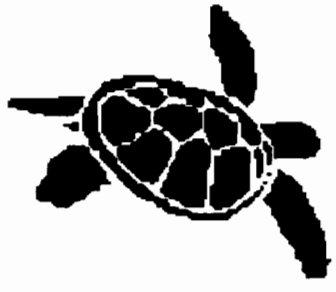
The Sea Turtles of the Northern Marshalls: A Research Expedition to Bikar & Erikup Atolls, and Jemo Island



The Sea Turtles of the Northern Marshalls: A Research Expedition to Bikar & Erikup Atolls, and Jemo Island

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by

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INTRODUCTION

The Marshall Islands, along with the Marianas, Carolines, and Gilberts encompass the region in the Pacific Ocean known as Micronesia. With a history not unlike many other island groups, the Marshalls were entangled in a complicated involvement with colonial powers. First reported by Spanish explorers in 1526, additional atolls were later sighted by Dutch and English captains throughout the seventeenth and eighteenth centuries. It was not until 1788, when two English captains, Marshall and Gilbert, stumbled upon the atolls that they became recognized as a single archipelago. The first systematic survey occurred with the coming of the Russian explorer Otto von Kotzebue in 1816. By 1885 the Germans, who at the time were deeply involved in the Pacific region, laid sole claim to the Marshalls. They held exclusive jurisdiction of the atolls until the coming of WWI in 1914, when they were succeeded by the Japanese. Following the end of WWII in 1948, the Marshalls, along with the Carolines

and Marianas, came under the control of the United States and were administered under the name of *The Trust Territories of the Pacific Islands (TTPI)* until its fragmentation in the 1970's. By public referendum, the natives of the Marshalls Islands opted to separate from the rest of *TTPI* in favor of a compact agreement with the United States. Operating *de facto* since the late 70's, the Marshall's free association compact was fully implemented in October of 1986. Today, the Marshall Islands are recognized as an independent country throughout much of the world. In complete control of its internal affairs, including the management of its natural resources, the Marshalls have formed regional alliances with neighboring Pacific Island groups.

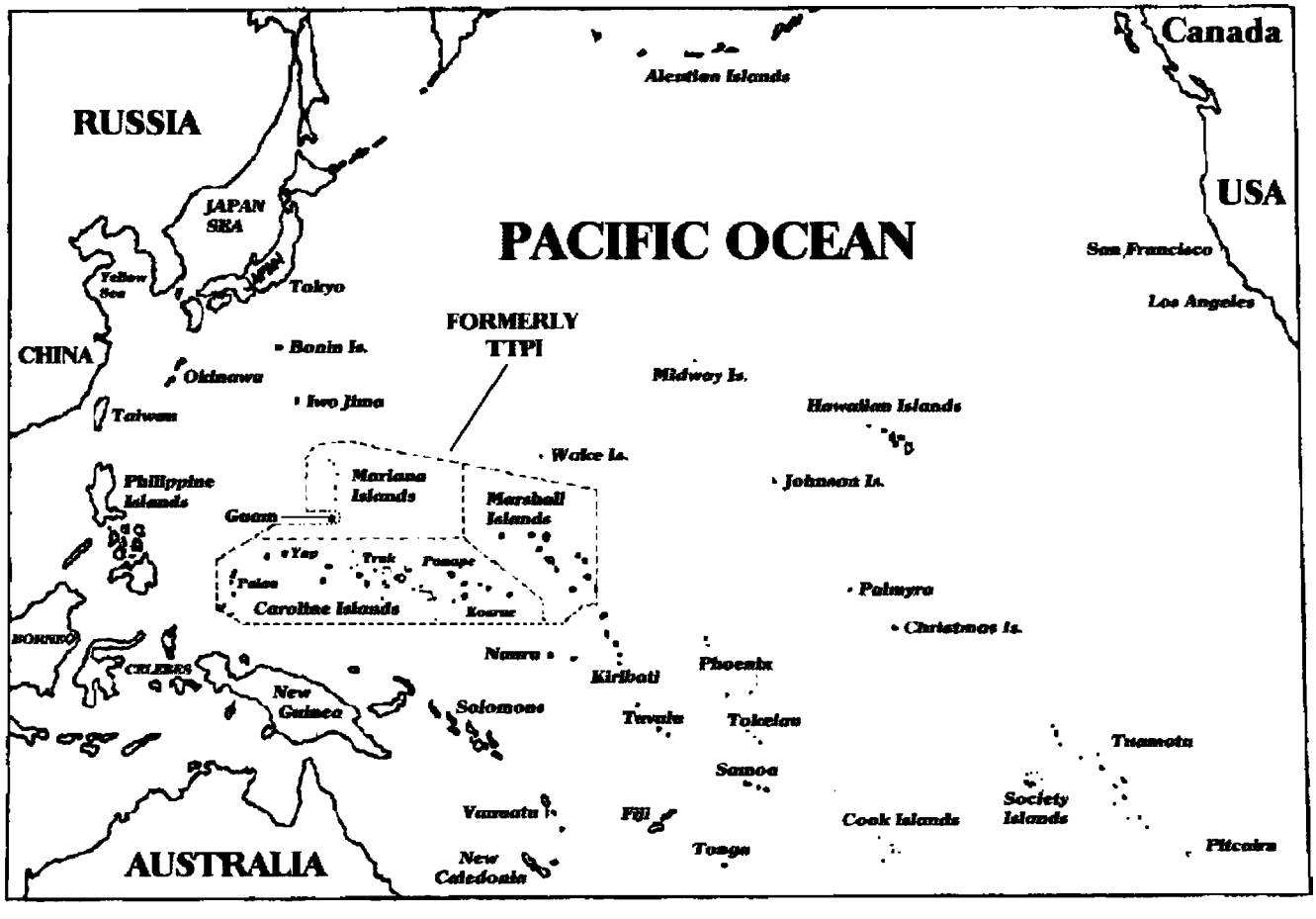


Figure 1: Pacific Area

Comprised of 29 atolls and five isolated coral islands, the Marshall Islands has a total land mass of 181 km^2. Located in the western Pacific just above the equator, the archipelago is divided into two roughly parallel chains stretching north to south for some 1,300 kilometers. The western chain called *Ralik* or "sunset" consists of 15 atolls and three coral islands, and includes the well–known Marshallese atolls of *Bikini* and *Kwajalein*. The *Ratak* or "sunrise" chain lies approximately 240 kilometers to the east and consists of 14 atolls and two coral islands. *Bokar*, sometimes called Taongi, at a latitude of 14° 43' N is recognized by some as the northernmost atoll in the *Ratak* chain. Still to be litigated is the ownership of Wake Island, another atoll lying an additional 1,200 km north of *Bokar*. Known to the Marshallese as *Enen Kio*, this remote outlier was repeatedly visited by undaunted native adventurers long before its annexation by the United States in 1899. Verbal accounts allude to a particular sea bird found there and nowhere else in the Marshalls. A special bone from this bird was much sought after for use as a tool in ancient tattooing ceremonies. Also mentioned in Marshallese oral history is a particularly attractive orange flower from *Enen Kio*, which was gathered and displayed by returning sailors as proof of their sailing exploits. If included as part of the Marshalls as claimed by traditional chiefs, *Enen Kio* would establish the northernmost point of the archipelago at 19° 18' N. Also included in the *Ratak* chain is the capital and administrative center of *Majuro* Atoll, and the three survey sites of this study: *Bikar* Atoll, *Erikup* Atoll and *Jemo* Island. With a current population of 45,000 people, the Marshalls rank among the highest in the world in terms of population density. There is only one ethnic group speaking its own distinctive language, with some dialectical differences associated with the two chains of islands.

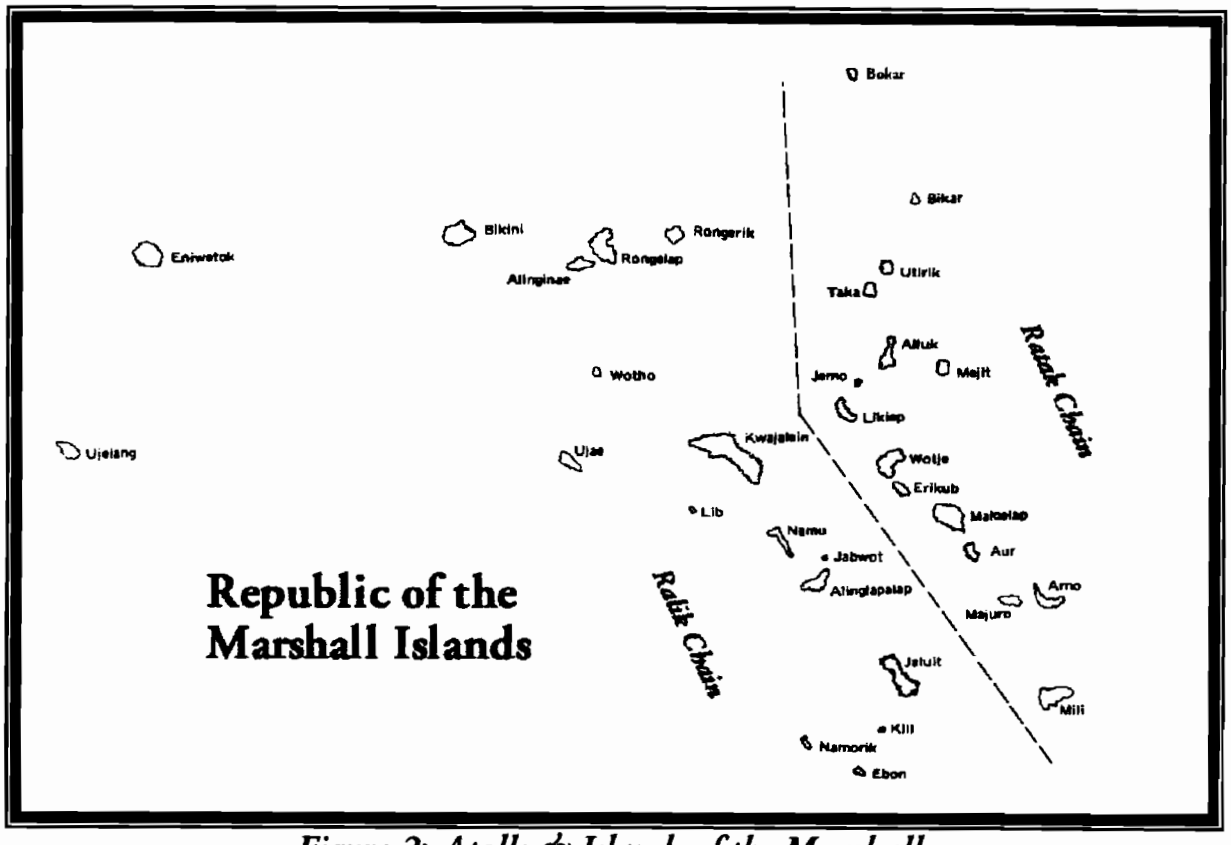


Figure 2: Atolls & Islands of the Marshalls

Except for five raised coral islands, the atolls of the Marshalls are characterized by irregularly shaped reefs forming asymmetric bracelets enclosing interior bodies of sea water known as lagoons. In the Marshalls, these lagoons can reach depths of 40 meters or more and are usually linked to the ocean by one or more "passes", or deep channels slicing through the reefs. Water movement in and out of lagoons are accomplished through these passes, and also by tidal fluctuations over reef flats between islets. These reef flats extend offshore to the open ocean from individual islets and are often completely exposed at low tides. Only during high tides, when the reefs are inundated by as much as two meters of water, can large animals such as sharks, and certain species of acanthurids, groupers, and scarids, enter the lagoons over the reef flats. Similarly in the case of sea turtles, access from the ocean to suitable nesting beaches must coincide

with these high tides. The timing of nesting activities is extremely critical when an animal's approach is from the oceanside. If not completed in time, a turtle may find itself separated from the ocean by an exposed reef flat. On several occasions we witnessed turtles with bleeding flippers caused by crawling over a well-honed limestone reef trying to reach deeper waters. An even worse fate await turtles encountering low tide in an elevated reef strewn with coral boulders.

Figure 3: Bleeding turtle

Figure 4: Barrier reef at low tide

Such a barrier may be as wide as one km (e.g. the southwest-ern side of *Bikar* Islet) and makes an ocean

escape extremely difficult, if not impossible. Mistiming of nesting activities on the lagoon side is not as detrimental. Here nesting sites are normally accessible over narrow sandy beaches, and movements to and from lagoon waters are largely unhindered whatever the tidal situation.

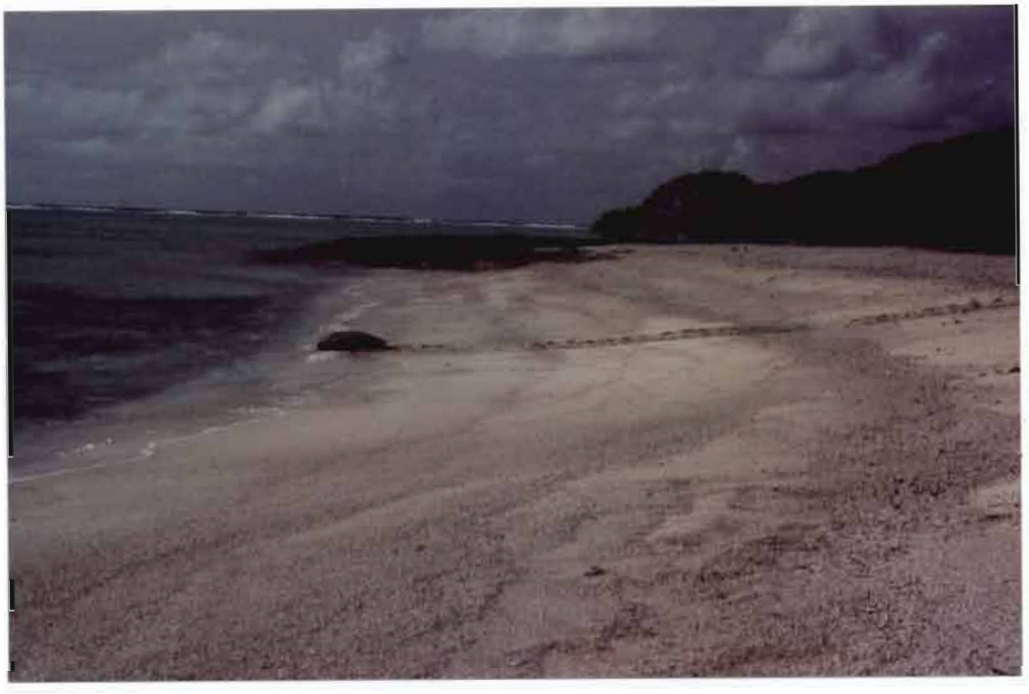


Figure 5: Returning into the lagoon

The number of islets in an atoll can vary from as few as two, as in the case of *Namorik*, to as many as 93 on *Kwajalein*, the world's largest. They range in size from mere sandy treeless cays to several hundred hectares like *Wotje* Islet, *Wotje* Atoll. Most of the inhabitants reside on the principal islets, which often have the same name as the atoll itself. The more than one thousand islets of the Marshall Islands archipelago together amount to no more than 170 km^2 of fast land, approximately one tenth the size of Upolu Island, Western Samoa. Unlike high volcanic islands, the makeup of these atoll islets is predominantly calcium carbonate in the form of beach sand, limestone, sandstone, sea shell particles, and coral reef fragments of various sizes. The interior of these islets can vary from the soft

spongy detrital accumulations of Pisonia dominated forests, to the sharp boulder sized coral fragments deposited by violent storms. In similar fashion, the periphery of these islets can vary from the gentle sloping white sand beaches of a quintessential south pacific paradise, to the outcropping of well-honed limestone bedrock forming a virtually inaccessible barrier.

Figure 6: Maloelap Atoll from the air

DESCRIPTION OF PROJECT

Over time immemorial, the Marshallese have developed an intimate and essential relationship with marine sea turtles. Marshallese have much prized and long depended on turtles and their eggs as a source of food. Turtle by-products such as the shell, scaly skin, and the flipper spurs were also utilized. Some of these were fashioned into body adornments, while others were incorporated as part of native arts and crafts. Attesting further to their close relationship with sea turtles is the many references to these marine reptiles in Marshallese folklore. Traditional songs and legends are replete with sea turtle allusions, in which some

even attain the stature of supernatural beings. It is not surprising, therefore, to see the prolific recurrence of the turtle motif throughout the Marshallese culture.

Three extant species of marine turtles are known to occur in the Marshalls. The most common by far is Chelonia mydas, the green sea turtle, or *won.* Smaller in size and less frequently seen but still highly prized because of its shell is Eretmochelys imbricata, the hawksbill, or *jabake*. Less known of the three is Dermochelys coriacea, the pelagic giant leatherback turtle. Restricted to the open seas between atolls, there have been occasional reports of leatherbacks being washed up on remote beaches in the archipelago. Of the three species, only *won* and *jabake* have been known to reproduce in the Marshalls. The nestings of these animals are restricted principally to three well known rookeries in the *Ratak* chain. Two rookeries occur on the atolls of *Bikar* and *Erikup*. The third is on a single raised coral island known as *Jemo*.

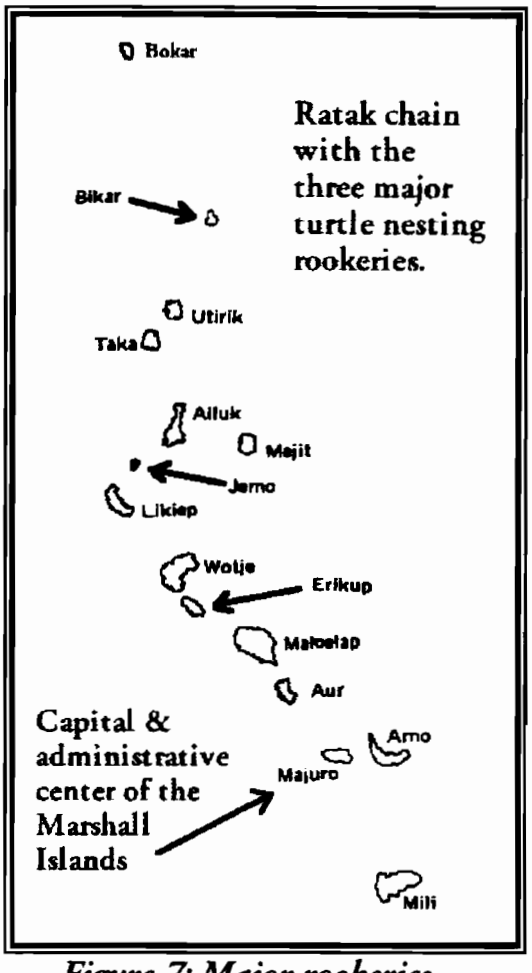


Figure 7: Major rookeries

While *Erikup* and *Jemo* were at times inhabited, *Bikar* has never experienced long term permanent settlement by natives. To harvest turtles in times past, sailing canoes assembled on inhabited atolls close to these known

rookeries. After appropriate preparations accompanied by traditional ceremonies, scores of open sailing canoes were dispatched over open seas, sometimes sailing more than 160 km. The durations of these voyages varied from several days to several weeks, depending on the weather and the distance to the rookeries. Invariably these collecting trips were planned to coincide with the nesting season during the summer months. Most of the turtles were captured as they came ashore to lay their eggs, but others were caught as they swam close to shore. The live animals were then transported back to inhabited atolls and distributed according to long standing customs. Choice animals and selected portions of individual turtles were awarded to the *iroij,* or chief. So abundant was this resource that a unique Marshallese expression evolved. The ancient phrase *"man loran"* was used to describe the event when many turtles were seen at once on nesting beaches. Nesting females were seen pushing and jostling each other in their frantic efforts to deposit eggs, often destroying existing nests in the process. Oral tradition depicts instincts so intense during *"man loran"* that turtles even abandoned the safety of darkness to invade nesting beaches during daylight.

During the summer of 1992, a project was initiated to retrace these traditional routes and visit the three major sea turtle nesting rookeries of the Marshalls. The explicit goals of the project were to:

(1) monitor nesting activities;

(2) assess the status of the rookeries;

(3) identify and tag as many sea turtles as possible;

(4) record morphological data;

(5) determine if any animals were afflicted by fibropapilloma, a disease seriously plaguing turtle

stocks in the Pacific and elsewhere;

(6) provide an *in situ* tagging experience for selected Marshall Islands Marine Resources Authority (MIMRA) personnel; and

(7) start a computerized database of tagged sea turtles from the Marshall Islands.

To accomplish these goals, it was necessary to obtain approval from Republic of Marshall Islands (RepMar) government officials. It was also necessary to acquire the sanctions of the traditional chiefs, the *iroij* and *alab,* who have local jurisdiction over the project locales. Additionally, outside support in the form of funding and tagging equipment was sought from the South Pacific Regional Environment Programme (SPREP), and a personnel loan was requested from the Hawaii State Department of Land and Natural Resources. While the field portion took only three weeks to complete, the acquisition of local approval and outside support spanned a ten-month period.

During the last week of July 1992, an agreement between the owner of the *MV Toojlok* and project coordinators was finally negotiated. A former troller from California, the *Toojlok* is a privately owned 13–m steel hulled diesel vessel. Having been recently refurbished, she is used for inter–atoll support of commercial ventures. With a range of 1,300 km and a maximum speed of 8 km per hour, the *Toojlok* has a freshwater capacity of 3,000 liters. Our project supplemented this water supply with an additional 1,500 liters stored in eight drums lashed to the deck. Also lashed on board was a 5–m

fiberglass runabout with a 25–HP outboard engine. Manned by a captain, a chief engineer, two deck hands, and a cook, the *Toojlok* was chartered for 15 days at a cost of US$14,000.00. Included in the charter was the cost of food and vessel fuel. At four p.m. on the afternoon of July 28, 1992, the project officially got underway as we departed the *Majuro* dock en route to *Erikup* Atoll.

Figure 8: MV Toojlok

ERIKUP, July 29-30

After sailing throughout the night on moderate seas, we sighted *Erikup* Atoll at 10 AM on the morning of July 29th. Lying at 9° 8' N, 170° 2' E, the atoll is approximately 27 km long and 8 km wide, oblong in shape, and oriented north to south. It consists of 14 islets totaling 160 hectares in land area. Normally uninhabited, *Erikup* lies only a half-day journey from the rapidly developing *Wotje* Atoll (a major Japanese stronghold during World War II). Close by and uninhabited, *Erikup* has historically been regarded as a private preserve by the people of *Wotje*. They frequently exercise clan rights and

sail to *Erikup* to exploit its many natural resources. Renowned throughout the Marshalls for its coconut crabs (Birgus latro), or *barulep*, *Erikup* is also famous for its abundance of turtles. Entry into its 23,000 hectare lagoon is possible through any of six passes, five of which are deep enough to accommodate deep drafted vessels.

Approaching from the south, we entered the lagoon at 12 noon through the southernmost pass, conveniently located adjacent to *Erikup* Islet (our intended landfall). At approximately 55 hectares, *Erikup* is the largest islet in this atoll and the only one capable of supporting a freshwater well. Greeting us on shore were Rubin Kobiea, his wife, four teenagers, 12 younger children, and another older couple. Rubin and his party had arrived on *Erikup* two months earlier from *Wotje* after partaking in a week long "Liberation Day" celebration. Instead of returning to *Majuro* they had decided to spend the remainder of the

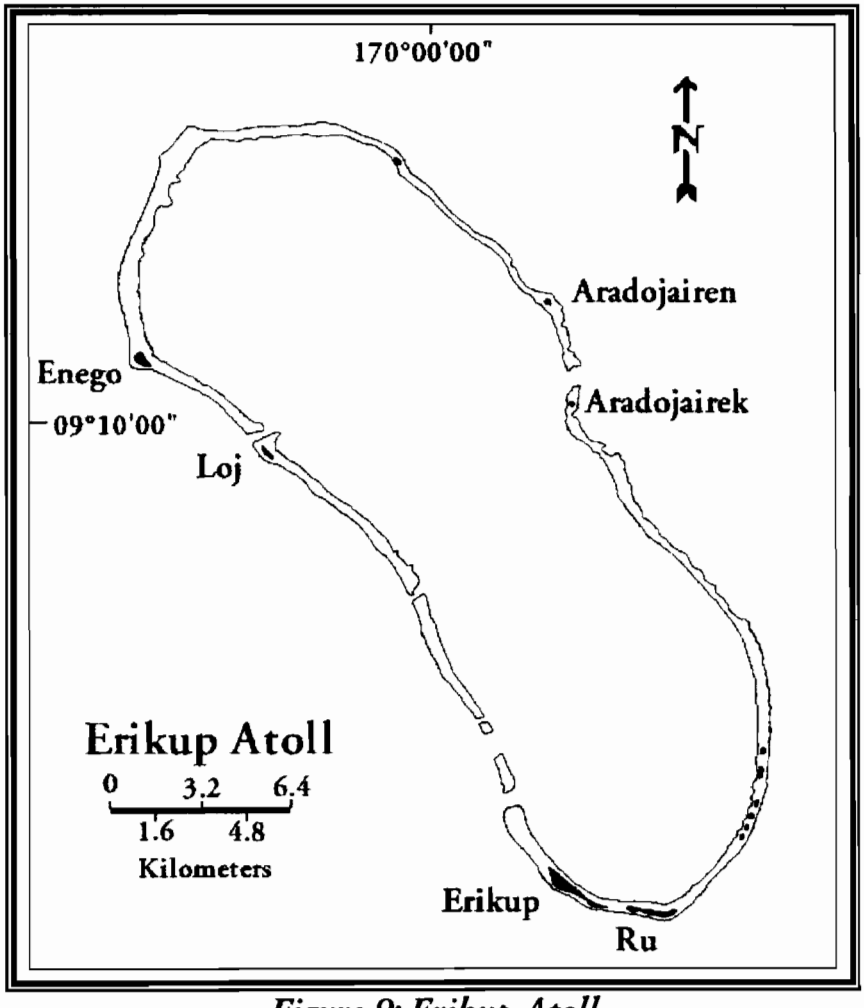


Figure 9: Erikup Atoll

summer on *Erikup*, where Rubin's wife has traditional rights. To earn some cash for the upcoming school year, he had been capturing turtles and salting their meat for resale in *Majuro*, the administrative center. We learned that during their two months on *Erikup* Islet, Rubin *et al* had managed to capture a total of 13 turtles. All were large mature *won,* nine males and four females. All but one were taken as they swam along the lagoon shoreline. Only one female was captured on shore. According to Rubin, she was left undisturbed until she completed her egg laying. Upon our arrival, we discovered one male still on the beach, tipped over upon his back. Measuring 98.5 cm in curved carapace length, it was captured close to camp and being held to be consumed as their last meal on *Erikup*. Also noted at the campsite were several containers with newly hatched turtles. Twenty one in all, they were discovered by the children during two separate hatching incidents on *Erikup* Islet. All being *won,* they were being held as pets to be transported back to *Majuro* with their departure. Upon further questioning, we obtained the following information:

(1) efforts were not maximized to capture as many turtles as possible and were limited to a few hours after sunset during favorable tides; only occasionally did they wake up in the middle of the night to look for turtles;

(2) of the 13 turtles captured, ten were butchered and salted to be sold in *Majuro*; two were consumed as food; the one male observed on the beach was yet to be eaten.

(3) four of the 13 turtles were captured on the oceanside; nine were captured on the lagoon side;

(4) Rubin estimated that for each turtle captured, two others managed to escape their attempts;

(5) all of their efforts were confined to *Erikup* Islet because they did not have a boat to visit other islets in the atoll, and

(6) none of the captured turtles was afflicted by tumors or fibropapilloma;

Rubin disclosed that he hoped to receive at least US$6.60 per kg for the salted meat. Since only the red meat muscle is salted, we estimated that only 25% of the total weight of any turtle could be converted to cash. Assuming an average weight of 110 kg per animal, the weight of meat available for salting was calculated to be 275 kg. (i.e., 10 turtles X 110 kg X 25%). Assuming a conservative 25% reduction in weight due to dehydration after salting and partial drying, the final estimate of salted turtle meat available for resale was 206 kg (i.e., 275 kg X 75%). If Rubin was to receive his asking price of US$6.60 per kg, he would realize a gross cash income of US$1,460.00, a substantial amount for native Marshallese. Thus, each mature turtle captured and salted represented a cash value of approximately US$146.00 to Rubin, or to anyone else so inclined.

After talking to Rubin, we walked along the sandy beach on the lagoon side of the islet. Almost 3.5 km from end to end, this picturesque white sand beach is bordered primarily by *kirin* (Tournefortia argentea) trees and *kanot* (Scaevola sericea) bushes. In the underbrush we noticed many nesting excavations, some well within the interior of the islet. So numerous were these excavations that no attempts were made to count them. Having determined for ourselves that turtles were still using this islet for nesting purposes, we arranged to meet Rubin later that night to conduct a beach watch.

We next set off to an adjacent islet known as *Ru*, which is 1.5 km long and

200 meters at its greatest width. Unlike *Erikup* Islet, *Ru* is predominately rocky and cannot be considered a prime nesting area. However, on its western most tip, we encountered a sandy stretch of beach approximately 45 meters long and very suitable for nesting purposes. Indeed, after inspecting most of *Ru*, we found this stretch to be the only place on the islet with evidence of nesting activities. Eight excavations were discovered high above the water line under the vegetation. At least four of these pits had been recently dug. Because the tides had erased their haul–out tracks, we were unable to determine the number of turtles responsible for the excavations. After spending an hour on *Ru*, we returned to the *Toojlok* and prepared for the night's beach walk on *Erikup* Islet.

As the tide turned at 9 PM, we returned to *Erikup* Islet to meet with Rubin. We divided up into four teams, each assigned to patrol one fourth of the islet. *Erikup* Islet is approximately 3.5 km long and 0.8 km wide. A white sandy beach covers at least three fourth of its periphery. Because the beach is narrow, high tides completely inundate long stretches submerging everything up to the vegetation line. Aside from being restricted to walking in the underbrush, the high tides also obliterated all haul–out tracks. Undoubtedly, the commotion created while struggling through the bushes must have frightened some of the turtles nesting in the near vicinity. Without the haul–out tracks and sounds created by flailing turtles, the detection of nesting animals on *Erikup* Islet became a most difficult task. The survey was further hindered by a lack of moonlight during the entire night. The 4 AM high tide made it impossible to continue the beach patrol and forced a retreat into the bushes to await daybreak. It was therefore not surprising that in spite of the expended efforts, no

turtle was tagged that night on *Erikup* Islet. The only turtle sighted was observed to be swimming close to the shoreline. Attempts to capture it were unsuccessful. Reassembling at Rubin's base camp, we departed *Erikup* Islet 8:30 AM the following morning, sailing north to a pass between *Aradojairen* and *Aradojairek* Islets.

The small and uninhabited islets of *Aradojairen* and *Aradojairek* straddle a narrow and shallow pass on the east side of the atoll. Initially arriving at *Aradojairek*, we drifted offshore briefly to launch a small skiff and went ashore. Most of *Aradojairek*'s shoreline was found to be rocky and unsuitable for turtle nesting. Its interior is dominated by *kañal* (Pisonia grandis), tall large trees that are favored by seabirds for nesting and roosting. Much of the ground under this *kañal* stand was covered by a deep spongy layer of distinctly pungent humus, which made turtle nesting less likely. Only two pits were found on this islet, both occurring in a sandy patch under a small *kanol* bush on the lagoon side. Returning to the small boat, we set off to the larger *Aradojairen* Islet where 48 pits were recorded. The entire

Figure 10: Pisonia grandis—"kañal"

seaward coast of *Aradojairen* was lined with rocks and coral rubble which made nesting nearly impossible. Most of the pits were densely confined to the lagoon side under *kanot* bushes. No doubt some of these were multiple excavations by single animals. Furthermore, it was clearly apparent that others were from a previous season (or seasons) because they differed so significantly in their appearances *vis–a–vis* those of obviously recent origin. These factors made it impossible for us to determine the exact numbers of turtles utilizing *Aradojairen* as a nesting site. Nevertheless, the concentration of dense excavations was an impressive sight.
Returning to *Toojlok*, we set a course to the solitary pass on the eastern side of the atoll without inspecting two other significant nesting sites in *Erikup* Atoll.

On the western side of the lagoon are two islets named *Enego* and *Loj*. Until recently, *Enego* and *Loj* were perhaps the islets most frequented by *Wotje* natives. Prior to the arrival of high speed outboards in the 70's, travel was largely accomplished by sailing canoes and slow moving diesel boats used for hauling copra. Lying closer to *Wotje* and easily accessible through a large pass on the lee of the atoll, *Enego* and *Loj* were the islets most frequented by *Wotje* fishermen in the past. Among the larger islets in the northern portion of the atoll, *Enego* and *Loj* have beaches that are suitable for nesting turtles (a fact exploited by the natives). Furthermore, both islets were sufficiently stocked with coconut crabs (*barulep)*, in the past which made the longer trips to *Erikup* and *Ru* unnecessary to gather this resource. Additionally, the long extended reef flats between the islets promoted daytime fishing of *mole* (Siganus argenteus), a schooling reef fish highly esteemed for salting. Since the shortest route to *Wotje* was through the pass on the opposite side of the atoll, these two islets could

not be assessed to evaluate current nesting activities. Entering the narrow passage between *Aradojairen* and *Aradojairek*, we set off to *Wotje* 30 km away under light winds and calm seas.

SAILING TO *BIKAR*, July 31-August 1

After arriving at *Wotje* Islet at 5 PM, we topped off our water supply and spent the night tied to the old Japanese dock. We departed promptly at 7:30 AM the next morning, Friday the 31st, en route to *Jemo* Island. During the night the wind, which had been gentle NE trades, suddenly shifted to strong southerly. Upon exiting *Wotje* lagoon, we discovered heavy seas that made our plans to land at *Jemo* over the reef to be very precarious. We therefore set an alternative, direct course to *Bikar*, with hope of visiting *Jemo* on the return trip. Under heavy sea conditions, we passed *Ailuk* Atoll (inhabited) off to starboard at 7:30 PM. that evening. Running all night in rolling seas, *Taka* Atoll (uninhabited) and *Utirik* Atoll (inhabited) was passed on the port side before sunrise. It was not until 2 PM on the following afternoon of August 1 that we sighted *Bikar* Atoll on the horizon.

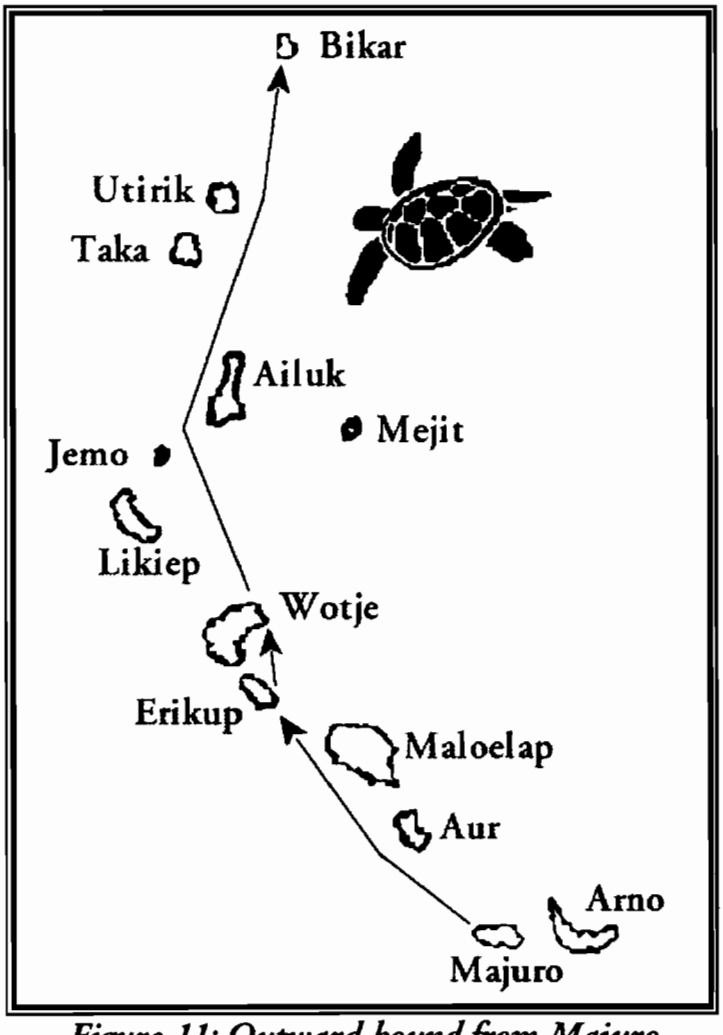


Figure 11: Outward bound from Majuro

It took two additional hours of sailing to reach *Bikar*

Islet at the southernmost tip of the atoll. We continued north following the western reef line while searching for the solitary pass leading into the lagoon. Along the way we counted seven pairs of turtles copulating next to the reef's edge. We entertained thoughts of hand capturing some of them for tagging, but were unable to approach close enough on the *Toojlok*. Crew members confided that copulating turtles have often been captured oceanside of *Wotje* Atoll by using a smaller and swifter boat. Approaching from down wind, the engine would be turned off just before reaching the preoccupied animals. At the appropriate proximity, someone would jump off the bow of the boat onto the animals. It was then possible to grasp at least one of the pair, preferably the male. We were told that if females were seized, the males would often attempt to bite their captors. On the *Toojlok*, we were unable to approach within 50 meters of any coupled turtles. Approaching closer resulted in their separation and escape. It was not possible to confirm the species of the copulating turtles despite the use of binoculars. However, their large sizes and behavior were similar to that observed at *Wotje* which made it highly probable that they were Chelonia mydas, the most common sea turtle in the archipelago.

Continuing north for another hour, the solitary pass at *Bikar* was easily located. The ebbing tide created a highly visible torrent to the ocean as the water rushed through the narrow pass. The water escaping from the lagoon created whirlpools that were visible as far offshore as 0.5 km. We launched our small boat and ventured into the pass, barely making headway in the maelstrom despite our 25–HP outboard. The pass was at least 200 meters long, of a uniform 15 meter width and deep enough to preclude us from seeing the bottom. The maximum out flow of water was at the

center of the pass and pockets of eddies were observed along both edges. Within these pockets, sharks and large jacks were seen preying on smaller fish that struggled to maneuver in the fierce current. On the lagoon side, an enormous coral outcropping that stood 0.5 meters above the water line produced two narrow forks in which the flow of water was as turbulent as the torrent in the pass itself. The right fork branched off sharply at 90°

Figure 12: Solitary Bikar Pass seen from ocean side at high tide. Jabwelo and Almani Islets in background.

into a deep channel approximately seven meters in width. It led into the lagoon amid isolated coral heads in depths of three to five meters. The left fork at eight meters in width presented a more navigable turn of 70°. However, the depth was considerably shallower, with the bottom easily discernible. Stuck on the coral outcropping in this left fork and exposed by the falling tide were the rusting remains of a motor launch. We speculated it had been manned by fishermen from a foreign vessel illegally attempting to enter the lagoon. Choosing the wider left fork because of the easier turn, they were probably alarmed to encounter

shallow water, and ran aground in their haste to retreat. We could only wonder how, or if, any of the occupants made their way back to their attending vessel.

To ensure the safety of our ship, we decided against entering the lagoon through the pass on the *Toojlok*. This meant that we had to return to the oceanside of *Bikar* Islet, unload all our supplies onto the small boat, and transported them over the reef during the high tides. It also meant that the *Toojlok* would have to remain adrift on the oceanside for the duration of our stay at *Bikar*. Anchoring the vessel on the fringing reef could have been extremely hazardous if the wind or current suddenly changed. With this decision, we sailed back to *Bikar* Islet following the reef line and again observed turtles in the act of copulation, this time four pairs.

Along side of the islet, project members were ferried on the small boat to the reef's edge that was still exposed by the low tide. Carefully timing the surging waves, we jumped off the skiff onto the algal ridge and scrambled about 0.5 km over reef flats to *Bikar* Islet. A site on the western side of the islet was selected for the base camp, making it possible to keep the *Toojlok* in constant view.

We took a quick walk around the island to orient ourselves before nightfall. Many excavations were observed around the perimeter of the islet. Some of these were located as far inland as 120 meters. The pits were so dense that it was impossible to obtain an accurate count of their numbers. It was also apparent that some were from earlier seasons because of the general accumulation within the pits that included bamboo segments, shriveled twigs, broken glass bottles, fish net floats, cargo net

fragments, and other debris. Nevertheless, the density of excavations was impressive and breathtaking. Recent haul out marks on sandy stretches

Figure 13: Nesting pits under "kirin" (Tournefortia argentea) trees on Bikar Islet

of the beach verified that many nesting females were still frequenting *Bikar* Islet. These tracks were so numerous and intermingled that it was impossible to estimate the number of turtles involved. Under waning daylight, we eventually returned to our makeshift camp to await nightfall.

DESCRIPTION OF *BIKAR*

An uninhabited atoll, *Bikar* is renowned throughout the Marshalls for its abundance of turtles and sea birds. Sometimes referred to as Dawson Atoll, *Bikar* is approximately 650 km from the administrative center of *Majuro*. Its closest inhabited neighbor is *Utirik* atoll, 120 km to the south.

Consisting of four islets (one of which, *Jaboero*, is a barren elevated cay), it encompasses a lagoon 3,800 hectares in size. *Bikar* Islet (the site of our base camp) is the largest in the atoll at approximately 24 hectares. It is oval in shape and oriented north to south, much like the atoll itself. It is 800 meters in length and 400 meters at its widest.

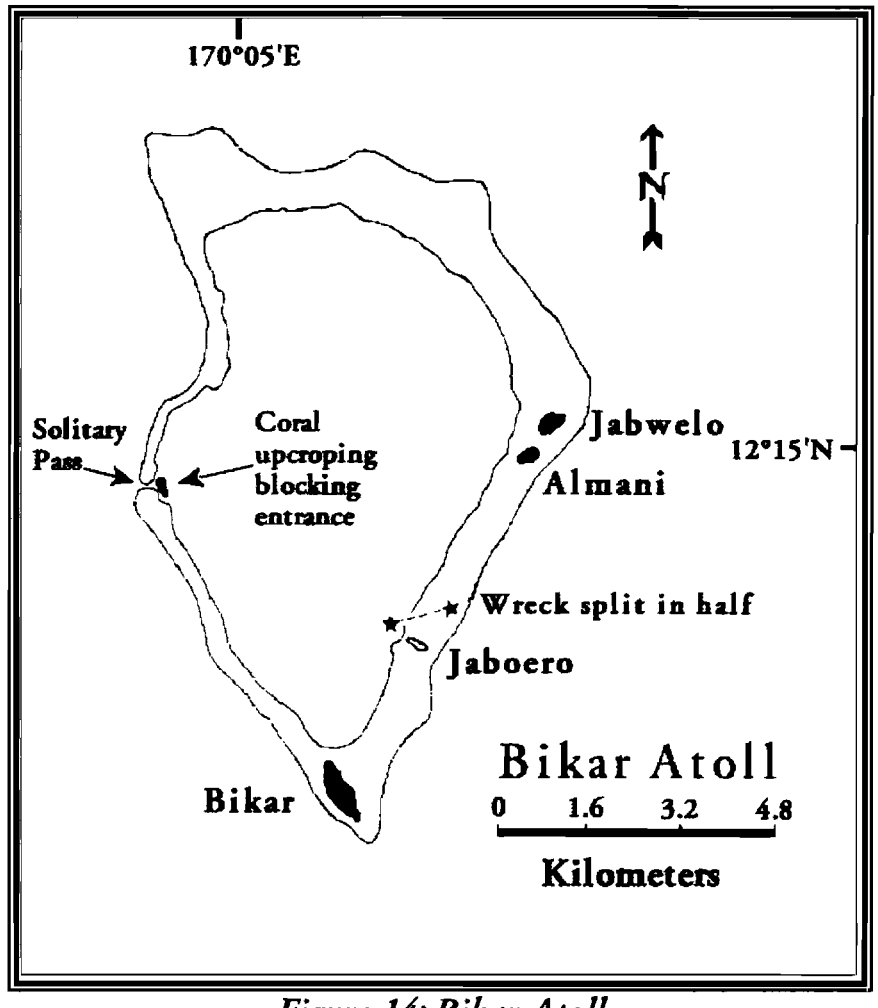


Figure 14: Bikar Atoll

Extending seaward for another 400 meters from the southernmost tip of the islet is an elevated limestone platform approximately 10 hectares in size. While parts of this hard pan feature are awash during high tides, most of it is elevated enough to remain completely dry most of the time. Turtles coming in on high tides, wander around on this elevated platform searching for suitable nesting sites. All of the tracks encountered here invariably meandered back to the sea without signs of nesting attempts. On one particularly elevated sand bar 300 meters offshore, several *kirin* trees had taken hold and had grown to two meters in height. It was only under these trees that we observed any excavations on this offshore geological feature. Since

these pits were dug before our initial surveillance, it was not possible to determine when they were dug or how many animals were involved. This

Figure 15: Elevated consolidated limestone reef flat located at the southern tip of Bikar Islet

suggests that turtles in *Bikar*, and perhaps elsewhere in the archipelago, may be visually keying on trees to locate potentially suitable nesting areas. Adding credence to this conjecture is that no nesting activity of any sort could be found on barren islets. *Jaboero*, one of the four islets on *Bikar*, is an elevated treeless cay supporting only small, low laying *kuran* (Portulaca sp.) and an unidentified species of grass. Rising to 4 meters at its highest point, it is approximately 2 hectares in size with a wide sandy expanse. Although containing ample space and a gentle sloping beach, we were unable to confirm any night crawls or nesting efforts on this treeless islet. In spite of seemingly favorable conditions, turtles appear to avoid nesting on this cay, favoring instead two adjacent wooded islets, *Jabwelo* and *Almani*. On these preferred islets, turtles were observed to struggle in their efforts to crawl over coral boulders and solidified

limestone fragments and in excavating shallow pits in rocky beds to lay their eggs. Unlike the treeless *Jaboero*, both *Jabwelo* and *Almani* have mature stands of *kirin* and *kanot* trees—an attractant perhaps to nesting females.

Figure 16: The major trees on low lying Marshallese atoll islets may help to indicate suitable nesting habitats to turtles; kirin and kanot bushes in foreground; taller kañal trees in the background and center of Bikar Islet.

Two-thirds of *Bikar* Islet's perimeter is lined with clean white sand. The remainder is composed of beach rock and coral rubble in an assortment of sizes and compositions. Strewn along the shoreline was a myriad of items discarded from passing ships. Empty whiskey bottles predominated among the debris that included glass and plastic balls from longliners, rubber zoris, medicine vials, bamboo flag sticks, plastic baskets, styrofoam, fishnet floats, and plastic bottles. Also beached were several large logs of unknown origin, one of which measured 30 meters long with a diameter of 1.5 meters. Four of these logs proved later to be handy as landmarks that pinpointed the locations of nesting activities. One particularly

interesting flotsam was the end section of a wooden hand hewn canoe. We were not able to identify the kind of wood nor were we able to confirm the design to be of Marshallese origin.

The southwestern side of *Bikar* Islet faces the open ocean and is particularly rugged with an elevated consolidated limestone outcropping. When exposed during the low tides, certain stretches are virtually impassable to sea turtles that nest on this side of the islet. Scattered about the rocks were many turtle skeletal remains, evidence of nestings and vain attempts to escape back into the sea during low tides. Ashore of this inhospitable stretch is a steep beach ridge made up of rocks and other coral debris. Further inland were even more storm strewn rubble, some

Figure 17: Rugged southwestern shoreline of Bikar Islet facing the open ocean.

up to one meter in size and deposited at the base of the interior *kañal* trees. Detection of turtles in this section was extremely difficult as very little crawl tracks were evident on the rubble substrate. Turtles nesting

in this stretch were usually detected only after hearing beach rocks being tossed about by the flailing animals. Surprisingly, post analysis of our data revealed most of the turtles tagged on *Bikar* were from this seemingly inhospitable span of beach. In spite of what seemed to be less than ideal conditions for nesting, this stretch of beach was the shortest distance to the open ocean where many copulating turtles were seen.

VEGETATION

Bikar Islet is well covered by vegetation. Dominating the interior is the broad leafed *kañal*, by far the tallest tree and most favored by sea birds for nesting and roosting. Apparently, many *kañal* had been toppled by a recent storm. As a reproductive adaptation of this species, new sprouts from fallen branches were evident everywhere. Coral debris and jetsam

Figure 18: Kañal (Pisonia grandis) with new sprouts from fallen branches

strewn around the bases of trees well inshore from the water's edge also attested to a recent storm passing. *Kañal* trees play a particular role in Marshallese folklore regarding nesting turtles. Traditional oral accounts claim that nesting female turtles eat the leaves of the *kañal* tree after nesting is completed. Eating the leaves, as the story goes, allows the turtles to regain their strength after their strenuous ordeal. We did not witness this event at anytime during our survey.

Surrounding the interior stand of *kañal* are *kirin* trees. While *kirin* often reach 10 meters or more elsewhere in the Marshalls, those on *Bikar* were only half that height. Found abundantly out to the sandy beach, *kirin* by far outnumbered other woody tress on *Bikar*. Extremely hardy and tenacious, they were even found on gravel bars and small pockets of sand on the reef

Figure 19: A young kirin (Tournefortia argentea) growing in a small sand and gravel pit on the consolidated limestone reef of Bikar

flat itself. Most excavations on *Bikar* occurred under the branches of this tree. Turtles were often located in the dark after we heard fallen *kirin* branches snapped by flailing flippers. Mixed among the *kirin* trees

Figure 20: Nesting turtle under kirin trees (Tournefortia argentea) amid fallen branches, storm strewn coral debris, and previously dug pits, Bikar Islet.

are *kanot* bushes. Rising to 1 to 2 meters tall, *kanot* bushes grew closer to the ground and were mostly restricted to sandy areas. Many nests were also located under these bushes that grow mostly on the lagoon side of *Bikar* Islet.

Standing among the *kañal* were several dozen *ni* (Cocos nucifera). Most of them were stunted due to the nominal rainfall on *Bikar*. In the past, coconut palms had been plentiful on *Bikar* Islet but its numbers have been greatly reduced in recent years. One member of the project who visited *Bikar* 14 years ago recalled vividly that at least one fourth of the islet was covered with *ni*. The original trees were reportedly planted by natives from *Utirik* during one of their forays for birds and turtles.

Although several were bearing nuts, they were drastically shriveled and useless for drinking. Conspicuously absent were *iu*, or newly sprouted coconuts, which are a favorite food item among Marshallese. In spite of our searches, we were unable to locate them among the fallen nuts, further attesting to the aridness at this latitude. *Bikar* Islet is the only islet in the atoll supporting coconut palm trees.

SEABIRDS

Seabirds of various species abound on *Bikar* Islet. By far the most conspicuous were the boobies. Constantly flying overhead and with little heed to our presence, they were heard even after nightfall returning from the ocean to roost on trees near our camp. The most common appeared to be *nana*, the red footed booby (Sula sula). Smallest of the species, it was seen nesting above the ground in both *kañal* and *kirin* trees. Also regularly seen was the brown booby (Sula leucogaster) or *kalo*. Easily distinguished by the clean cut brown and white colors on its breast, they were seen nesting on the ground under *kirin* and *kanot* bushes. Young fledglings of this species called *lollap* are much sought after as pets by Marshallese. The largest of the sulids, the masked boobies (Sula dactylatra) or *tol*, were occasionally seen but their nesting could not be confirmed on *Bikar* during our trip. Smaller resident sea birds on *Bikar* included the very common white fairy tern (Gygis alba), known as *mejo*. Many nesting pairs were observed inland on mature *kañal* and *kirin* trees on *Bikar* Islet,. Insatiably curious birds, groups of six or more often hovered five to six meters over our heads, following us as we walked around the islet. They were often observed gracefully flying in tandem, dipping and turning in wide arcs in the open sky. In what might be construed as courtship behavior, these acrobatic acts were performed in perfect unison and would last for hours on end. Another seemingly ubiquitous bird was *jekad*, the

common noddy (Anous stolidus). Many pairs were observed nesting on *Bikar* Islet mainly on *kirin* trees. Whenever disturbed, they would squawk loudly and fly off in a jerky manner characteristic of this species. Observed nesting on the ground were red-tailed tropicbirds (Phaethon rubricauda), or *lokwajek*. The larger of the two species found on *Bikar*, it was easily distinguished by its red bill and conspicuous black eye strip and its stiff red tail streamers. The smaller phaethonid was the

Figure 21: Ground nesting lokwajek (Phaethon rubricauda) on Bikar Islet

white-tailed tropicbird (Phaethon lepturus). In a manner not unlike the fairy terns, *jipkoraj* would sometimes follow us around the islet, hovering overhead and railing us with their distinctive cry. The other prominent bird we observed on *Bikar* was the frigate bird (Fregata minor), or *ak*. Nesting exclusively on *kañal* trees, these large birds were very common and readily identified by its large size and hooked bill. Many fledglings were seen on *Bikar* Islet, as well as on *Almani* and *Jabwelo*. Shearwaters of undetermined species were heard at night. Easily distinguished by their

eerie calls, these birds were heard occasionally but never actually seen on the islet during the day. Seen in open seas on our approach to *Bikar*, it was presumed that members of this species may be nesting on *Bikar* Islet. Conspicuously absent were *memej* or the sooty terns (Sterna fuscata). Although reportedly seen on *Bikar*, these ground nesting terns were not observed during our stay. A large rookery of *memej* is known to exist on *Bokar* Atoll, approximately 300 kilometers to the north of *Bikar*. The spotted eggs of *memej* are much sought after by Marshallese. Historically, the natives of nearby *Utirik* Atoll have made annual collecting trips to *Taka*, their uninhabited neighboring atoll, to collect the eggs of this bird. The Marshallese plan their trips to coincide with the start of the nesting season, usually mid–October. This allows the adult *memej* ample time to lay replacement eggs. In a custom unique to *Utirik*, hundreds of these eggs are placed in an earthen pit lined and covered with coral stones. The top of the pit, or *um*, is then trampled to break the shells and a large fire is started on top of it. When the fire is extinguished, the *um* is opened exposing the baked loaf–like eggs *sans* broken eggshells.

SHOREBIRDS

Migrant shorebirds were also observed during our stay on *Bikar*. Probably the most often seen were the *kotkot,* or ruddy turnstones (Arenaria interpres). Occurring in groups scurrying along the shoreline, they were readily distinguished by their patterned white stripped wings and their name mimicking call. Standing a little taller and more solitary in behavior was the bristle-thighed curlew (Numenius tahitiensis), or *kowak*. Much prized as food, *kowak* were difficult to approach. They flew away quickly with a sharp characteristic cry when disturbed. Another visiting shorebird seen on *Bikar* was the golden plover (Pluvialis dominica) or

kwolej. Solitary in nature, this bird was seen on the reef flats at low tides and along the sandy beach shoreline. Seen on only one occasion was the *kiril* or wandering tattler (Heteroscelus incanus) and the *kwol* or sanderling (Calidris alba). A shorebird conspicuously not seen during our stay on *Bikar* was the larger long-legged *kabaj* or Pacific reef heron (Egretta sacra).

It should also be noted that all seabirds and most shorebirds are considered edible by the Marshallese. After cleaned, they are usually cooked slowly upon heated coral stones. While the larger species like the *ak* and *lowajek* are preferred, smaller species like the *jekad* are occasionally consumed.

TERRESTRIAL FAUNA

Besides birds, two other terrestrial animals were very common on *Bikar* Islet. Several species of hermit crabs were seen everywhere, continuously roving the beach and undergrowth looking for something to eat. Being effective scavengers, they were seen by the thousands meandering at all hours of the day. In the mornings, they were swarmed over our campfire and fought for leftover scraps. Known collectively as *om*, larger individuals were invariably seen encased in discarded *jerul* (Turbo intercostalis) shells, some as large as 6 cm across. Smaller animals were housed in an assortment of shells, with the most common being that of several species from the family Neritidae.

An extraordinarily large population of Rattus exulans, the Polynesian rat, occupied *Bikar* Islet. Although reputed to be less aggressive than other species, the behavior of these rats was judged to be detrimental, and may even prove potentially disastrous to native birds and turtles on *Bikar*. Active both day and night, these introduced rodents were seen constantly

harassing the ground nesting birds. They were seen dodging in and out, nipping at the adult birds hoping to dislodge them from their nest in order to get to the eggs or hatchlings. In one episode, a tropic bird fending off persistent rat attacks from all sides was watched for over of an hour. In another incident, we saw and recorded on film the invasion of these rats into a turtle nest cavity while the eggs were being laid. While filming a nesting turtle one night, we were surprised to see dozens of rats scurrying out of a nest when the camera lights were switched on. Several were brazen enough to ignore the intense lights and remained in the nest long enough for us to record this phenomenon. We watched several of them gnawing through the soft pliable egg shells. Were it not for our lights scaring off most of the marauders, it is probable that most of the eggs would have been destroyed. So pervasive was Rattus exulans on *Bikar* that nothing was safe from their nightly invasions. We found it necessary to store our food, drinking water, clothing, equipment, etc. on the little boat, and to anchor the skiff offshore to avoid contamination. They easily penetrated our tents, punctured plastic bags covering our food, and even gnawed through our water containers. By the third night, it became routine for these animals to stray over sleeping bodies, whether on hammocks or in cots. Ironically, it was the tenacity of these rats that alerted us to our first sighting of turtle egg hatching while on *Bikar*. At 4 PM on the 8th day, we noticed several rats frantically converging on tiny objects about halfway down the beach. Upon investigation, we were startled to see that they were after newly hatched turtles scurrying to reach the water. We quickly rescued the baby turtles and fended off the rats providing safe passage to others attempting to reach the lagoon. By backtracking, the emergence nest was located well inland under some fallen coconut fronds close to our camp.

MARINE FAUNA

Being an uninhabited atoll with limited human pressure, *Bikar's* waters teemed with marine life. While waiting for nightfall, team members often fished and gathered items from the reef for their evening meals. Forays usually started after the intense heat of the mid–day sun had abated, around 3 to 4 PM. So abundant were the resources that it often required only an hour or so to obtain enough to feed the whole camp. While prevailing local wisdom suggested that fish from northern atolls were poisonous, we found those in *Bikar* to be free of ciguatera. Even top predators such as *jawe* (Plectropomus laevis) and *lange* (Caranx melampygus) were eaten without incident. Our only encounter with ciguatera was to occur during our next landfall on *Jemo* Island where two team members were mildly stricken after eating *atkeru*.

Figure 22: Atkeru (Polydactylus sexfilis) from Jemo Island, a source of mild of ciguatera.

Fish were caught in a variety of ways. On some days, trolling in the lagoon with the little boat would produce several species of jacks and

groupers. Shallow water snappers were easily captured with line and hook. On other days during an ebbing tide, walking on the reef flats with a throw net provided parrotfish, mullet ,and rudderfish.

Besides fish, the reefs surrounding *Bikar* provided team members with other edible items. Easily the most conspicuous because of their brilliantly iridescent mantles were Tridacna maxima and T. crocea. Known collectively as *mejenwor*, these clams were abundant everywhere, and relatively easy to gather during low tides. It is significant to note that nowhere in *Bikar* Atoll did we observed Tridacna gigas. This giant relative of *mejenwor* is a prominent member of the reef fauna in atolls further south. On other occasions when the tide was appropriate, team members would sometimes gather Turbo intercostalis, a gastropod known locally as *jerul.* Boiled and eaten, their discarded shells later became the shelters for the thousands of marauding hermit crabs around our camp site. One other invertebrate present at *Bikar* but not actually seen was the spiny lobster, Panulirus penicillatus. Because the traditional method of catching lobsters at night conflicted with our primary task of tagging turtles, no fishing was done for *wor* on *Bikar*. Their presence on *Bikar*, however, were confirmed by the many molted shells encountered on the beach. *(SEE APPENDIX 4, p.67-9)*

TAGGING ON *BIKAR*, August 1-11

A total of 12 days and 11 nights was spent on *Bikar* Atoll. During this period 48 turtles were tagged, all on *Bikar* Islet. Ranging from 83.0 to 120.0 cm in curved carapace length (average = 99.2 cm), they were all fully matured female Chelonia mydas, or *won.* Each were either triple or quadruple tagged on their flippers with stainless tags provided by SPREP which read:

"RETURN SPC/SPREP
BPD5 NOUMEA CEDEX
NEW CALENDONIA"

Curve measurements and other pertinent information (e.g., torn flipper, deformed shell, etc.) for each turtle were recorded. None of the turtles encountered on *Bikar* was previously tagged. *(SEE APPENDIXES 1 & 2)*

For tagging purposes, project members were divided into three teams, with two persons each. Each team was assigned one round per night, with their starting time varying from day to day. The first round commenced immediately after dark (usually at 8 P.M.), with subsequent patrols at midnight and 4 A.M.. Sometimes when no activity was encountered, another round was initiated within an hour. In such instances, the starting times of ensuing cycles were adjusted accordingly. Consequently, team members often walked around the islet more than once a night. To avoid duplicating earlier team efforts, all newly encountered tracks were identified by the placement of conspicuous tidal debris across the impressions. Often, these were in the form of staked tree branches, inverted whiskey bottles, stacked plastic floats, etc. When these objects were seen in such a manner, it was understood that the animal that

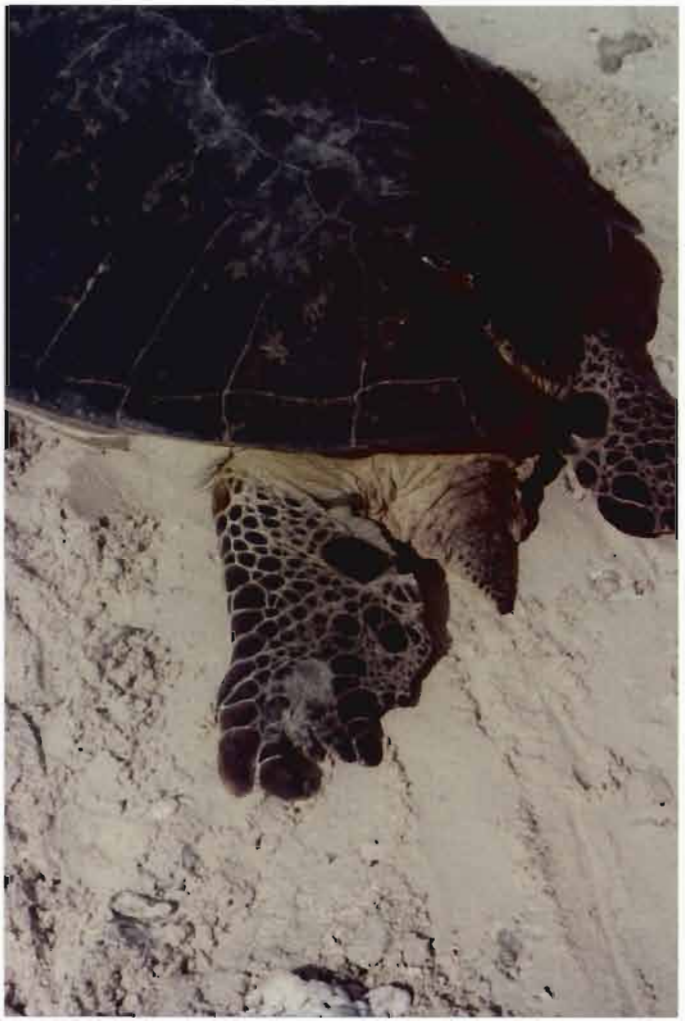


Figure 23: Tag on left hind

produced these tracks had already been documented. These markings were then removed the following morning. With a circumference of almost three kilometers, each surveillance round took approximately 1-3 hours to complete, depending on the number of turtles encountered.

Figure 24: Measuring curve carapace length

Marshallese wisdom dictates that turtles will not come ashore if they hear noises or see light on the beach. Because of their alleged sensitivity to these distractions, the camp fire was promptly extinguished at nightfall. Even the *Toojlok* was sent to another part of the atoll, or instructed to drift far offshore to prevent the vessel's lights from scaring turtles coming ashore. Consequently, all rounds were conducted with the conservative use of illumination, and all conversations conducted in a subdued manner. Whenever a flashlight was necessary to record data, its use was kept to a minimum and always screened from the water. Cigarette smoking was prohibited while walking on the beach. Smokers were instructed to go inland and to shield the light from their matches and cigarettes from the water. Artificial lighting was never used to scan the beach or to search for

nesting turtles in the underbrush. Thus, all turtles were located by one of the following methods:

(1) following observed crawl tracks on sandy beach stretches;

(2) hearing the snapping of fallen branches or twigs by meandering turtles;

(3) hearing the sound of sand, pebbles, rocks, etc. being flailed about during excavations;

(4) hearing the heavy exhalations by resting turtles; and

(5) actual visual contact of the turtles (usually the reflected moonlight off their wet carapaces).

All but six of the 48 animals tagged on *Bikar* were encountered high above the water line in the vegetation. Generally, every opportunity was allowed for these animals to complete their nesting before tagging. Each team waited until the turtles started their return to the sea before measuring and applying the tags. However, on certain occasions, some turtles were flipped over prior to initiating nesting activities. These individuals would then be measured, tagged, and released at daybreak of the following morning. This procedure was only used when turtles were encountered

Figure 25: Applying tag to front flipper

early during a surveillance round. It was felt that a prolonged wait would allow turtles up the beach a chance to complete their nesting activities and escape back into the sea without being tagged, thus compromising data gathering. Any turtle observed in the later phases of nesting (e.g., actual excavations, egg laying, nest tamping, or backfilling), was allowed to consummate its activity before being flipped over. In such cases, one team member stood by while the other would continue up the beach to hopefully secure other animals returning to the sea. Prior to all releases, each animal was numbered on its back with a fast drying enamel paint. This facilitated identifying returning animals that were previously tagged, thus avoiding potential duplication of effort and loss of time.

Figure 26: Measuring curve carapace width under kirin bushes

Not all turtles were successful in their nesting attempts. In some instances egg laying efforts were aborted. As mentioned earlier, those detected early and not yet actively excavating were quickly flipped over. Others were inadvertently stumbled upon and frightened, causing them to terminate their efforts. Still others were encountered on their retreat to

the ocean after short false crawls. Additionally, six turtles were captured while still in the water. Two of these had just emerged on land and were captured as they tried to retreat into the water. Four others were observed swimming slowly along the water's edge and were subdued and pulled ashore. Many opportunities of this nature were passed up because turtles captured in this manner had to be tagged immediately if caught on an incoming tide. Their huge bulk made it next to impossible to drag them up shore to escape the raising water. Furthermore, this method caused much commotion which discouraged others from coming ashore. Consequently, attempts at capturing swimming turtles were limited to the last round, just before daylight.

Eleven of the turtles whose nesting attempts were aborted, as described above, were later observed returning to *Bikar* Islet to successfully complete their egg laying cycle. Two of these eleven were inadvertently alarmed a second time, causing them to abandon yet another attempt. Interestingly, these two animals were observed again on those same nights at yet another site on the islet. In both instances, they were successful in what became their third attempt at egg laying on *Bikar*. *(SEE APPENDIX 3, p. 66)*

All animals encountered on *Bikar* were found free of fibropapillia tumors, an insidious and potentially fatal disease recorded from the Hawaiian Islands and elsewhere. While *jabake*, or hawksbill turtles have been reported from this atoll, none were seen nor encountered any during our stay on *Bikar*. All of the tracks observed on *Bikar* during this trip were clearly made by Chelonia mydas. *(Note: several Eretmochelys imbricata were observed swimming in Bikar's lagoon by a team member during a visit in 1978).*

While on *Bikar*, we were able to verify two hatchings. One occurred during daylight, and was detected when dozens of rats were seen in pursuit of the hatchlings. The other incident occurred during the night, and was discovered the next morning when we chanced upon track marks left by escaping juveniles in sand pockets. In both cases the emergence holes of the hatchlings were located.

Figure 27: Contrasting sizes of hatchling vs mature nesting female

Several trips were made during late afternoons to assess the situation at *Almani* and *Jabwelo* islets. On each trip we saw large mature *won* swimming in the shallow lagoon water next to the islets, apparently contemplating nesting attempts. Both islets were large enough to support trees and avian life. The larger of the two, *Jabwelo*, was estimated to be 12 hectares in size and predominantly covered with *kañal* trees. Densely wooded fourteen years ago, many trees on *Jabwelo* had been toppled by a storm. Scattered throughout the islet were broken *kañal* branches sprouting new growth. *Kañal* trees also grew on smaller *Almani*, but were not as plentiful. Fringing both islets were the omnipresent *kirin* trees. *Kanot* were scattered about, mostly in sandy areas. Bird life abounded on both islets, with *nana* and *ak* predominating.

The shorelines of both islets were notably rocky, particularly on *Jabwelo*. Coral rubble and other debris were found well inland. Only on the lagoon side of *Almani* did we encounter any substantial sandy areas. In spite of this less than ideal situation, we found numerous turtle excavations on both islets. Most of them were seen on the larger *Jabwelo* although it was the less hospitable of the two. We estimated a minimum of 100 nesting attempts on *Jabwelo*, and a minimum of 50 on *Almani*. Because of the rocky nature of both islets, excavations were not well defined and only a very conservative estimate of their numbers was possible.

One attempt was made to tag turtles on *Jabwelo* and *Almani*. Three project members were dispatched to these islets on the night of August 7. Unfortunately, this attempt coincided with a passing storm that hindered tagging efforts on these two islets and on *Bikar*. No turtles were tagged that night on either *Jabwelo* or *Almani*, and only one was tagged on *Bikar* Islet. 

TYPHOON KENT

Because of the remoteness of *Bikar* and our apprehension of inclement weather conditions, the project was scheduled for the latter part of summer. As such, we were assured to be well within the "calm season" for the Marshalls. Unfortunately, our schedule may have coincided with the ending of the nesting cycle for turtles in the northern Pacific. In spite of this, we managed to tag an average of four turtles per night during our stay on *Bikar*. In addition, we never experienced a night in which we did not encounter any turtles at all on *Bikar* Islet. However, during the 6th and 7th nights on *Bikar* Islet, only two turtles were tagged, one each night. This was attributed to a passing storm that produced enormous breaking waves on the reef's edge for two consecutive days. These waves were so huge that

ocean access to *Bikar* by turtles seemed an impossibility. Indeed, all five turtles encountered during those two nights were on the lagoon side of the islet. This storm, which bought lightning and rain to *Bikar*, was later identified as Typhoon Kent. Originating below the Marshalls in Kiribati, it moved north with its eye just missing *Wotje* Atoll, 270 km south of *Bikar*. Communication with *Majuro* alerted us on the progress of this typhoon, and it was suggested that the project be aborted in favor of seeking security within the lagoon at *Utirik* Atoll. However, team members opted to weather the storm on *Bikar* Islet. The *Toojlok* was allowed to abandon it's commitment to the project to seek safety, if and when necessary. Fortunately, Typhoon Kent veered westward and away from *Bikar* soon after passing between *Wotje* and *Likiep* atolls. It did, however, leave in its wake heavy seas and strong southerly winds. These conditions appeared to have hampered the project's efforts on *Bikar* for at least two nights. With the passing of the storm and the calming of the seas, the number of turtles seen each night steadily increased, culminating in our highest tagging incident anytime during our survey on the eleventh and final day on *Bikar*, five nights after the passing of Typhoon Kent.

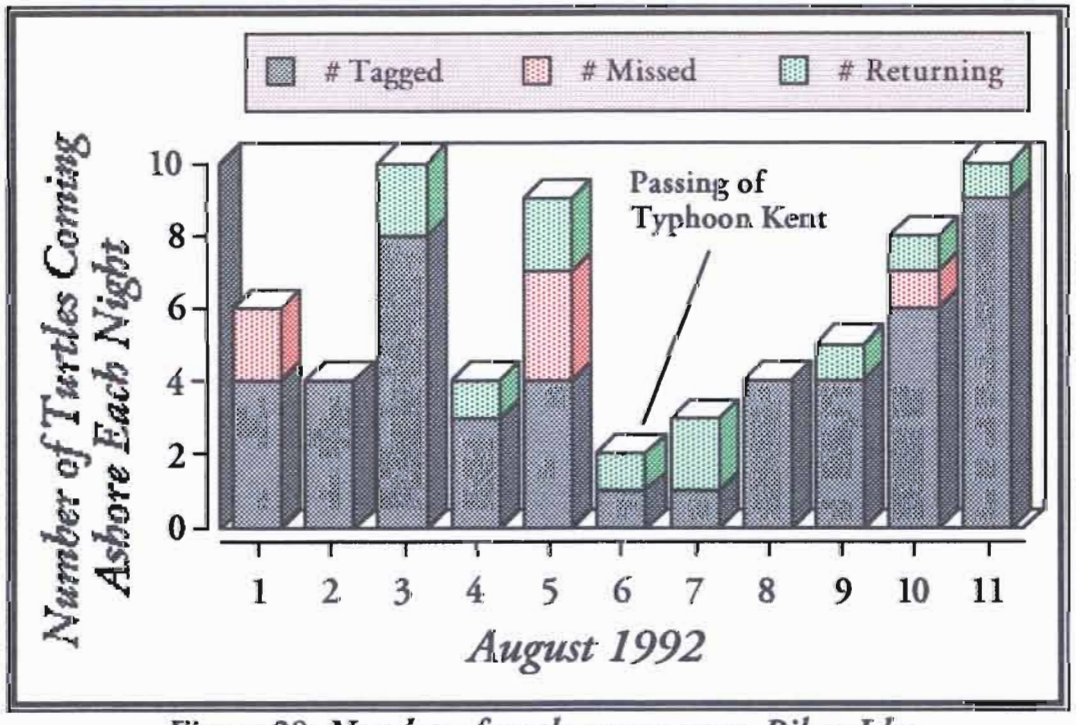


Figure 28: Number of turtle occurrences, Bikar Islet

JEMO, August 13

On the morning of August 12, fifteen days after our initial departure from *Majuro*, we broke camp on *Bikar* Atoll. Fully aware of our intrusion on this pristine atoll, we carefully gleaned our campsite carrying all rubbish back to the ship for proper disposal elsewhere. Faced with an ebbing tide, we were obliged to rendezvous with the *Toojlok* at the pass four miles to the north. It took five trips and seven hours to transport all our gear, supplies, and refuse. It was not until 3 PM that afternoon that we were able to departed *Bikar* heading south for *Jemo* Island. We sailed for the rest of the day and throughout the night, sighting *Jemo* Island at 9 AM the following morning on August 13.

Approximately 220 km south of *Bikar*, *Jemo* is one of five singularly raised coral islands in the Marshalls archipelago. Long revered as a turtle sanctuary, *won* from *Jemo* are renown throughout the Marshalls to be the best eating from anywhere in the archipelago. Normally uninhabited, it is located at 10° 08' N latitude, 169° 35' E longitude, approximately midway between *Likiep* and *Ailuk* atolls. *Jemo* is historically linked to *Likiep* Atoll, its closest inhabited neighbor 40 km to the east. Oral history alludes to a time when large sailing canoes called *jiton* followed a submerged reef from *Likiep* to *Jemo* Island in order to make landfall. An oval shaped island of approximately 16 hectares, it lies on the western edge of an 8 km long submerged ocean reef. Without a sheltered lagoon, landing on *Jemo* is best during normal NE trades when the island provides a lee over a narrow reef to a white sandy beach lined with *kanot* bushes and shaded by large *kirin* trees. Only occasionally visited during pre-contact times, *Jemo* now displays signs of more permanent human encroachment. At the turn of the century, clan members from *Likiep* chose to exercise their traditional rights to live on the island. The interior was

cleared and coconut palms planted. During the US administration after WWII, heavy equipment was brought in and further modification of the land was done. Long since abandoned, evidence of this enterprise still exists to this day. Still standing are remnants of a wooden framed dwelling, an outdoor cooking hut, a copra shed, and a toppled aluminum water tank. A more recent display of human encroachment can be found on the southwestern shoreline of *Jemo* Island. Stuck on the reef is the *MV Marshall Islands*, a 300-mt interisland field vessel stranded during the 80's. Abandoned and left to rust in the unforgiving elements, it serves as a constant reminder of the perils of sailing among these far flung and low lying atolls and reefs.

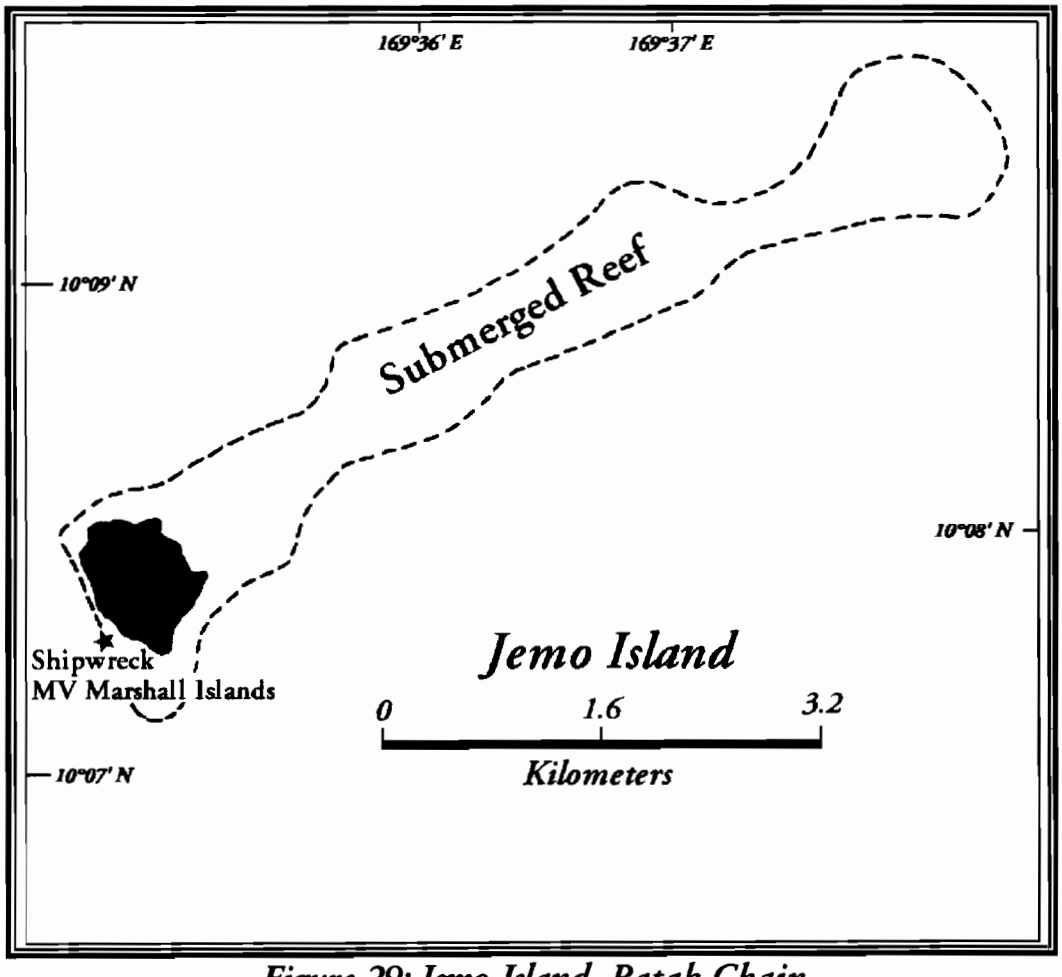


Figure 29: Jemo Island, Ratak Chain

A camp was set up by noon on the southwestern beach for the overnight stay. Walking around the island, we discovered it to be more luxuriously vegetated than *Bikar*. Being closer to the equator, *Jemo* has a higher rainfall that was reflected in the more varied and robust plant life. The interior was dominated by coconut palms, many of them producing *ni*, or drinking coconuts. Among the damp undergrowth were many edible *iu*, newly sprouted coconuts conspicuously absent on *Bikar*. The greater rainfall on *Jemo* is also reflected by the presence of several types of ferns not noticed on *Bikar*. Springing from tree branches was the epiphytic *kino* (Microsorium scolopendria) and the bird's nest fern (Asplenium nidus) or *kartop*. Fringed by large *kirin* trees and pure stands of *kanot*, we also found dispersed on *Jemo* several large *kono* trees (Cordia subcordata). Present also was *kañal*, the favorite perching tree of sea birds. Polynesian rats, the rodent that proved so troublesome on *Bikar*, were also observed in limited numbers. Exposed to view when scurrying around on *kirin* tree branches, they were not judged to be as plentiful on *Jemo* as they were on *Bikar* Islet. While the heavy underbrush may have concealed their actual numbers, we did not encounter them during our nocturnal surveillance.

Investigating the interior of the island, two immature *barulep* or coconut crabs were observed secretively hiding in the undergrowth. Bird life was well represented on *Jemo*, but not as plentiful or diverse as that on *Bikar*. Similar to *Bikar*, passerine birds were completely absent and the avian fauna was represented solely by oceanic sea birds and pan Pacific migrant shorebirds. Among the smaller species seen were *mejo*, and the ubiquitous *jekad*. *Nana* and *kalo* were commonly seen, along with several juvenile *lollap*. Conspicuously absent were the frigate birds or *ak* and both species of the ground dwelling tropic birds, *jipkoraj* and *lokwajek*.

It took us one hour to circumnavigate the perimeter of *Jemo* Island, which at 15 hectares is approximately 25% smaller in size than *Bikar* Islet. An attempt was made to enumerate the number of crawl tracks on *Jemo*. After counting a total of eight pairs of tracks, a stretch of shoreline composed of stones and solid coral bedrock was encountered making enumeration impossible; further track-counting efforts were therefor abandoned. Exposed to the prevailing trades, this northeastern shoreline was covered with rubble and other coral debris thrown up by waves. Facing an 8 km submerged ocean reef with no protective lagoon, coral fragments were strewn inland as far as 100 meters. In spite of this precarious situation, nesting excavations were still discovered in selected portions of the undergrowth on this side of the island. Later that evening two turtles seeking to come ashore on this seemingly inhospitable stretch of beach were captured by team members.

Figure 30: NE shoreline, Jemo Island

The northwestern and southern portion of *Jemo* presented turtles with almost ideal nesting conditions. Turtles approaching the island from

these directions came in directly from the ocean over a narrow reef flat. A gentle sloping beach lead to shaded sandy grounds where numerous nesting pits were observed. As with *Bikar*, the density of excavations was impressive. Diggings were located under almost all *kirin* and *kanot* trees, many overlapping one another. There is no question that *Jemo* Island must be considered another major turtle nesting rookery in the Marshalls Islands. In spite of its proximity to two inhabited atolls and its history of human occupation, *Jemo* indeed lived up to the Marshallese adage: "*Ekkarokrok arin Jemo*", i.e., "The beaches of *Jemo* are always full of turtle nests."

Returning to our campsite to await nightfall, the chance emergence of newly hatched turtles was witnessed. Team members were alerted to the event by the commotion caused by dozens of beach crabs known as *karuk*

Figure 31: Midday hatching of won on SW beach, Jemo Island

(Ocypode ceratophthalma) as they darted from their burrows to snare passing baby turtles. By following the hatchling tracks, a single

emergence nest was located under a *kanot* bush not far from the base camp. A total of 52 hatchling *won* was safely escorted to the sea, although several had been badly injured by the predatory crabs.

Figure 32: Karuk preying on won hatchling, Jemo Island

After dividing into three teams of two persons each, three rounds were conducted during our single rainy overnight stay. This resulted in the tagging of eight female green sea turtles, six of them during the rising tide. Two of these were captured at the water's edge on the rocky northeastern side of the islet. One turtle displayed parallel "double humps" longitudinally on its back, an indication of high turtle fat, or *wiwi*, to the native Marshallese. Of turtles found anywhere in the Marshalls, these double humped *won* of *Jemo* are considered the tastiest and therefore are the most sought after. Except for on *Jemo*, this distinctive physical characteristic on turtles was not observed elsewhere. The eight sites on *Jemo* where turtles were encountered and tagged are depicted in Figure 33.

After making one last trip around the island, the third and final campsite of this project was dismantled on Friday morning, August 14. As on *Bikar*, the area was carefully cleaned of trash. All refuse found around our campsite was picked up and ferried to the *Toojlok* that set sail at 9 AM for *Wotje* Atoll, approximately 65 km to the south. Nine hours later, residents eager to learn the results of our tagging efforts greeted the *Toojlok* at the old Japanese built dock. Following a festive on board celebration commemorating our safe return, the next morning was spent refueling the *Toojlok* and replenishing the freshwater supply reduced to less than 150 liters at the time we departed *Jemo*. At 3 PM on August 15, we departed *Wotje* on calm seas, and were guided by a full moon later that night. Traveling at a top speed of 7 km per hour, the final leg of the project was completed as we came alongside the *Majuro* dock at 6 PM the following day on August 16.

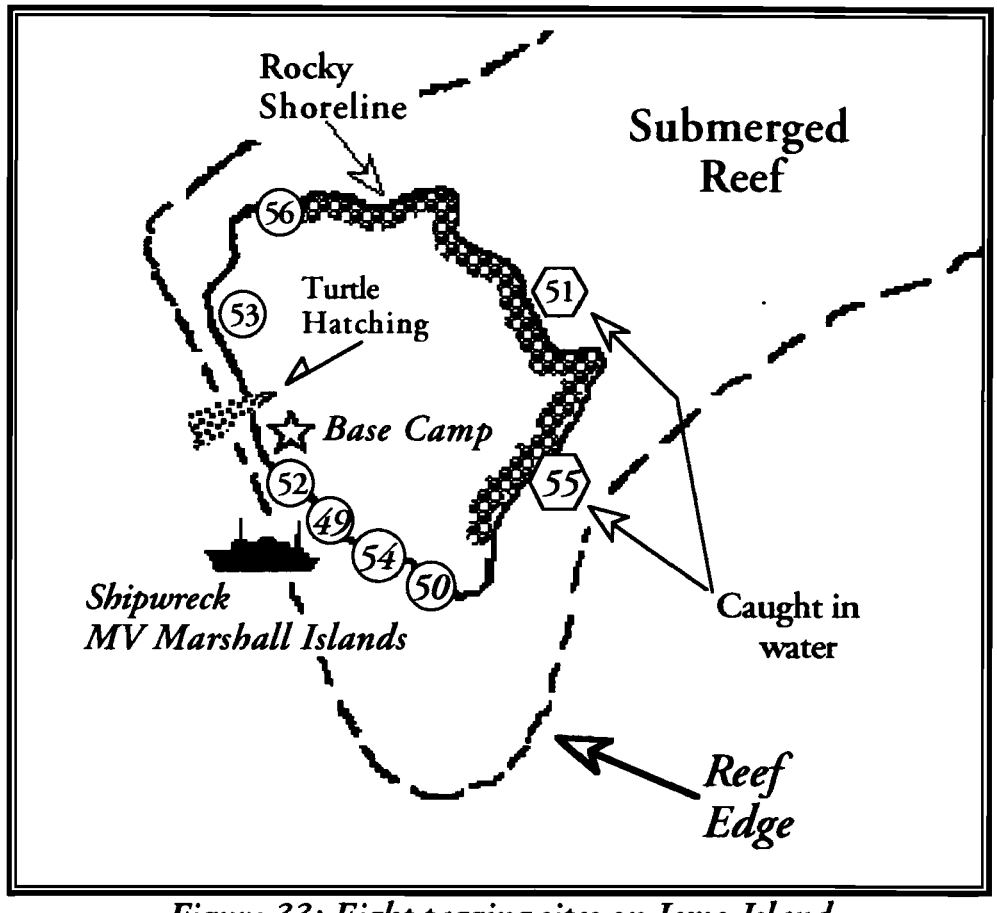


Figure 33: Eight tagging sites on Jemo Island

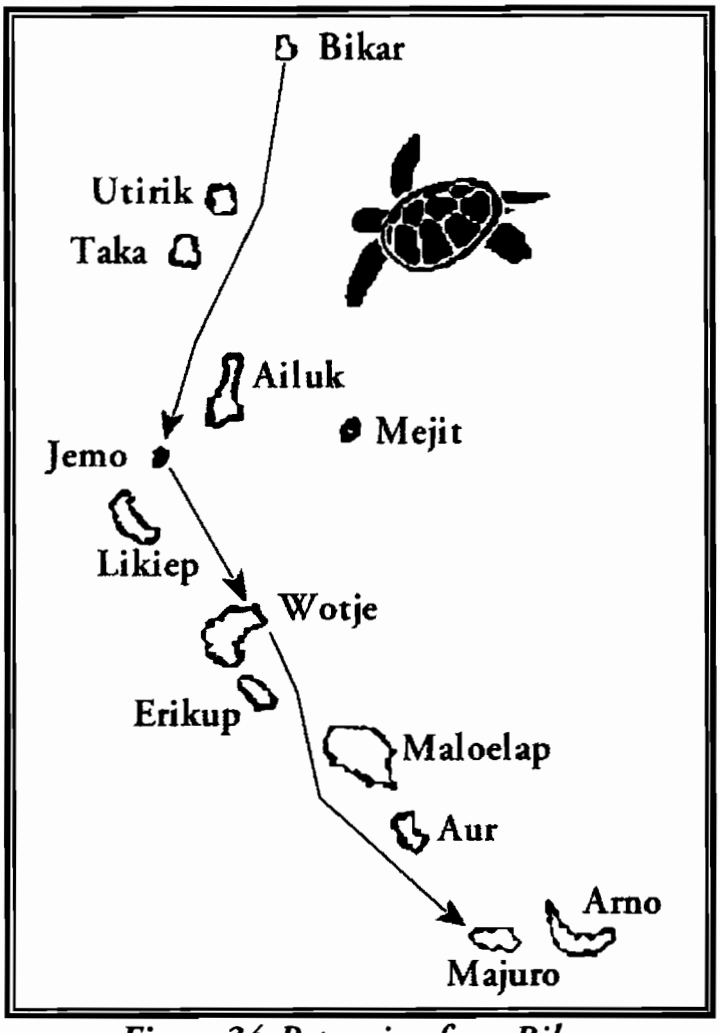


Figure 34: Returning from Bikar

MAJURO, August 17

On Monday morning August 17, a meeting was held with the administrator of the Marshall Islands Marine Resources Authority (MIMRA) and his staff. Also at the meeting was the Honorable Amsa Jonathan, Cabinet Minister of Resources and Development, Government of the Republic of the Marshall Islands. The results of our turtle tagging efforts were discussed at this meeting. Addressed also were project follow-ups such as the distribution of information, tag recovery procedures, the establishment of a database, the disposition of project equipment and supplies, and the stock assessments of resources on *Erikup*, *Bikar*, and *Jemo*.

1. Dissemination of Information:

   It was decided that the results of the project would be disseminated via several media. English and Marshallese versions of our findings were printed in the *Marshall Islands Journal,* a widely read local newspaper. Public announcements were broadcast over the local radio station for several days to further inform the public. These radio

announcements were particularly effective as they were heard throughout the country. The *Journal*, while avidly read on *Majuro* and *Kwajalein* atolls, is not readily available to natives residing in remote atolls. Other RepMar agencies and officials were informed of the results by Minister Amsa Jonathan during a session of the local legislative body, the *Nitijela*. His address was broadcast live throughout the Republic, which further help publicize the purpose and results of our turtle tagging project.

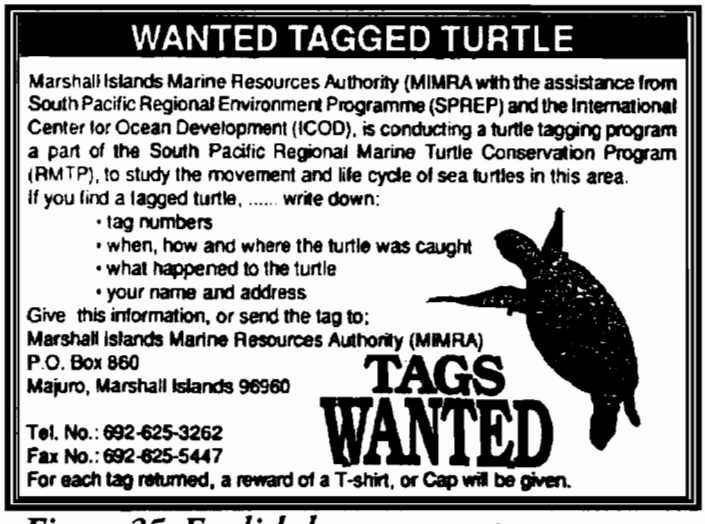


Figure 35: English language poster

2. Tag Recovery Procedures:

Future tag recovery information will be collected by the Marshall Islands Marine Resources Authority (MIMRA). A staff member was assigned to devise a report form in order to record all pertinent recovery data. Posters written in both English and Marshallese were printed and distributed throughout the atolls. As incentives, caps and T-shirts provided by the South Pacific Regional Environment Programme (SPREP) were offered for information of any

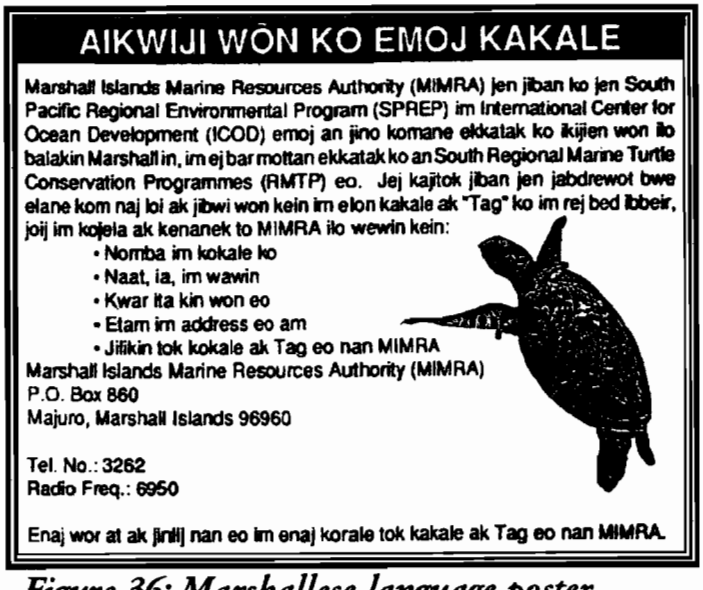


Figure 36: Marshallese language poster

recaptured animal.

3. Database:

   An electronic database listing tag numbers, morphographic information, recovery data, location, movement, sizes, etc. of all tagged sea turtles in the Republic of the Marshall Islands is to be established in the office of MIMRA. This database will include all pertinent information generated by this project, as well as from any other similar endeavors by RepMar or other research agencies engaging in the study of movement and life cycle of sea turtles in the Marshall Islands. The gathered information would be shared with other island nations in hopes of developing a regional management plan for sea turtles in the northern Pacific.

4. Disposition of Project Equipment and Supplies:

   Equipment and supplies purchased by project money were turned over to MIMRA to be used in conjunction with future research projects. These included tents, shading material, flashlights, cots, batteries, coolers, a wooden table, and a small portable stove. In addition, the unused tags and applicators were left with MIMRA in anticipation of future tagging efforts by staff members.

5. Stock Assessments:

   Also discussed at this meeting was the assessment of resources encountered during the trip. Without quantitative baseline data, it was difficult to evaluate the current stock condition of sea turtles and other natural resources. However, it was known that more and more trips were being made to these far off rookeries to capitalize on the wealth of wildlife. Apprehension about the continued and unregulated exploitation of these resources was expressed. It was feared that with the arrival of faster and more comfortable motorized vessels, these major rookeries

would be over harvested. Additionally, the rat situation on *Bikar* was addressed in detail and was of particular concern. It was felt that if this problem was not corrected soon, a major turtle and sea bird rookery in the northern Pacific would be jeopardized. Plans were proposed for a follow-up project to eliminate the rodent problem on *Bikar* Atoll. It was felt that this activity should be in conjunction with the continued tagging of turtles in the Northern Marshalls.

Also discussed in detail was the ongoing draining of natural riches from *Jemo* Island and *Erikup* Atoll. Because of their proximity to atolls with burgeoning populations and diminishing resources, it was felt only a matter of time before Jemo and *Erikup* would be severely affected at the current rate of exploitation. To counteract this, it was proposed that more education on the conservation of atoll resources should be emphasized in schools, via public announcements, teacher workshops, symposiums, etc. Finally, it was suggested that additional research projects be strongly encouraged for the purpose of obtaining baseline data while resources were still intact. 

ADDENDUM: *WOTJE*, August 24-31

As a result of the interest expressed earlier by the residents of *Wotje*, a return trip was made to further discuss turtles. With the approval of MIMRA, several project members flew back to *Wotje* and presented life history information and other facts concerning sea turtles to various groups. During these discussions, the deep respect and concern by Marshallese for their natural resources became readily apparent. Their close ties to nature were evident everywhere. Sea birds and sea turtles were frequently retained and customarily kept as family pets. On *Wotje* and *Ormed* Islets, several families holding newly hatched *won* in containers

were encountered. Fed daily and kept for several years, these sometimes reach 50 cm in curved length before being released back into the sea. During the conversations, it was discovered that the juveniles observed were captured from neighboring *Erikup* Atoll. Several dozen in all were found to be vigorously healthy and well cared for. Uniformly small in size, they were judged to be hatchlings from the current nesting season. Offers to include them as part of our current studies were declined in as much as the turtles were too small for tagging.

Coincidentally, we had met a family with two pet turtles during our last stop on *Majuro*. Held for over a year, these were larger than the ones we saw on *Wotje*. The offer to have them tagged as part of our study was readily accepted. The measurements of these turtles, tagged and released in *Majuro* lagoon, are as follows:

Date	*Curved Length (cm)*	*Curved Width (cm)*	*Tag Right Front Flipper*	*Tag Left Front Flipper*
8/18/93	51.5	47.0	5584	5585
8/18/93	45.5	43.5	5586	5587

Table 1: Chelonia mydas tagged on Majuro

Project members learned during conversations that the harvesting of sea turtles was an ongoing activity on *Wotje* Islet. Natives told of night fishing trips during low tides to oceanside reefs, where deep serrations in the outer edge of the reef flat known as "spurs and grooves" are found. In the shallow portions of these grooves, with the help of flashlights, they often found sleeping turtles. If the animals were small enough, they were pounced upon and captured with relative ease. This activity was usually carried out by younger and more agile men because of the inherent danger associated with this technique, e.g., surging waves, sharp coral, and the

thrashing of the turtles. Three to five turtles might be captured in this manner during each outing. Informants estimated that during the course of a year, approximately 100 turtles were taken by this procedure on *Wotje* Islet alone. Both *won* and *jabake* are susceptible to this technique. Green sea turtles taken were usually juveniles and sub–adults. Sexually matured *won* were avoided because of their imposing size and strength. By contrast, both juveniles and adults of the smaller *jabake* were taken.

Figure 37: Ocean side "spurs and grooves"

A few nights prior to our return to *Wotje*, several fishermen using this technique had caught four turtles, two *won* and two *jabake*. After personal interviews, project members were allowed to tag and liberate three of the smaller animals, one of which was a small hawksbill. All three juvenile turtles were released into the lagoon at the old Japanese dock. The remaining turtle, a large fully matured female hawksbill, was kept by the fishermen and later butchered along with two other large *won*. These four turtles caught in the "spurs and grooves" are shown in Figure 38.

Figure 38: Sea turtles captured in "spurs & grooves", Wotje Islet

Another method by which sea turtles were captured on *Wotje* was described by local residents. In calm weather soon after daybreak, fishermen in outboard boats would set out to the ocean side of reefs ringing the atoll. Using masks and fins, sleeping turtles would be located among the corals and crevices on the reef drop-off. Free diving as deep as eight meters, they would secure the unsuspecting animals with grappling hooks tethered to lines. Large sized *won* and *jabake* were oftentimes hauled into the boats and subdued in this manner. Coincidentally during our visit, two large *won* seized using this technique were being held on *Wotje* Islet. These were later butchered, along with the large hawksbill mentioned earlier, and the salted meat was sent to clan members on *Ebeye* Islet, *Kwajalein* Atoll for a *kameen* or birthday party.

Date	*Species*	*Length (cm)*	*Width (cm)*
8/31/92	C. mydas	84.0	80.5
8/31/92	C. mydas	92.0	87.0
8/31/92	E. imbricata	81.0	74.0

Table 2: Curved measurements of butchered turtles Wotje, Wotje

Figure 39: Butchered won ready for salting

Three sea turtles were measured and tagged during our stay on *Wotje*. Two were juvenile *won* and the other was a sub–adult *jabake*. Though relatively small in size, these were destined to be eaten had it not been for our intervention. All three were captured during the night in the "spurs and grooves" of *Wotje* Islet. Measured and tagged, they were released back into the lagoon after the data in Table 3 was recorded.

Figure 40: Releasing turtles, Wotje lagoon

Species	*Curved Length (cm)*	*Curved Width (cm)*	*Tag Right Front Flipper*	*Tag Left Front Flipper*
C. mydas	46.5	43.0	5592	5591
C. mydas	48.0	47.0	5588	5589
E.imbricata	66.0	59.0	5593	5594

Table 3: Turtles tagged on Wotje–8/31/92

Interviews with local residents suggested that E. imbricata could be more than just a casual visitor to *Wotje*. Discussions with knowledgeable fishermen disclosed that *jabake* have been known to frequently nest on various islets of this atoll. Most recently, a hawksbill was observed depositing her eggs on the southwest beach of *Wotje* Islet during the summer of 1991. Concerning that incident, no attempts were made to disturb nor capture the nesting female. She was allowed to complete her act and escape back into the lagoon. Furthermore, the nest was not tampered with and the eggs were allowed to develop in a normal fashion. Another episode of hawksbill nesting was reported two years ago from *Nibung* Islet in this same atoll. A female *jabake* was sighted crawling up the beach searching for a place to lay her laying eggs. Additional information regarding the results of her attempts, or her final disposition, was not available. While there remains little doubt that Chelonia mydas is the predominant sea turtle around the waters of *Wotje*, personal interviews, coupled with our observations, indicate possibly that this atoll may also be a center of activity for Eretmochelys imbricata.

During our stay, we learned that residents of *Wotje* continue to regularly visit *Erikup* Atoll, only 12 km to the south and an hour away by outboard boat, to gather turtles. Preceding our survey, we learned of a large gathering that convened on *Wotje* during the month of June. Several hundred former residents of *Wotje* and their dependents converged on the

atoll from throughout the archipelago to commemorate "Liberation Day," the emancipation of the Marshalls from Japanese control. As part of their celebration, traditional food items were prepared and consumed. It was learned that several hunting trips to collect turtles had been made to *Erikup* and stockpiled for this affair. Estimates gathered from reliable sources indicated that 20-30 turtles were captured from the islets of *Enego*, *Loj*, and *Erikup*. These included females apprehended while on the beach and several males caught along the water's edge. Most were cooked in the traditional manner of placing inverted carapaces filled with sliced turtle meat, intestines, and turtle fat in underground pits, or *um*. . Covered with their plastrons, these were then overlaid with leaves and allowed to cook for several hours. Placed separately within the *um* were other customary staples such as sweet potatoes and various breadfruit dishes.

Figure 41: Characteristic hawksbill beak; note SPREP tag on left front flipper

Appendix 1

Tagging and Measurement Data of 61 Sea Turtles During the Summer of 1992 in the Marshall Islands

	Date	*Left Front Flipper*	*Right Front Flipper*	*Left Hind*	*Right Hind*	*Curved Carapace L X W (cm)*	*Site*
1	1-Aug	R5452	R5451	-	R5453	107 X 89	Bikar
2	1-Aug	R5454	R5455	-	R5456	103 X 93.5	Bikar
3	1-Aug	R5458	R5457	-	R5459	106.5 X 99.5	Bikar
4	1-Aug	R5461	R5460	-	R5462	99.0 X 89.0	Bikar
5	2-Aug	R5463	R5464	-	R5465	97.0 X 88.0	Bikar
6	2-Aug	R5467	R5466	-	R5469	102.0 X 95.0	Bikar
7	2-Aug	R5472	R5471	-	R5473	97.0 X 87.0	Bikar
8	2-Aug	R5475	R5474	-	R5476	100.0 X 89.0	Bikar
9	3-Aug	R5478	R5477	R5479	-	96.0 X 88.0	Bikar
*10**	3-Aug	R5481	R5480	-	R5482	95.0 X 85.0	Bikar
		** distal portion of left hind missing; stump.*					
11	3-Aug	R5485	R5484	-	R5487	102.0 X 94.0	Bikar
*12**	3-Aug	R5490	R5489	-	R5488	100.5 X 91.0	Bikar
		** barnacles knocked off*					
13	3-Aug	R5492	R5491	-	R5493	101.0 X 92.0	Bikar
14	3-Aug	R5495	R5494	-	R5496	95.0 X 82.0	Bikar
15	3-Aug	R5498	R5499	-	R5500	95.0 X 91.0	Bikar
16	3-Aug	R5527	R5526	-	R5528	95.0 X 88.0	Bikar
17	4-Aug	R5531	R5530	-	R5529	101.0 X 92.0	Bikar
18	4-Aug	R5533	R5532	R5534	-	99.0 X 90.0	Bikar
19	4-Aug	R5537	R5536	-	R5535	105.0 X 93.0	Bikar
20	5-Aug	R5541	R5540	-	R5538	99.0 X 92.0	Bikar

Appendix 1 (continued)

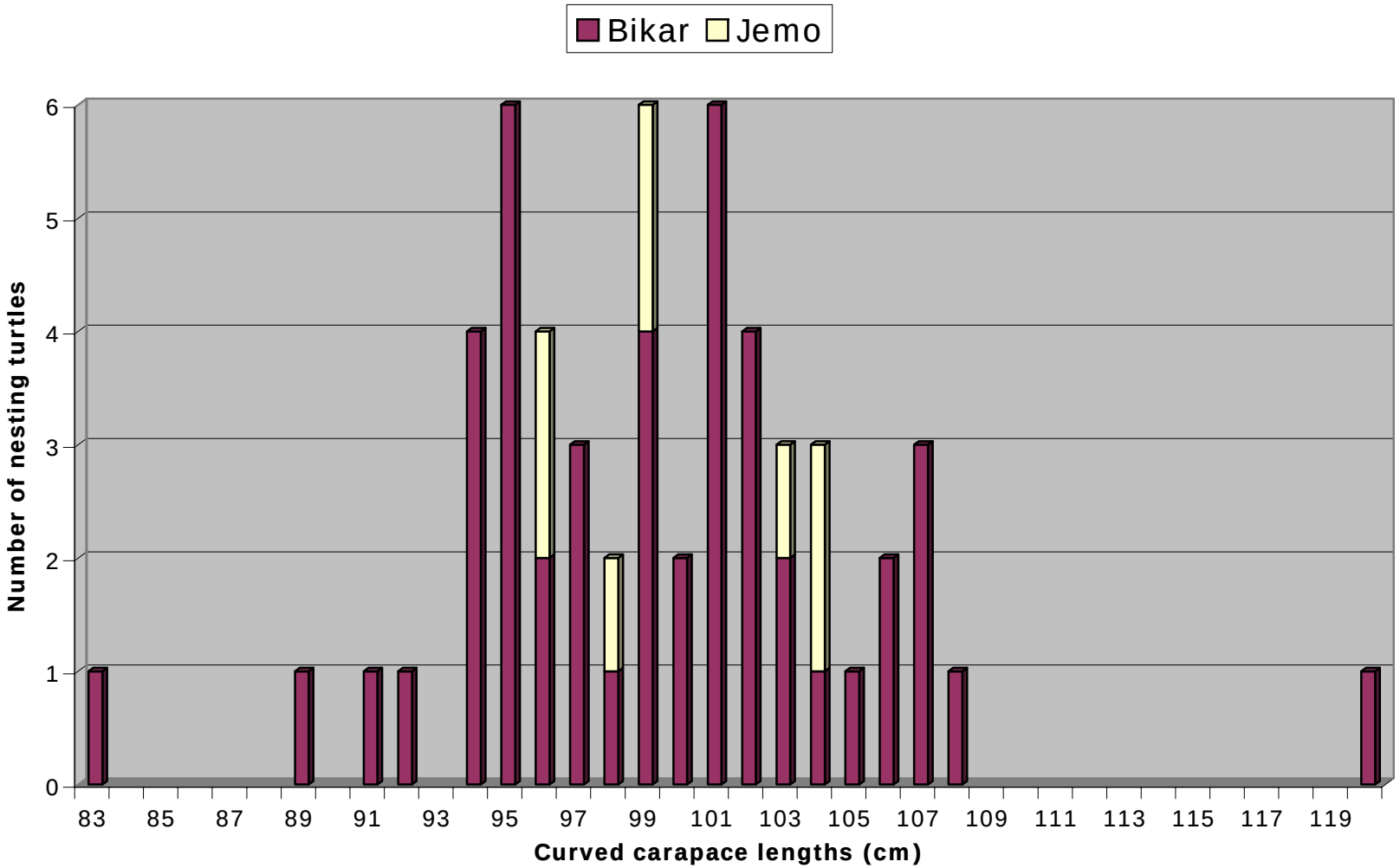
	Date	Left Front Flipper	Right Front Flipper	Left Hind	Right Hind	Curved Carapace L X W (cm)	Site
21	5-Aug	R5542	R5543	-	R5544	105.5 X 101.5	Bikar
22	5-Aug	R5546	R5547	-	R5545	93.5 X 85.5	Bikar
23	5-Aug	R5549	R5548	R5550	-	95.0 X 91.0	Bikar
24	6-Aug	R5503	R5502	R5501	-	91.0 X 84.0	Bikar
25	7-Aug	R5653	R5652	R5651	-	98.5 X 92.5	Bikar
26	8-Aug	R5505	R5504	R5506	R5507	102.0 X 92.0	Bikar
27	8-Aug	R5509	R5508	R5510	-	107.0 X 101.0	Bikar
28	8-Aug	R5512	R5511	R5514	R5513	101.0 X 92.0	Bikar
*29**	8-Aug	R5516	R5515	R5518	R5517	89.0 X 80.5	Bikar
		** right rear bitten by shark; healed over.*					
30	9-Aug	R5521	R5520	-	R5519	103.0 X 90.0	Bikar
31	9-Aug	R5523	R5522	R5524	-	91.5 X 89.5	Bikar
32	9-Aug	R5551	R5525	R5552	-	94.0 X 82.5	Bikar
33	9-Aug	R5554	R5555	R5556	-	108.0 X 98.0	Bikar
34	10-Aug	R5557	R5558	R5560	R5559	120.0 X 111.0	Bikar
35	10-Aug	R5562	R5561	-	R5563	94.0 X 90.5	Bikar
36	10-Aug	R5565	R5564	-	R5566	98.0 X 86.0	Bikar
37	10-Aug	R5568	R5567	-	R5569	95.0 X 86.5	Bikar
38	10-Aug	R5570	R5571	-	R5572	94.0 X 87.0	Bikar
*39**	10-Aug	R5575	R5573	-	R5574	97.0 X 83.0	Bikar
		** left side bitten by shark; healed over.*					
40	11-Aug	R5656	R5655	R5657	-	83.0 X 81.0	Bikar
41	11-Aug	R5659	R5658	R5660	-	100.5 X 88.5	Bikar
42	11-Aug	R5662	R5661	R5663	-	96.0 X 91.0	Bikar
43	11-Aug	R5665	R5664	R5666	-	103.5 X 97.0	Bikar

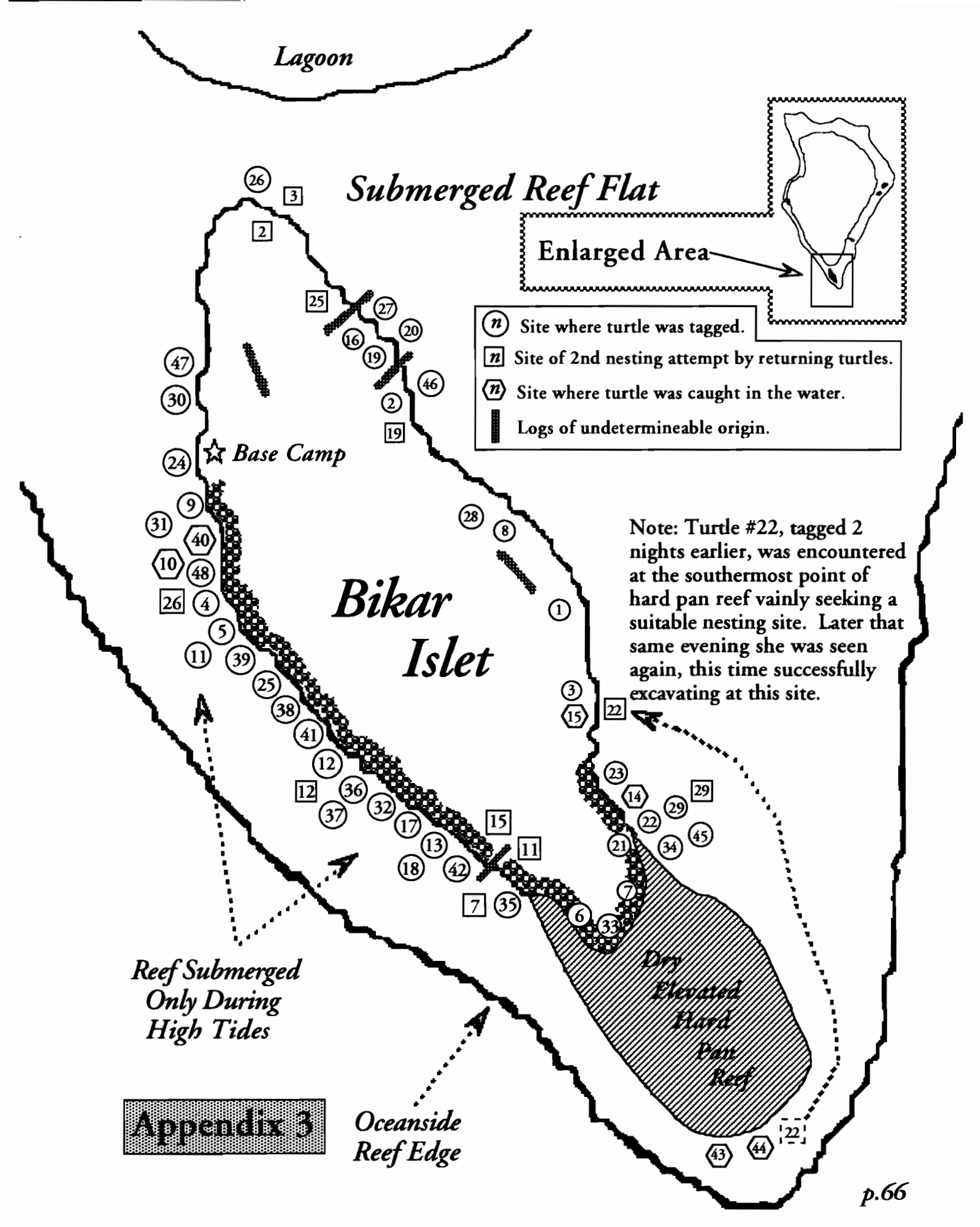
Appendix 1 (continued)

	Date	Left Front Flipper	Right Front Flipper	Left Hind	Right Hind	Curved Carapace L X W (cm)	Site
*44**	11-Aug	R5668	R5667	R5669	-	99.5 X 92.0	Bikar
		* *deep tear on LFF between scales 3-4.*					
45	11-Aug	R5671	R5670	R5672	-	105.5 X 94.0	Bikar
46	11-Aug	R5674	R5673	R5675	-	100.0 X 93.0	Bikar
47	11-Aug	R5677	R5676	R5678	-	100.5 X 90.0	Bikar
48	11-Aug	R5681	R5680	R5683	-	102.0 X 90.0	Bikar
*49**	13-Aug	R5685	R5684	R5686	-	104.0 X 96.0	Jemo
		* *double humped*					
50	13-Aug	R5688	R5687	R5689	-	96.0 X 92.0	Jemo
51	13-Aug	R5690	R5691	R5692	-	99.0 X 88.0	Jemo
52	13-Aug	R5694	R5693	-	R5695	98.0 X 92.0	Jemo
53	13-Aug	R5698	R5696	R5699	-	98.5 X 86.0	Jemo
54	13-Aug	R5576	R5700	R5577	-	96.0 X 87.5	Jemo
55	13-Aug	R5579	R5578	-	R5580	103.0 X 90.5	Jemo
56	13-Aug	R5582	R5581	-	R5583	104.0 X 95.5	Jemo
57	18-Aug	R5585	R5584	-	-	51.5 X 47.0	Majuro
58	18-Aug	R5587	R5586	-	-	45.5 X 43.5	Majuro
59	31-Aug	R5589	R5588	-	-	48.0 X 47.0	Wotje
60	31-Aug	R5591	R5592	-	-	46.5 X 43.0	Wotje
*61**	31-Aug	R5594	R5593	-	-	66.0 X 59.0	Wotje
		* *Eretmochelys imbricata*					

Discarded Tags: 5468 5483 5497 5553 5697 5590
5470 5486 5539 5679 5682

Appendix 2: Shell lengths of nesting turtles in the Marshall Islands August 1992




Lagoon
Submerged Reef Flat
Enlarged Area
(n) Site where turtle was tagged.
n Site of 2nd nesting attempt by returning turtles.
(n) Site where turtle was caught in the water.
Logs of undetermineable origin.
Base Camp
Bikar Islet
Note: Turtle #22, tagged 2 nights earlier, was encountered at the southermost point of hard pan reef vainly seeking a suitable nesting site. Later that same evening she was seen again, this time successfully excavating at this site.
Reef Submerged Only During High Tides
Dry Elevated Hard Pan Reef
Oceanside Reef Edge

Appendix 3

Appendix 4

Partial Checklist of Prominent Native Flora & Fauna Encountered During Survey:

	Scientific Name	*Common Name*	*Vernacular Name*	*Atoll*
1.	*Chelonia mydas*	*green sea turtle*	*won*	*B,E,J,W*
2.	*Eretmochelys imbricata*	*hawksbill*	*jabake*	*W*
3.	Sula leucogaster (adult)	brown booby	kalo	B,E,J
4.	Sula leucogaster (juv.)	brown booby	lollap	B,J
5.	Sula dactylatra	masked booby	tol	B
6.	Sula sula	red footed booby	nana	B,J
7.	Gygis alba	white fairy tern	mejo	B,E,J,W
8.	Anous stolidus	common noddy	jekad	B,E,J,W
9.	Sterna lunata	spectacled tern	kear	W
10.	Phaethon rubricauda	red–tailed tropicbird	lokwajek	B
11.	Phaethon lepturus	white–tailed tropicbird	jipkoraj	B
12.	Fregata minor	frigate bird	ak	B
13.	Arenaria interpres	ruddy turnstone	kotkot	B,E,J,W
14.	Numenius tahitiensis	bristle–thighed curlew	kowak	B,E
15.	Pluvialis dominica	golden plover	kwolej	B,W
16.	Heteroscelus incanus	wandering tattler	kiril	B
17.	Calidris alba	sanderling	kwol	B
18.	Egretta sacra	Pacific reef heron	kabaj	W
19.	*Paguridae (family)*	*hermit crabs*	*om*	*B,E,J,W*
20.	*Birgus latro*	*coconut crab*	*barulep*	*E,J,W*
21.	*Panulirus penicillatus*	*spiny lobster*	*wor*	*B,E*
22.	*Ocypode ceratophthalma*	*ghost crab*	*karuk*	*B,E,J,W*
23.	*Grapsus tenuicrustatus*	*black grapsid crab*	*maeo*	*B,E,J,W*
24.	Tridacna maxima	tridacna clam	mejenwor	B,E,J,W
25.	Tridacna crocea	tridacna clam	mejenwor	B,E,J,W
26.	Hippopus hippopus	–	dimuj	B,W
27.	Turbo intercostalis	top shell	jerul	B,E,J,W
28.	Trochus niloticus	trochus	likebejdat	B,W
29.	*Rattus exulans*	*Polynesian rat*	*kijdrik*	*B,E,J*
30.	Carcharhinus melanopterus	blacktip shark	bako korak	B,E,J
31.	G. flavimarginatus	moray eel	dreb	B,E
32.	Spratelloides dilicatulus	–	aol	W
33.	H. quadrimaculatus	gold–spotted sardine	mamu	W

Appendix 4 (cont.)

34. Adioryx spinifer	soldierfish	jerra	W
35. Myripristis berndti	squirrelfish	mun	W
36. Chaenomugil leuciscus	mullet	ikaru	B,E
37. Mugil cephalus	stripped mullet	yiol	B,E
38. Mulloidichthys samoensis	goatfish	jo	W
39. Parupeneus barberinus	dot–dash goatfish	motal	W
40. Polydactylus sexfilis	threadfin	atkeru	J
41. Sphyraena barracuda	barracuda	nitua	B
42. Anyperdon leucogrammicus	white–lined grouper	kelaolap	W
43. Cephalopholis argus	blue–spotted grouper	kalamej	W
44. Epinephelus maculatus	grouper	lejibjib	W
45. Epinephelus microdon	grouper	kuro	B,W
46. Epinephelus cyanopodus	grouper	booklim	W
47. Plectropomus laevis	grouper	jawe	B
48. Plectropomus leopardus	grouper	joanuron	B
49. Variola louti	grouper	walalu	W
50. Kuhlia marginata	flagtail	jerwot	W
51. Priacanthus cruentatus	glasseye	lol	W
52. Caranx melampygus	bluefin jack	lange	B,E,W
53. Caranx lugubris	black jack	arong	B
54. Caranx sexfasciatus	bigeye jack	ikibwij	B
55. Carangoides orthogrammus	yellow–spotted jack	rewa	B
56. Scomberoides lysan	leatherback	aolet	B,W
57. Elagatis bipinnulatus	rainbow runner	ikairik	B,E,W
58. Aphareus rutilans	jobfish	lajeptaktak	W
59. Aprion virescens	gray snapper	lom	E,W
60. Lutjanus bohar	red snapper	ban	W
61. Lutjanus gibbus	paddletail snapper	jato	W
62. Lutjanus kasmira	bluelined snapper	jetar	B,W
63. Lethrinus variegatus	emperor fish	rigin	W
64. Lethrinus xanthochilus	emperor fish	ronanet	W
65. Gnathodentex aurolineatus	yellowspotted emperor	tinar	W
66. Kyphosus cinerascens	rudderfish	bajarik	B,E
67. Hipposcarus longiceps	parrotfish	ikimouj	B
68. Scarus atropectoralis	parrotfish	mera	B
69. Acanthurus lineatus	surgeonfish	kwi	W
70. Acanthurus triostegus	convict surgeonfish	kwiban	E,W
71. Naso unicornis	bluespine unicornfish	mone	W
72. Naso literatus	orangespine unicornfish	bulak	B

Appendix 4 (cont.)

73. Siganus argenteus	rabbitfish	mole	E
74. Grammatorcynos bilineatus	double–lined mackerel	ikabe	E,W
75. Gymnosarda unicolor	dogtooth tuna	jilo	E
76. Katsuwonus pelamis	skipjack tuna	lejabwil	B,E,W
77. Euthynnus yaito	wavy back tuna	loj	E
78. Thunnus albacares	yellowfin tuna	bwebwe	B,W
79. Tournefortia argentea	*beach heliotrope*	*kirin*	*B,E,J,W*
80. Scaevola sericea	–	*kanot*	*B,E,J,W*
81. Cordia subcordata	–	*kono*	*J,W*
82. Calophyllum inophyllum	–	*lukwej*	*W*
83. Artrocarpus altilis	*breadfruit*	*ma*	*E,W*
84. Pemphis acidula	–	*koñe*	*W*
85. Guettarda speciosa	–	*utilomar*	*W*
86. Pisonia grandis	–	*kañal*	*B,E,J*
87. Terminalia samoensis	–	*kotol*	*W*
88. Morinda citrifolia	–	*nen*	*J,E,W*
89. Asplenium nidus	*bird nest fern*	*kartop*	*J,E,W*
90. Microsorium scolopendria	*fern*	*kino*	*J,W*
91. Cocos nucifera	*coconut*	*ni*	*B,E,J,W*
92. Pandanus tectorius	*screwpine*	*bob*	*J,E,W*
93. Hibiscus tiliaceus	-	*lo*	*W*

Recommendations

1. Expand the turtle database in the Marshalls archipelago by continuing the tagging of sea turtles, particularly at *Bikar* Atoll.

2. Continue to protect and monitor the three major turtle nesting sites of *Bikar* Atoll, *Erikup* Atoll, and *Jemo* Island.

3. Make eradication plans to reduce the population of Rattus exulans at *Bikar* Atoll.

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