving nuclear submarines and underwater detection systems.

No information is known to exist on turtles or any other marine biological aspects of Kingman Reef.

Palmyra

Palmyra is an atoll containing 50 well-vegetated coral islands located 60 km southeast of Kingman Reef at 5°53'N, 162°05'W. The total land area is approximately 100 ha. Since 1929 Palmyra has been privately owned by the Fullard-Leo family (Bryan, 1942, Inder, 1978). During World War II the U. S. Navy joined several of the islands together by dredging, and an 1800 m aircraft

runway was constructed. Black rats (*Rattus rattus*) were apparently introduced during the military's tenure. The atoll is presently used as a copra plantation and has a small resident human population consisting in part of natives from Kiribati (formerly the Gilbert Islands). Large colonies of seabirds nest on some of the islands. In June of 1979 the U. S. Government announced that Palmyra was one of three Pacific islands being considered as a storage site for nuclear wastes (Scott, 1979, Shapiro, 1979, Wilson, 1979, Anonymous 1979).

During visits made from 1958 to 1965, green turtles were periodically sighted in shallow waters on the eastern side of Palmyra (P. Helfrich, personal communication). On one of these visits J. Naughton (personal communication) observed 11 adult turtles foraging together at one time. There are no reports of nesting.

Jarvis

Jarvis is located 730 km southeast of Palmyra at 0°23'S, 160°01'W. This sparsely vegetated coral island consists of 445 ha with a fringing reef 100 m from shore. A small shoal occurs off the east side. From 1857 to 1879 the island was mined for guano. From 1935 to 1942 Jarvis was again inhabited by a small number of people for the purpose of reestablishing U. S. ownership. Cats were introduced at that time and a large population now exists (King, 1974, U. S. Fish and Wildlife Service, personal communication). No evidence of Polynesian ruins or artifacts was found during an archaeological survey conducted in 1924 (Emory, 1934). In 1974 the island was designated as a National Wildlife Refuge (U. S. Department of the Interior, 1976b). Large colonies of nesting seabirds are present.

A low level of nesting, apparently involving green turtles, was recorded along the west coast of Jarvis by residents present in August of 1935. A large turtle estimated to weigh 225 kg was also seen inside the fringing reef during October of 1935 (Bryan, 1974). No other information on turtles is known to exist for Jarvis. It should be noted, however, that at some marine turtle nesting areas feral cats are known to prey on both eggs and hatchlings (Stancyk, in press).

Howland

Howland is a sparsely vegetated coral island consisting of 162 ha located at 0°48'N, 176°38'W. A narrow fringing reef surrounds the entire island and large colonies of nesting seabirds are present. From 1858 to 1891 the island was mined for guano, and from 1935 to 1942 a small human population was in residence to reestablish U. S. ownership. In 1937 an aircraft runway was constructed for Amelia Earhart. During World War II the island was extensively used by the U. S. military (Bryan, 1942, Inder, 1978). A small population of cats currently exists on the island (U. S. Fish and Wildlife Service, personal communication). The presence of a few archaeological sites and stone paths indicates that the island was inhabited or at least visited by early Polynesians (Emory, 1934). In 1974 Howland was designated as a National Wildlife Refuge (U. S. Department of the Interior, 1976b).

Turtles of an unstated species were reported to be "abundant" in the waters around Howland during May and June of 1935 (Bryan, 1974). No other information on turtles is known to exist for Howland.

Baker

Baker is a sparsely vegetated coral island located 67 km southeast of Howland at 0°13'N, 176°28'W. The island consists of 135 ha with a narrow

fringing reef. Like Howland, Baker was mined for guano during the late 1800's, had a small resident human population from 1935 to 1942, and was heavily used by the U. S. military during World War II (Bryan, 1942, Inder, 1978). Cats were also introduced and it is thought that their presence has prevented the recovery of nesting seabird colonies (King, 1973). In 1974 Baker was designated as a National Wildlife Refuge (U. S. Department of the Interior, 1976b).

No information on turtles is known to exist for Baker. Baker is only 330 km north of Canton, an important nesting site for green turtles and the northern-most island in the Phoenix group (Balazs, 1976).

American Samoa

Tutuila and Manua Group

Tutuila (14°16'S, 170°40'W) consists of 135 km^2 and is the largest island in American Samoa. Approximately 94% of the 31,000 inhabitants of the island group reside at this location. The small island of Aunuu is situated a short distance off the southeastern coast. The Manua Group is located 110 km to the east of Tutuila and is comprised of three islands, Tau (44 km^2), and Olosega and Ofu (13 km^2) which are contained within the same fringing reef. All five of these islands are of volcanic origin with mountainous interiors and limited coastal plains (Inder, 1978).

Both green and hawksbill turtles occur in the waters surrounding these islands, but apparently only in small numbers. There is some indication that the hawksbill may be the most common species. Sporadic nesting on isolated beaches is thought to take place (Coffman, 1977, Dodd, 1978, S. Swerdloff, W. Pedro and R. Wass, personal communications).

Swains Island

Swains Island is located 370 km north of Tutuila at 11°03'S, 171°05'W. The island is 2 km in diameter and consists of a continuous ring of coral surrounding a lagoon of depths to 15 m with no surface connection to the ocean (Bryan, 1942). Swains has been used as a copra plantation since 1841 when it was colonized by natives from Fakaofu in the Tokelau Islands. Since 1856 Swains has been privately owned by the Jennings family (Bryan, 1974, Inder, 1978).

Both green and hawksbill turtles are reported to nest at Swains (Dodd, 1978, S. Swerdloff, personal communication). Turtle eggs were observed being gathered by the native inhabitants during July and August of 1963 (W. Pedro, personal communication).

Rose Atoll

Rose Atoll, one of the smallest atolls known, contains two islands and is located 145 km east of Tau at 14°33'S, 168°09'W. The nearly square reef (3.2 by 3.7 km) is composed principally of the pink coralline alga, *Lithothamnion*, which shelters a lagoon with depths to 15 m. The larger of the two islands, Rose Island, is approximately 320 m long by 230 m wide and contains a dense forest of *Pisonia grandis*. Some of these trees are up to 26 m high. Large colonies of seabirds nest on Rose Island. The smaller island, Sand Island, is 185 m long by 45 m wide and devoid of vegetation. Rose Atoll is uninhabited and has been a National Wildlife Refuge since 1974 (U. S. Department of the Interior, 1976b). An aerial color photograph of the atoll appeared in a *National Geographic* article by Rockefeller and Rockefeller (1974). Additional information on the biological and historical aspects of the area has been compiled by Bryan (1942) and Sachet (1954).

Green turtles, and probably some hawksbills, presently nest on both islands at Rose Atoll. An early account stated that large numbers of turtles nest during August and September, and that when hatching takes place numerous sharks prey on the young turtles as they pass through the surrounding waters (Graeffe, 1873 quoted by Sachet, 1954, Weins, 1962 and Hirth, 1971). In another early account a turtle captured within the atoll was found to have been feeding extensively on the green alga *Caulerpa* (Girard, 1858).

During a one day visit on 7 October 1970, Hirth (1971) counted 35 and 301 nesting pits of varying age on Sand and Rose Islands, respectively, but no turtles nested that night. Many of these pits may have represented unsuccessful nesting attempts. On Rose Island the beach was found to be composed of coral fragments, thereby suggesting to Hirth (1971) that nesting in such substrate must be a "formidable task." Hirth (1971) also reported that fishermen in Pago Pago (Tutuila) had told him that the nesting season at Rose Atoll was between August and September.

During a low-level aerial reconnaissance in October of 1974, 75 adult turtles were counted within the lagoon (P. Sekora, personal communication).

During a five day visit in May of 1976, only three adults and one immature green turtle were observed in the lagoon and no nesting took place. However, old pits were found on both islands (Coffman, 1977).

During a daytime visit on 29 March 1978, Coleman (1978) recorded one recently excavated pit on Rose Island and four that were thought to be about one month old. Other older pits were noted, as well as a single adult green turtle in the lagoon and some rib bones on Sand Island. Numerous black-tipped sharks 20 to 40 cm long were seen around Rose Island.

On 3 November 1978 passengers from the M. S. LINDBLAD EXPLORER visited Rose Atoll and observed numerous nests along the beach of Rose Island. Sand

Island was found to be "literally covered with turtle nests, perhaps 100-150." However, only two green turtles and one hawksbill were reported by divers in the lagoon (T. Ritchie, *in litt.* to J. B. Giezentanner).

The impact of rats on hatchling turtles at Rose Island warrants some attention. Direct observations of predation have been made during recent years (S. Swerdloff, personal communication), but the extent and significance are currently unknown. Mayor (1921) was the first author to record rats on the island, which he described as being small, gray-brown in color, tame and very abundant during a visit in 1920. Sachet (1954) assumed that this was the Polynesian rat (*Rattus exulans*), however specimens deposited at the Bernice P. Bishop Museum in Honolulu were never identified (see Ewing, 1924). Hirth (1971) stated that Rose Island "swarms with rats (possibly *Rattus exulans*)." Coleman (1978) found that rats were "extremely abundant" in the center part of the island under the *Pisonia* trees. Rather than the Polynesian rat, this investigator thought that black rats might be present. Four traps were set but no captures were made. Two passengers of the M. S. LINDBLAD EXPLORER reported seeing four "rat-like mammals" during their short visit. T. Ritchie *in litt.* to J. B. Giezentanner stated the following: "The animals ranged from light brown to golden in color, and both people thought they may have had a loose fold of skin between the forelimb and hindlimb on each side (not unlike that found on flying squirrels). The structure of their tails was not positively noted. They were described as being about the size of large mice."

Both islands at Rose Atoll are currently being reviewed by the U. S. Fish and Wildlife Service for possible designation as Critical Habitat for marine turtles under the Endangered Species Act (Dodd, 1978).

Wake

Wake is a triangular atoll consisting of three islands located at 19°18'N, 166°35'E. The nearest land is Taongi Atoll in the northern Marshall Islands, a distance of 600 km to the south. Prior to 1935 Wake was uninhabited except for visitations by Japanese seabird feather hunters. In 1935 an aircraft runway, refueling facility and hotel were constructed by Pan American Airways. The three islands (Wake, Wilkes and Peale) were later joined together by bridges and roads to form a usable land area of 650 ha. The lagoon is less than 4 m deep and partially exposed to the open ocean on the northwestern side. During World War II the Japanese military occupied Wake from December 1941 to September 1945 (Bryan, 1942, Inder, 1978). The Fifteenth Air Base Wing of the U. S. Air Force currently has jurisdiction over the atoll and approximately 200 personnel reside at the facilities. Wake is one of the islands being considered as a storage site for nuclear wastes (Shapiro, 1979).

Both immature and adult green turtles occur in the lagoon and along the outside perimeter of the atoll. However, nesting has never been recorded. Turtles are frequently observed foraging in the narrow channel between the islands of Wake and Peale. In July of 1976 an immature green turtle was found at Wake that had been tagged six months earlier at Midway, a distance of 1900 km. However, the weak condition of this turtle, both at the time of tagging and at recovery, suggests that it may have passively drifted to Wake with prevailing winds and currents.

Standardized report forms are being used by resident personnel on Wake to communicate information to the author on the sightings of turtles.

References

Amerson, A. B., Jr. and P. C. Shelton. 1976. The natural history of Johnston Atoll, Central Pacific Ocean. *Atoll Research Bulletin*, 192:1-479.

Balazs, G. H. 1976. Marine turtles in the Phoenix Islands. *Atoll Research Bulletin*, 184:1-7.

Balazs, G. H. 1978. Terrestrial critical habitat for sea turtles under United States jurisdiction in the Pacific region. *'Elepaio*, 39, 4:37-41.

Balazs, G. H. 1979. Synopsis of biological data on the green turtle in the Hawaiian Islands. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, contract no. 79-ABA-02422, September, 180 pp.

Bryan, E. H., Jr. 1942. American Polynesia and the Hawaiian chain. Tongg Publishing Company, Honolulu, 253 pp.

Bryan, E. H., Jr. 1974. Panala'au memoirs. Pacific Scientific Information Center, Bernice P. Bishop Museum, Honolulu, 249 pp.

Buggeln, R. G. and R. T. Tsuda. 1966. A preliminary marine algal flora from selected habitats on Johnston Atoll. University of Hawaii, Hawaii Institute of Marine Biology, Technical Report No. 9, September, 29 pp.

Coffman, D. M. 1977. An inventory of the wildlife and wildlife habitat of the islands of American Samoa. Report to U. S. Fish and Wildlife Service. Environmental Consultants Inc., Volume 1.

Coleman, R. A. 1978. Trip report - Rose Atoll National Wildlife Refuge, 28-30 March 1978. U. S. Fish and Wildlife Service, Honolulu. 3 pp.

Dodd, C. K., Jr. 1978. Terrestrial critical habitat and marine turtles. *Bulletin Maryland Herpetological Society*, 14, 4:233-240.

Emory, K. P. 1934. Archaeology of the Pacific equatorial islands. *Bernice P. Bishop Museum Bulletin 123*,

Ewing, H. E. 1924. Ectoparasites of some Polynesian and Malaysian rats of the genus *Rattus*. *Bernice P. Bishop Museum Bulletin 14*, 7-11.

Girard, C. F. 1858. Herpetology. U. S. Exploring Expedition, volume 20, Philadelphia, 756 pp.

Graeffe, E. 1873. Samoa oder die Schifferinseln I. Topographie von Samoa. *Jour. Mus. Godeffroy*, 1:1-32.

Hirth, H. F. 1971. South Pacific islands - marine turtle resources. A report prepared for the Fisheries Development Agency Project. Food and Agriculture Organization of the United Nations, Rome, 34 pp.

Inder, S. editor. 1978. Pacific Islands Year Book. Pacific Publications, Sydney, 512 pp.

Johannes, R. E. 1978. Traditional marine conservation methods in Oceania and their demise. *Annual Review of Ecology and Systematics*, 9:349-364.

King, W. B. 1973. Conservation status of birds of Central Pacific islands *The Wilson Bulletin*, 85, 1:89-103.

Krauss, N. L. H. 1970. Bibliography of the Line Islands, Central Pacific. University of Hawaii Library, Honolulu, July, 18 pp.

Mayor, A. G. 1921. Rose Atoll, Samoa. *Science*, 54:390.

Rockefeller, M. and L. S. Rockefeller. 1974. Problems in paradise. *National Geographic*, 146, 6:782-793.

Sachet, M. W. 1954. A summary of information on Rose Atoll. *Atoll Research Bulletin*, 29:1-25.

Scott, N. W. 1979. Museum official hits Palmyra N-storage plan. *Honolulu Star-Bulletin*, 23 June, A:9.

Shapiro, D. 1979. 3 Pacific isles on U. S. list for N-storage. *Honolulu Star-Bulletin*, 14 June, A:1.

Stancyk, S. E. in press. Natural predators of sea turtles and their control. *Proceedings of the World Conference on Sea Turtle Conservation.*

U. S. Department of Commerce. 1978. Final Environmental Impact Statement: Listing and protecting the green sea turtle (*Chelonia mydas*), loggerhead sea turtle (*Caretta caretta*), and Pacific ridley sea turtle (*Lepidochelys olivacea*) under the Endangered Species Act of 1973. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Washington, D. C. July, 144 pp.

U. S. Department of the Interior. 1976a. Briefing sheet - Johnston Atoll National Wildlife Refuge. Fish and Wildlife Service, Honolulu, Hawaii, October, 2 pp.

U. S. Department of the Interior. 1976b. Conserving our fish and wildlife heritage. Annual report FY1975, Fish and Wildlife Service, Washington, D. C., 96 pp.

Weins, H. J. 1962. Atoll environment and ecology. Yale University Press, New Haven, 532 pp.

Wilson, G. C. 1979. Plan for storing nuclear wastes on Pacific atoll strongly protested. *The Washington Post*, 23 August.

Anonymous. 1979. Owner is unaware of plans for Palmyra. *Honolulu Star-Bulletin*, 12 June.

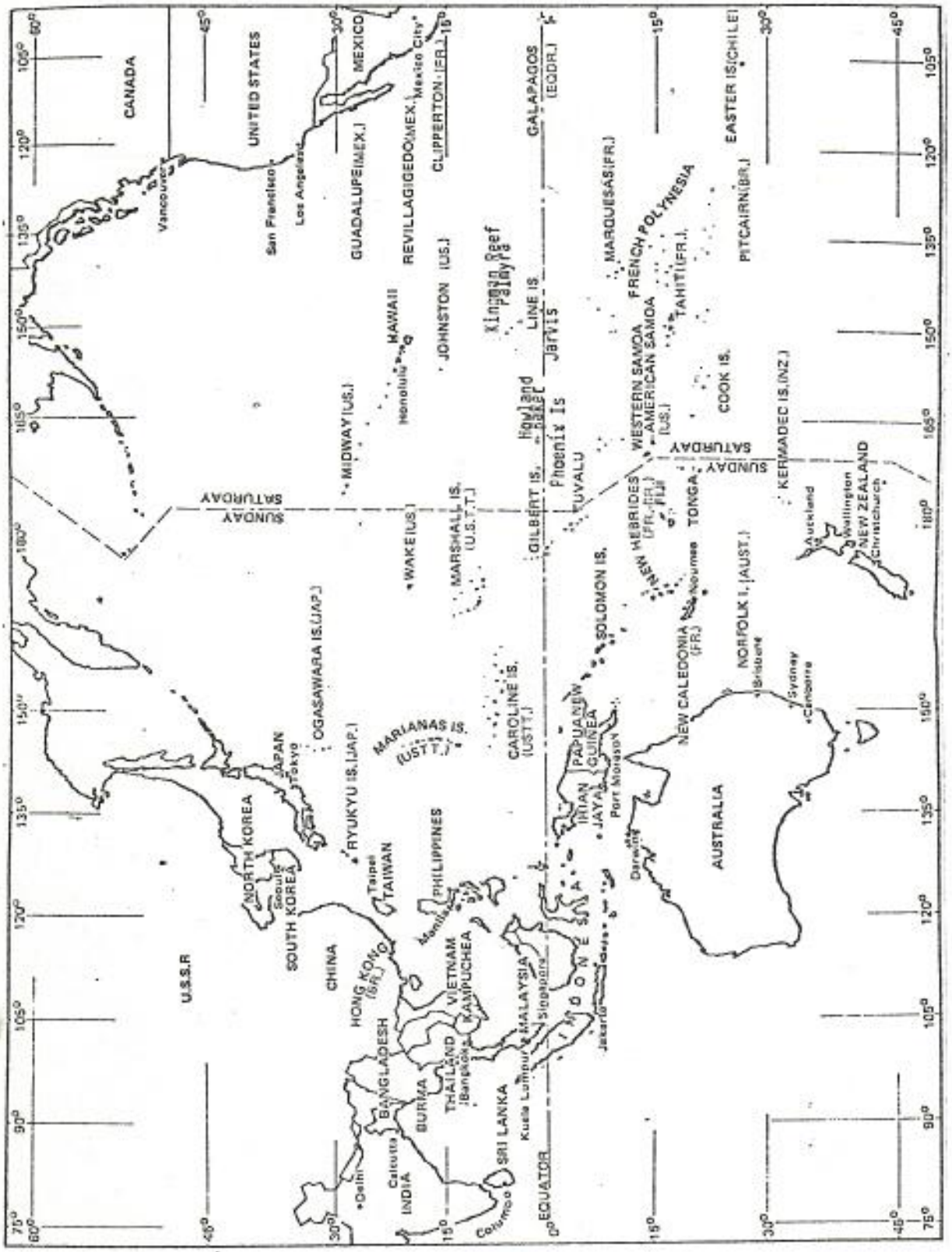

Figure 1. Pacific Ocean (from Inder, 1978).

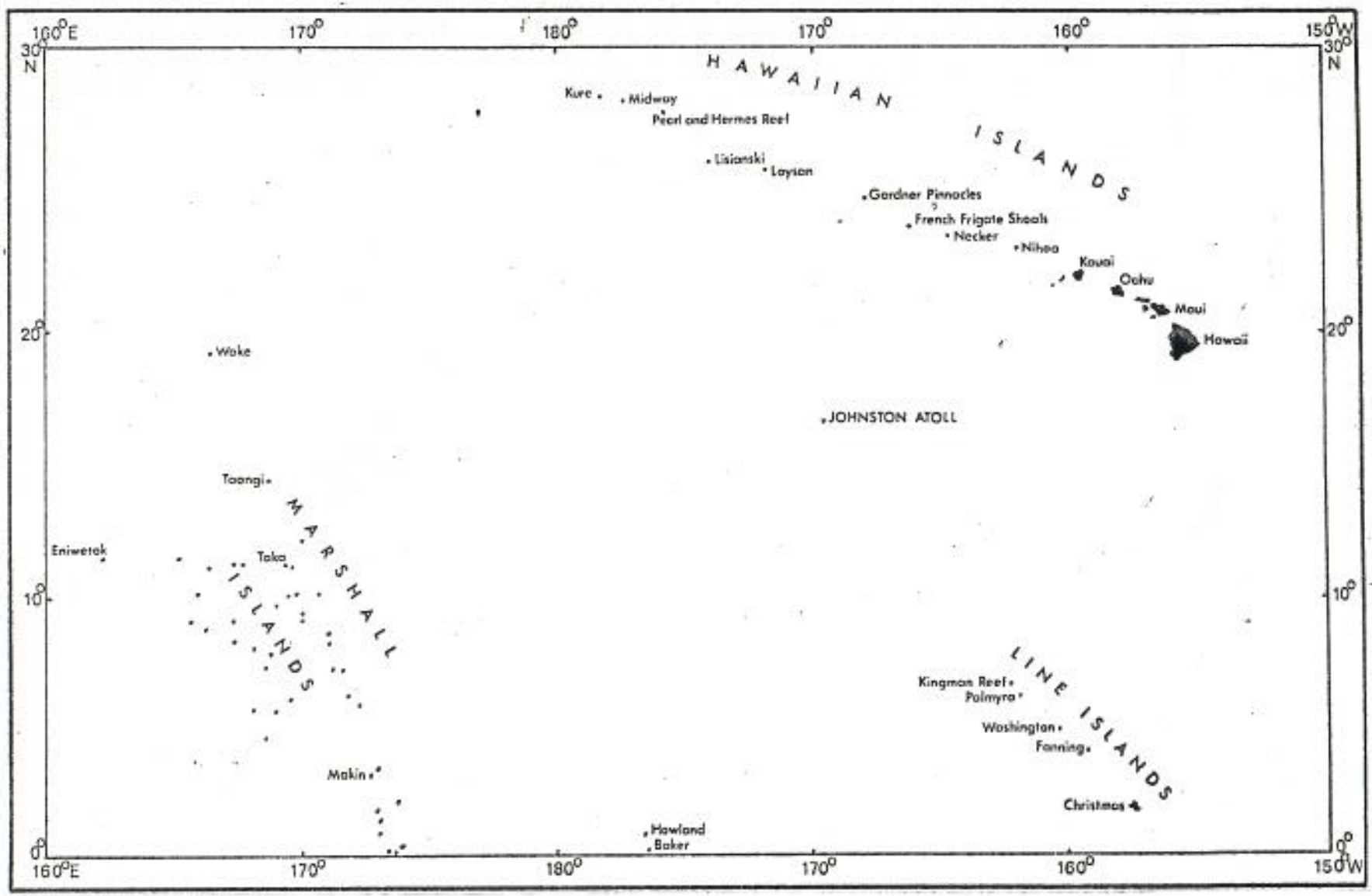

Figure 2. North Central Pacific Ocean (from Amerson and Shelton, 1976).

MARINE TURTLES OF MICRONESIA

(UNITED STATES TRUST TERRITORY, INCLUDING GUAM AND THE NORTHERN MARIANAS)

by
Peter C.H. Pritchard
Florida Audubon Society
P.O. Drawer 7
Maitland, Florida 32751

Report
prepared for
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

December 1979

Table of Contents

MARINE TURTLES OF MICRONESIA

Peter C.H. Pritchard

The islands of Micronesia comprise one of the three 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 United States 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 Kiribati - independent), Nauru (independent) are considered part of Micronesia, and Nukuoro and Kampingamarangi 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; it is commonly stated that Micronesia occupies an equal area 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 2203. The 1973 population was 114, 973 (excluding Guam), with an annual growth rate of 3.6%. The total land area is only 715 square miles.

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, Messerschmidtia, Portulaca, Sida, and Scaevola.

Species Present

The hawksbill (Eretmochelys imbricata) and the green turtle (Chelonia mydas) are present throughout Micronesia and are widely recognized animals among those

familiar with marine life in all districts. Nearly everywhere the green turtle is the more plentiful species, though in the Palau Lagoon area the hawksbill appears to be more common. The local name for the hawksbill is ngasech in Palau; winichen in Truk (wounlele in the Namoluk dialect, according to Marshall 1975); sapake in Ponape; jebake in the Marshall Islands; darau in the western Yap District; mau in the eastern Yap District. The green turtle is called melop in Palau; winimon in Truk (pronounced wounamon in the Namoluk Dialect); calap in Ponape; won in the Marshall Islands (though this is really a general name for all sea turtles, only the green turtle being frequently seen); wel in the western Yap District, and mwon in the eastern Yap District.

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 November 30, 1973. These authors also recorded a small (29cm.) olivacea from Lamotrek, in the easternYap District. Cushing (1974) reported five olivacea that were caught accidentally by long lines and plankton nets between September 13 and 20, 1974, in the southern Palau District (0^{o}-4^{o}N, 131^{o}-137^{o}E). In addition, I saw an immature stuffed 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, and is recognized by the name mirang in the Truk District, though it appears to be only encountered 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 September 2, 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. The local name in the eastern Yap District is wongera (literally - 'whale-turtle'). I also have an unidentified newspaper cutting describing a large leatherback (978 lbs. in weight, 7.11 feet in total length) caught by two Kapingamarangi fishermen off Parem Reef, Ponape Island. The District Fisheries Specialist for Ponape, Alan Millikan, described to me the excitement caused by the capture of this huge turtle, and the great difficulties encountered in preserving it.

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 United States 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 long, or green turtles less than 34 inches long (though only recently has the code differentiated between the two species). In addition, turtles are totally protected by Trust Territory Law during the months of June 1 to August 31 and December 1 to January 31 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 species. 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 only had 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 political or appropriate to thrust unwelcome conservation obligations upon people who would be likely to reject them totally when political independence is reached.

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 Palau District is the westernmost district of Micronesia. It consists of the large but sparsely inhabited island of Babelthaup (the largest island in Micronesia), with an area of 153.24 square miles. Extending north of Babelthaup are some extensive reefs (Kossol, Valasco, Cormoran, North-West, and Nguarangi Reefs), but only a few small islands (Kayangel Islands, Ngarekeklau, Ngaregur). South of Babelthaup is an extensive reef and lagoon, with several relatively large islands (Koror, Urukthapel, Eil Malik, Peleliu, Angaur), and a large number of small, high, irregular, vegetation-covered islands usually known as the Limestone Islands. Bryan (1971) counted 343 islands in the Palau complex. Also included in the Palau District are the isolated southern islands - the Sonsorol Islands, pulo Anna, Merir; and Tobi, and Helen Reef. Tobi Island is less than two hundred miles from the nearest island of Indonesia (Morotai, north of Halmahera).

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 everyday 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% by Dr. Jim McVey, who conducted a head-starting program for hawksbills in Palau in the early 1970's. Adult turtles too are highly persecuted. Virtually any group of Palauans out in a boat in the lagoon will give chase to any hawksbill they see, and with a powerful outboard, a hawksbill chased over shallow reef flats has very little chance of escape. An entire carapace sold for about $75 in 1976; those that were carved with elaborate traditional erotic carvings sold for considerably more. 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 % with the advent of regular air service in the early 1970's; 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 fifteen day intervals, two or three times in a season. Favored islands include Eomogan, where Jeff June of the Peace Corps saw three turtles nesting in one 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, formerly a Peace Corps volunteer teacher on Kayangel and now District Fisheries Officer on Truk, reported about ten years ago he found fully mature green turtles to be plentiful in the Ngaruangl Lagoon, at the northern tip of the Palau complex. A scuba diver could see a turtle every five minutes or so, he said, and villagers from Kayangel could catch five in half an hour to one hour. 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 only reported seeing one male turtle in the area. Nesting (probably by greens) takes place on the barely exposed Ngaruangl Island, since natives of Kayangel returned from

the lagoon with fresh eggs. Raids on the turtles were sporadic, and could only be made during calm weather. The turtles were only used by Kayangel people for special occasions, though they werealso used for trade with villagers on northern Babelthaup.

Green turtles also nest in small numbers on Honeymoon Beach, Pelelieu Island, and, on one 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 miles to the south; coordinates are $4^{o}19'$ N, $132^{o}19'$ E for Merir, and $2^{o}48'$ to $3^{o}01'$ N, $131^{o}44'$ to $131^{o}51'$ E for Helen Reef. Merir now unfortunately has a small permanent settlement, numbering seven 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 two-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 rendevous 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 was Mike McCoy, 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 Turtle in the

Central Carolines" is one of the most valuable sources available on human attitudes to turtles in Micronesia.

The Islands of the Yap District are generally small atolls of minimal elevation; however, Yap itself is a complex of relatively large hilly islands surrounded by a reef. The total area of the Yap Islands is 41.98 square miles. Fais Island, east of Yap, has an area of 1.083 square miles and an altitude of 60 feet. Other islands of the district are measured in acres rather than square miles, but many include extensive reef systems, and nearly all except for the most miniscule have human populations.

Turtles do not appear to nest on Yap itself, though both hawksbills and green turtles (nearly all immatures) are caught around the Yap Islands. The most important nesting area (for green turtles) in the Yap District is probably the atoll of Ulithi, about ninety miles east, and slightly north of Yap. The total land area of Ulithi is 1.799 square miles, and the population in 1970 numbered 585. The turtles nest principally on the uninhabited islands of Gielap and Iar, in the Zohhoiiyoru Bank about fifteen miles west of the principal atoll. Some nesting also occurs on Pig Island at the southernmost tip of the principal atoll. The nesting season is from May to August, and Jesse Marehalau, a native of Ulithi now assistant Fisheries Officer on Yap, estimated that about 8 or 9 turtles nest each night on Iar, 13 or 14 on Gielap, and 7-8 on Pig Island. Marehalau also mentioned that adult turtles may be seen in the water in large numbers over a shallow sandbank between Ulithi atoll and the Zohhoiiyoru Bank, near the islands of Losiep, Bulubul and Pau. 34 turtles were seen here by Marehalau on a three-hour fishing expedition. Most of the turtles appeared to be females which had migrated into shallow water to avoid the attentions of the males; the latter were found mainly in deeper water, and on the sandbank there were 7 or 8 females to each male. Some, but not very many, hawksbills also nest on the Ulithi Islands, although half-grown hawksbills are often seen in the water.

Ngulu atoll, southwest of Yap, has very little land area (0.165 square miles), but has a large lagoon of 147.707 square miles and a small human population that numbered 61 in 1948 and 43 in 1970 (the island was unpopulated in 1935). The northern islands of North Island and Meseran are used by nesting green turtles. The northern end of North Island has a sandspit that appears to above the spring tide level which is sometimes used by nesting turtles. A peculiarity of the Ngulu nesting ppoulation is a very early nesting season; McCoy found that the turtles were well into their nesting season in February. Ngulu atoll is very susceptible

to storms, and this provides some degree of protection from the natives, who live on Ngulu Island at the southern end of the atoll, about fifteen miles away from the turtle islands.

Sorol atoll, about 150 miles east of Ngulu, has a human settlement of about 12 people on Sorol Island. Some green turtles are reported to nest during the summer on the more remote islets - numbers are uncertain, but probably a few each night.

Gaferut, a single, uninhabited island nearly a mile long, located some 500 miles east of Yap, may have the second best population of nesting turtles in the Yap District (after Ulithi). Moreover, as McCoy (1974) reports, "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 accomodate many large turtles. The turtles often stay in this natural hole during the day or days preceding their nesting. A standard method of capture on Gaferut is to silently sneak up on this depression in the reef and capture the turtles resting there."

Another important nesting island for green turtles is Pikelot, a tiny uninhabited spot of land (0.036 square miles) situated in the extreme eastern part of the Yap District, at $8^{\circ}05'$ N, $147^{\circ}38'$ E. Viti (1975) wrote as follows regarding a one-week stay on Pikelot during May 1972: "...Pikelot had the precious sea turtles. For some reason, this is one of the few turtle-breeding islands in Micronesia. Every night we found at least four turtles coming ashore to lay eggs. The first time I walked around the island, I was amazed at the turtle tracks on almost every square foot of sand."

West Fayu is a single uninhabited island associated with a small lagoon; the island is situated at $146^{\circ}44'$ E, $8^{\circ}05'$ N, and has a land area of 0.024 square miles. Turtle nesting is minor on this island - one or two each night during the season - but the resource is one of great economic importance to the people of Satawal Island, 47 miles to the south-southeast.

Other turtle islands in Yap District include Ifaluk, where Bates and Abbot (1959) reported some nesting activity on Ella Islet and often found the turtles browsing on the two species of marine grass found in the lagoon.

Turtles also nest in small numbers on Olimarao (two islets) and on the small atoll islands south of Elato known as Lalolior, or Namoniur. Elato is, incidentally, named after an unidentified type of sea grass which grows in the shallows of the lagoon. This would appear to be favored by green turtles; McCoy (1974) saw four turtles inside the Elato Lagoon during his canoe's approach to the island in November 1972. In former times turtles may have nested on Woleai, but with a

human population that numbered 576 in 1970, there are now probably only one or two nestings annually on this atoll.

Turtles are the most favored marine resource in the Yap District, and elaborate customs and ownership systems have grown up around the use of turtles. Perhaps the most noteworthy are those of Ulithi, where the turtles on the outer islands of the Zohhoiiyoru Bank are considered to be the property of the chiefs of the islet of Mogmog, even though the outer islands themselves are considered the property of the people of Falalop (which lies considerably closer than Mogmag to the turtle islands). Neither turtles nor their eggs may be taken from the nesting beach without permission from the chiefs of Falalop. However, even Falalop people must take turtles that they capture to Mogmog for slaughter under supervision of the chiefs of Mogmog; moreover, the Mogmog claim a substantial part of the turtle for themselves as a sort of commission. Anon (1975) wrote that the chiefs kept all but the shell and "part of the hind bone without any of the flesh," and McCoy (pers. comm.) reports that the chiefs of Mogmog still keep about 97% of the useable part of the turtle. Consequently, pressure on the nesting turtles is moderated, and the Falalop people usually just collect eggs, which do not have to be taken to Mogmog.

In September 1974, someone, presumably from Falalop, killed a turtle on the nesting beach and failed to conceal the shell and bones adequately. Later, a Mogmog chief visited the nesting island and found the remains. Unable to identify the culprit, the Mogmog chiefs issued an order to everyone on Falalop that was reported by the Marianas Variety newspaper of October 11, 1974 as follows:

> No one on Falalop may touch the sea water for three weeks; do not use the sea for cooking, do not catch any fish or anything from the sea; do not use the water for benko; do not swim in the sea; do not travel on or under the sea within or outside the lagoon in the vicinity of Ulithi atoll; there is nothing in the sea which you can eat.

This edict was obeyed, since the alternative punishment was possible destruction of one's house and crops. The punishment even extended to U.S. government employees, Peace Corps volunteers and a Jesuit missionary. Finally, all the chiefs of Falalop travelled to Mogmog and presented 77 lavalavas to the highest chiefs (lavalavas are intricately woven skirts worn by the outer island women). These lavalavas were presented in order to obtain certain favors - four were donated as part of a petition to be allowed freedom of the sea again; one was

presented in order to obtain permission to enter the chiefs mens club on Mogmog; and 72 were given in the hope of being granted freedom to collect turtles without the necessity of bringing them to Mogmog for slaughter. This latter request was, fortunately for the turtles, refused.

The one time of the year when the Falalop people have a particular need for turtle meat is in May when the graduation ceremonies are held at the Outer Islands High School, situated on Falalop. This ceremony requires the meat of perhaps thirty turtles for the feast afterwards; but the turtles are still taken to Mogmog for slaughter. On turtling trips, the islanders typically stay on the nesting island for about three nights, waiting until each turtle has nested and then turning it on its back. Not all are kept, but on the third day the best turtles are selected and the rest released.

Traditional ownership rights for sea turtles also exist in Yap itself. Here, if a turtle is caught, it must be presented to a member of the family which owns the rights to turtles. Turtles accidentally caught in the course of other fishing operations are thus frequently released to avoid the bother of giving them away; but nowadays these customs are dying and people who catch turtles tend to keep them. Formerly turtles were caught by means of nets and traps; a favored type of trap consisted of a V-shaped arrangement of rock walls in shallow water; as the tide recedes, turtles may be caught in the deep, enclosed end of the V. A few of these traps are still in use; however, most turtles now are caught by divers operating from a powered boat. The economic sense of the people appears to be poorly developed and a hunt is considered a success even if the value of the fuel consumed is greater than the value of the turtle or turtles caught.

On Ifaluk, where perhaps ten to fifteen turtles may nest in the course of a year, the turtles belong to the ranking Kovalu clan to whose chief belongs the perogative of butchering and distributing turtle meat (Anon, 1957).

McCoy (1974) has described the patterns of traditional ownership and exploitation of turtles in other islands of the Yap District. For example, the people of Satawal obtain their turtles principally from the island of West Fayu, 47 miles to the north-northwest; turtles brought alive from West Fayu are placed at the disposal of the chiefs of Satawal for distribution among the inhabitants. Satawalese also collect turtles on occasion from Pikelot, but this is a more difficult journey, against the prevailing winds, and the landing is dangerous. Nevertheless, the turtles there are considered to belong to the people of Satawal, and voyagers traveling to Satawal from Truk District invariably stop at Pikelot to bring turtles to the chiefs of Satawal. However, the Pikelot turtles may be

exploited by the people of Pulusuk, Puluwat, and Pulap-Tamatam in Truk District without obtaining permission from Satawal.

Turtles on Namoniur and Olimarao belong to the people of Lamotrek and Elato; however, exploitation of these turtles is carried out by motorized boats rather than the traditional canoes used by the Satawalese. One man stands in the bow of the boat, while the other operates the outboard; when a turtle is spotted, it is chased and harpooned. The turtles of Gaferut, on the other hand, belong to the people of Faraulap, though they may be also exploited by people from Woleai and Ifaluk. However, the use of Gaferut turtles by Faraulap has declined since a typhoon in the 1950's killed most of the able-bodied men and destroyed all of the sea-going canoes.

The only efforts to date to take positive steps to augment the Yap District turtle populations were hatcheries operated on West Fayu by Mike McCoy in 1972 and Mike Gawel in 1974. Approximately 600 hatchlings were produced in 1972, and 250 in 1974. The turtles were raised in captivity but were released in batches after a few months, as they began to outstrip the food supply.

Marianas District and Guam

Hendrickson (ms) quoted the following information, received from Issac 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 15lb. to 400lb. are taken, but the informant estimates that the average size is around 60lb (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, informed me that he had made a number of flights over the Guam coast during the last couple of years, and that he had seen sea turtles - sometimes in concentrations of 40 or 50 individuals - off the northern coast of Guam, between Ritidian Point and Pati Point. Kami also informed me that he sometimes saw 3 or 4 turtles off the coast near Inarajan Bay, on the southeast coast, and that turtles formerly nested on Cocos Island, off the southwest coast, though 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 which lessen the suitability of this beach for nesting may include the shallow reef (only three feet 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 large from an aircraft at 200-250 feet altitude; but mating pairs had not been seen.

Kami found one 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 July 12, 1976) that Dick Randall of the University of Guam Marine Laboratory reported six recent turtle nests on June 26, 1976, at the north edge of Sella Bay on the southwest coast of Guam.

Recently, Molina (1979) has reported on five years of aerial surveys of turtles around Guam. The following section is extracted from this report:

Study Site.

Island of Guam divided into 12 survey regions (Figure 1).

Turtle Sightings.

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 five years.

Distribution.

Far more turtles were sighted within region 12 (Pati Pt. - Ritidian Pt.) than in

any other (Figure 2). The 285 sightings made within this region represent 36.4% of the five-year total. This is almost as many turtles as were observed within regions 8, 9, 10, and 11 (Cocos Lagoon - Pati Pt.) combined; that is, 294 turtles or 37.5% of the five-year total. Taken together, approximately 74% of the observed turtles were seen within these five regions alone. The most probable explanations for this distribution are the low levels of development and fishing pressure found in these areas.

Seasonality.

Marine turtle abundance appears to peak twice during this year (Figure 3). In general, these peaks coincide with the winter (December - February) and late spring (May - 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.

Multi-Annual Cycle.

Reports have been made of larger than usual numbers of turtles visiting Guam about every three 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 shows the winter increase in numbers. However, this year's influx of turtles doesn't appear to be as strong as the one which occurred in 1976.

Remarks.

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. This species has a known gestation period of about three years which would explain the tri-annual increase in numbers of turtles observed on the aerial surveys. This also supports information offered by Manuel Castro, property-owner and resident at Tarague Beach (west end), that turtle nesting at that site is heavier every third year or so.

It may be that mating (and possibly nesting) occurs every year among the "resident" portion of Guam's turtle community, and that the tri-annual increase in numbers is due to the return of the "migrating" portion for mating and nesting. Extra effort, by whatever means available, should be expended to insure the greatest

possible survival of at least the tri-annual adults and hatchlings. This would help keep the largest possible number of turtles returning to Guam.
Mr. Castro has also stated that human interference with nesting turtles is a serious problem at Tarague Beach. According to him, 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 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 it is very expensive - though 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, the objection being that turtles protected in Guam may well be caught in the Trust Territory. However, Guam being 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. To the average fisherman, capture of a turtle is looked upon as a fortunate bonus that may add greatly to the value of his catch. In former times in Guam, turtle blood was looked upon as a cure for a great variety of diseases, including asthma and tuberculosis.

North of Guam, the Northern Marianas Islands stretch in a slightly curved elongate chain. From south to north, they are: Rota, Aguijan, Tinian, Saipan, Farallon de Medinilla, Anatahan, Sarigam, Gaguan, Alamagan, Pagan, Agrihan, Asuncion, Maug, and Farallon de Pajaros. Saipan has a population of over 10,000 people; the population of Rota was 1,363 in 1970, and of Tinian was 711. A few families visit Anatahan from time to time, and about fifty people live on each of Alamagan, Pagan and Agrihan, but the remaining islands are uninhabited. 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

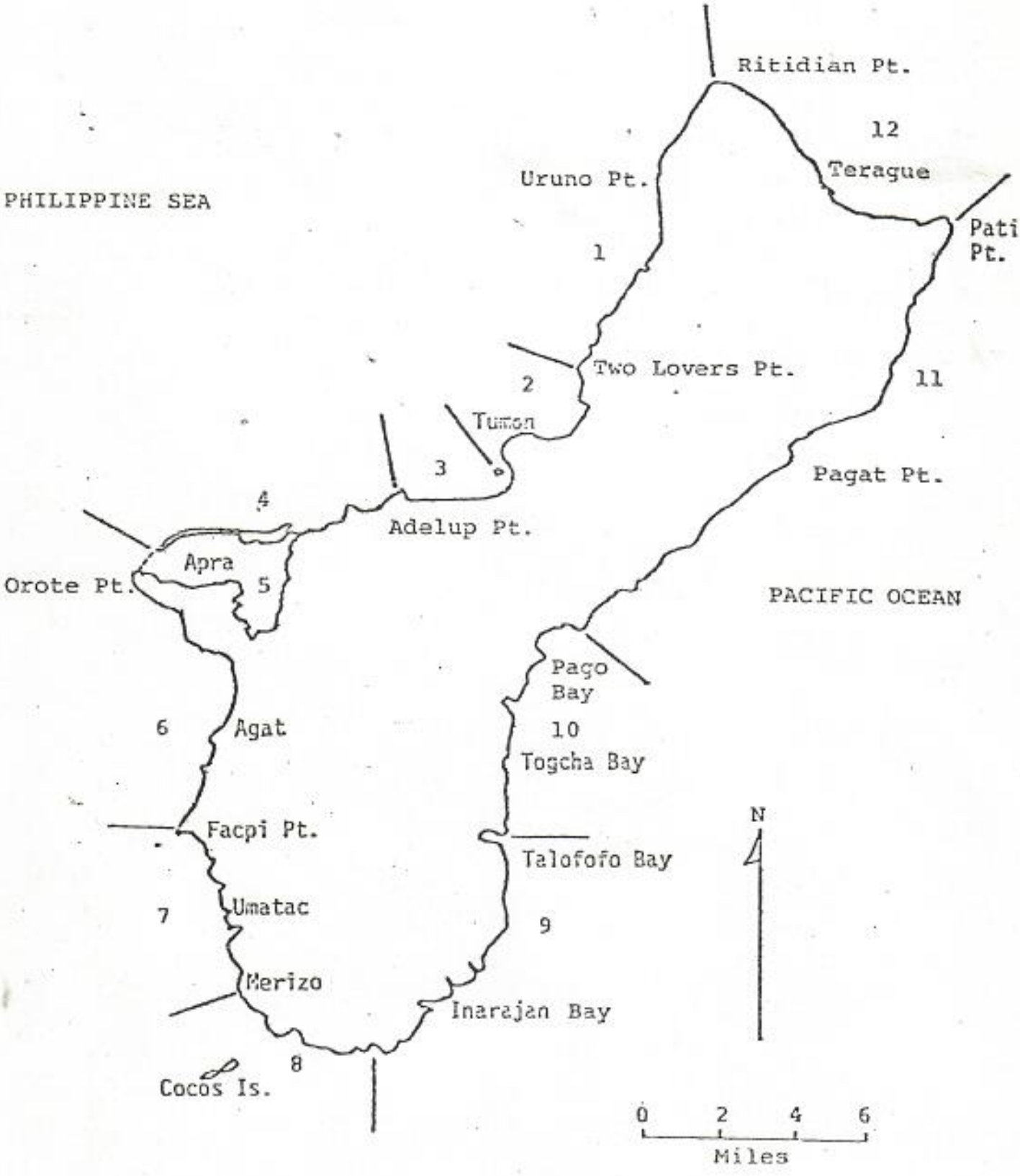

Figure 1. The island of Guam with its twelve aerial survey regions.

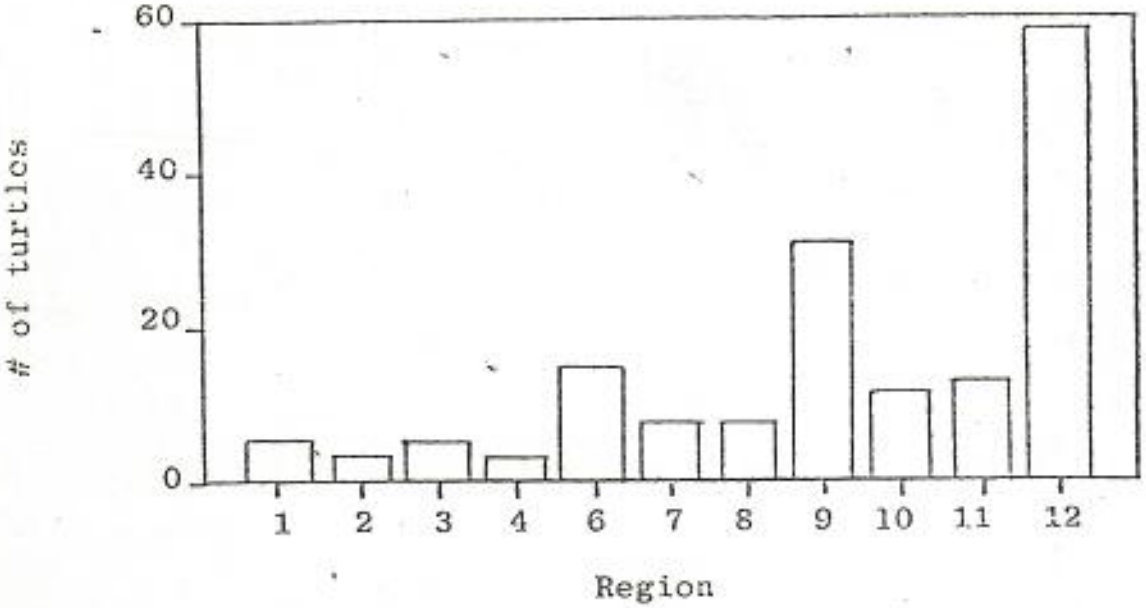

Figure 2. Mean number of turtles observed in the survey regions during Fiscal Years '75-'79.

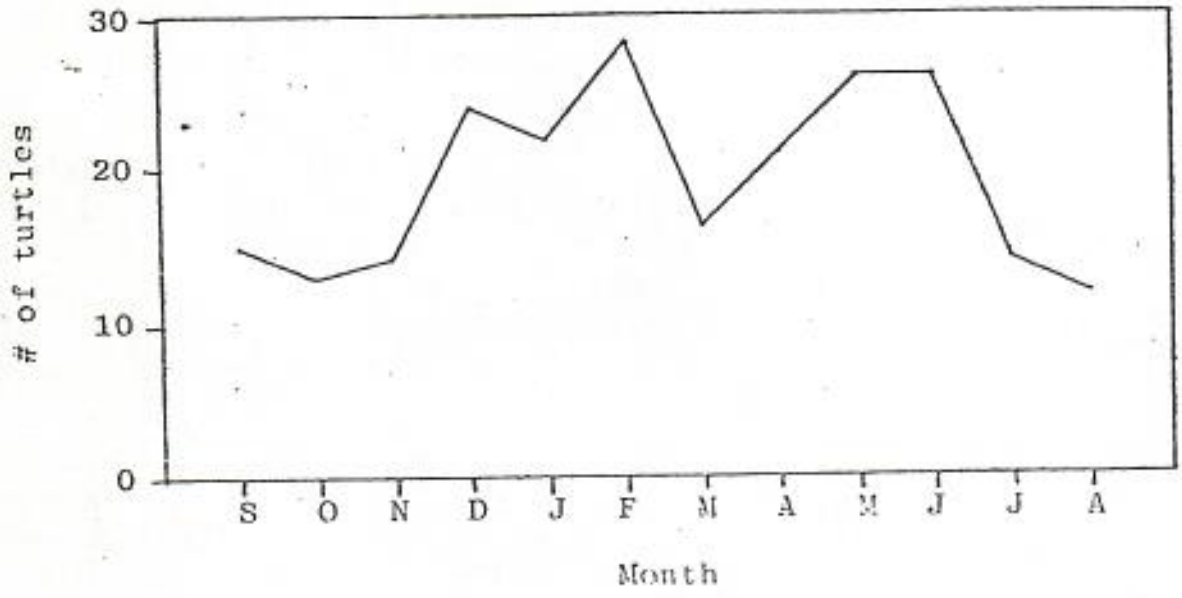

Figure 3. Mean number of turtles observed per month during Fiscal Years '75-'79.

TABLE 1. Summary Of Turtle Sightings By Aerial Survey Region For Fiscal Years 1975 Through 1979.

	REGION													
	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL	# MONTHS
FY'79	4	1	1	1		1	6	2	43	31	18	77	185	12
FY'78	6	3	1	9		6	14	3	10	1	15	15	83	12
FY'77	0	3	1	1		4	1	5	10	0	8	8	41	2
FY'76	7	5	6	6		35	8	14	44	10	12	42	189	9
FY'75	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		

TABLE 2. Summary Of Turtle Sightings By Month For Fiscal Years 1975 Through 1979.

	MONTH													
	J	A	S	O	N	D	J	F	M	A	M	J	TOTAL	# FLIGHTS
FY'79	12	3	6	6	7	12	18	52	24	14	20	11	185	24
FY'78.	7	6	10	4	16	17	7	5	0	3	4	4	83	24
FY'77	23			18									41	4
FY'76		20	28	24	20	42	16	10	7	22			189	18
FY'75							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		

whatever. Saipan has several miles of beach on the west coast, but this 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 yards of the beach suggest good feeding habitat for green turtles. Rota has several beaches, and Tinian two small, marginal ones, but I have no evidence that these are used by nesting turtles.

I spent one day on Saipan in the course of the survey and saw stuffed turtles for sale at several locations. At the Continental Hotel, three mounted green turtles were on sale; the medium-sized specimen was priced at $200. This hotel also had a hawksbill shell on display that was not for sale.

In a handcraft shop on Beach Road, thirteen stuffed green turtles (half grown to mature) were for sale; also three hawksbills, and one ridley. The ridley, although a rarity in the area, was considered less attractive than the others, and was priced at $59.95; the hawksbills were around twice that price. The turtles were reportedly all locally caught.

While on Ponape, I received a report from Ben Sablan that turtles were 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 one diver could easily catch four or five turtles in a day.

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 forty miles in diameter. The lagoon is fringed by a reef which is broken in several places and which reaches above sea level to form small, low islets, principally in the northern and south-eastern 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, Pulap, Puluwat and Pulusuk are low atolls.

Anon (1957) describes the methods used by Trukese for hunting turtles in aboriginal times. In one method, a net approximately two hundred feet long and from ten to twenty feet wide was constructed from sennit twine. At night when the tide was high the net would be tied to poles and suspended in the water.

When a turtle was sighted the net would be drawn around it in a wide circle. The diameter of the circle was gradually diminished until the turtle was enmeshed and could be taken alive. This method is no longer used. Turtles were also caught on the nesting beaches. Later, when they acquired metal, they fashioned harpoons and would go hunting at night by torchlight. The Japanese in the Truk District used to dive for turtles while carrying a long, barbed pole to hook the turtle in the neck, after which it could be dragged to the surface and maneuvered into the boat. In former times in Truk, certain parts of the turtle (and of all the larger and more important food resources) were offered to the chief, or the most important person on the island where the turtle was caught. This however has now been discontinued.

One experiment to produce turtles in captivity took place during Japanese times. Two turtles, a male and a female, were enclosed in the lagoon near Tunnuk Village on Moen Island in Truk. An artificial beach was constructed in the hope that the turtles would breed and deposit eggs, but after a little more than a year no eggs had been laid, and the project was abandoned.

Although only two 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 only seen occasionally, and always in deep water; there are no nesting records in the area. The other two species are both widespread, but the green 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 liable to get killed. Mr. Pius informed me that the casual nesting in this area (perhaps one or two turtles per night on each beach during May to October) had not diminished perceptibly during the last fifty years. In the Lower Mortlocks, Marion Henry reported casual hawksbill nesting in all three 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 seventy miles north-northwest of the Northeast Pass leading out of the Truk Lagoon, is an important one for green turtle nesting. About six or seven turtles are reported to nest here each night during the season, which begins remarkably early (February), and lasts until about June. This corroborates with the belief of the Satawal people in the Yap District, as reported by McCoy (1974), that turtles start nesting earliest in the easternmost of the turtle islands known to them, i.e. East Fayu. The island is elongate, less than a mile 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 miles to the east. A few greens (one to three per night) are also reported to nest on Fanang Islaet, 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 repprted in the Western Islands, all of which are inhabited. However, the people of Pulusuk, and also of Puluwat and Pulap (Tamatam 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 three or four times during the two-month period, and a typical catch is about twenty turtles, which are collected on the beach during a stay of one 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 (vide supra) 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. I was informed that a turtle could 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 contrast to Palau, where a (justified) belief in a nesting cycle of about fourteen days for sea turtles is widespread, the Trukese have some elaborate, and worthless, methods for calculating the number of days before a turtle can be expected to return to lay another clutch. According to Anon (1957), the Trukese

count the number of eggs, and the odd number of eggs over even hundreds is the number of days after which the turtle could be expected to return. Thus, a clutch of 217 eggs indicates that the turtle will return after 17 days etc. A variant of this, which was described to me while I was on Truk, is to add ten to the number of eggs over an exact number of tens (e.g. 153 eggs - re-nesting expected in thirteen days). Even my informants must give little credence to this, however, since they also said that the green turtle will renest after ten to thirteen nights. The Trukese informants also stated that they know no way of telling whether a clutch is the first or the last of the season, although in some other parts of the Trust Territory it was claimed that the first nest of the season had a few deformed (e.g. oval) eggs at the bottom (i.e. the first to be laid), while the last clutch had similarly deformed eggs at the top (i.e. the last to be laid). It is quite possible that this observation is correct.

In the Truk District, it was reported to me that the green turtle often weighs 300 to 350 lbs., and occasionally 400, and usually laid 80 to 120 eggs. The hawksbill weighed 100 to 150 lbs, 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 sea grass and algae. When I questioned an informant (Appo Pius, a fisherman of fifty years standing) on this, he appeared absolutely certain that stomachs 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.

Slightly different methods of preparation of turtles for consumption prevail in the Hall Islands and in the Mortlocks. In the former, the intestines of the turtles are pulled out by cutting around the vent and extracting them, the otherwise intact turtle then being placed over a fire for cooking; this method was said to retain juices better. However, in the Mortlocks the more usual method of removing the plastron before cooking was followed.

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 2500 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 people 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.

Anon (1957) described the traditional methods used for capturing sea turtles in the Ponape District in early times. The turtles were caught by the following methods: 1) searching for turtles associated with long strips of floating seaweed, and catching turtles spotted by teams of expert swimmers equipped with ropes; 2) during calm weather, turtles could be caught by jumping on their backs from a canoe, stunning them to make them easy to catch; 3) baiting marked areas of the reefs with types of seaweed known to be especially favored by the turtles; 4) placement of large nets across areas through which turtles can be expected to flee when alarmed; 5) capturing the male of a copulating pair, and keeping the female to attract other males, which are captured after they have mounted the tethered female; 6) flipping nesting turtles on their backs during the season (March to July).

In the Ponape District, anyone was allowed to catch turtles, but the meat had to be offered to the Nanmwarki, or highest-ranking individuals on the island. If the meat of eggs were not offered to the Nanmwarki, punishments would be meted out; such punishments could include exile, the offering of prolonged atonement feasts to the Nanmwarki, destruction of the house of the offender, or even death.

I spent five 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 20 inches long) are easily seen and caught. Ben Sablan observed five such turtles on an underwater survey of the 6-square mile Mokil Lagoon in 1974.

Around Kusaie, Sablan found 31 green turtles and 6 hawksbills during a three-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 Mategan, 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 three 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 nine and fifteen turtles nest on Oroluk on the average night, with up to twenty 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 and keep them in a

corral made of coral rocks and sticks, in which the turtles are able to swim by high tide but are stranded by low tide. Ben Sablan released six turtles confined in this corral in July 1975; carapace lengths ranged from 38 to 43 inches. The turtles were tagged before release.

Ben Sablan submitted a memorandum to the District Administrator of Ponape on April 11, 1974, urging that Oroluk be established as a turtle sanctuary. The document was persuasively written and describedthe benefits to science as well as to the people of the Ponape District that would result from protection of the turtles, their eggs, and nesting habitats. Nevertheless, no results were forthcoming and Sablan was prevented by pressure of other duties from tagging turtles on Oroluk during the 1976 season. In another 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 two years ago, the number of turtles nesting had dropped considerably. This may well have been due to excessive predation, though 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 camp fires maintained until midnight; 3) copra operation with outboard motor until 9:00 a.m.; 4) ship generator and lights were 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 slavage crew every night. The ship had spilled 600 tons of oil and was not completely de-fueled until more than six months after the wrecking.

Anon (1957) described some early attempts at captive culture of sea turtles in the Ponape District. Interestingly, it was reported that the meat of such captive-raised turtles was not highly prized. During Japanese times several individuals raised turtles under government sponsorship and special pens were constructed for this purpose. On Mokil such pens were still (1957) kept for this purpose. The shells of these animals were used for ornaments and for containers and tools.

A recent experiment described by Sablan was performed in 1975. Mr. Moses Saimon of Madolenihmw, Ponape, obtained 121 newly hatched hawksbill turtles and attempted to raise them. The turtles prospered reasonably well, with 91 of the turtles still alive after 3½ months, when they were released. At that time, their average carapace length was 8.8 cm.

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 two parallel axes, the northeastern being the Ratak Chain and the southwestern the Ralik Chain. None of the islands reaches a height of more than a few feet above sea level, and the total land area of the District is only 69.84 square miles. 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 World War II when these islands were used for atomic weapon 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 Anon (1965), while excellent maps and directories to names of islands are provided by Bryan (1971). Anon (1957) provided the following historical information on the use of turtles in the Marshall Islands:

A. Methods of Capture or Killing.

The northern Radak atolls of Bikar, Bokak (Taongi), Toke, the island of Jemo and the islands of Lrik and Luij in Erikub Atoll have been used from time immemorial as game reserves by the Marshall Islanders. Periodically, turtles and their eggs were harvested there, The traditional practices of harvesting these animals and their eggs usually took place on special islands with the chief opening the season. Stylized and elaborate rituals were connected with these first food gathering expeditions of the year which occurred in the summer. This gathering was apparently done at the time when the turtles were ashore laying eggs. Both the eggs and the turtles would be taken at this time. Though turtles and their eggs are still taken the ceremonialism formerly connected with this activity is no longer practiced.

The ability of the Marshallese to capture turtles at sea depends to a great extent on the fact that the habits of turtles, an important source of protein to the atoll dwellers and highly prized by them, are well known, having been observed by them for centuries. Certain of the Marshallese know more than the others about these reptiles and their opinion and guidance as sought and respected.

B. Local Custom Regarding Capture of Turtles and Use of the Meat.

As has been previously noted, expeditions were assembled to go to some of the islands known to be heavily populated by turtles. Upon arriving at the island the chief and all of the members of the expedition went ashore. The chief had to lead the first trip of the year and he was the first person to step ashore. Before the party commenced their search for eggs, supernatural sanctions were requested. Everyone assembled on the beach, before proceeding in and cut a leaf of coconut frond. With the chief leading the way they walked in single file, each carefully stepping in the footprints of the person in front of his so that only one set of footprints would appear, as if only one person had been there.

The women were required to hold mats over their heads while on the island so that they could only see the ground well enough to gather the eggs and other items. Strict silence was observed. Often medicine was made by the chief from the leaves of a small rare plant (marutto). The leaves were pounded and the juice extracted and drunk by all to prevent anal bleeding and diarrhea which might result from the unaccustomed meal of turtle and birds' eggs. After the eggs were gathered the group assembled at a specified place before consuming any eggs. Four eggs were thrown in each of the four cardinal directions by the chief as an offering. These "sacrificial" eggs were then re-gathered and eaten by the leader of the party and the remaining eggs were then divided up and eaten by the others.

Turtle flesh was distributed according to a specified, traditional pattern but this custom is not followed today.

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. Valuable information was also obtained from the writings of Anon (1957), Hendrickson (ms.), Fosberg (1969), Helfich (ms.), and Hiatt (1951).

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 square miles.

Anon (1956) said of Bikar: "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:

> Bikar Islet, the largest of the three, is of sand, except for areas in the interior where this has been cemented into phosphate rock. On the western and southern coasts are sand flats with rather open vegetation much frequented by turtles as nesting sites. An outstanding feature of these parts, especially on the south coast, is the way the sand has been churned up by turtles digging holes in it. On the afternoon of August 6th, I counted 596 tracks. That night six more turtles came ashore, of which three were seen by the party. One was measured, being 70 cm. across and 135 cm. long. She was strong enough to move on land with a small man sitting on its back. When caught she shed tears. When released she headed back to sea, climbing over very rough pitted rock remnants with some difficulty, but successfully. A few turtles came ashore on each of the following five nights, on August 10 about 15. One August 11, three were seen, but probaly more came ashore. One night one blundered through our camp, creating much havoc. One that was spotted coming out of the water was frightened by the light and turned back. Two more turtles were measured, one being 80 cm. wide and 122.5 long, and the other 70 cm. wide and 115 cm. long. Colors and patterns on shells were most varies.
>
> I watched one come ashore at 8:10 p.m., August 11, before the moon rose. She walked about 50 m. inland, poked her front end into a large Scaveola bush, stopped and began to scratch with her hind flippers could reach, using a peculiar back-hand scooping motion with alternate feet, each time, while digging with the one foot, flipping away the sand that was brought up by the other foot previously. This appeared to be a very inefficient method of digging. When the hole was finished the rear end of the turtle projected over the hole and the tail pointed downward. Eggs were expelled 1-2 or even 3-4 at a time, dropping into the hole. This turtle laid 92 eggs, taking 11 minutes for the actual laying process. The she filled the hole very carefully with sand, which she patted and pressed down in a mound over the eggs. Gradually she spread this mound out and covered it with dead leaves, then dug a pit to one side and threw dirt over the hole where the eggs were laid, making a low broad mound over it, so that one would scarcely guess where the eggs were laid. The whole process took over three hours.
>
> Newly laid eggs were seen from 3 different individuals, varying somewhat in size from turtle to turtle. In the clutch of 92 mentioned above was one tiny egg, the size of a marble.
>
> The sand flats outside of and especially in the open Tournefortia belt around the Pisonia forest that covers most of the islet, were thickly spotted with the shallow pits, 60 cm. to 1 m. across, each with a low

> mound at one side. Two of these mounds were observed to have small holes in them, with numbers of small flies buzzing about them, and, in one case, hermit crabs in the holes. These holes may have been made by the hermit crabs, but were probably made by young turtles emerging. One hole had a broken shell in it.
>
> 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 carapace, the rats through the plastron. On August 10 and 11, at about 8 p.m., batches of young turtles hatched out and came running through camp, on their way to the sea. They followed lights.
>
> 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.

The location of the hole containing the eggs beside the pit excavated by the turtle is in marked contrast with the situation in Malaya and Sarawak, reported by Hendrickson (Personal Communication), where the hole with the eggs is some distance from the pit.

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, Mr. Maynard Neas. It is hoped that this protection may be strengthened, as clearly Bikar is the principle turtle nesting area in the Marshalls and should be kept as a stocking area for the rest of the archipelago.

Judging by the numbers given in the earlier part of this quote, 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.

Hendrickson (ms.) was able to visit Bikar on July 2-3, 1971 and made the following observations:

> The consultant visited Bikar Atoll and all three 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 seven-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 six days (78 tracks, half ascending, half descending). Thirty-five of the 39 turtles had used the beach on Bikar Islet, one had ascended the Arumeni and two 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 0.06 square miles. The turtles on Jemo were described as follows by Anon (1956):

> Many turtles visit 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 December 18 to 22, 1951 and observed tracks corresponding to the nesting of 22 turtles during the past several days. A nesting turtle observed by Fosberg measured 75 cm. across and 120 cm. long (presumably total length).

The Rev. Elden Buck of Kwajalein informed me that a boat from Likiep sometimes brings ten to fifteen 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 Enego 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 Missle 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 (0.0996 square miles). 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 six miles long and has an area of 1.083 square miles. Bryan (1971) lists the 1970 population of Ebon as 480 - substantially reduced from the 1935 and 1948 censuses. Ebon has a reputation for abundance for 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. Two to four can be caught per night. 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. 93 islets are listed by Bryan (1971). The atoll is of irregular, meandering shape, generally elongate in form with the eastern end bent sharply downwards and the northern part formed into a point. The islets of Kwajalein (at the southern tip) and the 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 ten or fifteen miles.

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. Major Barnett described how turtles are caught by children on the island off the ocean side of Kwajalein: A fishing line is equipped with a hook baited with bread and a children's balloon; the trade wind carries the balloon to the edge of the reef, where turtles often take the bait. Most turtles break the line or otherwise escape, but an estimated 25 turtles per year are caught in this fashion. 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.

Turtles are maintained in captivity in two pools on Kwajalein; one pool contained two yearling green turtles, while the other contained about ten half-grown greens and one nearly mature hawksbill, reportedly from Ebon.

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 northwestern end of the atol (the islets from Keko to Boggerik, known to the Americans as Hemel, Hamilton, Hampton, Harden, Harland,

Harley, Harvey, Henry, Herald, Herlet, Herman, Herschel, Hollis and Homer).

Major Barnett, in a letter dated July 16, 1976, reported that on July 10 a green turtle was found nesting on the ocean side of Bigej Island, about 12 miles north of Kwajalein Islet. About 150 eggs were collected and eaten by the boy scouts who found the turtle.

Ujelang Atoll

Ujelang, or Ujilang, is an elongate atoll about thirteen miles 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 (ms.) 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---though at this point it is not possible to ascertain whether the numbers represented only one or two successful nests, or whether there were numerous nests erupting simultaneously. Two of these hatchlings were transmitted alive to Dr. Carr. Phil Helfich, in a brief manuscript report communicated to me through the courtesy of George Balazs, reports on an interview with Chief Johannes, chief of the exiled Enewetakese people on Ujulang. In this report, Helfich stated: "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

square miles and had 128 people in 1948, but none in 1970. However, Anon (1972) wrote that there are now 100 people, mostly civilians, living on Enewetak. Anon (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 (ms.) 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 Vera. The last two 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 twenty miles 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-V-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 fifteen turtles, all females.

Jaluit

Jaluit is a large, irregularly shaped atoll, about thirty 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 (ms.) 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.

BIBLIOGRAPHY

Agassiz, L., 1857. Contributions to the natural history of the United States, Vol. 1. Little, Brown & Co., Boston, 452 pp.

Anon., 1956. Military geography of the Northern Marshalls. U.S. Army, Office of the Engineer, Army Forces Far East and Eighth United States Army. pp. xi+320.

_____1957. Notes on the present regulations and practices of harvesting sea turtle and sea turtle eggs in the Trust Territory of the Pacific Islands. Anthropological Working Papers, Trust Territory of the Pacific Islands, 18 pp.

_____1972. Tragedy of Eniwetok: One good bombing deserves another. Pacific Islands Monthly, 43(9): 28-29.

_____1975. Mid-Pacific Marine Laboratory. Enewetak, Marshall Islands, 25 pp.

Bates, M. & D.P. Abott, 1959. Ifaluk. Portrait of a coral island. London, Museum Press Ltd., pp. 1-287.

Brewer, Y., 1975. Micronesia: An historical summary. In: Trust Territory of the Pacific Islands. Volume III: The Annual Preservation Plan, Edition II. 172 pp.

Bryan, E.H. Jr., 1971. Guide to place names in the Trust Territory of the Pacific Islands (The Marshall, Caroline, and Mariana Islands). Pacific Science Information Center, Bernice P. Bishop Museum, Honolulu. Pages unnumbered.

Carr, A.F., 1952. Handbook of turtles. Cornell Univ. Press, Ithica, NY, pp. xv+542.

_____1965, The navigation of the green turtle. Scientific American 212(5): 79-86.

_____and A.R. Main, 1973. Turtle farming project in Northern Australia. Report of an enquiry into ecological implication. 41 pp.

Cushing, F.A., 1974. Observations on longline fishing methods conducted aboard the R/V Bosei Maru. Univ. Guam, Marine Lab. Misc. Rept. No. 17.

Deraniyagala, P.E.P., 1939. The tetrapod reptiles of Ceylon, Vol. 1, pp. xxxii+ 412.

Falanruw, M.V.C., M. McCoy & Namlug, 1975. Occurrence of ridley sea turtles in the western Caroline Islands. Micronesica 11(1): 151-152.

Fosberg, F.R., 1969. Observations on the green turtle in the Marshall Islands. Atoll Research Bulletin No. 135. pp. 9-12.

Girard, C., 1858. United States exploring expedition during the years 1838-1842, under the command of Charles Wilkes, U.S.N. Philadelphia, J.B. Lippincott & Co. Herpetology, 20: i-xvii, 1-496.

Helfich, P., (ms.). Report on the abundance of turtles and turtle nesting areas in the northern Marshall Islands. 2 pp.+map.

Hendrickson, J.R., (ms.). South Pacific Islands--Marine Turtle Resources. A report prepared for the South Pacific Islands Fisheries Development Agency. 15 pp.

Hiatt, R.M., 1951. Marine zoology study of Arno Atoll, Marshall Islands. Scientific investigations in Micronesia: native uses of marine products. Atoll Res. Bull. (3-4): 1-13.

Hirth, H.F., 1971. Synopsis of biological data on the green turtle Chelonia mydas (Linnaeus) 1758. FAO Fisheries Synopsis No. 85. Pages unnumbered.

_____and A.F. Carr, 1970. The green sea turtle in the Gulf of Aden and the Seychelles Islands. Verhand. Konink Nederl. Akad. Wetensch., Afd. Natuurkunde. 2nd series: 58(5): 1-44.

Johnson, S.P., 1972. Palau and a Seventy Islands Tropical Park. Nat. Parks and Conservation Mag. 46(4): 12-17; 46(7): 4-8; 46(8): 9-13.

Marshall, M., 1975. The natural history of Namoluk Atoll, Eastern Caroline Islands. Atoll Res. Bull. No. 189: i-ii, 1-53+13 pls.

McCoy, M., 1974. Man and turtle in the Central Carolines. Micronesica 10(2): 207-221.

Niering, W.A., 1963. Terrestrial ecology of Kapingamaringi Atoll, Caroline Islands. Ecol. Monogr. 33: 131-160.

Pritchard, P.C.H., 1969. Studies of the systematics and reproductive cycles of the genus Lepidochelys. Ph.D. Dissertation, Univ. of Florida. pp. i-iii, 1-197.

_____1971. The leatherback or leathery turtle. IUCN Monographs No. 1. pp. 1-39.

Rüppell, E.W.P.E.S., 1835. Neue Wirbelthiere zu der Fauna von Abyssinien gehörig. III. Amphibien. Frankfurt a. M., pp. 1-18, pls i-vi.

Smith, H.M. & E.H. Taylor, 1950. An annotated checklist and key to the reptiles of Mexico, exclusive of the snakes. Bull. U.S. Nat. Mus. 199: vi+1-253.

Sowerby, J. de C. & E. Lear, 1872. Tortoises, Terrapins, and Turtles. London, pls. i-lx (letterpress pp. 1-16 by J.E. Gray).

Viti, C., 1975. Voyage from the last century. Glimpses of Guam 15(2): 17-32.

Wermuth, H., & R. Mertens, 1961. Schildkröten, Krokodile, Brückenechsen. Gustav Fischer, Jena, pp. i-xxvi, 1-422.

Wilson, P.T., 1969. Trust Territory of the Pacific Islands. In: Encyclopedia of Marine resources, F.E. Firth, ed., New York, Van Nostrand Reinhold Co., pp. 687-695.

_____1976. Conservation problems in Micronesia. Oceans 9(3): 34-40.