July 2004

Defining Parameters for Sea Turtle Research in the Marshall Islands

Prepared by

Mike A. McCoy
Gillett, Preston and Associates
Kona, Hawaii

ADMINISTRATIVE REPORT AR-PIR-08-04

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Pacific Island Region

PACIFIC ISLANDS REGIONAL OFFICE

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Explanatory Note

Sea turtle conservation and management is a major issue for the Pacific Islands Region. The incidental catch of sea turtles in the fisheries of the western and central Pacific (WCPO) have prompted some groups to call for a complete ban on certain fishing techniques. However, before imposing these sorts of management measures it is important to be able to determine whether any actions taken have the intended effect on the turtle resource.

In the case of WCPO sea turtle stocks, the factors causing population declines appear to be open to debate given the dearth information on population trends, distribution, abundance and basic biology of these unique animals. For several years NOAA Fisheries has been engaged in a variety of projects to better illuminate the basic biology of the WCPO sea turtle stocks. One of the areas of research has been the extent to which these stocks have been affected by man-induced mortalities (e.g. fishing, destruction of habitat). Current activities include tagging studies, observing fishery interaction rates, beach counts, and preservation of habitat. An additional activity has been to document the current state of knowledge in Pacific Island areas for which scientific studies have been limited or non-existent.

This report documents the current state of knowledge on sea turtles in the vicinity of the Republic of the Marshall Islands. Importantly it documents their traditional and current use. The Marshall's encompass a considerable ocean area of the equatorial North Pacific, yet very little is known about the turtle resources of this extensive area of atolls, islands and islets. This report provides a summary of the available knowledge. It is hoped that it will be considered by decision and policy makers when determining how scarce research dollars can be applied to ensure the sustainability of this culturally important resource for the future generations of Marshallese.

I thank all of those who assisted in the production of this report, especially the five reviewers who provided comments and suggestions of various drafts.

Charles Karnella, Ph.d
International Fisheries Officer

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ACRONYMS AND ABBREVIATIONS

CMI	College of the Marshall Islands
EEZ	Exclusive Economic Zone
EPPSO	Economic Planning Policy and Statistics Office
MIMRA	Marshall Islands Marine Resources Authority
NGO	Non-Governmental Organization
nnr	name not recorded
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
RMI	Republic of the Marshall Islands
RMIEPA	RMI Environmental Protection Authority
SPC	Secretariat of the Pacific Community
SPREP	South Pacific Regional Environment Programme
WCPO	Western and Central Pacific Ocean
WUTMI	Women United Together in the Marshall Islands

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1. INTRODUCTION

Background to the Study

Increased awareness of the world's declining and depleted sea turtle populations during the latter part of the twentieth century has led to increased scientific research underpinning important conservation and management efforts focused on sea turtles. The role of sea turtles in contributing to the health and maintenance of the marine environment, including coral reefs and seagrass meadows, has been increasingly recognized and made an integral part of coral reef conservation and management efforts in many locations.

In the Republic of the Marshall Islands (RMI), as in many coastal and island communities in the Western and Central Pacific Ocean (WCPO), turtles have long been known as a food source and in some situations have played important cultural roles in the lives of inhabitants. There has not, however, been much of an effort to conserve and manage this food resource, nor has there been a concerted research focus to support either conservation or management directed at sea turtles in the country. In a thorough, general inventory and review of coastal resources in the Marshall Islands, Smith (1992) summarized the situation by concluding that:

- the historical and cultural uses of turtles in this region have not been well documented
- the level of exploitation of turtles within the RMI is unknown
- there are no reports available on the status of turtle stocks in the RMI

The importance of these three points is intensified by a general perception among inhabitants of the Marshall Islands backed up by recent anecdotal information that (at least in the inhabited atolls) there are fewer turtles now in the Marshall Islands than in the past.

Sea turtles can present a difficult subject for research. The complexity of sea turtle life cycles include an open ocean pelagic phase where long migrations can often take place, relatively slow growth and delayed maturity, as well as high juvenile mortality.

Researchers attempting to solve important parts of the sea turtle puzzle are at a disadvantage if they do not have at an understanding of the physical and human environment in which they plan to work. The importance of understanding the human environment was underscored at a workshop convened by the Western Pacific Fishery Management Council in Honolulu in February, 2002. In addressing the needs of researchers, the Chair emphasized that "there is a substantial information gap with respect to the way human populations in the western and central Pacific interact with sea turtles" (Kinan 2002).

Handicaps in furthering conservation and management also exist on the government side in the Marshall Islands. Both the national government and local atoll governments have important roles in devising realistic conservation and management measures relating to sea turtles. In the absence of background information and hard data on the resource, it can be difficult for administrators and resource managers to determine what research is most feasible, what the objectives should be, and which recommendations may be the most practical to implement.

Purpose of the Study

The purpose of this study is to provide a bridge between researchers and potential researchers on the one hand and administrators and resource managers in the Marshall Islands on the other, through the provision of information and background material relevant to sea turtles in the Marshall Islands. The study is not intended to design a comprehensive conservation or management program for sea turtles in the Marshall Islands, nor debate the various pros and cons of all elements of such a program. The study does, however, recognize the need for such a program and recommends basic first steps that could and should be taken based on the information presented here.

Several factors have argued strongly for a study such as this being undertaken before the formulation of specific research plans. In some instances involving turtle research in other locations, factors that might have strongly contributed to the success or failure of a project were either ignored or only addressed after the research plan was devised or instituted. This not only greatly hinders chances for success, but perhaps more importantly can sour relationships between researchers or funding bodies and local people that can lead to social or political opposition to future research efforts.

The intended audience for this report includes researchers and potential researchers, as well as government officials and resource managers in the Republic of Marshall Islands. This divergent audience may already be aware of some of the information presented; nevertheless some has been included to provide a more complete picture of the Marshall Islands and its sea turtle resources. The intention is to have the contents of this report serve as a basis of discussion when planning sea turtle research in the Marshall Islands.

With the global status of sea turtles found in the Marshall Islands being classified as Critically Endangered (hawksbill) or Endangered (green, olive ridley, and leatherback)[1] and the limited financial resources available to researchers and governments alike, there is little time to be wasted by inappropriate or incomplete planning by researchers, government administrators and resource managers. In a nutshell, those who arrange for and execute the research need to get it right the first time.

Major Premise

It is a major premise of this study that scientists and researchers planning to investigate or work with turtles in the Marshall Islands need to understand the relationships between turtles and the country's inhabitants. Appreciating these connections in both the historical and current context can greatly assist in the planning and successful execution of scientific research. Campbell (2003), in writing of her own interdisciplinary research work with turtles notes that "It is one thing for a natural scientist to look at statistically analyzed results of a quantitative opinion survey, and quite another to appreciate the merit of an ethnographic account of local cultural practices". Her (appropriate) conclusion is that "the big pay-off that will come through conservation gains, with collaborations ideally yielding data that can feed into workable programs that start to address biological and socio-economic objectives".

At the same time, many Marshallese also need to better understand and appreciate the interest shown by "outsiders" in the country's sea turtle resources. While the Marshallese have their own uses for sea turtles, e.g. as a source of food or cash, or in reaffirmations of social status, to many scientists and lay people who value the existence of turtles globally, the animals have taken on a

[1] Reference is to the IUCN Red List of Threatened Animals, International Union for the Conservation of Nature and Resources, www.redlist.org.

highly charismatic nature. The migratory nature of turtles makes it almost certain that the resource is a shared one, and ensuring turtle resources for the Marshalls in the future will require investigation and international collaboration.

This is not to say that some Marshallese have not already been exposed to these attitudes. The efforts of some, including the Environmental Protection Authority, have begun to put the spotlight on biodiversity. Some atolls, Jaluit is one notable location, have begun efforts aimed at managing atoll resources. While this work will take years and has not yet come to fruition, including turtles in the discussion and implementation of resource conservation and protection measures at the local level is a large and worthwhile step in the right direction.

Methodology

Research for this project commenced in October 2003. An online literature search was augmented by visits to the Pacific Island Collection at the Hamilton Library at the University of Hawaii, the library of National Oceanographic and Atmospheric Administration (NOAA) Fisheries' Pacific Islands Fisheries Science Center in Honolulu, the Alele Museum and library in Majuro, the document collection of the Marshall Islands Historic Preservation Office, and the private collection of Mr. Kevin Hart at Boken islet, Ailinlaplap atoll. Four professional Hawaii-based biologists with experience in the Marshall Islands were also consulted prior to departure. Assistance in local research and compilation of the information contained in Appendix 2 was received from Ms. Nancy Vander Velde in Majuro.

A visit to the Marshall Islands was undertaken from November 5 to December 8, 2003. While in the Marshall Islands, a research trip was taken to Ailinlaplap atoll from November 14 to December 3, 2003. Because the intention of this portion of the project was to gather information that would be descriptive in nature rather than definitive, no specific surveys requiring either written or oral answers, were undertaken. Instead, 31 informal interviews of varying length were conducted with people in the Marshall Islands during the course of the project.

Organization of this Study

The report first describes the Marshall Islands, its physical attributes, social and political structure, as well as legal and institutional aspects that can affect sea turtles. Subsequent sections review existing information on sea turtles in the Marshall Islands, and the utilization of sea turtles by the inhabitants. A short summary of past and current research in the Marshall Islands focusing on or touching on sea turtles is presented, along with any past recommendations made by researchers and/or institutions. A final section considers future research requirements to enhance sea turtle conservation and management and puts forward recommendations for that research.

Four appendices are included for reference. Appendix 1 lists physical attributes of the 29 atolls and five discrete islands that comprise the Marshall Islands. Appendix 2 is a compendium of references and information relating to sea turtles or sea turtle habitat for each atoll and island in the Marshalls, including information that, for sake of brevity, was not placed in the body of the report. Appendix 3 summarizes past recommendations relating to sea turtles from the most significant studies undertaken during the last 30-plus years. Appendix 4 lists the persons contacted and/or interviewed for during the course of the study[2].

[2] A separate list is contained in Appendix 3, since some of that information was collected from those sources prior to the current study.

Relationship of this Study to Other Sea Turtle-related Research Activities

In recent years, the interaction of tuna fisheries with sea turtles has generated significant concern in the WCPO that has led to increased activity aimed at identifying approaches that will reduce adverse interactions between tuna fisheries and sea turtles.

Several significant sea turtle-related activities undertaken by NOAA Fisheries continue to focus on interaction between WCPO commercial fisheries and sea turtles. This report is intended to contribute to overall knowledge of sea turtle resources, and particularly to lay the groundwork for additional work on reducing adverse interactions between sea turtles and the domestic-based foreign longline fishery in Majuro.

An upcoming second phase of work in the Marshall Islands funded by NOAA Fisheries will expand the outreach efforts to commercial tuna fishermen in sea turtle fishery interaction mitigation. This will be accomplished by improving the capabilities of MIMRA local staff and observers in recognizing, handling, and reporting interactions between sea turtles and commercial tuna fisheries in the Republic of the Marshall Islands. A necessary portion of this work is dissemination of knowledge on turtle resources in the Marshall Islands, while sensitizing those engaged in commercial fishing to the importance of enhancing survival of sea turtles encountered during the course of their operations. Data in this second phase of the project is to be collected on sea turtle interactions, and appropriate instructions provided on how to handle specific sea turtle interaction situations. These activities are intended to integrate the topic of sea turtle-commercial fishing interactions into MIMRA's ongoing management program, including relations with foreign and domestic fishing operators.

Limitations to Results Presented

The author readily admits several limitations to the compilation and presentation of this report. First and foremost, while he has extensive experience in atoll communities in Micronesia and the western and central Pacific in general, he is not an expert on either the Marshall Islands culture or its language. As such, reliance was placed on informants and interpreters with greater knowledge and a better understanding of the language and culture of the Marshall Islands.

The time available to undertake research for this report was limited by several factors. An unavoidable conflict in schedules led to the bulk of research in Majuro being carried out during a period when national elections were being held, severely limiting access to some sources of information who were fully engaged in the election process. Travel schedules to outer atolls in the Marshall Islands are always difficult to maintain, even under the best circumstances. A planned one-week trip to Ailinlaplap atoll turned into a two-week sojourn, further diminishing the opportunity to consult sources in Majuro and elsewhere.

Marshallese Spelling and other Textual Conventions

No attempt has been made to standardize the spelling of Marshallese words in this report. This study, like several recent ones before it, recognizes that, like many languages in the Pacific Islands, the spelling system of the Marshallese language is in a dynamic and transitory state (National Biodiversity Team 2000).

In the Marshalls there can be several ways to spell even common words, and words can often be expressed in writing with or without diacritical marks. Several attempts have apparently been made to produce "standard" orthographies for Marshallese, including a Marshallese-English dictionary (Abo et al.) published in 1976. This study relies to a large degree on published material and information from informants. Published material can reflect either the orthography in vogue

at the time of writing, or the author's own interpretation of how Marshallese words are spelled. To complicate the situation, informants with varying degrees of formal educational training can adhere to the spelling of others, or add their own versions. The present author's solution to this vexing problem has been to use the words as they have been presented to him, and to trust in the highly-honed skills of Marshallese speakers to either identify the words directly or infer meaning from the context. Non-Marshallese speakers should not be bothered so much by the problem.

There are both single islands and atolls in the Republic of the Marshall Islands. When a reference is to the "outer atolls" it can be assumed that it includes the single islands unless otherwise stated. There are also islands within atolls, so to avoid further confusion these islands are called "islets", even though the piece of real estate in question might cover a relatively large area in relation to other islets in the Marshall Islands.

Acknowledgements

The author acknowledges the assistance of the many people in the Marshall Islands, Hawaii and elsewhere, including those listed in Appendix 4, who took the time to discuss the subject of sea turtles in the Marshall Islands before, during, and after the field work phase of the study. The cooperation of the Executive Director of the Marshall Islands Marine Resources Authority, Mr. Danny Wase, and the assistance of his staff is also gratefully acknowledged. Mr. Raymond Clarke and Mr. Steven Kolinski of the NOAA Fisheries Pacific Islands Regional Office in Honolulu provided guidance and technical support for this project.

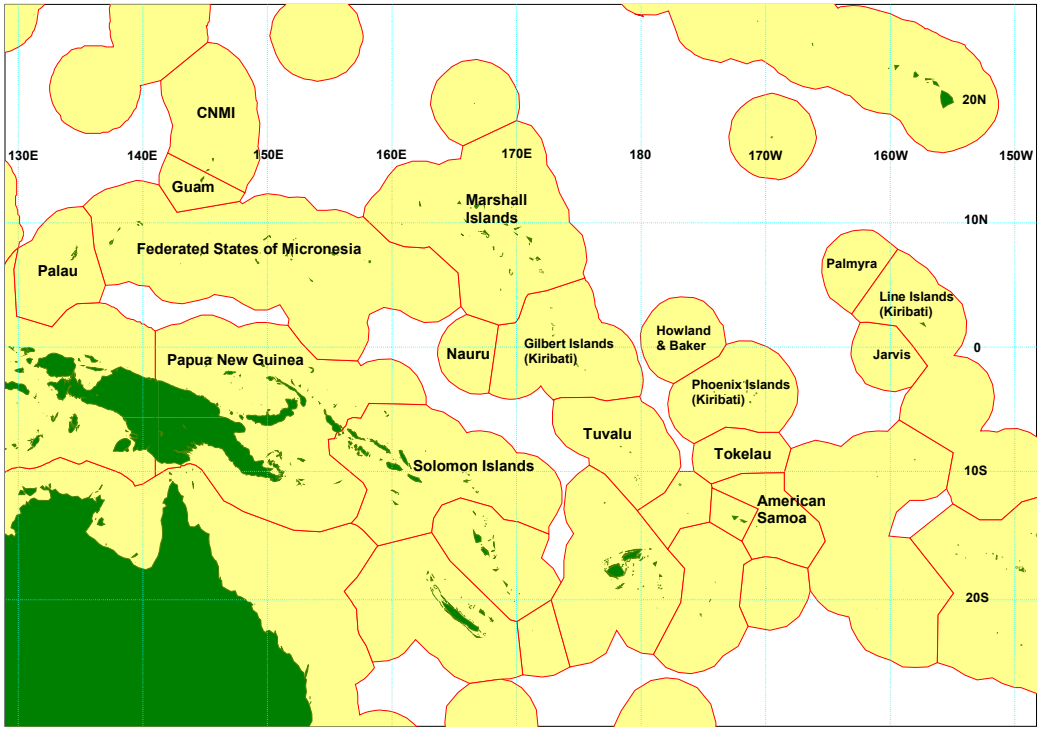
This report was funded by contract NFFR5010-3-00040 from the National Oceanic and Atmospheric Administration. The views expressed herein are those of the author and do not necessarily reflect the views of NOAA or any of its sub agencies.

2. BACKGROUND

2.1 Physical Description of the Marshall Islands

The Marshall Islands are located in the WCPO north of the Equator, stretching from 160° East to 173° East longitude, and from 4° North to 14° North latitude. The Republic of the Marshall Islands' Exclusive Economic Zone (EEZ) is bounded on the west by the Federated States of Micronesia, on the south by Nauru and Kiribati, and the north by the United States territory of Wake Island. Figure 1 depicts the location of the Republic of the Marshall Islands in relation to other countries in the Western and Central Pacific Ocean.

Figure 1. The Western and Central Pacific Ocean



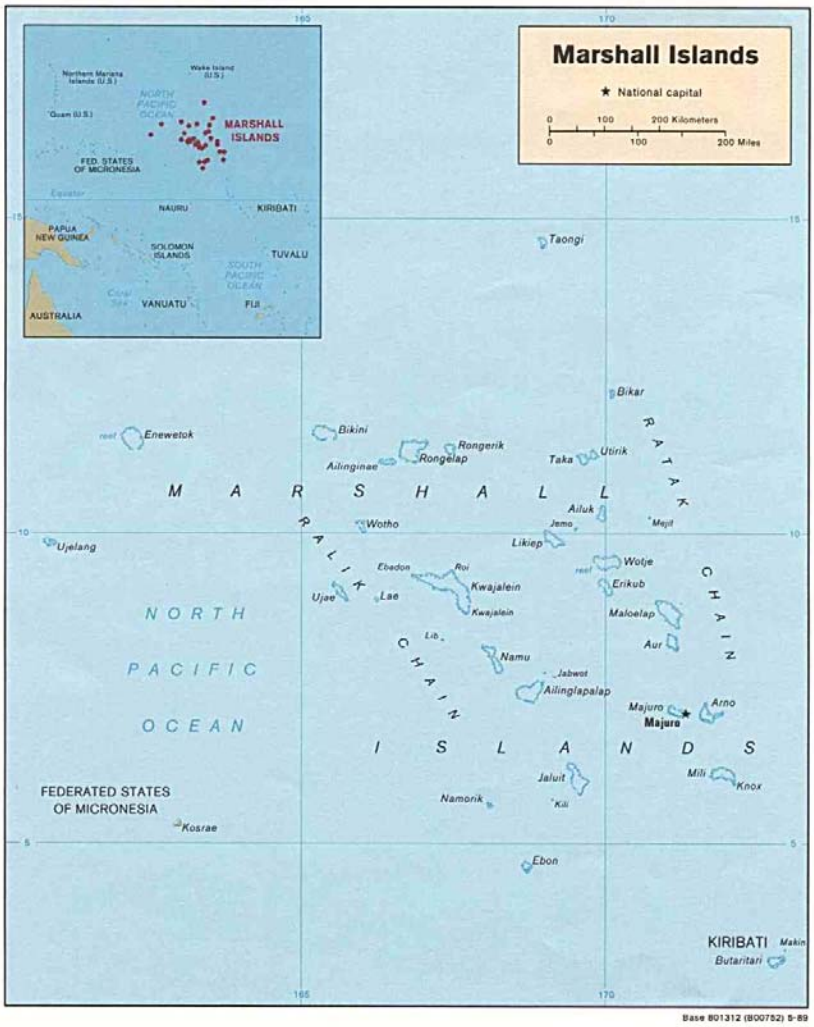
Source: SPC

The country consists of a parallel-chained archipelago of atolls and low coral islands aligned in roughly a northwest-southeast direction. Traditionally, the eastern chain is known as Ratak, and the western chain as Ralik. There are 29 atolls and five discrete islands in the archipelago with a total land area of approximately 70 square miles, and a total lagoon area of about 4,500 square miles.

Figure 2 depicts the relative locations of atolls and individual islands of the Marshalls. As noted, the spelling of the Marshallese language is not consistent and the names of several atolls and

islands in Figure 2 may not reflect spelling elsewhere in this report. The atoll of Bokak in the far north is also shown on this and some other charts as "Taongi".

Figure 2. Atolls and Islands of the Marshall Islands



The number of islets in atolls in the Marshalls range from a low of two in Namdrik (Namorik) to 93 in Kwajalein. Total land area among the 29 atolls and 5 islands is the least at Jemo Island, .2 square kilometers, and greatest at both Mili and Kwajalein, 16 square kilometers. Patch reefs are common within most lagoons, with Ebon atoll having the most, 694, and Lae atoll the least, 24 (Eldredge et al. 1999). A summary of data on islands and coral reefs in the Marshall Islands is provided in Appendix 1.

Rainfall is one of the most important factors for human survivability on atolls. The southernmost atolls receive over 200 inches annually, but there is less than 60 inches in the most northerly atolls. Annual rainfall at Majuro atoll in the central Marshalls averages 132 inches. Historically, population densities in the southern atolls were three to four times higher than in the northern ones because the lush and varied vegetation associated with greater rainfall could support more

people. The months of May through November are about 50 per cent wetter than December to April.

The Marshall Islands are affected by the northeast trade winds from about November/December to May/June. During this period the prevailing winds are from east to northeast and can bring trade wind showers, although these are absent in the most northerly atolls. The trade winds also can carry salt spray onto the islands, where increased salinity has a strong bearing on many natural and human phenomena (Fosberg 1990).

The north equatorial current flows most of the year throughout the Marshalls. During the summer months, the generally eastward-flowing north equatorial counter-current moves northward and can affect the southern islands and atolls up to around 8°North latitude during some years[3].

The Marshalls are located east of the normal paths of westward-moving typhoons, so such phenomena are normally rare, although westward-moving storm systems from which typhoons may form, are not infrequent in the fall. When the Pacific weather system shifts dramatically towards the east (1500 miles or more during a strong El Niño), there is a strong probability that the atolls will be struck with at least one typhoon that year. The prolonged period of drought associated with El Niño is often more damaging than the typhoon threat because such events usually affects the entire archipelago.

2.2 Historical Overview

The Marshall Islands are thought to have been first inhabited around 2,000 years ago (Weisler 2000), with the first settlers probably coming first from the sea area around Vanuatu to the south who moved up the Gilbert and Marshall chains. The islands and their inhabitants were unknown to Europeans until an expeditions led by Alvarao de Saavedra Ceron on a voyage from New Spain (Mexico) to the Moluccas happened upon what was likely the atolls of Enewetak and Bikini in 1528. The islands remained unknown to Europeans until 1788 when two English captains, John Marshall and Thomas Gilbert, took their ships from southeastern Australia where they had delivered prisoners to the new British penal colony, eastward and then north through two island archipelagos that bear their names today[4] (Hezel 1983).

The first systematic scientific survey of the Marshall Islands was undertaken by the Russian explorer Otto von Kotzebue in 1816. Commercial interest in the islands centered on the production of copra beginning in the 1860s, with Germans predominant in the trade. In 1885 Germany annexed the Marshall Islands, and in 1887 handed over effective day-to-day control of their colony to the Jaluit Company, a joint stock company owned and controlled by German trading firms. The islands remained under German control until World War I when taken over by the Japanese and later made a part of its League of Nations Mandate that included the Caroline and Mariana Islands (except for Guam).

At the conclusion of World War II, the U.S. maintained effective control of the islands. The U.S. assumed complete administrative and protective responsibilities when the Marshall Islands were placed into a Trust Territory under the United Nations in 1947. Internal self-government was established under a constitution in 1979, and independence linked to a Compact of Free Association with the United States became effective in 1986. Significant U.S. interest in the

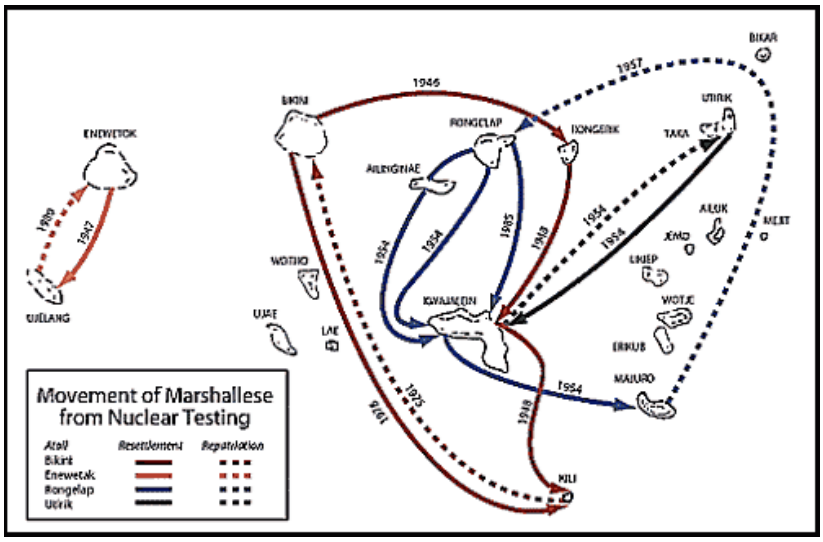
[3] Since the two chains of atolls intercept and tend to deflect such currents, the actual flow is of course not linear in either direction.

[4] The Gilbert Islands are part of the Republic of Kiribati.

Marshall Islands remains, primarily because of a long-term lease to portions of Kwajalein atoll, an important part of the U.S. Pacific Missile Testing Range.

Nuclear testing undertaken from 1946 to 1958 resulted in a shifting and shuffling of the human populations of several atolls that continues until today. Figure 3 depicts the movement of displaced populations of nuclear affected atolls that began in 1946.

Figure 3 Movement of Human Populations Caused by Nuclear Testing



Source: RMI Embassy

As Figure 3 shows, several population groups have been moved and removed from uninhabited islands and atolls over the course of the last 38 years. There have been no studies conducted to determine the consequences for sea turtles from the nuclear testing or subsequent events and activities linked to movements of human populations. Although sea life is said to have returned to normal in Bikini and Enewetak, no reports were found during the course of this study that might indicate the impact, if any, of contaminated terrestrial habitats on sea turtle nesting in those atolls.

3.0 ASPECTS OF GEOGRAPHY AND NATURAL HISTORY RELEVANT TO SEA TURTLES

Knowledge of aquatic habitats is recognized as being essential to understanding the population status of sea turtles (Kinan 2002). Terrestrial features of the atolls are also important to understand, since they provide nesting sites. For research purposes, both aquatic and terrestrial sea turtle habitats in the Marshall Islands can be described in two general categories:

(1) the uninhabited atolls and individual islands where seasonal turtle mating and nesting is concentrated and which in some cases have been used in the past as "game reserves" by the Marshallese people,

(2) the inhabited atolls where the occurrence of both adult and sub-adult sea turtles is known, but where nesting is far less common.

The most significant native land animals in the Marshalls are crabs: land hermit crabs (*Coenobita spp.*), the coconut crab (*Birgus latro*) and other land crabs (Family *Gecarcinidae*). Several species

of crabs are known to prey on newly-hatched turtles as well as on turtle eggs (Vander Velde and Muller 1999). Likewise, introduced land animals such as the three species of rats present in the Marshall Islands, the Norway rat (*Rattus norvegicus*) the common or "European" rat (*Rattus rattus*) and the Polynesian rat (*Rattus exulans*) are known to prey on both hatchlings and eggs. Monitor lizards (*Varanus indicus*) that are also known to prey on turtle hatchlings were introduced on some atolls during the period of Japanese rule between the two World Wars, and can still be found on the atolls of Aur, Wotje and Enewetak (National Biodiversity Team 2000).

3.1 Uninhabited Atolls and Islands

Describing some atolls as "uninhabited" in the Marshall Islands can lead to confusion, since many are still used as resource atolls for the gathering of food as well as the production of copra. In addition, some atolls considered "uninhabited" have experienced periods of intense forced habitation such as when U.S. nuclear testing required the people from Bikini to be relocated to Rongerik from 1946-1948 (Thomas, et al. 1989), or when the people of Enewetak were removed to Ujelang from 1947 to 1980[5]. For the purposes of this report, Bikar and Erikub atolls (and the island of Jemo) are considered uninhabited because humans have not been continuously resident and have not developed societal ties resulting from that residency.

The uninhabited atolls and islands most important for green sea turtle nesting in the Marshall Islands occur in the northern reaches of the Ratak chain. Those atolls most recognized as significant sights for nesting include Bikar, Erikub and the island of Jemo. Other northern uninhabited atolls where nesting is known to take place are Bokak (shown as Taongi in Figure2), Ailinginae, Rongerik, and Taka. The westernmost atoll in the Marshall Islands, Ujelang, is not often mentioned in connection with significant turtle nesting.

There have been at least three useful scientific descriptions of Bokak, Bikar, Erikub and the island of Jemo over the past 40 years. The first, and most complete physical terrestrial descriptions are found in Fosberg (1955 and 1990) from information gathered on visits in 1951-1952 during the Northern Marshall Island Expedition sponsored by the Pacific Geological Mapping Program of the U.S. Army. Chronologically, the second complete description appears in Thomas et al. (1989), the report of a natural diversity and protected areas survey undertaken from September 7 to 24, 1988 sponsored by the South Pacific Regional Environment Program (SPREP) and the East West Center of Honolulu. The third, and most comprehensive from the standpoint of illuminating information regarding sea turtles is Puleloa and Kilma (1992), which reports on a research expedition to the northern Marshalls during July and August 1992 focusing specifically on sea turtles. The expedition was financially supported by SPREP, with assistance from the Marshall Islands Marine Resources Authority (MIMRA)

Bikar and Bokak are considered the least disturbed of the atolls in all three reports[6], with the latter described as "possibly the only example of a completely natural, unaltered, semi-arid atoll ecosystem remaining in the world today" (Thomas et al. 1989). Bikar is recognized throughout the Marshalls for its abundance of green sea turtles and sea birds (Puleloa and Kilma 1992). The atoll possesses only one pass in its entire circumference, creating strong tidal surges that make

[5] Ujelang is about 125 miles southwest of Enewetak, and was known to be inhabited by a Marshallese population until a typhoon killed many of the inhabitants and destroyed the island's vegetation in the late 19th century. The atoll was later developed as a commercial copra plantation during the German and Japanese eras, with a small resident labor force. It was abandoned during World War II, but was re-populated from 1947 to 1980 when the U.S. moved the entire population of Enewetak there to enable nuclear testing on their home atoll (Kiste 1987).

[6] The 1992 expedition visited Bikar but did not visit Bokak.

human approaches difficult. Because of its importance as a sea turtle nesting area, parts of the illuminating physical description of Bikar by Puleloa and Kilma are worth repeating:

> Consisting of four islets (one of which, Jaboero, is a barren elevated cay), it encompasses a lagoon 3,800 hectares in size. Bikar islet 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. 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.
>
> 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.
>
> 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 nesting 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 up to one meter in size and deposited at the base of the interior *kañal* (*Pisonia grandis*) trees[7].

Other uninhabited atolls farther to the south of Bikar enjoy greater rainfall and thus have at times supported increased human activity. An important consideration in determining the level of human activity that might interact with sea turtles is the existence of coconut plantations, since the presence of large stands of planted coconuts infers at least periodic human activity for the purpose of producing copra. Taka atoll was reportedly cleared for the planting of coconut plantations in the past, as was Jemo (Fosberg 1990). On Rongerik, only the largest islet has significant coconut stands (Thomas et al. 1989), while the two largest islets on Erikub, Erikub and Ru, host coconut plantations.

3.2 Inhabited Atolls

The inhabited atolls and islands of the Marshall Islands are where most human interactions with sea turtles take place. In some atolls there are islets that are relatively isolated from human habitation that can and do serve as occasional nesting sites. As a general rule, however, sea turtle

[7] Puleloa notes that "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".

nesting sites within inhabited atolls are more common in inverse proportion to the closeness of human habitations and activities[8].

Lagoons throughout the atolls in the Marshalls provide significant areas of potential shallow water foraging habitat for sea turtles. The presence of sea grasses, a common food for green sea turtles has been documented on several atolls and is likely on many others. Ailinlaplap, Ujelang, and other atolls are known to host *Thalassia hemprichii,* while *Cymodocea rotandata* is known from Majuro and *Halophila minor* from Kwajalein (National Biodiversity Team 2000). The Marshallese term for seaweed (including some algae) is *wujooj in lojet*, literally, "grass of the sea"[9]. It was not possible to determine the extent of algae present for use by turtles as a food resource, however it is likely that benthic algae such as *Caulerpa racemosa* would be found on the numerous pinnacles and coral reefs within lagoons. Collectively, sea grasses and some species of macroalgae known by the Marshallese to be the food of green sea turtles are called *kijin won*, or food of the turtles (B. Vander Velde, pers. comm.). Sponges, which are thought to make up a large portion of the hawksbill turtle diet, are also known to exist in numerous atolls throughout the Marshalls[10].

In addition to sea grasses and macroalgae, mangroves have also been shown to be part of the diet of green sea turtles in other locations. Reports from Western Australia show green sea turtles grazing on the mangrove *Avecinnia marina* in Shoalwater Bay (Limpus and Limpus 2000), while mangrove roots and shoots have also been shown to be a part of the diet in turtles in the Galapagos Islands (Pritchard 1971). According to Limpus (1998), in Queensland, Australia, green turtles have been so commonly observed feeding on mangroves that there are now three main vegetation groups identified when describing the herbivorous diet of that species: sea grasses, algae and mangroves.

Although mangroves are usually more commonly found surrounding high volcanic islands such as Kosrae and Pohnpei to the west of the Marshall Islands, they can be found in several atolls in the Marshalls. Species known to be present in the Marshalls are primarily *Bruguiera gymnorrhiza*, the black mangrove or *joñ* in Marshallese, with lesser numbers of *Sonneratia alba*, the white mangrove or *bulabol* and *Lumnitzera littorea*, a mangrove known as *kimeme* in Marshallese (Merlin et al. 1994). Hatheway (1953) pointed out that Marshallese in prehistoric times likely transported and introduced several species of mangroves to the Marshall Islands. Fosberg (1953) indicates that "at least *Bruguiera* found in landlocked pools and muddy depressions have been deliberately introduced and planted by the Marshallese".

While most native forests were cleared to make way for coconut plantations beginning in the 19th century, much of the foreshore on many atolls has been left to native trees. Some atolls, however, are using introduced *Casuarina equisetifolia* (described by some Marshallese as a "pine tree") that crowd out the kõnnat (*Scaevola servicea*) forests that serve well to stabilize beach areas. This particular introduction has been documented elsewhere as being a poor defense against typhoon-strength winds, and also detrimental to sea turtle nesting since the turtles cannot nest in the tangled roots (Mohanty 2002).

Major anthropogenic changes occurred in the physical environment of some atolls in the Marshall Islands, although the consequences for sea turtles from such changes to the environment are

[8] This is expected, as artificial lights and noises ashore would tend to discourage nesting by turtles on inhabited islands.

[9] Recent introduction of the seaweed *Kappaphycus alvarezii* from Kiribati for the purpose of operating a small pilot project aimed at future commercialization of the species in Majuro lagoon may alter the situation, and not coincidentally prove to be an added food source for turtles there.

[10] A small Japanese sponge farm was attempted prior to WWII at Ailinlaplap atoll, but abandoned for unknown reasons

unknown. There were significant alterations made to the landscape from military activities in the 1940s with the coming of World War II. The Japanese fortified the major atolls of Jaluit, Mili, Maloelap, Wotje, Kwajalein, Majuro, and Enewetak. They also built smaller fortifications, air fields and radio stations at other locations in the Marshalls. Such fortifications did not mean that large amounts of nesting or grazing areas were denied sea turtles, however. Many of the atolls mentioned are very large and such activities might not have disturbed turtles everywhere. During World War II, significant minesweeping and coral-clearing exercises were undertaken by U.S. forces throughout the islands in the western Pacific where important military anchorages were created. Although complete records of such activities are not easily accessible, perusal of navigational charts depicting the Marshall Islands show minesweeping activities took place during or after the war in Majuro, Enewetak, Jaluit, and Kwajalein atolls.

After the war Bikini and Enewetak were chosen by the U.S. as sites for nuclear testing that lasted from 1946 to 1958, with a total of 66 nuclear devices detonated on those two atolls that obviously destroyed some habitat. The impact on sea turtles of nuclear testing is not known. Indirectly, nuclear testing did have consequences for sea turtles on several of the northern atolls. Due to the highly radioactive nature of many of the islands, the people from Enewetak, Bikini, and later Rongelap were removed from their ancestral homes, with one net effect being the resultant reduction in turtle harvest from these atolls. In the case of both Bikini and Rongelap, recent commercial tourist operations that include scuba diving and snorkeling have revealed potentially significant populations of sea turtles in each location.

4. POLITICAL AND SOCIAL CONTEXT

In the Marshall Islands, as with many of the Pacific Island countries, there is a traditional system that proscribes the utilization of many marine resources as well as a legal system covering resource use which may not always be in accord with traditional use, beliefs or understanding.

It is not uncommon in many countries for people, particularly those in outlying areas, to be unaware of regulations and laws relating to the use of some marine resources. Even where there is recognition of regulations such as a ban on the taking of turtles, compliance is often poor. A recent detailed comparative study of coastal resources management in five Pacific Island countries (Palau, Solomon Islands, Fiji, Samoa, and Tonga) noted that the two main reasons cited for poor compliance with government bans on the taking of turtles were that the rules conflict with the communities' cultural obligations (such as the custom of giving turtles to the chiefs), and that "turtle meat is just too tempting to resist" (World Bank 1999). Indications in the Marshall Islands are that the latter, and to a degree the former, also represent the major reasons for poor compliance. Non-compliance with government bans on the taking of turtles can also be attributed to unfamiliarity with government regulations.

The following two sections describe the legal framework relating to the utilization of sea turtles in the Marshall Islands, and what is generally understood to be the "traditional" approach. The explanation of the latter may not be complete, as time constraints and the unavailability of some key people during field work did not make it possible to corroborate information from some sources.

4.1 Current Legal Framework for Management and Conservation of Sea Turtles

The laws in the Marshall Islands at the national level are made by the parliament, the *Nitijela*, with an advisory council of high chiefs, *iroij*. The *Nitijela* has 33 members (senators) elected for

concurrent 4-year terms. The president is elected by the Nitijela from among its members and chooses cabinet members from the Nitijela.

The Marshall Islands constitution provides for a 12-member Council of Iroij, consisting of five "eligible persons" from districts of the Ralik Chain and seven "eligible persons" from districts of the Ratak Chain. The Council of Iroij acts in an advisory capacity to the cabinet and, in accordance with the constitution may request the reconsideration of the Nitijela of any Bill affecting the customary law, or any traditional practice, or land tenure, or any related matter (Article III, Section 2(b)).

The constitution (Article IX) also provides for a system of local government. The local government system is deemed to extend to the surrounding sea and seabed to a distance of five miles from atoll or island baselines. Local governments are empowered to make ordinances, as long as such ordinances are not inconsistent with any Act or other legislative or executive instrument.

The Local Government Act of 1980 provides for the local governments' manner of operation, including such minimum requirements as a written local constitution. The Ministry of Internal Affairs is given oversight of the local governmental system, and acts as liaison with the national government through its Local Government Affairs division.

4.1.1 Marine Resources Act of 1997

Responsibility for management of all living marine resources in the Marshall Islands is vested in the Marshall Islands Marine Resources Authority. The Marine Resources Act (1997) revised certain statutes already in place that delegated management responsibility and changed slightly provisions relating to sea turtles that had been in place in the Marshall Islands since the period of Navy administration after World War II[11].

Sea turtles are covered in Part III, section 33 of the Marine Resources Act. The Act specifies that:

1. while all turtles are on shore none shall be taken or intentionally killed, nor shall their eggs be taken.
2. hawksbill turtles may not be taken or killed except for subsistence fishing and only if the shell is at least 27 inches in curved carapace length.
3. green turtles may not be taken or killed except for subsistence fishing and only if the shell is at least 34 inches in curved carapace length.
4. the taking of sea turtles and eggs are allowed for scientific purposes when specifically authorized by the Marshall Islands Marine Resources Authority.
5. no turtles or turtle products may be sold, purchased, displayed for sale, offered for sale or otherwise marketed.

[11] The wording of a regulation promulgated under the U.S. Naval administration of the Trust Territory in 1949 on "Limitations on Taking of Turtles" (Regulation No. 3-49) was copied in its entirety by the Department of the Interior when it assumed control of the Trust Territory in 1951 and remained a part of the Trust Territory Code and later the Code of the Republic of the Marshall Islands until finally revised in 1997 by MIMRA. The original wording that lasted almost 50 years stated, "No hawk's bill turtle or sea turtle shall be taken or intentionally killed while on shore, nor shall their eggs be taken. No hawk's bill turtles or sea turtles shall be taken or intentionally killed in the water, except those whose shells are twenty-four (24) inches or more in length. No hawk's bill turtles of any size shall be taken or intentionally killed from June 1st to August 31st inclusive, nor from December 1st to January 31st inclusive".

Of the five provisions, those that limit the taking of turtles to subsistence use and banning the sale of turtles and turtle products are new and can be considered as steps in the right direction. The maximum penalties provided for in the law for violation of 1,2,3, and 5 above are a fine of not more than $10,000 or imprisonment of up to six months, or both.

The Marine Resources Act also addresses the powers of Local Government Councils with respect to the management of marine resources, including turtles, and provides those Councils with the ability to adopt ordinances relating to fishery management. The content of the law, however, seems to skew the powers of the Councils heavily towards management and development of commercially viable fisheries. Part IV, Section 45 of the Act gives the Councils the following powers, and requires them to exercise such powers "consistently with fisheries management and development measures or policy adopted by the Authority and in accordance with this Act and relevant laws:

(a) fisheries management, development and sustainable use, including the establishment of marine protected areas;

(b) recommend to the Authority the declaration of a designated local fishery in accordance with section 47

(c) adopt Ordinances for fisheries management and development in accordance with sections 49 and 50;

(d) issue fishing licenses for species which may also be licensed by the Authority in accordance with section 49

MIMRA has an ongoing program aimed at fostering greater community involvement in managing marine resources in the outer atolls through the development of community marine resources management plans. As of late 2003 only Likiep and Rongelap had developed preliminary plans, along with the Rongelap community at Mejatto islet in Kwajalein atoll. Marine turtles either were not addressed in some or did not figure prominently in others[12].

The contents of Part III, section 33 of the Marine Resources Act constitute the major expression of government policy on the subject of sea turtles. There are no specific management plans in place for sea turtles in the Marshall Islands, nor are there separate specific policy statements relating to objectives for the management of sea turtles.

4.1.2 Marshall Islands Environmental Protection Act

The Republic of the Marshall Islands Environmental Protection Authority (RMIEPA) was created by the National Environmental protection Act in 1984. The objectives of the Authority as stated in the Act (Part II) include:

- study of the impact of human activity on natural resources;
- prevention of degradation or impairment of the environment

[12] Jaluit atoll has taken a somewhat different approach in development of community-based management structures through the development of the Jaluit Atoll Marine Conservation Area beginning in 1999. Assistance was obtained from the South Pacific Regional Environment Program (SPREP) and the Marshall Islands Environment Protection Authority (EPA), and the process of delimiting protected areas within the atoll is ongoing.

- regulation of individual and collective human activity in such manner as to ensure to the people safe, healthful, productive, and aesthetically and culturally pleasing surroundings
- preservation of important historical, cultural and natural aspects of the nation's culture and heritage, maintaining at the same time an environment which supports multiplicity and variety of individual choice.

RMIEPA has been given broad and general powers to make regulations with respect to:

- primary and secondary drinking water
- pollutants
- pesticides and other harmful chemicals
- hazardous waste, including the storage and disposal of nuclear and radioactive waste
- preservation of important historical, cultural and natural aspects of the nation's heritage
- other aspects of the environment which may be required

The RMI Endangered Species Act was adopted by the Nitijela for protection of endangered and threatened species. The list of specific turtle species covered by the Act includes the hawksbill and leatherback turtles only (National Biodiversity Team 2000).

4.1.3 Local Regulations

The compendium of local regulations in the National Biodiversity Report lists only Bikini atoll as having a specific regulation protecting turtles[13].

4.2 Traditional Rights and Control of Land and Marine Resources

In understanding current utilization of sea turtles described in a later section of this report, it is helpful to have a basic understanding of the social and political structure of Marshallese society as they affect land and ocean use, particularly in the outer islands away from the population centers of Majuro and Ebeye.

The development of traditional social and political structures in the Marshall Islands has been circumscribed by the limited resources of the atoll ecosystem. One author has pointed out that in such an environment, survival was best served by a collective effort to sustain the most amicable life possible. This resulted in "an astonishingly intricate pattern of paramutual social obligations grounded in caring for one another"(Hart 1998).

The basic land unit is the *weto*, or ancestral land division that is typically delineated from the ocean to lagoon across an islet. Descriptively, the society consists of a stratification of individuals with reciprocal duties and obligations as well as privileges with respect to these land divisions (Tobin 1952). The varying degrees of these duties, obligations and privileges have changed considerably over the past century with the increasing prevalence of a money economy and emergence of some democratic institutions. Nonetheless, the basic categories remain: the

[13] Contained in the Regulations of Local Government Council July 28, 1997.

commoners or workers, or *dri jerbal*; the *alabs* or heads of lineages; and the chiefs or paramount chiefs, *iroij* and *iroij laplap*.

There are many nuances and details of the social system that need not be discussed here[14]. The basic divisions are that as members of a lineage or *bwij*, the workers are charged with working the communal land holding or *weto*, particularly with respect to copra production. They have primary use rights and an ownership interest in land that comes to them through several sorts of inheritance. The lineage heads, *alabs*, also have use and ownership rights, and also decision making control over the use of the land for which they area in charge (Poyer 1997). They receive a portion of the land's production and represent his or her lineage in their relations with other members of the society, and the chiefs (Tobin 1952). They also can play a prominent role in government at both the local and national level.

The *iroij* also receives a portion of the land's production and is ultimately the one considered to own the entire islet's land. He need not be a member of the *bwij* that inhabit the land, and in fact is usually not since many *iroij* land holdings came about as a result of former war victories or promises of protection from war (Poyer 1997).

Of relevance to the potential turtle researcher is the fact that many *alab* and *iroij* no longer physically reside on lands in the outer islands to which they have rights, but often live in Majuro, Ebeye, or elsewhere. It should thus not be assumed that permission for certain activities could be obtained on the island where the research is to take place. One can expect at least some degree of discussion and negotiation to precede the granting of permission by *alab* and *iroij* for research to move ahead, although this will likely vary depending on the island and people concerned.

According to Tobin (1952), the property rights of a lineage (*bwij*) traditionally extended onto the reef from the communal land-holding (*weto*) out to the area where people could stand to fish with a pole. Reefs within a given atoll that contained good fishing were normally claimed by the chief (*iroij*) as his personal property or *emo*. Tobin notes this system continued until 1934 when the Japanese authorities declared all marine areas up to the high water mark as being the property of the Japanese government. According to Tobin, the practical effect of ending chiefly rights over specific fishing grounds was to enable everyone to utilize these once forbidden fishing grounds.

The concept of *mo*, literally meaning a prohibition or a taboo, is an important one that is still applied within some inhabited atolls, and also to the northern uninhabited atolls where turtle nesting is known (Tibon 2000)[15]. Islets or atolls were designated as *mo* by chiefly decree. They are described more as reserves than preserves: as pantries for harvesting birds, turtles, and their eggs (National Biodiversity Team 2000). Tibon (2000) describes the use of *mo* designations (also referred to as *laroij*, denoting chiefly land ownership) as a means of conservation of food resources such as crabs, fishes and other marine animals used for food.

While some locations continue to be *mo* on the basis of past chiefly edicts, a revival of sorts in the use of the concept in modern-day protected areas is occurring in some atolls where the practice had been abandoned. These efforts, notably in Jaluit atoll, do not rely solely on chiefly decree but rather are attempting to foster cooperative efforts between the national and local governments while at the same time involving the *iroij* and *alab* who are the traditional owners and caretakers of *mo*.

[14] For example, in the Ratak chain there are also *iroij erik*, or lesser chiefs and in Ralik there are numerous different levels of *iroij* based on their relation to the paramount chief or *iroij laplap* (K. Hart pers. comm.).
[15] The atolls of Bikar and Bokak in particular, are reported to be under the control of the traditional high chief or *iroij laplap* of the northern Ratak chain.

4.3 Organizations Involved in Environmental Policy, Planning, and Execution

The key agencies involved in environmental policy and planning at the departmental level include the Environmental Protection Authority, the Ministry of Resources and Development, and the Marshall Islands Marine Resources Authority. The Office of Environmental Policy and Planning provides oversight of overall activities. Formulation of government-sponsored legislation is usually done by the office of the Attorney General, while funding of government initiatives is handled by the Ministry of Finance.

Several semi-governmental organizations are involved in research, education and the promotion of sustainable use: the Alele Museum, the College of the Marshall Islands, and the Marshall Islands Visitor Authority have been active in these fields. Non-governmental organizations are also sometimes involved in environmental issues. The most active of these in Majuro are Women United Together Marshall Islands (WUTMI) and Youth to Youth in Health.

At the time this study was undertaken, there were also several nascent non-governmental organizations or plans to start them. Mr. Satoshi Yoshii, operator of Marshall Dive Adventures in Majuro indicated that his Marshalls Oceanic Institute cooperates with Tokai University of Japan in coral reef research. Researchers at the College of Marshall Islands were discussing plans to develop an environmental non-governmental organization, as was one person with land rights on Mili atoll.

4.4 Important Demographic and Economic Considerations

Detailed information on the economy and demography of the Marshall Islands is available in the Republic of the Marshall Islands Statistical Yearbook, produced by the Economic Policy, Planning and Statistics Office (EPPSO). For the purposes of this study, the two most important factors to consider for the consequences to turtle resources are human population growth and the distribution of cash income. Population increases are significant in signaling an increased need for food resources, particularly in the outer islands. It is likely that population growth in urban centers, coupled with greater opportunity for higher cash incomes there, provides a more ready market for turtles than that which might have existed 40 or 50 years ago.

The 1999 census cited by EPPSO lists the total population of the Marshall Islands at 50,840, with 23,676 (46.6%) residing in Majuro and 10,902 (21.4) in Kwajalein. Of the remaining approximate one-third of the population, Arno (2,069), Ailinlaplap (1,959), and Jaluit (1,669) have the largest outer atoll populations.

The population of almost 51,000 in 1999 had risen from just 9,726 in 1948. In addition to such overall population growth, the most significant shift during the 52-year period between 1948 and 1999 was growth of the urban population on Majuro and Kwajalein. While the rural population doubled from 7,361 to 14,657 (a significant amount for atolls with limited resources) the urban population increased by a factor of 13, from 2,364 to 34,578.

The manner in which turtles are included into the money economy of the Marshall Islands is discussed in more detail in Chapter 6. It is, however, worth noting the figures for per capita income in the Marshall Islands as these figures confirm what one would expect: there are significantly larger per capita incomes in the urban areas than in the outer atolls. Per capita income in the Marshall Islands in 2002 is listed by EPPSO as $1,867. This figure is not uniform

throughout the country, with per capita incomes of $3003 on Kwajalein and $1,849 in Majuro. These two locations are significantly higher than the outer atolls, where per capita income is $424[16].

Turtles thus are used as a food source out of necessity more in the outer islands than the urban areas. Although no systematic study was undertaken, the perception among several people contacted was that when turtle use as a food source takes place in the outer islands, there is no direct commercialization, i.e. turtles are not bought and sold. On occasion turtle meat, most commonly salted and dried, is sometimes sent to relatives in Kwajalein or Majuro as gifts or for barter. This use of turtles in this context is part of a larger system, described by McCoy and Hart (2002):

> Exports for barter or cash include salted/dried fish and mollusk meat, coconut syrup (*jakamai*) and oil *(binep*), and, if a family member is traveling to Majuro or Kwajalein by ship and can accompany them, bananas, pandanus, coconut apple, pigs and chickens. These are commonly sent to relatives in the urban centers who welcome them as gifts of a sort and are prosperous enough to reciprocate in kind with rice, flour, sugar, canned foods, or other imports for which the recipient may not have adequate cash. Occasionally, urban relatives will sell these products to businesses and purchase goods with the proceeds to send to their outer atoll cousins.

5. SEA TURTLES IN THE MARSHALL ISLANDS

5.1 Species Known to Occur in the Marshall Islands

Four species of sea turtle are known to occur in the Marshalls: the green, *Chelonia mydas*, hawksbill, *Eretmochelys imbricata*, leatherback *Dermochelys coriacea,* and olive ridley, *Lepidochelys olivacea*[17].

Discussions with Marshallese make it clear that by far the most common turtle in the Marshall Islands is and always has been the *won,* sometimes written as *wõn*, the green sea turtle. Also known but not nearly as common is the *jebake,* hawksbill. Both are known to nest in the Marshall Islands, but nesting by hawksbills is rare.

Several western scientists and writers have described the occurrence of sea turtles in the Marshall Islands during the 20th century. A review of the literature describing turtles in the Marshall Islands mirrors the perception of Marshallese and others that green turtles are much more plentiful than hawksbills in the Marshall Islands. Thomas et al. (1989) stated that only one individual hawksbill was seen and one possible nesting site identified on Bikar atoll during a survey of 96 lagoon and ocean reef stations, and over a hundred hours in or on the water. Hendrickson (ms) indicated that one set of tracks out of 39 seen during a short trip to Bikar approximately 15 years earlier were hawksbills.

A comment published by Erdland in 1914 about the occurrence of sea turtles in the Marshall Islands could also be made today. Referring to green sea turtles he noted, "large tortoises[18] are

[16] This figure is calculated in McCoy and Hart (2002) and does not include the nuclear affected atolls of Enewetak and Kili, where government payments result in significantly higher per capita incomes.

[17] There is one anecdotal report, uncorroborated, from a dive master of the presence of a loggerhead turtle, *Caretta caretta,* at Bikini (see Appendix 2).

found occasionally in every lagoon, but they are more common near the uninhabited north islands, especially Jemo and Bikar." Several other writers have remarked on the predominance of green over hawksbill turtles. In observations about Arno atoll at mid-century, Hiatt (1950) mentioned that the green turtle was the only species observed there, and that while hawksbills "undoubtedly occur" they were rarer than the green turtle. Writing about results from a trip to the then-Trust Territory in 1972, Hendrickson stated that the "most common turtles in the Trust Territory are green turtles, with hawksbills distributed rather sparsely in the northern and eastern portions of the area[19]".

Puleloa and Kilma (1992) reported that on Wotje atoll "discussions with knowledgeable fishermen disclosed that *jebake* have been known to frequently nest on various islets of the atoll. He cites an incident in the summer of 1991 where a hawksbill was observed nesting on the southwest beach of Wotje islet. These discussions coupled with the capture of one subadult hawksbill (later released) during Puleloa's short stay on the atoll led him to suggest that "…possibly that this atoll may also be a center of activity for *Eretmochelys imbricata*"[20].

Neither leatherback nor olive ridley turtles are well known in the Marshall Islands. According to Puleloa and Kilma (1992) "there have been occasional reports of leatherbacks being washed up on remote beaches in the archipelago" but no details on such strandings or the possible causes are given. Hendrickson mentions that throughout the then-Trust Territory "no substantial records of loggerheads are available" and in the Marshalls "no appropriate name in the native tongue for such a turtle exists".

There is no local name for the leatherback and those interviewed during this study did not recognize the turtle when shown representative photographs[21]. The olive ridley also lacks a name in Marshallese, and people interviewed during the study did not identify photographs of the species as being present in the Marshall Islands.

While most of the local populace in the Marshall Islands does not recognize leatherbacks or olive ridleys, the existence of the species in RMI waters has been confirmed by fishery observers onboard foreign longline vessels based in Majuro. Such vessels have fished for tuna in the EEZ of the Marshall Islands since the early 1990s. Beginning in 1995 MIMRA and the Secretariat of the Pacific Community (SPC) cooperated in placing trained fishery observers onboard longline vessels operating from Majuro[22]. Four fishery observers from SPC took a total of eight trips on Chinese longline vessels based in Majuro from 1995 to 1997. Turtles were recorded as caught incidentally to tuna longline fishing on two of these trips. No turtles were caught on the remaining six trips.

In February, 1997 the SPC observer noted one leatherback (possibly a subadult[23]) caught and released during fishing operations by a Taiwanese longliner about 80 miles west of Ailinlaplap atoll at about 7° North latitude (Fukofuka 1997). In August, 1997 another SPC observer reported

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[18] The English word "tortoise" appears to have been inappropriately used for the German "schildkroete" in this context.

[19] The Marshall Islands represented the eastern portion of the Trust Territory. Hendrickson believed that hawksbills became more common in the southern and western sections (i.e. Yap and Palau).

[20] It is indicative of the current population status of hawksbills worldwide that one observed nest one year and the capture of one subadult the next would lead to an atoll being described as possibly a "center of activity".

[21] A recreational scuba diver reported an encounter with a small sub-adult leatherback estimated to be about 35 cm carapace length on the ocean side of the southwestern reef of Majuro near Laura in water about 15-20 meters deep (J. Kawakami, personal communication).

[22] Brogan (1997) states, "the main objective of the trip was to keep an eye on the number of turtles caught by the fleets in the equatorial latitudes".

[23] Estimated by the observer to weigh from 50 to 70 kg.

an olive ridley landed and released by a Chinese longliner fishing for tuna about 60 miles east of Mili atoll at about 6° North latitude, (Brogan 1997).

MIMRA began regularly placing observers onboard domestic-based foreign longline vessels in early 2004. A summary of sea turtles caught incidentally by longline fishing operations and recorded by all observers are shown below in Table 1. The information is useful in identifying species occurring in the Marshall Islands and confirming that these species can and are incidentally caught by longline fishing. It is important to recognize that the very small sample size in relation to overall longline effort in the Marshall Islands does not enable any further conclusions to be made from the available data.

Table 1 Reported Interaction in the Marshall Islands between Sea Turtles and Foreign Domestic-based Longliners

Date of interaction	Organization/Trip Identification	Vessel Flag	Turtle species	Fate	Condition
February 1997	SF 97-02/SPC	China	Leatherback	DSO	U
August 1997	DAB 97-05/SPC	China	Olive ridley	DSO	U
April 3, 2004	DPZ-04/02/MIMRA	China	Olive ridley	DSO	A1

Source: MIMRA unpublished data
DSO = discarded, struck off before landing, U = unknown, A1 = Alive and healthy

Two descriptive names for green sea turtles in the Marshall Islands also deserve some comment. The first is *"won waan"*, described by some Marshallese who were queried during the study as meaning "common turtle", or translated by others as "useless turtle". Since the definitions were used in conjunction with turtles seen in the lagoons, the latter definition initially encouraged the author to pursue the possibility of the presence of olive ridley turtles in other than the usual pelagic habitat. With those queried unable to identify or even describe anything other than the green turtle in conjunction with *won waan*, the conclusion is that the name is probably used for both meanings directed at the green turtle[24]. The translation of the descriptive adjective *waan* as "common" makes sense since green turtles are the most numerous among all species in the Marshall Islands. The translation as "useless" may be applied to describe smaller, sub-adult green turtles in the context of their inability to provide much sustenance in the form of meat or eggs.

The second descriptive name, *won atto*, is known to specifically apply to the green turtle. Those people interviewed from the Ralik chain identified such a turtle only as a nesting female, distinguished primarily by its size. People interviewed from the Ratak atolls, however, specifically mentioned *won atto* as a very large turtle that has a higher peaked shell than other green turtles of a similar size. Without providing a Marshallese name or label, Puleloa and Kilma (1992) describe a turtle captured and tagged at Jemo in 1992 with "parallel 'double humps' longitudinally on its back" and say that to the Marshallese this is an indication of high turtle fat content, making such turtles highly desirable[25].

Because the green turtle is by far the most common sea turtle in the Marshall Islands, and due to the almost complete lack of information on other species in the country, the following discussion

[24] The definitions found for the word in the Marshallese-English dictionary (Abo 1976) include both "common" and "useless".
[25] One of the authors indicates that although he personally did not see such a turtle, he inserted the comment because the Marshallese were certain of their existence (W. Puleloa, pers. comm.).

on nesting, foraging, migration, and population size and structure will refer to the green turtle unless otherwise specifically noted.

5.2 Nesting

Estimating the size of an annual nesting population is a critical component in developing conservation and management strategies. The general subject of sea turtle nesting was discussed with most Marshallese interviewed (particularly those from the outer islands) during the course of the study. In discussing turtle nesting, it was found that most of those interviewed are aware of the fact that female sea turtles usually nest more than once during a particular year. There was not, however, any agreement on the period in days between a successful nesting and the first attempt at a subsequent nesting by an individual turtle during a single nesting season (the "inter-nesting interval"). There was less of an appreciation or even awareness (understandably) of the fact that an individual female turtle does not return to nest each year. There was little or no thought given to the "remigration interval" (the period in years between nesting seasons for an individual female)[26].

The traditional use of the uninhabited atolls of the northern Marshalls as "game reserves" due to the presence of nesting turtles and seabirds is well known and has been described by Tobin (1952) and others. These atolls include Bikar, Bokak, Taka, the island of Jemo, and certain islands in Erikub atoll. Information relating to nesting at these locations has been described by Fosberg[27], Hendrickson (undated), Puleloa and Kilma (1992) and Eckert (1992). Bokak, perhaps because of its more northerly geographic location at 14°30 North latitude, has not been reported to host large numbers of nesting turtles, but is well known for its abundance of sea birds and eggs used as a food source.

These references provide adequate and in the case of Puleloa and Kilma (1992), detailed descriptions of nesting behavior of green turtles in these areas of the Marshall Islands. Puleloa and Kilma further cite an "ancient phrase" in the Marshallese language, *man loran*, that was used to describe an event when many turtles were seen at once on nesting beaches. According to the description of the term, "nesting females were seen pushing and jostling each other in their frantic efforts to deposit eggs, often destroying existing nests in the process[28]." The authors further note that "oral tradition depicts instincts so intense during *man loran* that turtles even abandoned the safety of darkness to invade nesting beaches during daylight". The phrase may or may not have undergone a change in meaning with the lessening number of turtles in the Marshall Islands. Eckert (1992) reported interviewing people on Wotje atoll who described the term as referring to the nesting season, April to July, "the time of year when turtles are available".

Several authors with experience in the Marshall Islands have either ranked or inferred a ranking of the uninhabited atolls with respect to their importance to turtle nesting. From these accounts it can be deduced that Bikar hosts the largest amount of turtle nesting in the Marshall Islands. Thomas et al. (1988) and Puleloa and Kilma (1992) rank Bikar, Jemo, and Erikub in descending

[26] Alvarado and Murphy (1999) provide a discussion of nesting periodicity and interesting behavior for all sea turtles in general.

[27] See for example Fosberg (1955) and Fosberg (1969) for narrative descriptions of visits to the northern atolls and Fosberg (1990) for a general review.

[28] The description of large numbers of nesting turtles may be hard to visualize, but may be similar to current-day descriptions of nesting by the world's largest remaining green sea turtle nesting population at Raine Island, on Australia's northern Great Barrier Reef. There, thousands of green turtles may nest nightly during the peak of the season on an island just 400 meters wide and 800 meters long (Limpus et al. 2003), resulting in perhaps a similar kind of mayhem described by the ancient Marshallese term.

order as the most important nesting sites for turtles in the Marshall Islands. Fosberg (1990) remarked on the nesting of green turtles as being Bikar's "outstanding feature". Hendrickson visited the area in 1972, and on the basis of a trip to Bikar and "information available" ranked Bikar as the most important nesting site in the Marshalls[29] (an "AA"), with Bikini on a level with Bokak as a second level of importance ("A") with Erikub Jemo, and Wotje third ("B").

In contrast to the information available on nesting in the northern atolls Very little information exists in scientific literature on nesting on the inhabited atolls of the Marshall Islands. Anecdotal information from Marshallese today indicates that very little nesting takes place in inhabited atolls, even on uninhabited islands within those atolls.

Following on these impressions and information, the islands and atolls of the Marshalls can be grouped into three categories for the purpose of describing nesting activity over the last 30 to 40 years. In the first category are the northern atolls of Bikar, Erikub, and the island of Jemo that are considered those with the most turtle nesting. A second category consists of the uninhabited atoll of Taka and northern atolls that have experienced little or no habitation since after World War II because of nuclear testing and other reasons: Rongerik, Ailinginae and Bikini. Beyond this third tier, ranking on the basis of nesting becomes blurred, although generally atolls in the Ratak chain would be ranked higher than those in Ralik.

5.2.1 Seasonality of Nesting

Seasonality of sea turtle nesting in the Marshall Islands is generally ascribed to the summer months, which in the latitudes of the Marshall Islands means the season from about May to November when trade winds are not as prevalent as in other months. In estimating green turtle population size on Bikar (discussed below), Hendrickson assumed that "approximately 75% of the year's nesting takes place during a 90-day peak period between mid-June and mid-September at the latitude of Bikar".

Although it has not been well documented, Marshallese interviewed during the course of the study indicated that nesting can, and does also occur in months other than the May to November period. For example, a mature female attempting to nest came ashore on Katiej island, Ailinlaplap atoll just before Christmas, 2002 (K. Hart, pers. comm.).

5.3 Presence and Behavior in Foraging Habitats

Bjorndal (1999) notes that most of the research on sea turtles is conducted on nesting beaches, with little work having been done on the role of sea turtles in the structure and function of ecosystems. While turtles spend most of their lives in the sea, most of the literature on sea turtle biology from around the world is based on nesting beach studies[30]. The Marshall Islands is no different, with little descriptive information regarding the behavior of sea turtles in foraging habitats. The two habitats of critical importance are the pelagic habitat where most species spend their early stages, and the inshore habitat consisting of the outer reefs and atoll lagoons.

[29] In addition to estimating 38 beach ascents by green turtles during a 6 day period, Hendrickson also reported one hawksbill track on Bikar during his short stay there.

[30] Of interest is that the major turtle nesting atolls of Bikar, Erikub and Jemo are probably not important as resident areas for several life stages of green turtles. These areas were surveyed by Thomas et al. in 1998, and virtually no juvenile turtles were sighted during numerous underwater surveys at these sites (Naughton 1991).

5.3.1. Pelagic Habitat

Almost nothing is known of the location(s) of the initial pelagic life-stage of all sea turtle species found in the Marshall Islands, and even anecdotal information is sparse. Viala (1997) reported seeing an unidentified juvenile turtle of about 4 inches carapace length swimming alongside a Chinese longliner at 8:30 AM of November 1995 while the vessel was moving ahead slowly hauling its fishing gear about 50 miles west of Jaluit atoll.

The pelagic environment is also where interaction takes place between sea turtles and commercial fishing activities in the Marshall Islands, mostly with longline fishing but also on rare occasions with purse seine as well. Incidental catch of sea turtles can occur in longline fisheries when turtles are either accidentally tangled with the deployed fishing gear[31], or when turtles feed on baited longline hooks.

The depth at which longline hooks are set has been shown to be the most important factor in determining the incidence of sea turtle bycatch by longliners targeting tuna, swordfish, and sharks. Estimates from observer data from several countries in the western tropical Pacific and studies elsewhere (e.g. the Hawaii-based longline fishery) show that marine turtle encounters by vessels that set their longline shallow are an order of magnitude higher than encounters by those vessels utilizing deep-set strategies (SPC 2001). This coupled with scientific investigations into the feeding habits and amounts of time spent at varying depths in the central northern Pacific has led scientists to hypothesize about a "turtle layer" extending to about 40 meters below the surface.

Typical daytime deep sets by longliners targeting bigeye tuna can reach 250 to 400 meters below the surface, while night-time sets by vessels targeting swordfish range from 35 to 80 meters and include the hypothetical turtle layer (Parks 2004). Recent U.S. regulations applicable to U.S. vessels require an increased number of hooks set between the floats on a longline to enable most or all of the hooks to remain below the turtle layer while the longline is "soaking".

Except for the observer data noted above and that from the Hawaii-based longline fleet, there is relatively little information on this subject from tropical Pacific latitudes such as are found in the Marshall Islands and where longliners are active. Sea turtle behavior in relation to depths at which foraging in the pelagic environment in the Marshall Islands takes place may or may not be the same or similar to that behavior reported elsewhere. However, given the need for all turtles to return to the surface to breathe, it can be expected that sea turtles are exposed to the potential for capture wherever the longline fishery operates within the Marshall Islands EEZ.

Capture of turtles by tuna purse seiners is uncommon, but when reported is usually because turtles can sometimes be found near floating logs and other flotsam, apparently because of the existence of food in the vicinity or the potential protection that such floating debris might afford. Tuna purse seine fishermen sometimes set their nets around this flotsam to capture the tuna schools beneath and in the vicinity, and can incidentally catch turtles. On the rare occasion when turtles are captured, they are encountered alive in the net and are subsequently scooped up and released by the fishermen (SPC 2001).

[31]Olive ridley turtles are taken primarily when they are hooked while trying to eat the bait on longlines. From observations in the Hawaii-based longline fishery, leatherback turtles appear to be taken primarily by being hooked externally or entangled in the fishing gear rather than by ingesting the hook. This is probably due to their foraging strategy as well as their physiology (NMFS 2001).

5.3.2 Inshore Habitat

The inshore habitat is where most Marshallese encounter sea turtles. The inhabitants of most outer atolls spend a considerable amount of time in the water engaged in subsistence fishing. They are familiar with the food sources for sea turtles noted in Section 2.2.2, and are generally cognizant of where sea turtles are most likely to be found. Inhabitants of Airok islet in Ailinlaplap atoll, for example, recognize that the sea grass beds near Jabwon as well as a small patch of sea grass at the end of Airok islet are a location where sea turtles can be found, (K. Hart, pers. comm.). Puleloa and Kilma (1992) mention islanders on Wotje who search for turtles in the surge channels on the ocean side of reefs during night-time fishing trips undertaken at low tide[32].

Several observers (including Pritchard (1977) for Ebon and M. Trevor (pers. comm.) for Majuro) have remarked on the Marshallese knowledge of specific locations where, if a turtle is captured in that place, another will soon move to the same spot. These locations are typically in the coral, or under protective coral outcroppings[33].

In atolls where scuba diving is undertaken for recreation or in conjunction with tourism, a body of knowledge is developing on the occurrence of sea turtles that has gone largely unrecorded or analyzed. In Majuro, one of the major tourist scuba diving operators reported that green turtles are often seen on dives along the northern outer reef eastward from the main pass back towards Majuro (S. Yoshii, pers. comm.). In contrast, an instructor at the College of the Marshall Islands noted that in over two and a half years of diving (more than 100 dives), he had experienced just five turtle sightings, and these occurred at only two of the four sites that he frequented on the southern outer reef near the airport.

Such revelations by visiting scuba divers are not news to the Marshallese in Majuro who are familiar with turtle habitats. During the course of the study several people in Majuro mentioned that there are at least two fishermen in or near Laura village at the western end of the atoll familiar with locations where turtles are most likely found and who can catch and provide turtles for special occasions on request.

5.4 Migration

A key requirement for the effective management of sea turtles is knowledge of the connection between known foraging grounds of turtle stocks and nesting populations. Tag recoveries have been the primary method by which these connections have been made, with passive tags that are

[32] Puleloa and Kilma report that both juvenile and sub-adult green and hawksbills could be found during such fishing trips, but that fishermen usually avoided the larger sizes of green turtles due to the difficulty of capturing them by hand. Of note is that two of four turtles caught using this method in late August, 1992 were hawksbills, one small and one "large, fully matured female hawksbill. The smaller turtle of 66 centimeters curved carapace length was tagged, while the larger turtle was later butchered along with the two green turtles taken.

[33] It is possible that this turtle behavior may contribute to a lack of understanding of the concept of resource depletion on the part of Marshallese who are familiar with the behavior.

usually attached externally to the trailing edges of flippers on turtles being the most common types used[34].

In several areas of the world, a large amount of tag recovery data has been created that gives a better picture of migrations than was possible a few decades earlier. Throughout Micronesia, however, there is little information available to connect the turtle nesting population(s) with their foraging habitat. Yap state in FSM is an exception, where returns from turtles tagged with passive tags in the outer islands of Yap indicate that migration is primarily undertaken to foraging areas in the Philippines (Kolinski 1995). Newer technologies such as satellite telemetry are also used in the identification of migratory pathways, but are expensive and as a result only small numbers of animals are tracked. Using both sets of tagging information can lead to a more comprehensive understanding of the linkage between nesting beaches and feeding grounds (Limpus 2002).

The very few known returns of passive tags from either turtles tagged in the Marshall Islands or recovered there are intriguing, but hardly constitute proof of migratory routes. There are just three known tag returns related to the Marshall Islands that can be associated with scientific inquiry. On June 22, 1997 one female turtle was reported captured at Aliej islet in Ailuk atoll. Inquiries revealed that the tags, one on the trailing edge of each front flipper (numbers 6597 and 6598 with a return address of the Hawaii Institute of Marine Biology at the University of Hawaii) had been tagged on January 28, 1983 in Molokai, Hawaii (Puleloa, pers. comm.)[35]. One female green turtle that was reportedly captured in Majuro on or before January 21, 1992 had been tagged on Gielop Island, Ulithi atoll on May 27, 1991 (Kolinski 1995)[36]. A third female green turtle was reported as opportunistically tagged by Eckert at Erikub atoll in 1992 with the result that the turtle was reported captured in the Philippines (Eckert, pers. comm.).

There are also at least two anecdotal records of an informally tagged turtle defining a specific migration. Joe DeBrum, a resident of Likiep atoll told of an incident years ago (undetermined date) when a resident of Likiep, Johannes John, captured a live turtle at Jemo island and transported it to Likiep where it was to be loaded onto an interisland vessel to be taken elsewhere. Concerned that someone might claim the turtle before the vessel reached its destination, John painted his name (or initials) on the turtle's carapace. While loading the turtle onto the vessel, however, it was dropped into the water and escaped. A few days later a turtle hunting party recovered the turtle back at Jemo Island, approximately 30 miles northeast of Likiep (DeBrum, pers. comm.).

A person from Wotje who was said to be knowledgeable about turtles related an incident where a turtle was brought to Wotje from Erikub and a hole drilled in the edge of the turtle's carapace to try and tether it in the shallow water near the beach. The turtle escaped, but was later found and captured again at Erikub and identified by the hole in the carapace edge (B. Kotiak, pers. comm.).

DeBrum also reported having captured a green turtle with a tag indicating it was from "New Caledonia". He mentioned having sent the tag to MIMRA employees in Majuro (without recording the tag data himself), but never heard anything further. It is highly likely that the tag

[34]Balazs (1999) notes that "sea turtles are tagged to achieve the recognition of individuals or cohorts for research purposes. Tagging is most often conducted to obtain information on reproductive biology, movements, strandings, residency and growth rates".

[35] In an amazing coincidence, the person who had tagged the turtle in Hawaii, Bill Puleloa, had worked several years before in the Marshall Islands as the Chief Fisheries Officer, and is also the primary author of the Puleloa and Kilma (1992) report cited in this document.

[36] The tag, number RMTP789, was verbally reported by Suzie Geermans of the South Pacific Regional Environment Programme in 1992 to Steve Kolinski, the researcher who had tagged the turtle while it was on the beach at Gielop island. The period between tagging and recapture is listed as 239 days (Kolinski, pers. comm.).

was one from SPREP, the headquarters of which had previously been in New Caledonia and had distributed tags throughout the Pacific with the inscription "RETURN SPC/SPREP, BPD5 NOUMEA CEDEX, NEW CALEDONIA" stamped on each tag. The Puleloa expedition of 1992 to Jemo, Erikub and Bikar, for example, used such tags. Current MIMRA employees were quizzed on this "lost tag" reportedly turned in by Mr. DeBrum, but none of them had any recollection of it and no records existed at MIMRA on its fate.

5.5 Population Size and Structure

Estimating population size of a particular stock of turtles is important to evaluate the seriousness of threats to the stock. If we know, for example, that 50 turtles are captured annually on a particular nesting beach, it is necessary to know the total size of the nesting population to evaluate the impact such a take would have on the population as a whole.

Gerrodette and Taylor (1999) note that since sea turtle life history characteristics make it nearly impossible to estimate a specific turtle population's size directly, it is common to estimate the size of only one part of the population, such as adults (typically, adult females who are more easily counted on nesting beaches). When this is done, it is necessary to clarify what part of the total population is being estimated (e.g. nesting females) and what assumptions are being made regarding extrapolation to achieve an estimate of the total population.

Two types of estimates of population size can be made: an absolute population size, which represents the actual number of turtles, and a relative population size, also called an index of abundance. An example of a common index of abundance is the using the number of nests to detect trends in abundance over long periods of time. Gerrodette and Taylor (1999) point out that estimates of relative population size are usually simpler and less expensive to obtain than estimates of absolute population size. Estimates of relative population size do, however, require more assumptions, and if these assumptions are violated, the estimates may be biased.

Determining population structure is important to better define sea turtles as management units. This includes better definition of stock boundaries in both foraging and nesting habitats. Importantly, some newer tools used in defining management units can be applied to males and juveniles, something that is not possible when relying on nesting beaches to define populations. Dutton et al. (1999) describe three basic tools that are used: molecular genetics, tagging and telemetry. Molecular genetics can help identify turtles that interact with fisheries in the pelagic environment, or which are captured in foraging areas. Genetic sampling has, for example, determined that there are two genetic stocks of olive ridleys in the Pacific: an Eastern Pacific stock, and a Western Pacific one. These two stocks appear to forage throughout the central Pacific. Evidence collected from olive ridley turtles captured incidentally in the Hawaii longline fishery, for example, shows that 30% of the turtles were from the Western Pacific (Dutton et al. 1999).

As might be expected, almost nothing is known of the sea turtle population structure in the Marshall Islands. It is not known, for example, if foraging subadult green turtles seen in various atoll lagoons represent the population that nests at sites such as Bikar and Jemo. There was general agreement among knowledgeable Marshallese queried during this study that there are more turtles present in the northern part of the Ratak chain, including inhabited and uninhabited atolls, than anywhere else in the Marshalls.

Hendrickson attempted to define the size of a nesting population from observations he made at Bikar in 1972. Although the data he had to work with was sparse, he stated that "no matter how

tenuous the evidence, a reasoned, explained prediction of population size is better than no figures at all".

Hendrickson observed that 38 green sea turtle nests were made during a six-day period on Bikar, based on high tides having wiped out previous tracks before his arrival. He used this data to estimate of the size of the nesting green turtle population on Bikar atoll using certain assumptions in three steps:

1. Assuming that approximately 75% of the year's nesting takes place during a 90-day peak period between mid-June and mid-September at the 12° N. latitude of Bikar, and that the central 30-day period of the 90 days has twice the nesting density of the two marginal periods:

initial 30 days: 5 six-day periods X 38 =	190 nests
central 30 days: (double intensity) =	380 nests
final 30 days: (same as initial 30) =	190 nests
sub-total	760 nests
plus 25% for remainder of the year: =	190 nests
Total nests per year:	950 nests

2. Assuming an average of 4 nestings per female per year: 950/4 = 237 females nesting each year

3. Assuming a triennial nesting pattern, there would be three groups with roughly equivalent size:

3 groups X 237 = 711 sexually active adult female turtles in the Bikar breeding population.

Hendrickson's opinion of his own estimates was that "a 50% margin of error is called for in considering the above figures, and, even then, they must not be considered as more than the most crude sort of first-level estimates". He further pointed out that there is too little known about sex ratios in any breeding populations of sea turtles, much less the Bikar population, to warrant hazarding a guess as to the number of males and the resultant total population size. He also shied away from making "even a rough guess" as to mortality and recruitment rates, or to estimate the numbers of immature turtles which might be expected in this population".

Despite significant qualifications to his own calculations, Hendrickson's conclusion is nonetheless significant:

> Even the most favorable interpretation of the data available (granting the assumptions made) allows consideration of a population of only small size, *not constituting an exploitable wild resource of any significant magnitude* (his emphasis).

Eckert (1992) visited Erikub and counted turtle "activities" (nesting pits associated with crawls) on the islets of Enego, Loj, and Erikub, but made no attempt to infer a female nesting population from his observations. He reported density of nesting on Enego was high, with 98 activities counted in what he estimated was the previous 2.5 months. Loj islet, with less suitable nesting habitat had 26 activities counted, and Erikub had 81.

Writing more than 30 years ago, when presumably green turtle stocks were in a more robust condition than at present, Hendrickson concluded that if Bikar represented one of the major breeding populations of sea turtles in the then-Trust Territory, then "This entire area possesses no sea turtle populations capable of supporting sustained exploitation by wild catching—on the contrary, total protection of the wild immatures and adults seems to be called for…".

5.6 Turtle Mortality and Threats to Stocks

In other locations where populations of sea turtles are in decline, factors contributing to this decline are identified as:

- direct harvest of adults and juveniles
- taking of eggs for human food, and their destruction by natural and introduced predators
- degradation or loss of nesting habitat related to human activities
- degradation or loss of foraging habitat related to human activities
- incidental capture in commercial fisheries

At present there is not enough information to completely rank these factors as to their impact on turtle populations in the Marshall Islands. In particular, incidental capture by past and present commercial fishing operations has not been investigated or quantified, and migratory patterns of turtles in the Marshall Islands are still unknown. The direct harvest of adults and juveniles is known to occur, as is the second factor, particularly the taking of eggs for human food. Yet even less information exists for this aspect than for a direct harvest.

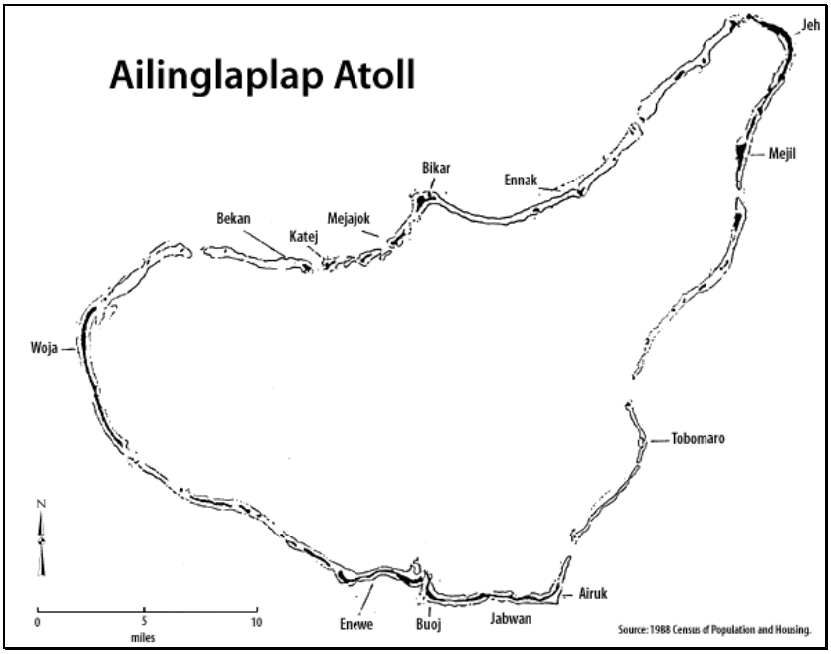
An almost complete lack of reliable data prevents any useful estimate on the magnitude of the direct harvest of adult and juvenile turtles and turtle eggs in the Marshall Islands. Anecdotal information is available for Wotje and Erikub (Puleloa and Kilma, 1992)[37]. On Wotje, Puleloa was told in 1992 that a rough estimate of annual take was around 100 turtles from the reefs around Wotje islet itself[38]. Puleloa also mentions several hunting trips to Erikub to collect turtles for a large "liberation day" feast that resulted in 20-30 turtles brought to Wotje. These turtles included nesting females as well as "several males" caught in shallow water. Later, on Erikub, Puleloa encountered a man and his family who had spent the better part of the summer there and had captured 13 turtles, estimating that two escaped for each turtle captured.

A person described as knowledgeable about turtles on Wotje and Erikub who was interviewed in late 2003 as part of this study estimated that approximately 40 turtles per year captured on Wotje are consumed there in connection with family or island-sponsored feasts or parties. He said that these turtles consist mostly of the larger sizes, both captured in the lagoon and while nesting within the atoll, as smaller turtles are not captured for this purpose. He also volunteered that there are occasions when turtles are not available for these feasts, in which case pigs are substituted.

[37] Eckert (1992) relates that one inhabitant of Wotje estimated roughly 1,000 turtles per annum were captured annually on Wotje and Erikub; a highly dubious number, given information from other sources.
[38] This is where the majority of the human population resides on the atoll and where fishing pressure would be expected to be greatest. A guess could be that the 100 turtles represent 75% of all turtles captured annually in the atoll, for a total of 134 turtles throughout the atoll.

Ailinlaplap atoll (Figure 4) was visited for ten days during the course of this study. It is one of the larger atolls in the Marshalls, with a total lagoon and reef area of 754 square kilometers, and a population of just under 2,000 in 1999. The atoll contains a total of 52 islets, many of which are uninhabited, and a total land area of 15 square kilometers. There are 114 patch reefs within the lagoon, and eleven passes through the reef to the open ocean.

Figure 4 Ailinlaplap Atoll



Several informants on different islands in the atoll were queried to obtain an estimate of the annual take of turtles for the entire atoll. Those interviewed were in agreement that more turtles are taken in the eastern and southern portions of the atoll where sea grasses and mangroves are present and where a majority of the population resides. A compilation of responses from various informants resulted in an estimate of the average annual take to be around 30 to 50 green turtles for the entire atoll, with the distribution shown in Table 2. With the exception of nesting females possibly encountered on uninhabited islets in the atoll, the figures listed represent captures in the water.

Table 2 Estimated Average Annual Take of Green Turtles, Ailinlaplap Atoll

Islet or Geographic Area	Number of Turtles
Katiej and northwestern islets	1-2
From Buoj to Airok	10-15
From Jeh and eastern islets	10-15
From Woja and western islets	10-15
Uninhabited islets	2-5 nesting females
TOTAL	33-52

From descriptions provided by informants, the sizes of turtles captured on Ailinlaplap range from about 30 centimeters straight carapace length, to 50 or 60 centimeters straight carapace length. Except for the nesting females, no information on the sex of captured turtles is available.

It is possible that inhabitants may selectively capture only sub-adults because they are easier to subdue. One informant described activities at Airok islet during the early 1980s when an unusually large number of turtles appeared inshore near sea grass beds over a three-month period. The informant estimated that although around 30 turtles were caught during the period (an unusually high number for that location) people intentionally did not try to capture the larger animals because they were concerned with injuring themselves (K. Hart, pers. comm.). The avoidance of larger turtles in the water may be unique to atolls where turtles are not as prevalent, with the result that the inhabitants are not as familiar with capture techniques as inhabitants of atolls where there might be a greater abundance of turtles.

6.0 TURTLES AND HUMANS IN THE MARSHALL ISLANDS

In contrast to the sparse scientific knowledge relating to sea turtles in the Marshall Islands, the amount of information available relating to the rich folklore and traditions encompassing turtles in the Marshalls is considerable. The information in the following sections relies primarily on secondary accounts and should be considered illustrative, rather than exhaustive.

6.1 Turtles in Marshallese Folklore

Folklore relating to turtles in the Marshall Islands can be divided into two categories. The first category contains those traditions that relate to beliefs of aspects of turtle behavior, scientifically proven or otherwise. The second category relates to folk tales, *bwebwenato*, that were orally transmitted in the past and which make reference to turtles as protagonists in stories that describe origins of traditions, values and attitudes in Marshallese society.

6.1.1 Folk Traditions

The number of folk traditions concerning turtle behavior that were recorded during this study is small, reflecting the limited time available for contact with Marshallese in a manner that would enable discussion and explanation of such traditions. It was deemed necessary to hear the same story from at least two informants before accepting it as a folk tradition. There was only one instance where such validation could be made: the telling of an aspect of believed turtle behavior first heard on Ailinlaplap atoll. That tradition involves mature female turtles after nesting. Several informants from different parts of the atoll related the belief that female turtles return to the

shallows where they have nested, and rest with their mouths open to devour the hatchlings as they reach the water. It was said that this behavior by females is not exhibited all the time, nor is the purpose of the activity known.

Several other beliefs concerning sea turtle behavior were related, but not repeated beyond the first speaker. A person said to be knowledgeable about turtles in Wotje and Erikub atolls related that one can tell the direction of subsequent nests from an original examined by noting the tracks made from a female's emergence and re-entry back into the water. If the turtle tracks indicate a counter-clockwise movement from shore to the original nest and back to shore, then the subsequent nest will be in the direction to the left of the original nest when the observer faces inland. If the movement is clockwise, the observer should look somewhere to his right when facing inland to find the nest.

An informant in Ailinlaplap atoll stated that after nesting female turtles eat the leaves and bark of the kone (sometimes written as *kone*) (*Pemphis acidula*) tree. He stated that one way to identify places where turtles have been nesting is by the damage they do to these trees, and that some people can identify the actual location of the nest by identifying where the bark has been stripped. There are also folk traditions relating to nesting frequency. The Ailinlaplap informant cited above stated that turtles must nest twice, but only the old people knew how to determine when it would nest again. When asked what the interesting period might be for green turtles, the person from Wotje quoted above was definite in stating it was "two weeks minus a day". He was also certain from what old people had told him when he was young[39] that a turtle lays eggs four times, using alternating ovaries and starting with about 140 eggs in the first clutch, reducing each time to about 60-80 eggs in the last clutch.

6.1.2 Folk Tales

The major source used to obtain references to turtles in published Marshallese folklore is the extensive collection of folk tales gathered by Downing et al. (1992) and published by the Historic Preservation Office in Majuro. Some of the same content is available in Spennemann (1998) and is accessible via the worldwide web.

Both sources contain details of two folktales that feature Lijebake (literally "female hawksbill turtle") who had become the "Great Mother Turtle" and is depicted as a special kind of turtle with the most beautiful shell. As recorded, these folktales provide insights into past beliefs and customs in the Marshall Islands relating to turtles[40].

In the first, the legend of Lijebake, an explanation for the prevalence of turtles in the northern atolls of the Ratak chain is provided. According to the legend, Lijebake and her husband Wullep were gods whose daughter was married to a chief in Kiribati. Their daughter died, leaving a granddaughter named Lemaninpit. After the Kiribati chief remarried, the stepmother was cruel to Lemaninpit and treated her badly. When Lemaninpit inadvertently allowed a prized sleeping mat to become soaked with rain, she was banished from her father's family. When Lijebake learned of this event, she decided to rescue her grand-daughter and transformed herself into a giant turtle, also changing her husband into a large frigate bird. Lijebake placed Limaninpit on her back and swam northward away from Kiribati, while the husband/frigate bird flew high overhead. As they reached the southern Marshall Islands Lijebake asked the husband if he could still see the Kiribati islands. Since her husband could still see them to the south, they continued northward past several atolls, each time Lijebake asking the husband/frigate bird if the Kiribati islands were still visible.

[39] The informant was about 70 years old when interviewed.
[40] The folktales are summarized here and may differ in detail from some versions, as can often be the case.

Finally, when they had reached Jemo in the northern Ratak chain he announced he could no longer see the Kiribati islands, even after flying as high as he could. On Jemo, Lijebake stopped swimming and put Limaninpit ashore and turtles and frigate birds have preferred the island ever since.

The Lijebake and Limaninpit folktale is well-known in the Marshall Islands, and in 1995 a $.32 stamp containing artwork depicting Lijebake rescuing her granddaughter was issued by the Marshall Islands government.

A second story concerns two gods who were brothers and the sons of Lijebake: Letao, the clever god who occasionally appeared as a human, and an elder brother, Jemeliwut. When the brothers were young they set off on a voyage to find their mother to obtain magical powers. They had heard that she was living in the ocean area of the northern Ratak chain, near Bikar. The two brothers sailed to Bikar, which was covered with bird and turtle eggs, but had no fresh water. Letao suggested they wait for their mother to come and provide them with water; eventually she arose from the sea and brought them some water. But the container was dirty and even though he was very thirsty, Jemeliwut would not drink from it. Letao, on the other hand, closed his eyes so as not to see how dirty it was and drank.

Lijebake gave each son a piece of her turtle shell to wear. She deduced that her younger son was the better person, and gave him a piece of fine shell from "around her shoulders". These contained wonderful powers, such that Letao could change himself into almost any being or object he desired. But when Lijebake gave these magical powers, she forgot to make Letao wise and kind, and subsequently he became a "player of tricks", often used the power of life and death for sport or in a cruel manner. To the other son, Jemeliwut, she gave a piece of poorer shell that grew near her tail, with no magical powers.

There are other folktales featuring Letao and involving turtles to some degree, but a possible significance of this one is the linkage to the statement by Erdland (1914) that "tortoise shell was a prominent magical charm, and in fact the neck plate of the upper shell had greater magical power than the tail plate".

6.2 Cultural Attitudes and Practices Involving Sea Turtles

The provision of a complete compendium of knowledge regarding cultural attitudes and practices involving sea turtles in the Marshall Islands is not possible in this report. Presented here are some aspects of the subject deemed to be relevant to researchers involved in turtle studies. In setting out what are believed to be the relevant attitudes and practices, it is not intended to delve into what is "traditional" and what is not. Johannes (1986) correctly points out that an entire book could be written on how and why the term has been variously used and defined.

A reasonable place to start when assessing cultural attitudes and practices is the Marshallese language. The existing Marshallese-English dictionary (Abo et al. 1976) provides some definitions. As would be expected in a work that covers so many subjects, there are many more existing terms relating to turtles than are found in the dictionary. Some of those missing have to do with turtle behavior, anatomy, and fishing terms.

A wealth of information can be gleaned by spending time with informants detailing many of these terms. For example, a few terms for techniques used in capturing turtles are: *atartar*, a technique for catching turtles at night when they are in the shallow water close to the beach; *boojak*, the technique used when capturing mating turtles; *ikkiij*, a technique for capturing turtles while they are resting under coral outcrops; *le-ok in bon,* a modern night-time capture technique using a net (Bungitak, pers. comm.).

Several writers have pointed out what Puleloa (1992) calls the Marshallese development of "an intimate and essential relationship with sea turtles". He notes that Marshallese have much prized and long depended on turtles and their eggs as a source of food, and that most portions of the turtle, including the shell, skin and flipper spurs were utilized as ornaments or implements[41].

Reaching a bit further, Spennemann (1992) mentions the prior use of a design of joined hexagons representing the plates of a turtle shell in tattoos. He says that "the turtle shell has a special meaning in Marshallese customs and stands for strength and intellectual power and cunningness", and implies that this meaning was connected to its use in tattoos.

6.2.1 Historical Reports

Information on humans and turtles in the historical context is available from several secondary sources, such as Johannes (1986) and Fosberg (1990). Those accounts usually quote the American administrator Tobin (1952) and (1961) and the earlier works of the Germans, Erdland (1914) and Kramer and Nevermann (1938).

The descriptions of the rituals surrounding visits to Jemo for the purpose of harvesting turtles and turtle eggs by Tobin (1952) provide insight into not only the manner in which turtles were harvested, but also how the animals were intertwined with pre-Christian beliefs as well as the absolute power of chiefs. According to Tobin, these practices applied to the northern Ratak atolls of Bikar, Bokak, Taka, Jemo, and the islands of Erik and Luij in Erikub. The elaborate rituals were connected with the first food gathering expeditions of the year, which occurred in the summer.

Summer is not only the time of turtle abundance at these atolls, but also a period of fickle and unpredictable winds that would have made voyaging all the more difficult for the Marshallese. It should be remembered that not only were sailing canoes being employed during periods of unreliable winds, but also that the islands were likely less hospitable than the inhabited atolls where the voyagers originated. Except for water captured during rain showers, fresh water would have been non-existent, for example, and shelters only temporary. The need to return to home islands where day-to-day domestic requirements awaited probably also contributed to short stays on the uninhabited islands by the food-gatherers. These factors could have resulted in periods of respite from exploitation for the resident populations of turtles and seabirds[42].

Tobin's description of a typical first visit to Jemo for the purpose of "opening the season" for the gathering of turtles and turtle eggs, as related in Johannes (1986) provides insights into practices long-abandoned[43]:

> Divine sanction was requested before the landing party began its search for eggs. This entailed carrying a coconut leaf and walking single file behind the chief, stepping in his footprints, as the landing party walked towards a sacred tree in silence. Women had to

[41] A common use of hawksbill turtle shell in many island cultures of the Pacific was in the manufacture of sturdy fish hooks, particularly those attached to pearl shell lures used in catching tuna with short (2-2.5 meter) poles. These lures are considered by many to be the most characteristic fishing gear of the Pacific Islands region and can be found in many handicraft shops in the Pacific Islands region as well as on display in many museums of the region and around the world (Gillett et al. 2001).

[42] This situation likely changed with the introduction of an economy based on copra, and the subsequent deforestation and planting of many islands with coconuts, beginning in the late 1800s.

[43] The more detailed description found in Tobin (1952) includes details of chants and esoteric words employed during the rituals.

hold mats over their heads. Upon reaching the tree each man placed his coconut leaf on a leaf branch, sat down and waited for a breeze to blow the leaf off.

Once this condition had been satisfied, the party progressed to a special place where a small rare plant grew. Three yellow and three green leaves from the plant were pounded together and the extracted juice drunk by all. This was to prevent anal bleeding and diarrhea, which might result from the unaccustomed meal of turtle and birds' eggs that was anticipated. Turtle eggs were then gathered independently.

Before eating, everyone reassembled before the sacred tree, where the chief or his representative uttered a special chant. As the four cardinal directions were named in the chant, four eggs were thrown in each of these directions as an offering. The eggs were recovered and the chanter consumed all of them. The remaining eggs were then divided and eaten.

Another chant was used to obtain supernatural aid in attracting turtles ashore. While on the reserve island sexual intercourse was forbidden, as was the use of normal Marshallese language.

After this initial trip was made by the chief or his representative, anyone could travel to these islands during the rest of the season.

Tobin's analysis of these practices was that they were for practical ends. "Rather than allow people to swarm all over the island, possibly frightening away nesting fowl and egg-laying turtles, the *iroij* (chiefs) and senior people led the way and the food gathering proceeded in an organized, methodical fashion". Using the recollections of informants, Tobin estimated that the ritual was last performed at Jemo during German times, i.e. before WWI, and by 1952 none of the taboos of the past were being observed.

Descriptions of cooking and consumption activities by Erdland (1914) and Kramer and Nevermann (1938) during the first decade of the 20th century, are somewhat detailed in keeping with the ethnographic practices of the time. The latter authors described how turtles are "first laid before the chief, who selects the best ones for himself". They note that "the fat on the abdomen between the legs or "*wuiwui*" ('*jil*' in Ratak) and part of the gut ('*madjinal*' in Ratak) are regarded as especially good." As for actual cooking, they describe the use of an earth oven, with "the entrails and layers of fat are wrapped in leaves and with the meat, put in the oven, which is covered with earth and the plastron. The meat remains in the oven one night"[44]. They concluded by citing a Marshallese belief that, "before eating the tortoise one must not eat any raw fruit, otherwise the teeth will become brittle".

As the foregoing demonstrates, there has been some attention paid to recording the ritualistic catching of turtles in the Marshall Islands, and to their preparation as food. There does not, however, appear to be a great deal written on any ritualistic restraints placed upon turtle consumption[45].

Whether this absence is a result of an absence of such restraints or simply omission from the reporting is unknown. There was some, but not much, reporting of customs which might have had

[44] Writing of Maloelap, Poyer (1997) described a type of basket, *jali*, which is no longer made that was a special one for cooking turtle eggs in the earth oven. Puleloa and Kilma (1992) describe cooking "in the traditional manner" on Wotje that consisted 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".

[45] In the western Carolines, for example, certain food taboos and customs related to distribution of both live turtles and turtle meat played a role in limiting consumption and as a result may have lessened exploitation (see for example, McCoy (1974) and Lessa (1983)).

consequences for the past levels of turtle consumption. In an elaboration on the methods of butchering and preparing turtles, Erdland (1914) noted that "every one that is caught must be brought to the Chief" and that "the lion's share and the best pieces belong to the Chief". Erdland also notes with little elaboration that "It is the task of a navigator or person versed in legends to carve the animal; the various parts are regarded as the mats and foods of a legendary person." This coincides with Kramer and Nevermann (1938), who say that "Since parts of the tortoise are regarded as mats and food of a mythological person (Lijebake) only mariners or those who know the myths can divide them".

In other locations in Micronesia such as the central and western Carolines, control over turtles, their eggs and nesting grounds were (and to an extent still are) intimately entwined with the political system, with each reinforcing the other (Lessa 1983). There is some evidence of this in current-day Marshall Islands society, as the next section explores.

6.2.2 Current Attitudes and Practices

The short time available for research in the Marshall Islands did not enable an in-depth look at all aspects of attitudes and practices relating to turtles there. As a result, high priority subjects were identified for investigation that are considered to be those likely to affect the planning of future research: (1) the manner in which control is exerted over turtles and turtle habitat; (2) how turtles are utilized and valued, and (3) how the Marshallese perceive the current status of turtle stocks and turtle abundance in the Marshall Islands.

Although not falling into any of these categories, some mention should be made of the turtles on Kwajalein atoll that have been kept in a "turtle pond" at the missile testing facility/base there for an undetermined number of years, but at least since 1970 (Schilling 2003). The pond is said to hold several sea turtles (typically four or five green turtles and one hawksbill in April 2003) and some fish, with their care unofficially entrusted to personnel on the base who feed the turtles kitchen scraps. It is reported that "conditions of the turtles and the pond are monitored by government agencies" (Anon. 2003)[46]. A recent report (Morris 2003) indicated the existence of the pond provides an excellent educational opportunity for Marshallese who might have access to the pond, such as day workers resident on Ebeye or school children from Ebeye that might visit on field trips.

It is agreed that the educational opportunity the pond offers is useful. Information could be conveyed to Marshallese on (1) attitudes that might not be the same as their own with respect to sea turtle conservation or utilization (2) some aspects of sea turtle behavior such as dietary preferences, and (3) recognizing passive tags on turtles in the Marshall Islands and providing information on the importance of tagging and instructions on the reporting of such tags when encountered.

6.2.2.1 Control over Turtles and Turtle Habitat

As with the scarcity of descriptions on ritualistic restraints, there is a paucity of information in the literature regarding control of turtles in specific situations. Although validation was attempted for those cases and situations described in this section, it is likely there are exceptions and nuances that have escaped the author's efforts.

[46] Time and other restrictions did not allow a visit to Kwajalein to further investigate this subject during the study.

It is illustrative of the overall situation that the Constitution of the Marshall Islands indirectly protects traditional rights to *mo*, but makes no mention of the rights of citizens to access to natural resources. Article X of the Constitution specifically addresses "traditional rights" and preserves customary law and "any traditional practice concerning land tenure or any related matter in any part of the Marshall Islands, including, where applicable, the rights and obligations of the Iroijlaplap, Iroijedrik, Alap, and Dri Jerbal". The subjects of land tenure and "any related matter" could be construed to apply to turtle nesting areas and *mo* in particular.

The following section of Article X gives the Nitijela the responsibility to declare customary law. The Nitijela "may include any provisions which, in the opinion of the Nitijela, are necessary or desirable to supplement the established rules of customary law or to take account of any traditional practice."

In the situation where the chiefs are assured of their "traditional rights" under customary law but the Nitijela is the one who can make the rules on what that customary law might be, exercise of traditional rights by the chiefs could have significant consequences[47].

Terrestrial habitat, i.e. nesting areas, can be placed in two categories. The first are the "turtle islands" that are claimed by *iroij* as *mo* (section 2.2.4). An example cited by Tobin (1952) is that while the Germans used the uninhabited nature of the northern atolls to justify the seizure of Bikar and Bokak as government property (subsequently taken over by the Japanese at the departure of the Germans), during the U.S. administration the *iroij laplap* "claimed personal title to Bokak and Bikar as *mo* land.

The second category is the islets, inhabited or not, which are not under the control of a chief as *mo*. These lands are divided into *weto* (section 2.2.4), with each controlled by an *alab*. As related to the author, at least theoretically the disposition of turtles found on a particular *weto* is determined by the relevant *alab* or *iroij*, depending on the atoll, circumstance of capture and importantly whether those people who traditionally control the resource are even aware that a capture has even been made. In an incident that occurred on Ailinlaplap in December, 2002, a nesting female was captured on one of the inhabited islets in the atoll. The *alab* in charge of the land where the turtle was captured was present on the island, and directed that it be sent to the *iroij* located on a different island in the lagoon (Hart, pers. comm.). In practice, many of the *alabs* do not reside on the lands under their control and may be resident in Majuro, Ebeye, or even overseas and this may have implications for the ultimate disposal of turtles found on particular *wetos* over which those *alabs* exert control.

It should be pointed out that obligatory offerings of turtles or turtle meat to chiefs and the place of such actions in the social system are not easily separated or placed in isolation to the overall relationships between chiefs and commoners in the Marshall Islands[48]. These relationships are undergoing a fundamental change in some areas, and any significant discussion of the subject is far beyond the ability of the author of this study to present in any detail or comment upon[49].

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[47] The intention here is not to delve into Marshallese constitutional law, but to point out that there might be more than just turtles at stake when ownership or use rights are exerted over nesting areas and the resources found there.

[48] Carucci (1997) in reporting on the butchering of a turtle at Enewetak in 1982 stated that " The several types of meat are separated into stacks and special portions are set aside for the chief and minister. Added to other foods for *kamolo*, such high-ranked complements increase the chances for a *jepta* to win the evening's songfest competition.

[49] One view (with the experience and knowledge of relationships between traditional leaders and atoll inhabitants in other locations in Micronesia in mind) is that there are significant limits to the effectiveness of traditional controls on turtle harvesting in the Marshall Islands.

Specific expeditions to hunt for turtles on islands or atolls where nesting is known to occur are normally preceded by a request to the relevant *alab*. Such a request would usually only be made if the person making it had some connection to the island or land in question.

The situation where a hunting expedition is undertaken within a lagoon of an inhabited island is less clear. Some informants mentioned that on Aur, Wotje, and Maloelap (all atolls in Ratak) specific permission from a chief is usually required. One informant from Wotje indicated that turtle hunting expeditions to Erikub from Wotje required the approval of both the *alab* and the *iroij*.

In the Ralik chain, it is understood that in the main there are no restrictions to fishing for lagoon resources, and that this carries over to turtles found in the water. Circumstances on a particular atoll may invalidate this rule, such as in the case where turtles are found in foraging areas in close proximity to islets where *iroij* have specific rights.

The land holding system in the Marshall Islands that often provides individuals with use rights on multiple islands and the resultant relative fluidity of the population complicates the picture of not only who might have specific rights to harvest turtles but also who habitually might undertake the harvest. Without trying to oversimplify the situation, Table 3 below provides a general matching of the uninhabited atolls where turtles are known to nest with the origin of people most likely to possess the rights to utilize the turtle resources there. Bikar, as *mo*, is a special case where the *Iroijlaplap* has the ability to provide access to whomever he chooses. While the reference is to the utilization of turtle resources only, it is understood that access to a particular uninhabited atoll's resources would usually include fish and birds (including bird eggs).

Table 3 Access to Turtle Resources on Uninhabited Atolls

UNINHABITED ATOLL	PRIMARILY UTILIZED BY INHABITANTS OF	SOURCE
Erikub	Wotje	Fosberg (1990), Pritchard (1977)
Ujelang	Enewetak	Fosberg (1990)
Taka	Utirik	Pritchard (1977)
Bikar	(?)	Fosberg 1990 says coconuts planted by people from Likiep
Jemo	Likiep	Tobin (1952)
Rongerik	Rongelap	J. Tibon (pers. comm.)
Ailinginae	Rongelap	I. Eknaelang (pers. comm.)

It is important to note that changes in transportation over the years have had an impact on access to turtle nesting beaches and the resultant ability of traditional owners to control such access. Prior to the mid-19th century sailing canoe voyages were the only means by which distant nesting areas could be reached from the inhabited islands. In order to take advantage of the turtle nesting season, the voyages had to be undertaken during the summer months when winds are the least predictable. Increases in inter-island and international trade centered on copra began during the latter half of the 19th century and introduced larger cargo schooners that reduced the risk of such canoe voyages, and were likely employed in some instances to obtain turtles. Later, the introduction of motorized vessels provided an even greater ability to reach the turtle nesting areas, irrespective of almost any weather or sea conditions.

The state of inter-atoll shipping at any one time can have an impact on the number of turtles that might be brought to Majuro or Ebeye from the outer atolls, particularly the uninhabited ones[50]. The availability of ships active in inter-atoll trade and transportation has fluctuated considerably over the last few decades. The status of such shipping in the Marshall Islands is largely related to copra price. In periods of high prices quantities produced are large and shipping requirements increase. For the last several years copra prices have been at record lows, and the scarcity of reliable inter-atoll shipping reflects this.

Even within atolls, the use of small diesel-powered boats known throughout Micronesia during the post World War II era as *bumbum*s (so called because of the slow drumming diesel propulsion noise) and later outboard motors have greatly increased the mobility of the population and enabled them access to areas that would have been much more difficult to reach in the past. These advances in transportation technology have also on occasion no doubt enabled some to gain access to uninhabited turtle nesting areas without obtaining the requisite permission.

Several factors mitigate the potential impacts of improved transportation, particularly the use of outboard powered boats, on turtles. Outboard engines are very expensive, relative to the income of people in the outer islands as is the fuel to power them. Because of poor inter-atoll shipping there is also usually a chronic shortage of fuel. Transportation by outboard powered boat is thus by no means ubiquitous in all islands at all times. No record could be found in EPPSO (2002) or other government publications documenting the number of either sailing canoes or outboard powered boats in the outer atolls. As a gauge, however, in November 2003 Ailinlaplap atoll had just 15 outboard powered boats (not all operational at the time) and 45 to 50 sailing canoes for a population of almost 2,000 people scattered on 10 different islands in the atoll.

6.2.2.2 Turtle Utilization and Monetary Valuation

First and foremost, turtles (in particular green turtles) are viewed as an important food source in the Marshall Islands. Its importance as a food source is more closely linked to its taste (partly due to high fat content in larger animals and the somewhat beef-like texture and taste of the muscle) than to its contribution as a source of protein in comparison with, for example, reef fish. In addition, by the nature of their bulk and size turtles represent a potentially large amount of food that can be obtained by the hunting or fishing effort of a relatively small number of people.

In the urban area of Majuro, those people interviewed during the study described turtles (the references are invariably to green sea turtles) as a food to be primarily consumed at parties, similar to pigs, for example. In the outer atolls there appears to be a mixture of usage: turtles hunted and consumed at parties or feasts and turtles used for a basic supplement to the every-day diet. The proportion of usage for the two categories is unknown. Anecdotal information from people familiar with the outer atolls points to the use of turtles as a basic diet supplement when they are opportunistically captured (such as when nesting on an isolated islet where people are camped and engaged in copra production). Use in parties or feasts predominate after purposeful turtle hunts.

Quantitative information on the amount of turtle meat consumed in the Marshall Islands as a whole or on any one individual atoll or island is not available. Indications from interviews conducted during the study and the relative scarcity of turtles in areas of high population density leads one to conclude that it likely does not play a major role in the nutritional intake of the vast

[50] An *alab* for an uninhabited atoll who is resident in Majuro indicated that the captain of one of the inter-atoll ships who also had rights on the atoll sometimes stopped by to capture turtles for transport to Majuro. On such occasions, the *alab* always received a share.

majority of inhabitants in the Marshall Islands. Respondents in a recent nutritional survey indicated that almost half of households surveyed did not eat turtle at all (Huskins 2002)[51].

This apparent scarcity does not diminish the importance or desirability of turtles in the diet of Marshallese, however. In many of the outer atolls, the opportunity to eat turtle is a welcome change to a diet where reef fish contribute the vast portion of locally derived protein[52]. When the subject of turtle consumption was discussed during the study with residents of Majuro who had migrated to that urban center, most recalled their earlier experiences in eating turtles on their home atolls in an almost nostalgic manner. To many, turtles represent the ultimate meat or protein food item.

It is worth noting that none of the persons queried during the study indicated there was any human poisoning associated with eating either green or hawksbill turtles in the Marshall Islands. Green turtles are not associated with human poisoning, but incidents of serious illness and death after eating hawksbills have been reported from various locations[53]. The apparent absence of such incidents reported from hawksbills in the Marshall Islands is interesting, since there is a prevalence of ciguatera fish poisoning in most atolls there.

There was some indication during the study that attitudes towards turtle as an important and desirable food source may be changing with younger generations in urban areas. There are many young adults and adolescents now who, while retaining links to their home atolls have lived only in Majuro or Ebeye and have had limited exposure to turtles as a food source. The diet in these urban areas is heavily biased towards imported food, and as a result at least some of this segment of Marshallese society is said to not be enamored of turtles as food to the extent of their parents or grandparents. It is unknown whether changing preferences have an impact on the volume of turtle meat consumed, however. The relative ease with which turtles can be acquired through the use of modern technology for those who do relish it may negate such changes in diet preference.

The consumption of turtles at important parties or feasts is an important use mentioned in the literature as well by people interviewed during this study. Eckert (1992) and Puleloa and Kilma (1992) describe an example of this use for a large feast to celebrate Liberation Day (the liberation of the island from Japanese control during World War II) in June, 1992 on Wotje atoll. Green turtles, in this case about 30 to 50 depending on which source is used, were captured for about a week before the celebration and stockpiled for the feast. At the celebration, turtles became a "centerpiece" food item, highly prized for their taste and capable of feeding the large number of people present.

Many people contacted in Majuro during the study also mentioned the desirability to have turtles included at important parties such as wedding feasts, but most importantly at *kemem*, or parties celebrating a child's first birthday[54]. A child's first birthday is reportedly an event of significant importance in the Marshall Islands, and preparations are often quite elaborate. Several Marshallese adults who were interviewed indicated that they believed the use of turtles at such

[51] Due to the small sample size, unknown biases and lack of detail shown in the survey results, not much information can be gleaned from this survey as presented. It is somewhat surprising, however that 30% (15 out of 49 respondent households) indicated that at least some turtle was consumed once per week.

[52] Protein from reef fish on some atolls (notably Jaluit) is severely limited by the prevalence of ciguatera fish poison. Information does not exist, however, to correlate the level of turtle consumption with incidence of ciguatera in reef fish on those atolls.

[53] See for example Silas, E.G. and A. B Fernando (1984) and Halstead, B. (1970), cited in Buden (2000). Two separate incidents of chelonitoxins causing three deaths and illness among 50-60 inhabitants in 1997 on Sapwuahfik atoll in the Federated States of Micronesia in 1997 are also reported in Buden (2000).

[54] The desirability of turtle(s) in such feasts can be likened to the Chinese practice of including high quality shark fin soup at similarly important family and business parties.

parties was a display of "conspicuous consumption" that was done primarily as an affirmation of the host's financial status (turtles being costly to acquire) or desire to be seen as a member of a social and/or political elite. Others believed that the presence of turtle meat at a party was just a part of the desire to provide the largest variety of local foods.

In addition to possibly providing affirmation of financial, social and political status, turtles are also reportedly used in the urban centers by politicians in feasts and parties during the election season. Although no incidents were seen by the author during the study period on Majuro (which occurred at a time when national elections were being held), it was reported by several people that more turtles than normal are brought to the urban centers of Majuro and Ebeye to attract voters to parties given by candidates during the election season.

The arrangements or conditions under which turtles are brought to the urban centers of Majuro and Ebeye are unclear. Depending on the situation it is believed the turtles can be "ordered", i.e. brought to the urban center for a particular feast, by someone with the political, financial or social means to do so. This situation is said to be more prevalent than the speculative transportation of a live turtle by its captor or a middleman to Majuro with the intention to sell.

The sale of fresh or preserved turtle meat may be handled differently. Two references, one from 12 and the other from 15 years ago mention the commercial use for turtle meat. Puleloa and Kilma (1992) describe the preparation (salting) of turtle meat from turtles captured in an outer atoll specifically for sale in Majuro. Referring to fieldwork undertaken on Taroa islet on Maloelap atoll in 1989, Poyer (1997) lists turtle meat as one of "several resources that are used extensively for cash income as well as subsistence". The degree to which the practice of selling fresh or preserved turtle meat continues today is unknown, although it should be recalled that such commercial use is prohibited by Marshallese national law.

Turtle hatchlings may also be collected by Marshallese to be used as pets. When hatchlings are found to have emerged from a nest, it is not uncommon for several to be obtained and kept in whatever receptacles are handy that can hold seawater: small basins, the bottoms of steel oil drums, old plastic ice chests, and the like. On some outer atolls where turtle nesting is known to occur, it is not uncommon to see such receptacles holding turtles that are fed for up to a year or two before being released. These pets are almost always small green turtles whose omnivorous nature when young makes them easy to feed with food scraps. With either the lagoon or seaward reef close at hand, it is not difficult to periodically change the seawater, and it is common for such turtles to be kept for up to several years, during which time they usually outgrow a succession of containers. Turtles kept in this manner are usually intentionally released when they reach saucer or dinner-plate size at the largest. There appears no intention to husband the animals to achieve large enough size to be considered a food source.

With very little turtle nesting recorded for Majuro, it is likely that such pets on Majuro originated as hatchlings in the outer atolls and were brought there. Puleloa and Kilma (1992) describe twenty such hatchling green turtles collected on Erikub and transported to Majuro.

In the tourist industry, the presence of turtles can enhance the attractiveness of a location to tourists, primarily those tourists that plan on spending a significant amount of time in the water. In the Marshall Islands this describes mainly diving tourists. Discussions with tourist dive operators in Majuro who conduct business in Majuro, Bikini and Rongelap indicated that dive tourists expecting to see turtles at each of these sites were usually not disappointed. For Bikini, where the diving attractions are primarily sunken ships, the general manager and one of his dive guides indicated that turtle sightings were a common occurrence appreciated by divers whose main purpose was to dive on the atoll's shipwrecks.

The current lack of utilization of turtle products in handicraft in the Marshall Islands is notable. Although anecdotal notes in Appendix 2 indicate some islands use turtle shell in handicrafts, it is believed that the use of shell has been actively discouraged by some wholesalers who understand that such use would be illegal in the U.S., the major market for Marshallese handicrafts. While one can occasionally find a preserved carapace for sale in Majuro (one was offered at the store lobby in the Outrigger Hotel in December, 2003), whole or pieces of turtle carapace plate do not normally appear in the weaving and basketwork for which the Marshalls is known. In comparison to some other Micronesian locations (such as Palau) there also does not appear to be much, if any, use of worked turtle shell handicrafts such as bracelets, rings, combs and so forth in the Marshall Islands. This is likely due to the scarcity of hawksbill, the carapace plates from which are the raw material for such items.

Since the traffic in turtles in the urban locations is done outside usual commercial channels (i.e. not offered for sale overtly in stores or markets), the monetary value attached to turtles is difficult to estimate.

An account of the monetary value of turtles in the Marshall Islands during the mid 1970s is given by Hendrickson (ms). He reported that the going price for sea turtles "where a cash economy is operative" was around $.40 to $.50 per pound, live weight. Hendrickson's knowledge of turtle prices elsewhere led him to comment that these prices "seemed unrealistically high in terms of the world market" and such pricing was a result of "the artificially inflated cash economy which is presently operative in the area as a result of U.S. metropolitan government and military activities."

During their interview of the turtle hunters on Erikub in 1992, Puleloa and Kilma learned that the expected price for salted turtle meat was on the order of $3 per pound ($6.60 per kilogram)[55]. The authors estimated that since only the red meat muscle was salted, about 25% of any one turtle could be converted to cash. They further estimated a 25% reduction in weight due to dehydration after salting and partial drying. On that basis and an average turtle weight of 242 pounds (110 kilograms) the authors estimated each turtle represented a cash value of around $146, or about $.60 per pound live weight.

Using the comparison of prices for whole turtles described by Hendrickson and those calculated from salted meat on Erikub nearly twenty years later may not be totally appropriate, since the factors setting the market price for the two commodities may be different, to say nothing of the valuing of their own labor or expectations of the sellers in the Erikub situation.

Information from one person who had procured a turtle for use in a *kemem* celebration on Majuro in 2003 indicated that the cost for a "medium" size green turtle captured specifically to order by turtle hunters on Majuro was $200. There was also some inference that the set price was somewhat dependent on the relationship of the buyer to the fishermen. Although no weight was given for a "medium" size turtle, it could be assumed that if caught in Majuro it was likely not a nesting female and might be on the order of 100 pounds (45 kilograms) live weight[56].

[55]This applied to the nesting females and mature males that had been captured on Erikub at the time.
[56] The lack of hard data on turtle size in this one account or knowledge of any price elasticity for the commodity in general prevents any useful comparison with Hendrickson's price quotes of 30 years ago.

6.2.2.3 Perceptions of Turtle Abundance and Status of Stocks.

An indication of the current perceptions of Marshallese regarding the status of turtle stocks and the abundance of turtles would be helpful in planning future research and management programs. The few written reports and narratives focusing on sea turtles in the Marshall Islands do not, in the main, address the perceptions of Marshallese regarding either the status of or threats to turtle stocks in the country. An exception is Eckert (1992) who interviewed a person on Wotje he described as someone "with experience in sea turtle hunting". That person stated there were substantially fewer turtles available than in previous years, and that nesting had declined by as much as 50% in the last 10 years[57].

The belief that there are fewer turtles now than in prior years was voiced by some people attending meetings to discuss community-based management of marine resources on Likiep and Mejatto (an islet in the Kwajalein lagoon) in 2003. According to a MIMRA official, some people on Mejatto wanted to discuss starting turtle ranching operations to increase the number of turtles available. The community decided not to pursue turtle ranching, reportedly because their having been allowed to settle at Mejatto after leaving Rongelap, might limit the practicality of such an undertaking (T. Keju, pers. comm.).

Although Puleloa and Kilma (1992) describe the concerns of administrators and government officials over increased access to Bikar brought about by "more and more trips being made to these far off rookeries to capitalize on the wealth of wildlife", there is no specific reference to any perceptions held regarding status of stocks at the time of the project.

As noted in section 3.1, only the green and hawksbill are known to most Marshallese, and generally held knowledge is that occurrence of the latter species is rare. In some instances during this study, so unfamiliar were some Marshallese with the hawksbill (mainly young adults under 30 years of age on Majuro), that they either did not know its vernacular name or could not identify it from photographs. For those Marshallese who were approached during this study and recognize hawksbills as distinct from green turtles, there was no differentiation in the degree of rarity associated with hawksbills; they are simply "rare and not seen often".

Interviews with atoll inhabitants from several atolls during this study indicated perceptions that a decline in turtle populations is occurring on Wotje, Erikub, Majuro, and Ailinlaplap. One informant from Wotje believed that there are fewer turtles now than before on both Wotje and Erikub, but said people can still find them. He attributed the decline primarily to egg collection, particularly at Erikub.

Marshallese with experience in Rongelap, Ailinginae, Bikini, and Jemo (islands or atolls with little or no large resident human populations) did not indicate serious concern with a decline in the number of turtles in those areas. An *alab* from Rongelap resident on Majuro said he has visited his home atoll several times, and the turtle population is greater than when the people of Rongelap left in 1985 due to problems associated with land-based nuclear contamination[58].

Most people interviewed were unaware of the endangered status of hawksbills under the national laws of the Marshall Islands, or any the restrictions on the taking of turtles for that matter.

Several interviews with residents of Ailinlaplap over a 10-day period confirmed that they perceived a decline in turtle abundance. One older man who had come with his wife to colonize a previously uninhabited islet in the atoll indicated that turtles were far less numerous now than

[57] The context of Eckert's discussion with his informant makes it likely that the reference to a 50% decline applies to Erikub atoll.
[58] Many of the Rongelap people relocated to Mejatto islet in Kwajalein lagoon in 1985.

during the 1960s and 1970s when they tended to catch more. He indicated however, that even 40 years ago the turtles captured were usually juveniles or subadults, and that even then it was rare to see a large turtle in the lagoon.

7. RESEARCH RELATING TO TURTLES IN THE MARSHALL ISLANDS

The Marshall Islands represents a worthwhile subject for research on the natural history of coral atolls. Access to the Marshalls for scientific research was denied to nearly all but Japanese scientists during much of the inter-war period, 1918-1945. After World War II, investigators of various aspects of coral atoll and reef ecology used the relative proximity of the islands to Hawaii and the logistics bases developed at Enewetak and Kwajalein in support of nuclear testing to assist in research that lasted from the 1950s through to the late 1970s. Very little of this research, however, focused on or even mentioned sea turtles.

7.1 Past and Current Research

The published research material focusing on sea turtles in the Marshall Islands is sparse. For example, in spite of the fairly extensive body of knowledge contained in reports produced by scientists working at the Enewetak Marine Biological Laboratory (later called the University of Hawaii's Mid-Pacific Research Laboratory) from 1955 to 1979, little mention is made of sea turtles and no published research results on the subject could be found.

Unlike some other areas of Micronesia, there have been no systematic long-term tagging or enumeration studies of turtles carried out in the RMI. In comparison, for example, awareness of turtle conservation is high in Palau and there have been numerous projects undertaken at institutions in Koror as well as in the Palau outer islands since the late 1960s. In the Federated States of Micronesia, the turtle resource, including cultural factors and attitudes, has been well documented in some locations[59], and sea turtle research projects in sea turtle conservation have operated in the outer islands of Yap (Kolinski 1995), and Pohnpei. In the Commonwealth of the Northern Mariana Islands, research has described turtles on Tinian Island (USFWS 1996), traditional uses of sea turtles (McCoy (1997), assessments of turtles and habitats (Kolinski et al. 2001), and projections on resident turtle demographics (Kolinski et al. 2004), to name a few studies.

Fosberg's various reports cited in Section 3 and the anthropological reports by Tobin, both cited in this study, represent the largest amount of anecdotal information on turtles from the post-war period up until the 1970s. Just two reports added to this information during the 1970s: Hendrickson's foray to Bikar in 1972, and Pritchard's survey in 1976. Both of these efforts in the Marshall Islands were portions of projects that encompassed all of the then- U.S. Trust Territory of the Pacific Islands.

Hendrickson's work was sponsored by the Food and Agriculture Organization of the United Nations as part of an overall assessment of turtle populations in the Trust Territory to ascertain the status of stocks and determine if there were any opportunities for turtle ranching. Pritchard's work was sponsored by the World Wildlife Fund, United Nations Appeal, and was undertaken

[59]See McCoy (1974 and 1981) and Lessa (1983).

"with the intention of providing some background information to lay the groundwork for an integrated conservation plan for Micronesian turtles".

A literature search indicates there was little directed research on sea turtles in the Marshall Islands subsequent to Hendrickson in 1972 until the subject was included in the ambitious work undertaken by the Northern Islands Natural Diversity and Protected Areas Survey in 1988 supported by MIMRA, SPREP and the East West Center (Thomas et al. 1989). That work seemed to have energized the 1992 expedition (Puleloa and Kilma 1992) that represents the largest single expedition in terms of information gathered to the northern islands for the purposes of researching sea turtles.

Co-incidental to the Puleloa-Kilma 1992 expedition, some research was undertaken by Dr. Scott Eckert, then Coordinator of the U.S. National Marine Fisheries Service Pacific Sea Turtle Recovery Team and visited the Marshall Islands from May 16 to 22, 1992. The objective of Dr. Eckert's short visit was to meet with resource management agencies of the Marshall Islands to assess interest in the inclusion of the Marshall Islands in the U.S. Recovery Plans for Marine Turtles[60]. He took the opportunity to travel to Wotje and interview people there regarding turtle harvesting. He also was able to travel to Erikub and briefly survey nesting on three islets, concluding that the highest concentration of nesting was on Enego and the next highest density on Erikub.

In the decade following the expedition reported on by Puleloa and Kilma, marine biological research in the Marshalls tended to include turtles rather than focus on them solely. A notable undertaking that included turtles was a comprehensive survey of Ailingnae atoll in mid-2002 to catalog marine and terrestrial life on this uninhabited atoll. At the time research was being conducted for this study (late 2003), no results had yet been published by the expedition. According to a local news report, the survey was requested by leaders of Rongelap atoll, who were interested in the listing of Ailinginae atoll as well as Rongelap as a "World Heritage Site" to further their attractiveness to tourism and promote conservation (Johnson 2002). The Rongelap Local Government Council received assistance from the U.S. Fish and Wildlife Service, the University of Hawaii, the University of Queensland, the University of California at Santa Cruz, and the College of the Marshall Islands in undertaking the survey, which included a survey team of 13 American and Australian scientists, with Dr. James Maragos of the U.S. Fish and Wildlife Service as team leader. Ms. Vanessa Pepi, then a graduate student at the University of Hawaii with extensive experience in sea turtles in Hawaii was responsible for collecting information on sea turtles during the expedition.

In addition to on-off studies such as that conducted at Ailingnae in 2002, there is an ongoing series of outer atoll Natural Resources Assessment Surveys undertaken by the College of the Marshall Islands under the direction of Dr. Sylvia Pinca. Dr. Pinca typically recruits a team of experts from overseas and includes a few hand-picked students who are trained to undertake a marine resources survey in a chosen atoll. Atolls where such surveys are to be conducted are chosen on the basis of interest and support shown by its leadership, and the support from the inhabitants. After analysis of the results of a survey, a return visit is made to the atoll for presentation of the results and discussion with the inhabitants.

[60] Section 4 of the U.S. Endangered Species Act requires NOAA Fisheries (NMFS) and the U.S. Fish and Wildlife Service to publish a recovery plan for species added to the list of threatened and endangered species. A U.S. Pacific Sea Turtle Recovery Team produced plans for all species in the region during the late 1990s, and included the Marshall Islands as well as Palau, and FSM in the plans. Recovery plans delineate reasonable actions which are believed to be required to recover and/or protect the species in question, and can be modified by new findings, changes in species status and completion of recovery tasks (National Marine Fisheries Service and U.S. Fish and Wildlife Service, 1998).

The surveys provide baseline information on a wide range of marine resources, including coral, at the chosen atoll. The first general marine survey and assessment was carried out at Likiep atoll in 2001, in Rongelap and Bikini in 2002, and a return to Rongelap and inclusion of Mili completed in 2003. Using several trained divers transect surveys were employed at representative sites at each of the atolls. Generally, encounters with turtles were rare during the surveys, with only two green turtles seen at surveyed sites on Likiep, one at sites on Mili, and two green turtles recorded at sites on Rongelap[61].

There has also been some data and information collected opportunistically by inhabitants and visitors to the Marshall Islands. Although the data collected is not the result of directed research, it can be valuable to future researchers nonetheless. For example, Dr. Dean Jacobson, a biology instructor at the College of the Marshall Islands and keen scuba diver has kept meticulous logs of his recreational and working dives in Majuro that include incidences of turtle sightings. Over the years, Mr. Mike Trevor, an employee of Air Marshall Islands in 2003 and a long-time resident of the Marshall Islands, has recorded or remembered a vast amount of information on coral reef ecology in the Marshall Islands, including that associated with sea turtles.

7.2 Some Considerations for Conducting Research in the Marshall Islands

Information presented in earlier sections of this report, particularly section 4, provides a general outline of topics that would require the attention of anyone considering research on turtles in the Marshall Islands. It is assumed that researchers would avail themselves of information available from the Marshall Islands Government regarding the usual considerations of visas, local sponsorship, and the like. Any work outside urban areas, such as visits to outer atolls or particularly nesting sites, will require significant preliminary planning and contacts with appropriate authorities: traditional leaders (the *iroij* and *alab* who have local jurisdiction over any proposed project site), mayors, Local Government Councils and national government officials. The main comment on this subject by Puleloa and Kilma (1992) should be carefully digested: "while the field portion (of the work) took only three weeks to complete, the acquisition of local approval and outside support spanned a ten-month period."

From the perspective of local logistics, undertaking research in the Marshall Islands, particularly when that research includes travel to outer atolls, can be daunting. Shipping schedules are rarely adhered to, and subject to delay and cancellation. Domestic air travel is safe, but has limited seat availability. In late 2003 air travel was highly subject to variations in schedules, including last-minute changes caused by unanticipated heavy bookings from some islands, and necessary but previously unscheduled maintenance, and a shortage of fuel in Majuro.

All outer atolls except the single island of Lib have airstrips used for domestic flights by Air Marshall Islands, with some of the larger atolls having more than one airstrip. The large atoll of Ailinlaplap, for example, has service to three airstrips on different islands within the lagoon. The amount of cargo space available is extremely limited, and subject to loading restrictions determined by the number of passengers on any one flight. A schedule in effect at the end of 2003 showed service to 24 different airstrips per week, with one served on a bi-weekly basis. Routes are sometimes changed, so it can be difficult to plan a trip with multiple planned stopovers on different islands.

Transportation for passengers and cargo by surface craft between the outer atolls and Majuro is provided by four government-owned vessels from 110 to 175 feet in length; four privately-owned vessels from 52 to 177 feet; and three smaller vessels owned one each by the Local Government

[61] A half-eaten turtle believed to be from a tiger shark attack was also found on the reef flat.

Councils of Wotje, Maloelap, and Enewetak (of the three vessels, only the one owned by Enewetak could be considered ocean going). A new addition in 2003 was a live-aboard dive vessel owned by the Rongelap Local Government Council with passenger accommodations for approximately 30-40 divers. There are also a number of privately-owned vessels in the 50-70 foot range. Charters can often be arranged with the owners of privately-owned and council-owned vessels, depending on schedules and availability. Local transport within atolls is usually by outboard motorboat, but is highly dependent on the availability of fuel.

7.3 Research Follow-up

It is absolutely crucial that any follow-up of research activities (such as plans for handling turtle tag recovery data and data base management) is carefully planned and the capabilities of local institutions be critically evaluated prior to their involvement. Incidents were uncovered during the field work for this report that indicated recovery data from tagged turtles was lost when simple protocols for forwarding the information and maintaining data locally were not followed. In these situations, not only has the hard work of the researcher gone for naught, but the opportunity to better inform the public about their resource will have been lost, and with it an opportunity to foster increased cooperation in the future.

In some turtle research projects in the Pacific Islands region, the high degree of interest and awareness that is initially generated among officials, resource managers, and the general public can be quickly lost unless reinforced by long-term programs. For example, given that the remigration intervals between nesting seasons are expected to be three years or more for green turtles, an intensive media campaign that lasts only a few weeks or months in publicizing the procedures for returning tags from turtles tagged on nesting beaches is highly inadequate. While radio announcements, posters and advertising campaigns can raise public awareness of such programs in a short period of time, arrangements must be made so that the publicity is repeated periodically over a period of years and ideally modified or intensified as conditions warrant.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 Identification of Research Priorities

If the Marshallese wish to continue to employ sea turtles in the variety of social, cultural, nutritional and economic (with respect to tourism) uses such as are described in this study, there must be serious attention paid to identifying the important factors that will enable such usage to continue in a sustainable manner. Research needs to commence that will answer important questions about the resource, one that is likely shared with other countries and could be subject to exploitation beyond the Marshall Islands. Since an important usage of turtles by the Marshallese people is as a food source, a primary research goal is to define a sustainable harvest level (or levels if more than one stock is concerned).

It may sound simplistic, but if we are going to answer the question of how many turtles can be taken (eaten or killed), we first have to know how large the population is from which we want to take those turtles. We need to know not only the number of turtles that are taken in any given year (nobody knows how many in the RMI), but also have a good idea of how many nest in a year, the

number of times turtles nest in any given year, how many years it is before they return to nest, where their major feeding areas are located, and what threats there are to their food sources.

Since it is known that sea turtles undertake migrations, there is also a need to institute tagging programs and employ advanced technological tools such as analysis of molecular markers (mitochondrial DNA is one) that will assist in quantifying essential demographic information. For example, how long do turtles remain in their feeding areas? Do the turtles that feed in the lagoons of RMI also nest on islands there? (We may assume so, but to date there is little empirical evidence they do.) Since there well may be a commercial fisheries bycatch component to turtle mortalities in the Marshall Islands, this also needs to be addressed in terms of its impact on turtle populations.

Admittedly, this is quite a bit to take in one bite for a country where little home-grown research has occurred. In looking at what might be done first, it is useful to review the central themes related to turtle abundance contained in the various reports written about turtles in the Marshall Islands and confirmed in this study. The major points are that:

- there are no quantitative baseline data on which to evaluate current stock conditions[62]
- there are greater, rather than lesser, economic and social pressures to harvest and utilize turtles than in the past, and
- the general feeling among most inhabitants knowledgeable about sea turtles (particularly the inhabitants of the outer atolls) is that there is a decline in the number of turtles in the Marshall Islands

From information collected during this study and an evaluation of the local capacities available, it is believed the emphasis must be on an estimation of the green turtle population and the annual take (including mortalities from commercial fisheries bycatch). Other subjects can be investigated coincidentally, but the thrust should remain towards these two major objectives.

As a start, research aimed at providing an estimate of the annual take of turtles throughout the Marshall Islands would appear to be the most practical to undertake. Several approaches are possible, including the use of surveys and enumerators. Techniques and methods would likely have to be developed to employ at least some surrogate indicators in areas where direct data collection is not feasible or possible. Important parameters such as sizes and sex of turtles removed from the population(s) all need to be taken into account.

Research to estimate the size of the turtle population(s) in the Marshall Islands should follow an estimate of the take, or be instituted concurrently. Census information can be obtained through a variety of techniques, including *in situ* sampling, tagging, and aerial surveys. An important consideration when focusing on nesting beaches for population estimates is that specific life-history traits of sea turtles require the work to continue over several seasons, no matter how appropriate the design of the sampling program.

[62] The major gaps in information are acknowledged to extend far beyond that required for stock assessment. For example, nothing is known of the impact on sea turtles of nuclear testing and other major anthropogenic changes that have occurred to the physical environment on some atolls.

8.2 Past Research Recommendations

Several of the reports cited in this study contain recommendations on what actions to take in regards to conservation and/or management of sea turtles in the Marshall Islands (see Appendix 3). Few of the recommendations address the subject of research or assign priorities for research. When they do, they are usually contained in overall recommendations for conservation and management actions.

Thomas, et al. (1989) were charged with investigating the potential for identifying suitable sites as protected areas. Their report produced well-documented recommendations relating to the establishment of national preservation areas, national parks, nature reserves, marine reserves, wildlife sanctuaries, resource conservation areas and historic/archaeological reserves in the northern atolls. Their conservation recommendations specifically addressing action to be taken with respect to sea turtles included giving priority to green and hawksbill turtles "within an overall national marine turtle conservation strategy to be prepared jointly by the proposed Conservation Service and the MIMRA". Of ten general recommendations, the one most important in the context of this report is that of determining a "scientific estimation of sustainable harvest yields".

The Thomas et al. (1989) report went further and recommended specific actions to be taken with respect to turtles on five atolls. These included:

1. Wotho: A research program into the status and dynamics of green turtle…populations of Wotho atoll be undertaken by the Marshall Islands Marine Resources Authority with the objective of determining the sustainable harvest …and appropriate species management needs.
2. Bikar: Special consideration be given to the conservation of green turtle habitat and the protection of this and other marine turtle species within the Preservation Area including the monitoring of the breeding population as part of a broader marine turtle conservation program for the Marshall Islands.
3. Taka: Nesting green and hawksbill turtles…be fully protected.
4. Jemo: A research program into green and other marine turtle nesting activity on Jemo be developed and implemented as part of a broader marine turtle research and conservation program for the Marshall Islands.
5. Erikub: That the islet of Enego be designated as a Wildlife Reserve specifically to protect the marine turtle nesting population; that in consultation with the *Iroijlaplap* and Wotje atoll residents monitoring of turtle…populations be undertaken by the proposed conservation Service and the Marshall Islands Marine Resources Authority and a sustained yield harvesting plan be developed and implemented.

As of late 2003, no changes reflecting these recommendations appeared to be in effect[63].

In hindsight, the issuance of so many recommendations (see Appendix 3) encompassing several subjects and without prioritization can confuse the situation. Generally, recommendations that are most likely to be seriously considered and (in the best of cases adopted and carried out) are those that are (1) practical to implement and (2) few in number. The recommendations at the conclusion

[63] In fairness to MIMRA, changes in the law and the structure of the organization undertaken in the late 1990s caused them to focus more on management and development of commercial fisheries, and allowed for the devolution of control of atoll resources to Local Government Councils.

of the report by Puleloa and Kilma meet both these criteria. The recommendations, based on the findings of the expedition were to:

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, Erikub atoll, and Jemo Island
3. Make eradication plans to reduce the population of *Rattus exulans* at Bikar atoll.

Sadly, none of these three recommendations appear to have been acted upon either since their formulation 11 years ago. Changes to the direction of MIMRA and problems of funding, manpower, and lack of motivation all appear to have been partially responsible. On the positive side, the banning of the commercialization (i.e. selling of turtles and turtle products) through adoption of changes to the Marine Resources Act in 1997 demonstrates an understanding of the kinds of steps that need to be taken to better promote sea turtle conservation in the Marshall Islands. As has been shown in this report, however, much more emphasis needs to be placed on enforcement of the law, particularly in the urban centers.

8.3 Other Research Considerations

There are several considerations that are important to note in the planning and undertaking of sea turtle research in the Marshall Islands. The listing below, while not all-inclusive, is believed to represent major points that need to be carefully considered.

Since there has been little or no action taken on the recommendations already put forward for research and conservation actions with sea turtles in the Marshall Islands, it is fair to ask if new recommendations will really result in any efforts towards implementation. The contacts made during this study and discussions with concerned Marshallese (primarily in Majuro) indicate that the situation in the Marshall Islands in 2004 with respect to taking action on research recommendations is somewhat different than it was 10 or 15 years ago for the following reasons:

- There is greater interest (and urgency) being expressed by donor countries and agencies in supporting the long-term survival of sea turtle populations.
- There is also greater support for the role of non-governmental organizations in assuming responsibility for some activities that governments cannot or will not undertake for a variety of reasons.
- Although the awareness of many Marshallese of the precarious nature of many turtle populations worldwide is low, there appears to be an increasing awareness of a decline in the availability of turtles locally that could contribute to support of efforts that might have been lacking in the past at the governmental level.

Changes in the structure of marine resources management in the Marshall Islands since previous recommendations were made indicates that it is inappropriate for the Marshall Islands Marine Resources Authority to take the lead in research as identified above. MIMRA is involved in fisheries development and management at the national level, but is in the process of devolving control to Local Government Councils. MIMRA should remain involved with respect to research in bycatch by commercial fishing fleets as part of their fisheries management mandate

The role of NGOs (including the College of the Marshall Islands) is thus believed to be central to the implementation of research recommendations in this report. Identification of a specific organization or individuals, however, is not possible at this time[64].

Research goals should be able to support a conservation plan. Future translation of research results into conservation measures will likely require long-term changes in the Marshall Islands value system and some adoption of attitudes that, for now, may seem foreign. Turtles are seen to have a charismatic nature in some countries and have been recommended as a flagship species to raise public awareness for various issues such as conservation of critical habitats such as sea grass, nesting beaches and coral reefs in the SPREP Turtle Action Plan. Such potential usage and accompanying symbolism should be carefully thought through in the Marshall Islands, particularly since there are strong cultural and traditional links between turtles and land rights as well as other issues.

There is a very limited capacity in the Marshall Islands at present to support sea turtle research of any kind. It is important that energy in this field in the Marshall Islands not be dissipated by sponsorship or involvement in projects locally that appear peripheral to the major research needs identified in this report.

It is a given fact that sea turtles are long-lived creatures, while most projects dealing with them in the Pacific islands are not. Every effort should be made to create and fund multi-year projects and to ensure continuity in research. The topic needs to be kept alive and in front of people through committed institutions and individuals in the Marshall Islands.

There is a subtle danger in what Bjorndal and Bolton (2003) and other biologists have referred to as the "shifting baseline syndrome". Used in this context it means the evaluation of population trends and setting recovery goals on current observation. For example, in the follow-up meeting with government officials and others after the northern atoll expedition, Puleloa and Kilma suggested "additional research projects be strongly encouraged for the purpose of obtaining baseline data while resources were still intact." Bjorndal and Bolton argue that what should be done is to define the ecological role of turtles and establish recovery goals set to population abundances at which sea turtles can *fulfill ecological* roles. While this ecosystem approach will have to be addressed at some point in the future in the Marshall Islands, there is merit now in being aware at the outset of the pitfall the "syndrome" represents.

There should be no misunderstanding that because of specific life history traits, e.g. delayed age of first reproduction and many years of potential reproductive activity, it is not possible to predict or guarantee quick results to conservation measures. Successful long-term monitoring programs typically involve several human generations, and institutional capacity must be developed to overcome reliance on an individual researcher. The development of linkages to institutions outside RMI with greater financial and human resources than currently exist in the Marshall Islands are thus particularly important.

Identification of the proper perspective (or a reliable baseline) against which to assess trends in sea turtle populations in the Marshall Islands is a challenge. Populations were already likely greatly reduced before the first significant recordings mentioned in this study were made (e.g. Hendrickson at Bikar in 1972). Quantification of the annual take and subsequent estimates of sea turtle population(s) in the Marshall Islands will only be the start, not the conclusion, of turtle research in the Marshall Islands.

[64] In addition to the NGOs identified in this report, additional nascent organizations are either in the planning or discussion stage at present.

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Appendix 1 Summary of Data on Islands and Coral Reefs in the Marshall Islands

Name (A=atoll, I=island)	Dry Land Area (km²)	No. of Islets	Reef Type	Lagoon and Reef Area (km²)	Reef Length (km²)	No. of Passes	No. of Lagoon Reefs
Ailinginae A.	3.3	25	atoll	153	67.4	2	52
Ailinlaplap A.	15.0	52	atoll	754	140	11	114
Ailuk A.	5.4	35	atoll	233	76.2	4	201
Arno A.	13.0	83	atoll	339	155.1	7	215
Aur A.	5.6	42	atoll	242	77.5	5	37
Bikar A.	0.5	6	atoll	57	34.9	1	217
Bikini A.	6.0	23	atoll	694	104.9	8	280
Bokak A.	4.8	11	atoll	115.8	/	0	?
Ebon A.	3.2	22	atoll	107	58.3	1	694
Enewetak A.	5.8	40	atoll	1,027	121.9	5	158
Erikub A.	1.6	14	atoll	302	81.5	6	100
Jabat I.	0.6	1	Fringing (table)	0	4.9	0	0
Jaluit A.	3.6	84	atoll	697	158.3	5	470
Jemo I.	0.2	1	Fringing (table)	0	2.4	0	0
Kili I.	0.9	1	Fringing (table)	0	5.0	0	0
Kwajalein A.	16.0	93	atoll	2,849	314.3	36	358+
Lae A.	1.6	17	atoll	26.0	20.8	1	24
Lib I.	0.8	1	Fringing (table)	0	5.4	0	0
Likiep A.	10.0	64	atoll	468	109.5	8	394
Majuro A.	9.0	57	atoll	296	96.4	4	345
Maloelap A.	10.0	71	atoll	1,010	?	12	71
Mejit I.	1.8	1	Fringing (table)	0	10.1	0	0
Mili A.	16.0	84	atoll	767	142.7	9	118+
Namdrik A.	2.6	2	atoll	8.45	20.2	0	31
Namu A.	6.2	51	atoll	400	138.1	4	189
Nadikdik A.	0.9	1	atoll	?	19.0	0	?
Rongelap A.	7.8	61	atoll	1,009	158.7	10	118

Rongerik A.	2.1	17	atoll	183	58.4	5	182
Taka A.	3.4	5	atoll	134	53.1	1	94
Ujae A.	1.6	14	atoll	?	?	5	140
Ujelang A.	1.7	32	atoll	94	53.4	2	67
Utrik A.	0.5	6	atoll	93	47.2	1	114
Wotho A.	4.1	13	atoll	119	52.1	4	72
Wotje A.	8.0	72	atoll	776	127.6	8	174
Total	173.6	1102					

Source: Eldredge, et al. 1999

Appendix 2 Atoll Information Summary

key to symbols:

 **= turtles reported**

 **= turtles reported regularly nesting**

 **= turtles no longer nesting or greatly reduced in number**

 **= hawksbill turtle reported**

 **= leatherback turtle reported**

 **= loggerhead turtle reported**

 **= mangroves present**

 **= mangroves formerly present but now extirpated**

 **= seagrass present**

 **= monitor lizards present**

 **= monitor lizards formerly present but now extirpated**

 **= *Casuarina* present**

 **= World War II battle location or fortified atoll**

 **= site of Nuclear Test Program**

 **= received extensive radiation during Nuclear Test Program**

= received some radiation during Nuclear Test Program

Ralik Chain

Ujelang Atoll   	
0.66 sq. mi. land **25.48 sq. mi. lagoon** (Douglas 1969, Levy 1997) ▪ currently uninhabited ▪ *Thalassia hemprichii* present (Tsuda et al 1977) ▪ "In a shallow area in the lagoon off Ujelang islet is a bed of turtle grass, *Thalassia hemprichii*, one of the few such in the Marshalls." (Fosberg 1990, pg 93)	▪ "For complements, the richest or greasiest items are most highly valued." (in a table ranking Wujlañ (Ujelang) foods places turtle as the highest of the sea foods.) "Groups dedicate greater effort to obtaining multiple complements – pig, chicken, and birds or turtle – as well as different types of fish. Each of these needs to be balanced by a staple..." (Carucci 1997a, pg 82-84)

▪ received fall-out from two bombs (Dibblen 1988)	

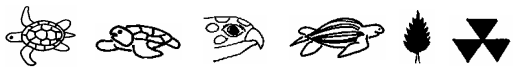
Enewetak Atoll 

2.25 sq. mi. land **387.99 sq. mi. lagoon** (Douglas 1969, Levy 1997) ▪ *Rhizophora mangle* introduced but did not survive (St. John 1960, Franko) ▪ monitor lizard introduced (Lamberson 1987, Spennemann 1998) ▪ *Casuarina* planted all along the ocean beach (Div. Ag., part-time resident, nnr) ▪ invaded during World War II (Heinl & Crown 1951)site of nuclear tests several islands vaporized extensively studied through laboratory	▪ "According to George Balazs (personal communication), only two species of sea turtles – the green turtle, Chelonia mydas, and the hawksbill turtle, Eretmochelys imbricata – are known to Enewetak.... At least one incidence of a possible sea turtle nesting on Ikuren Islet has been observed (P. Lamberson, personal communication and photo).(Lamberson J. O. pg 329) ▪ caption of photograph "Young boys look on as a large turtle is butchered on Jitto-en lands, Âne-wetak Atoll, in 1982. The several types of meat are separated into stacks (foreground), and special portions are set aside for the chief and the minister. Added to other foods for *kamolo*, such high-ranked complements increase the chances of a *jepta* to win the evening's songfest competition." (Carruci 1997, pg 69) ▪ Turtles no longer come ashore to lay eggs, although they used to in the past (part-time resident, nnr) ▪ "jebake" (hawksbill) present, recognizable by the 'plates not being as smooth' (part-time resident, nnr)

Bikini Atoll 

2.33 sq. mi. land(after testing) **229.42 sq. mi. lagoon** (Douglas 1969, Levy 1997) ▪ only sparsely inhabited ▪ site of nuclear tests ▪ several islands vaporized	▪ archaeological analysis of excavated midden on the larger islands included "sea turtle bone." (Streck 1990, pg 252) ▪ regulations of Local Government Council July 28, 1997 include: 5) all wildlife protected on and around Bikini, Aoemen and Eneu islands, including birds, nesting turtles and their eggs 6) all turtles are protected ▪ many turtles in the lagoon, one is known to frequent a deep wreck where it feeds on soft corals, possibly a hawksbill (Vander Velde, Niedenthal) ▪ turtle tracks observed along northwest beaches of Bikini Island (Vander Velde) ▪ a turtle with scales behind its eyes, probably a hawksbill, was observed while snorkeling in the shallow ocean reef of Bikini Island (Vander Velde) ▪ Bok-pata Island, by Bravo crater, a washed over sand island where debris gathers, is full of turtles; because of isolation, only single holes made rather than multiple (Tobin, L.)

	▪ loggerhead observed (Tobin, L.)

Rongelap Atoll 	
3 sq. mi. land **387.76 sq. mi. lagoon** (Douglas 1969, Levy 1997) ▪ only sparsely uninhabited ▪ received nuclear fallout 1954 ▪ *Casuarina* along road only (L. Tobin)	▪ green turtles seen on southern and eastern ocean sides of reef, none recorded from inside lagoon; on a truck dive off ocean side, side of the southern part of Rongelap Island "saw 2 green turtles, one very large male" (Pinca, July 2003 survey) ▪ half-eaten turtle on reef flat, presumed from tiger shark attack as tiger sharks seen in lagoon (Pinca, July 2003 survey) ▪ green turtles present and nesting, Rongelap island itself, also small islets along eastern shore, lagoon and oceansides, and along much of northern islands (Tobin, L.) ▪ hawksbills present, mixed in with greens (Tobin, L.) ▪ 3 or 4 leatherbacks observed in September 2003 upon returning to Rongelap from Rongerik, one near Rongelap itslef, in currents near point of island (Tobin, L.) ▪ no gathering permitted (Tobin, L.)

Rongerik Atoll 	
0.81 sq. mi. land **55.37 sq. mi. lagoon** (Douglas 1969, Levy 1997) ▪ only briefly inhabited from 1946-1948 ▪ recovered from disturbance ▪ environment too severe for human habitation ▪ turtles formerly plentiful (Myers 1989, Fosberg 1966, 1990, Thomas et al. 1989)	▪ "Evidence of Green turtle nesting was found mainly on Eniwetak islet with 33 pairs of tracks. One additional pair of tracks was found on Tarrowatt islet. The survey team was unable to visit Buck islet which appeared to have beaches particularly suitable as turtle nesting sites. The atoll ranked fourth of the seven visited for turtle habitat." (Thomas et al 1989, pg 72) ▪ "I've never seen so many turtles in my life! The sandy beach on the larger island looked like it had been bulldozed due to all the turtle nests." 30 nests were counted on one moonlit night on a single island (Tobin, L.) ▪ turtles rest under ledge of Bock Island (Tobin, L.) ▪ hawksbills present, mixed in with greens, composing perhaps 30-40% of turtles seen, hawksbill nesting tracts observed, distinguished by being smaller and with markings left by plastron (Tobin, L.) ▪ 3 or 4 leatherbacks observed in September 2003 upon returning from Rongerik to Rongelap (Tobin, L.) ▪ no gathering permitted (Tobin, L.)

Ailinginae Atoll 

1.29 sq. mi. land **40.93 sq. mi. lagoon.** (Douglas 1969, Levy 1997) ▪ uninhabited ▪ *Casuarina* only few in number and on only one island (Tobin, L.) ▪ nominated as World Heritage Site (Maragos)	▪ In 2002, Vanessa Pepi primarily surveyed the Ailinginae Atoll nesting beaches and tagged and measured green turtles that came ashore; one sub-adult hawksbill swimming in the water (Maragos) ▪ turtles nest on the southwest islands, 'Sifo' and 'Manchinkon' (Tobin, L.) ▪ hawksbills present, mixed in with greens, composing perhaps 30-40% of turtles seen (Tobin, L.) ▪ no gathering permitted (Tobin, L.)

Wotho Atoll 

1.6 sq. mi. land **36.64 sq. mi. lagoon** (Douglas 1969, Levy 1997) ▪ remains of natural vegetation ▪ more remains of purely Marshalls biodiversity than any other atoll for its size (Thomas et al 1989) ▪ received fallout from two bombs (Dibblen 1988, pg 29)	▪ "Green turtles nest on Wotho but low in numbers. A total of eight pairs of tracks were observed.... ▪ Indications are that the local people are very conscience of the vulnerability of the nesting turtle population and limit their harvesting activities accordingly." (Thomas et al 1989, pg 62) ▪ January 1997: turtle tracks found on other northern portion of Wotho Island (Vander Velde) ▪ Mejurwon islet: "Natives visiting this islet had gathered a bundle of dry pandanus leaves and some copra and turtle eggs, as well as 3 or 4 dozen coconut crabs" (Fosberg 1990 P. 78)

Ujae Atoll 

.62 sq. mi. land **71.78 sq. mi. lagoon** (Douglas 1969, Levy 1997) ▪ *Casuarina* planted by airport (Div. Ag.)	▪ turtle nested in close proximity to village on Ujae Island in early 1990s, but the eggs were dug up by domesticated dogs from the village (Alessio)

Lae Atoll 

.6 sq. mi. land **6.83 sq. mi. lagoon** (Douglas 1969, Levy 1997) ▪ *Casuarina* present, but still young trees (Div. Ag.)	▪ Lae Atoll Biodiversity Workshop Notes, 1998 'There are only two (2) types of turtle that we see in this atoll and we take them when they come to the land to lay their eggs. We also dive and tie the turtles. We use turtles for food and pets. We use the turtle skin [shell] for handicraft. [What is the status of turtles?] 'They are okay but fewer; ten (10) years ago, how frequently they were, coming on land day and night. The cause is that people take both the turtles and the eggs.'

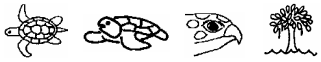
	‘Steps that we see that we can take to preserved these blessings from the sea for generations to come. Don’t eat turtle eggs.’

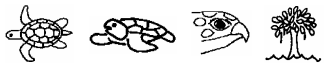
Kwajalein Atoll 

6.3 sq. mi. land **839.30 sq. mi. lagoon** (Douglas 1969, Levy 1997) ▪ very large atoll larger islets almost completely altered ▪ *Halophilia minor* seagrass in shallow lagoon areas of Kwajalein and Roi-Namor, first reported in 1989. (Whistler & Steele 1999) ▪ *Casuarina* present (Fosberg, Sachet & Oliver 1979) ▪ monitor lizard no longer present (Spenneman 1998) ▪ Ebeye heavily populated, very little vegetation	▪ “When the woman turned over a hawksbill turtle, all of her children returned alive.” (Carucci 1997b, pg. 91) ▪ “The food sources on Arbwâ are also quite plentiful....Turtles also come ashore to lay eggs at Arbwâ, thus providing a good source of meat. The turtles come ashore day and night.” “Even nowadays turtles are still plentiful there. The residents of those islets have a certain type of skill as to how to search for turtle eggs. They do not have to poke a stick in the sand to figure out if turtle eggs are there. They used to be able to just look at the area and know that there are turtle eggs located in the sand at that spot.” (Carucci 1997b, pg. 102) ▪ “These places are call Mo-kan-an-irooj, the reserves for the chiefs. These locations of islets are reserved for the chief to gather good such as birds, turtles, crabs, and other foods. They are Wōnwōt and Pekram.” (Carucci 1997b, pg. 117) ▪ “Most people contend that the larooj were held in reserve by chiefs for special occasions. In recent times this included celebrations like Kūrijmōj ‘Christmas’. At such times, people would travel to these islets [Wōnwōt and Pekram] to capture birds and turtles, and gather the eggs of both.” (Carucci 1997b, pg. 119) ▪ “Like Meik, the islets just to the north, Anet John notes that Pikeej was an islet rich in birds and turtles.” (Carucci 1997b, pg. 271) ▪ “In addition to its use as a primary location for capturing birds, Kowak-kan is an ideal location for capturing turtles. The lagoon-side reef contour here is elevated and undermined on the lagoonward side, providing sleeping areas for turtles during the day. The central section of this turtle resting area was destroyed when the current harbor and dock were constructed, but remnants are still visible to the south and north. In Marshallese these turtle resting areas are known as kilade, and Ato lañkio gives a description of the kilade on Kowak-kan: “ ‘This picture is of the location where turtles liked to stay (on the southern segment of Kowak-kaŋ). And these places where the turtles liked to stay were called

	kilade....And it was in such locations where those men of the past came to grab hold of turtles on those occasions when there were set aside for melo or parties and at those times they came and captured turtles when there were events on Eoon-ene, Kuwajleen or Ruõt and Nimur.....And it was in this location that there were a very large number of turtles in bygone days, in these kilade, or under these kilade, there were the light colored water abuts the interior reef. " '...And here (further north along the lagoon shore) you can see where the kilade extends nearly to the center of Kowak-kaŋ. And this offers another indication of where the turtles stayed, or slept. This is where the turtles like to stay in the middle of the day and, equally, where they liked to sleep at night....And these locations were one of the things that were critical to be able to maintain life in the days of the past.' " (Carucci 1997b, exclusions his, pg 275, 279) ▪ "Turtles used to come ashore at the sandy places adjacent to the islets (Meik and ane-wetak)." "Meik's gradual sand-only beach has now been replace with rip-rap elevated fifteen or twenty feet above high tide and far lagoon side of the former shore." (Carucci 1997b, pg 293, 290) ▪ "Known to most residents as a larooj location, the islet is protected by chiefly prohibition and can only be accessed for purposed of landing or resource exploitation with the permission of the chief. This prohibition is typical of islets frequented by chiefly food items...particularly large birds and turtles. Both of these items are found on Āne-wetak, though it is more renowned for large birds than turtles. (Carucci 1997b pg 302) ▪ "the islet [Kowak-kan] lies at a distance from the nearest population center and, therefore , is an ideal location for turtles to lay their eggs. These eggs are a valued Marshallese food and, in the ancient past, a resource that was monitored by chiefs. Some Marshall Islands now content that it was the chief's responsibility to preserve the resource, thereby tabuing some set portion of the eggs that could be gathered from the nest. (Carucci 1997b, pg 331) ▪ "He [Willy Mwekto] also notes that Ane-koran was an islet where many birds were caught and where, upon occasion, turtles and their eggs could be found." (Carucci 1997b, pg 337) ▪ "To the west of Ruot and Nimur lie two small islets that are part of the resource collections for Ruōt, Âne-piñ and Milu....The small islets were also prime locations to capture small birds and, upon occasion, turtles. (Carucci 1997b, pg 399)

	▪ "In addition to serving as rookeries for flocks of birds, turtles often come to the two islets [Wonwot and Pekram] to lay their eggs." "On a day-to-day basis, Wonwot and Pekram were off-limits but 'people would go to those islets to catch turtles (and birds) whenever there was a large atoll-wide feast.'" (Carucci 1997b, pg 401, 402) ▪ "During the early '60s most of the buildings [of USAKA]...had the older salt water cooling systems. The salt water run off ran into little ditches that ran along the side of these buildings and met at the present area that is now known as the Turtle Pond, before entering the lagoon. ▪ "Some of the BTL support personnel decided they wanted to make a pond and put all kinds of different fish in it.... ▪ "During the early '60s, turtles were not on the endangered list. The Marshallese would catch them for food, harvest the eggs and make all types of articles from the shell. Nothing was wasted. ▪ "Kwajalein people would go down to the shark pit after work and catch turtles. The meat was a delicacy and at most parties you went to, they had barbecue turtle steaks grilling. Some enterprising persons would cure the turtle shells, polish and varnish them and give the shells to people that were PCSing the island as a memento to time spent on the island. ▪ "One BTl support person became well-known as a turtle catcher. He would catch the turtles, put them in the pond and later, harvest the meat and work with the shells. Also, a lot of people had turtles as pets, and as soon as they were PCSing, would release the turtles in the pond. After a while the hawksbill turtle was placed on the endangered species list and then the green turtle, which ended turtle catching on Kwajalien (sic). ▪ "I presume that the turtles located in the pond are former pets that were released into the pond when they were small and the owners PCSed. ▪ " Later on, when the air conditioning system was updated and saltwater cooling system was eliminated the pond started to dry up. But BTL support personnel got permission to run a salt water line to the pond. They also built a permanent run-off dam, and an underground culvert pipe to the lagoon, and planted palm trees around the area. ▪ "The idea was to have a place where people could come and enjoy. We also had some hurt dolphins that were put into the pond to recover." (Koa 2003)

Lib Island 	
.35 sq. mi. of land **single island, no lagoon** (Douglas 1969, Levy 1997) ▪ low and sandy with central depression forming freshwater pond surrounded by trees (Amerson 1969, pg 167) ▪ *Bruguiera* and *Sonneratia* wetlands (Merlin et al 1994, Biodiversity workshop)	▪ *Wonenwe*, name of household (Abo et al 1996) Lib Island Biodiversity Workshop Notes, 1998: 1. To ko jej loi ilo lojet in ad einwot menin jeramman ak aorok ilo jukjuk bad in ad?...C. Won" "Won. 1. Jebake, 2. Won-waan. "Eor wot ruo (2) kain won jej loi ilo ailin in im jej jibwe ne rej wonene im lik. jej bareinwot turon im keke won. Won jej kaberbale nan mona im nejnej. Kilin won eo jej kojerbale nan amimono. Translation: '1. What things do we see in our sea that are as blessings or valuable to our community. C. Turtle C. Turtle. 1. Hawksbill, 2. Turtle-valueless. 'There are only two (2) types of turtle that we see in this atoll/land and we take them when they come to the land to lay their eggs. We also dive and tie the turtles. We use turtles for food and pets. We use the turtle skin [shell] for handicraft.'

Namu Atoll 	
2.4 sq. mi. of land **153.51 sq. mi. lagoon** (Douglas 1969, Levy 1997) ▪ *Bruguiera* and extensive *Pemphis* wetlands present (Vander Velde)	▪ turtles present, including some hawksbill (Pero) ▪ nesting of green turtles known from Āne-mok, Tokdik, Anil, Nalap, Bokaetoktok islets (Pero)

Jabot Island 	
.25 sq. mi. of land **single island** (Douglas 1969, Levy 1997) ▪ big waves, lots of sharks, fishes and octopuses; surrounded by a rocky reef (Mote)	▪ turtles probable, in view of close proximity to Ailinglaplap and the presence of sandy beaches (Alik) ▪ Turtles, if present, would be in very low numbers; during a one month period, no turtles were observed nor heard of (Mote)

Ailinglaplap Atoll 	
5.66 sq. mi. of land **289.69 sq. mi. lagoon** (Douglas 1969, Levy 1997) ▪ damaged by Typhoon Paka (Vander Velde) ▪ *Sonneratia*, *Brugueria*, *Lumnitera* present, with	▪ turtle grass and mangroves reported from eastern and southeastern areas of atoll. Residents cite greater prevalence of turtles found in the water in those areas compared with other areas in the atoll. ▪ large number of adult and sub-adult turtles caught on seagrass beds near Airok during 1980s during short, 3 month period (Hart)

some *Rhizophora* (Fosberg, Sachet & Oliver 1979) ▪ *Casuarina* present (Div. Ag.) ▪ *Thalassia hemprichii* present (Tsuda et al 1977)	

Jaluit Atoll 	
1.4 sq. mi. land **266.29 sq. mi. lagoon** (Douglas 1969, Levy 1997) ▪ former German and Japanese administrative center ▪ current location of SPREP sponsered conservation area ▪ *Thalassia hemprichii* present (Tsuda et al 1977) ▪ *Bruguiera*, *Sonneratia* and *Lumnitzera* present (Fosberg, Sachet & Oliver 1979) ▪ *Casuarina* present (Fosberg, Sachet & Oliver 1979)	▪ "Lijeron was probably a traditional bird and turtle reserve (Tobin 1952) in pre-European times and in recent times, even to 1958 regarded with a semi-superstitious awe, and usually avoided." (Fosberg 1990, pg. 88) ▪ during a mangrove workshop in April 2003, it was found that one of the uses for inland mangrove ponds was to raise sea creatures, including turtles. The one at Anman islet has a large turtle living in it, having been raised there from the time it was a baby. The people living there claimed that when they whistled, the turtle would come to them and let them ride it (Vander Velde) ▪ a young hawksbill, only about 3 or 4 inches in length, was discovered off of Mejatto islet in the spring of 2003, entangled in webbed material. It was rescued and kept as a pet in Majuro; by the end of the year, it was about 18 inches long (Vander Velde) ▪ nesting known from islets between Piñlap and Meña, also some in Jiktokan. Approximately twenty years ago, turtle eggs were also commonly found along the lagoon between Jabwor and Jaluit islands. (Bungitak)

Kili Island 	
.33 sq. mi. of land **single island, no lagoon** (Douglas 1969, Levy 1997) ▪ resettlement population of Bikinian ▪ small brackish pond and freshwater depression (Amerson 1969, pg 201) ▪ some *Casuarina* present (Ajan)	▪ about 20 or more turtles are seen every year (Lewis, P.) ▪ nesting occurs, but not all the time, only some months (Lewis, P.) ▪ hawksbill present, in lesser numbers than Greens but still often seen (Lewis P., Lewis, R., Ajan) ▪ hawksbill said to nest (Lewis P., Lewis, R., Ajan) ▪ in about 1998/9, a Leatherback was observed offshore (Lewis, R)

Namdrik Atoll 	
1.0 sq. mi. land **3.24 sq. mi. lagoon** ▪ two main islands (Douglas 1969, Levy 1997) ▪ *Casuarina* "blukum" present (Biodiversity workshop notes) ▪ *Sonneratia* wetlands on Madmid ▪ greater part of reef occupied by wide islets no natural passage into lagoon (Biodiversity workshop, Douglas 1969)	▪ *Wonejo-en* "'that-there' turtle lays eggs" name of tract (Abo et al 1976) ▪ turtle mentioned as food during atoll biodiversity workshop ▪ two young turtles raised in basins in Majuro in 2003 were brought from Namdrik as babies (Vander Velde)

Ebon Atoll 	
2.25 sq. mi. of land **40.08 sq. mi. lagoon** (Douglas 1969, Levy 1997) ▪ high rainfall, lush vegetation ▪ *Bruguiera* mangroves (Fosberg, Sachet & Oliver, 1979)	▪ *Wondik* "small turtle" name of tract (Abo et al 1976) ▪ turtles abundant in the water of Ebon; no place has more turtles than Ebon; nobody eats more turtles than Ebon people, the turtles do not come ashore on Ebon, they come ashore less on Majuro. It was only two or three times in his life that he saw turtle tracts on Ebon. The Ratak people eat a lot of turtles compared to those in Ralik – Ratak people and Ebon people are the big turtle consumers. (Herkanos) ▪ hawksbill present but quite uncommon (Herkanos)

Ratak Chain

Bokak (Taongi) Atoll 	
1.25 sq. mi. of land **30.12 sq. mi. lagoon** uninhabited (Douglas 1969, Levy 1997) ▪ 'low and dry, semi-desert, only 9 species of flowering plants, 6 vegetation types; possible the only example of a completely unaltered semi-arid atoll ecosystem remaining in world' 'least disturbed of	▪ "The Northern Radak atolls of Bikar, Bokak (Taongi) Toke, the island of Jemo, and the islands of Erik and Luij in Erikub Atoll have been used from time immemorial as game reserves by the Marshall Islanders." (Tobin 1961, pg 7) ▪ [There] "was a total absence of any marine turtle nesting activity (nests or tracks) on the atoll islets nor were turtles seen in the surrounding waters. Although the time of the visit coincided with the latter part of the summer breeding period, on the evidence of activity at Bikar and other atolls it would be reasonable to assume that any turtle activity on Taongi would have been noticed. The absence of

Marshalls' (Thomas et al. 1989) ▪ *Casuarina* and dwarf palm recently introduced (Div. Agri.) ▪ lagoon shallow, not exceeding 100 feet with many coral heads ▪ water level in lagoon averages 1 1/2 feet higher than ocean ▪ narrow passage, ebb tides water rushes out like waterfall ▪ previously "mo" ▪ protected during Trust Territory Administration, complete protection recommended as National Preserve appropriate "crown jewel" in Marshalls if system of natural areas is implemented (Thomas et al 1989)	marine turtles is also consistent with Fosberg's observations from his 1950's visit." (Thomas et al 1989: pg 34) ▪ ground hard, not suitable for turtle nesting (Tibon)

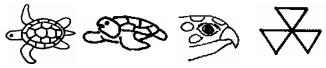
Bikar (Pikaar) Atoll 

.2 sq. mi. of land **14.44 sq. mi. lagoon** uninhabited (Douglas 1969, Levy 1997) low and dry ▪ protected under Trust Territory Administration ▪ protection again recommended as National Preserve (Thomas et al 1989) ▪ previously "mo" ▪ recommended as World Heritage Site (Thomas et al 1989) ▪ *Casuarina* and dwarf palm recently introduced (Div. Agri.)	▪ "The Northern Radak atolls of Bikar, Bokak (Taongi) Toke, the island of Jemo, and the islands of Erik and Luij in Erikub Atoll have been used from time immemorial as game reserves by the Marshall Islanders." (Tobin 1961, pg 7) ▪ "When they were young men, the two brothers [Etao and Jemeliwut] went on a sailing trip to find their mother, who was a goddess. She had become the Great Mother Tortoise and lived in the undersea places in the Pacific Ocean. Her name, Lijõbake, meant a special kind of tortoise, which carries on its back the most beautiful tortoise shell...." ▪ "They heard that Lijõbake was living in the ocean east of the island of Bikar, far to the north. Bikar Atoll lay lonely and apart in the Pacific Ocean. It had low, sand islands covered with thousands of birds' eggs, turtle eggs, flapping little baby birds, crawling with baby turtles, and their parent birds and turtles. ▪ "Almost every foot of the sands was covered with them. Hundreds of large sea turtles and tortoises crawled from sea to land and back again." [this would seem to imply both the green sea turtle and the

	hawksbill nested here in times past] (Grey 1951, pg 40) ▪ "The versions of the legend of Lijebake collected [by various writers] all differ in some of the details, including the itinerary of the bird and turtle. However, Pikaar [Bikar] is destination of the travelers, and the home of Lijebake in all versions of the legend". (Tobin 2002, pg 161) ▪ "The most significant feature of Bikar from the point of view of its conservation value was its obvious importance as a Green sea turtle nesting ground. Over 264 sets of nesting tracts were observed around the perimeters of Bikar....These tracks made Bikar the highest ranking atoll of those surveys for turtle nesting....Once set of fresh tracts on the north east side of Bikar islets were only about 1.5 ft (0.5 m) wide, and were probably made by a Hawksbill turtle." (Thomas et al 1989, pg 42) ▪ [The Green turtle] "utilises the sheltered waters and *Tournefortia* fringed sandy beaches of the atoll islets for nesting. The level of breeding exceeds that recorded on other atolls in the Marshall Islands. The quality of habitat on Bikar, together with the isolation of the atoll and the lack of human interference, combine to make the atoll an outstanding Green turtle nesting area of national (and possibly international) significance." (Thomas et al 1989, pg 43) ▪ "the outstanding feature of Bikar is the nesting of green turtles, *Chelonia mydas*, especially on Bikar islet. During three nights of observation in August 1952 over 300 female turtles came ashore to lay their eggs. The entire coastal sandy part of the islet is churned up by the nest-building, excavation of holes, egg-laying, and covering and concealing the nest sites." Recommended Bikar as prime candidate for preservation "as a natural area. This also would preserve the ancient Marshallese custom mentioned above."(Fosberg 1990, pg 53) ▪ "the pits were so dense that it was impossible to obtain an accurate count of their numbers (Puleloa and Kilma 19992) ▪ "so pervasive was *Rattus exulans* on Bikar that nothing was safe from their nightly invasions" (Puleloa and Kilma (1992)

Utdrik Atoll 

.2 sq. mi. of land **22.12 sq. mi. lagoon** (Douglas 1969, Levy 1997) ▪ *Bruguiera* mangroves present (Fosberg, Sachet & Oliver 1979) ▪ exposed to nuclear fallout in 1954 (Marshall Islands Guidebook)	▪ Weisler "believes that many, if not all, of the 98 marine turtle remains...are probably those of the green turtle (Chelonia mydas), which still nests on several of the islets of Utrök Atoll....[age and distribution of bones] suggests to Weisler (2001:130) that turtle was consumed over a 1000 year period without decimating the stocks – 'That is, there is not a declining frequency of turtle bones from throughout the cultural layer.'" ▪ "However, Weisler (2001:129) also notes: 'As marine resources were depleted near the main villages on Utrök and Aon, the smaller islets would have provided campsites for staging forays along the adjacent reefs or conducting fishing sorties beyond the oceanside coast, progressively farther from the main settlements.' This may indicate that the consistency he perceives in marine turtle consumption may be related to the relationship between a small human population and a large marine resource base. In contrast to other high volcanic and raised limestone islands, atoll environments have a high ratio of reef to land area. Utrök Atoll, with a land area of only 2.4 km² has a 57.7 km² lagoon, and 86.7 km² of ocean and lagoon side reefs. The extremely small estimated population density (Weisler 2001:131) coupled with huge expanse of lagoon and oceanside reef habitat makes it likely that prehistoric inhabitants of atolls never needed to overuse their marine resource base." (Luna 2003, pp 28, 29)

Taka Atoll 

1.32 sq. mi. **35.95 sq. mi. lagoon** uninhabited (Douglas 1969, Levy 1997) ▪ received fallout from one bomb (Dibblen 1988, pg 29)	▪ "...evidence of Green turtle nesting (24 sets of tracks) and a hawksbill turtle was sighted underwater..." ▪ "...had been a 'pantry' atoll for the people of nearby Utirik who harvest birds, fish, turtles...several times a year." (Thomas et al 1989, pp 48 & 50)

Mejit Island 

.7 sq. mi. **single island , no lagoon** (Douglas 1969, Levy 1997) ▪ small pond in center and linked to sea by channel	▪ **Mejit Biodiversity Workshop Notes, 1998**: What things do we see in our sea that are as blessings or valuable to our community?. Turtle 1. Hawksbill Turtle *Eretmochelys imbricata* 2. Green Turtle *Chelonia mydas*

lined by *Bruguiera* (Wiens 1957, pg 19) ▪ *Casuarina* present (Div. Ag.) ▪ received fallout from one bomb (Dibblen 1988, pg 29)	'Ways to catch turtles: 1. Watch in wait during dark nights for when the turtles come ashore 'Mejit rarely has turtles and it has been almost 5 years and turtles have just begun to come ashore again.' 'Turtles are used for: food, to sell, handicraft, Marshallese medicine, decoration, riding, also to win a lover's heart.' 'Just now it seems that the turtles coming ashore have been getting fewer on Mejit because of the increase in population on Mejit and turtles are staying away.' ▪ During a four month visit in 2000, only one turtle was caught (Tayag) ▪ *Kijen won* (food of turtle), a type of green alga, *Caulerpa cupressoides*, is gathered from Mejit and used in handicraft. It is said to be eaten by turtles (anecdotal accounts, nnr; Skelton)

Ailuk Atoll 	
2.07 sq. mi. of land **68.46 sq. mi. lagoon** (Douglas 1969, Levy 1997) ▪ received fallout from one bomb (Dibblen 1988, pg 29)	▪ female green turtle reported captured in June, 1997 at Aliej island carried tags applied in Molokai, Hawaii in 1983. ▪ anecdotal, second-hand of a long stretch of sandy area was covered with seagrass near Ailuk island until decimated by a typhoon in the late 1990s.

Jemo Island 	
.06 sq. mi. single island, no lagoon (Douglas 1969, Levy 1997) ▪ received fallout from one bomb (Dibblen 1988, pg 29)	▪ "this island is famous for turtles" "turtles are also abundant in the Marshall Islands, particularly at Jemu Island and Erikub Atoll" (Marshall Islands Guidebook pg 58, 88) ▪ "it is said, also, that Jemo was, in pre-European times, considered a turtle sanctuary, only infrequent visits being permitted, with turtles and eggs being taken in limited numbers, under close supervision by priests (Tobin, J.; Fosberg 1990, P 56) ▪ "The Northern Radak atolls of Bikar, Bokak (Taoni) Toke, the island of Jemo, and the islands of Erik and Luij in Erikub Atoll have been used from time immemorial as game reserves by the Marshall Islanders." (Tobin 1961, pg 7) ▪ "Fifty-three pairs of [Green] turtle tracks were counted around the shoreline and signs of nesting activity were prevalent with one nest containing fresh eggs being discovered. This level of activity is second only to that on Bikar Atoll...and indicates that this small island is a valuable and prominent green turtle breeding ground for the Marshall Islands."

	(Thomas et al 1989: pg 55) ▪ "long revered as a turtle sanctuary, *won* from Jemo are renown throughout the Marshalls to be the best eating from anywhere in the archipelago." "the northwestern and southern portion of Jemo presented turtles with almost ideal nesting conditions". "There is no question that *Jemo* island mujst be considered another major turtle nesting rookery in the Marshall Islands". "Jemo indeed lived up to the Marshallese adage: "*Ekkarokrok arin Jemo*, the beaches of Jemo are always full of turtle nests"; (Puleloa and Kilma 1992)

Likiep Atoll 	
4 sq. mi. of land **163.71 sq. mi. lagoon.** (Douglas 1969, Levy 1997) ▪ received fallout from one bomb (Dibblen 1988, pg 29) ▪ *Casuarina* present (Fosberg, Sachet & Oliver 1979)	▪ a project of raising turtle hatchlings was undertaken in the late '90 at the school but it was discontinued in 2002. Turtles raised by this project were tagged through the SPC tagging program; most of the tags never showed up but a few were later captured in the lagoon, some by the locals for consumption (Dawson 1993; Rilometo, J., James) ▪ when capturing turtles in the lagoon during turtle hunts, usually get more males than females (DeBrum) ▪ during reef survey in August 2001, saw 2 turtles, both on leeward ocean side (Pinca) ▪ **Likiep Biodiversity Workshop Notes 1998**: '1. What things do we see in our sea that are as blessings or valuable to our community. C. Turtle 'C. Turtle. 1. Hawksbill Turtle *Eretmochelys imbricata* 2. Green Turtle *Chelonia mydas* 'Ways to catch turtles: 1) watch in wait during dark nights for when the turtles come ashore 2) diving; 3) tying; 4) when breeding 'Ways turtles are used: 1) food 2) market 3) handicraft 'What is the status of these turtles during this period? They are less now due to continued consumption and selling of them.'

Wotje Atoll 	
3.16 sq. mi. of land **241.04 sq. mi. lagoon** (Douglas 1969, Levy 1997) ▪ mangroves present (Vander Velde) ▪ monitor lizard introduced and still present, have spread from original island to nearby one (Kiotak) ▪ *Casuarina* present (Div. Ag.) ▪ seagrass present (Vander Velde) ▪ much destructive bombing in World War II (Heinl & Crown 1954)	▪ *Wonmej* "turtle nesting site" name of islet (Abo et al 1976) ▪ turtles nest on some of the smaller islands (Rilometo, B.) ▪ hawksbill present (Kiotak) ▪ hawksbill nest observed, which was then dug up and the eggs harvested (Rilometo, B.) ▪ sometimes rather than bring the turtles in for a big "kemem" feast, people have gone out to Wotje instead; those feast have been so big, with ten or more turtles, much of the food could not be consumed (Rilometo, J.) ▪ "…the harvesting of sea turtles was an ongoing activity on Wotje islet"; "while there remains little doubt that *C. 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 *E. imbricata*". (Puleloa and Kilma 1992)

Erikub Atoll 	
.6 sq. mi. of land **88.92 sq. mi. lagoon** uninhabited frequently visited (Douglas 1969, Levy 1997) ▪ pantry atoll for Wotje no known water supply nesting site of green turtles (Thomas et al. 1989)	▪ "turtles are also abundant in the Marshall Islands, particularly at Jemu Island and Erikub Atoll." (Marshall Islands Guidebook pg 88) ▪ "The Northern Radak atolls of Bikar, Bokak (Taoni) Toke, the island of Jemo, and the islands of Erik and Luij in Erikub Atoll have been used from time immemorial as game reserves by the Marshall Islanders." (Tobin 1961, pg 7) ▪ "Erikub was ranked third in importance for Green turtle nesting habitat based on forty-nine pairs of track observed on the atoll islets...evidence of frequent visits by people from Wotje Atoll, the number of test marker sticks, temporary camps and "middens" of turtle remains, it is clear that human predation on eggs and adult females must account for a high percentage of the annual production." (Thomas et al 1989: pg 79) ▪ mating turtles observed (Kiotak) ▪ hawksbill observed but in small numbers (Kiotak) ▪ "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" (Puleloa and Kilma 1992)

Maloelap Atoll 

3.81 sq. mi. land **375.56 sq. mi. lagoon** (Douglas 1969, Levy 1997) ▪ extensively built up by Japanese ▪ damaged during World War II (Spennemann 1993)	▪ *Wonmak*, name of islet (Abo et al 1976) ▪ some nesting turtles on some small islands but not as many as other atolls (Tartios) ▪ "Turtles, crabs, and shellfish also provide important sources of food as well as raw materials" (Adams et al 1997, pg 3) ▪ "Turtles are occasionally captured; the eggs are eaten and the meat eaten or sold to Majuro....Turtles are most plentiful at Enebol and Loa, on the southwestern leg of Maloelap Atoll." "Visual documentation of marine resource use on Taroa for the Micronesian Resources Survey project included photographs of fishing sites and equipment, and photographs and videotape records of common fishing methods... Killing and butchering a turtles...were also videotaped." (Poyer 1997, pp 37, 38) ▪ "Turtle meat, lobster, coconut crab, octopus, and several kinds of fish are the major exports resulting from men's work." (Poyer 1997, pg 50)

Aur Atoll 

2.17 sq. mi. of land **92.59 sq. mi. lagoon** (Douglas 1969, Levy 1997) *Bruguiera* present (Fosberg, Sachet & Oliver 1979) ▪ monitor lizard introduced and still present on Āne-dik (Vander Velde) ▪ seagrass present (Lanwi) ▪ *Casuarina* present on Tobal (Lanwi)	▪ during a welcoming feast, turtle was served (Vander Velde) ▪ turtles nest along the oceanside of all the islands; they are harvested regularly by the local men, often sold; possibly as many as 20 or more turtles taken a year, plus the eggs (Lanwi) ▪ "jebake" present, recognized by its brown color, rare compared to other turtles (Lanwi) (note: this could also include brown Green Turtles as well as Hawksbills) ▪ December 31, 2003, two turtles observed on Majuro, which were being prepared to be cooked, were said to have been captured on Aur and sold on Majuro. They were both rather small, less than two feet long. ▪ concerning Bigen Island: Potential habitat for the green sea turtle and/or hawksbill turtles) was identified. However, there was no indication that the habitat has been used in the past or is currently being utilized." (USAKA Temporary Extended Test Range EA, pp 11, 12)

Majuro Atoll

3.5 sq. mi. of land
113.94 sq. mi. lagoon
(Douglas 1969, Levy 1997)

- capital atoll, densely populated, especially in downtown areas
- *Bruguiera* mangroves stressed downtown, less so in Laura (Thaman & Vander Velde in press)
- *Cymodocea rotunda* seagrass present (Thaman & Vander Velde in press)
- monitor lizard no longer present (Spenneman 1998)
- *Casuarina* present (Thaman & Vander Velde in press)

- "The two brothers, Etao and Jemeliwut, went by canoe to the Island of Mejuro (sic)..... "Etao said...'I'll be a tortoise. I'll swim slowly, close to shore, eating small fish and clams.'" [the behavior and the use of the term tortoise rather than turtle would imply hawksbill] (Grey 1951, pg 46)
- "turtle (won)...were plentiful at one time but scarce today." (Maragos et al 1993b, pg G-13)
- green turtles often observed on most daytime dives outside reef on northern reef area (Yoshii)
- hawksbill turtles observed (Ross)
- general opinion is that turtles used to nest but do not any more (Div. Ag.)
- while fishing off of Didij islet in the summer of 2003, two small plate-sized turtles were observed. They were pursued so as to get a better look but they swam away, over the reef flat into the lagoon (Muller)
- pilot project for growing *Kappaphycus alvarezii* brought from Kiribati in lagoon near Rongrong Island reported some damage from what they believe were grazing turtles in 2003 (MIMRA)
- in 1981, while diving off of Laura, a greenish turtle with a pointed nose and small bumps on its back, and a shell length of about 10 inches was observed and briefly held. Possibly a juvenile Leatherback (Kawakami)
- many years ago, upon returning by boat to Majuro, a huge turtle was seen, probably a Leatherback (Maddison)
- during the 1998 Majuro Atoll Workshop, turtles were not specifically mentioned by the marine resources group. However, the women involved with local plants mentioned that among other uses, "konnat" (*Scaevola taccada*) was "kijen won" ('turtle food').

Arno Atoll

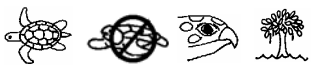
5 sq. mi. of land
130.77 sq. mi. lagoon
large atoll over 100 islets
(Douglas 1969, Levy 1997)

- extensively studied during Coral Atoll Project of 1950 - 1952
- *Bruguiera* and *Sonneratia* mangrove wetlands (Hatheway 1953)

- "The green sea turtle was the only species observed at Arno and this species is too scarce to be of any importance commercially or otherwise. The hawksbill turtle, undoubtedly occurs at Arno Atoll but it is rarer than the green turtle. There is no fishery for turtles, although the natives frequently catch them in stone fish traps (Hiatt 1950. pp 11-12)
- "Marine Turtle, Wön. – Seen only three times, in the lagoon." (Marshall 1950, pg 4)
- Loñar Village: "Turtles (won) are taken in very small numbers. Fewer than a dozen are sighted each

	year." (Maragos et al 1993a, pg E-16) ▪ Pikaar-ej Village: "Fishermen also reported occasionally spearing turtles but they are infrequently seen today. They also reported that turtles seen laying eggs on the small islets near Arno islet. However, these reports are unconfirmed by visual surveys." (Maragos et al 1993a, pg E-18) ▪ mating turtles observed (Yoshii) ▪ hawksbill turtles observed; rare compared to other turtles (Div. Ag., Ross, Joash) ▪ leatherback turtle, resting in about 180 feet of water was observed diving near the dynamited channel north of Arno island, first in the summer of 2001 in about 185 – 200 feet of water, then again in same area in September the same year, in about 140 – 150 feet; described as the "biggest thing" ever seen while diving (Ross) ▪ while traveling to northern Arno in about 1980 or 1981, a huge turtle was observed, the size of a whale but the outline of a turtle (Muller)

Mili Atoll 	
6 sq. mi. of land **294.71 sq. mi. lagoon** (including Nadrikdrik, below) large atoll over 90 islets (Douglas 1969, Levy 1997) ▪ seagrass present by Mili Island (Daniel) ▪ *Sonneratia* mangrove wetlands present, probably some *Rhizophora* (Vander Velde) ▪ *Casuarina* present (Div. Ag.) ▪ heavily fortified during World War II and suffered damage from bombings (Spennemann 1993)	▪ green turtles and hawksbill used to be abundant, and green turtles nested all over the place, all the islands. But about twenty years ago, they began to decline and now no more than two to ten will be observed a year and they are no longer seen nesting (Daniel) ▪ some turtles present but not in abundance (Tobin, L., Div. Ag.) ▪ limited nesting on islets of the northeast (Div. Ag) ▪ a few hawksbills, sometimes taken for food (Div. Ag.) ▪ "abundant and large size fisheries target fishes, and recorded abundant mega-fauna such as sea turtles, whales, and rays". But records only one green turtle seen on SE ocean side of reef (Pinca survey June-July 2003)

Nadrikdrik (Knox) Atoll 	
0.38 sq. mi. of land uninhabited small sub-atoll off of Mili (Douglas 1969, Levy 1997) ▪ completely washed over	▪ previously was full of turtles, both green sea turtles and hawksbill but now hardly any (Daniel) ▪ previously turtles would come ashore to nest all the time, both during the day and at night (Daniel)

by typhoon in 1905 (Spennemann 1993) ▪ possibly the only place in the Marshalls where there are seaward mangroves (Tobin, L.)	

Abbreviations for personal communications used in this Appendix and not otherwise found in Appendix 4:

Ajan – Aiwa Ajan, of Kili
Daniel – Elson Daniel, resident of Mili with hereditary rights on Nadrikdrik
Div. Ag. – RMI Division of Agriculture, (Chief, Jimmy Joseph)
Franko – Frank Mateaki, agriculturist for Enewetak
Isaac – Maas Isaac, MIMRA employee
James – Clyde James, MIMRA employee, member of Biodiversity Team
Joash – Bernice Joash, curator, Alele Museum
Herkanos – Erbi Herkanos, of Ebon, former school teacher
Lanwi – Harriet Lanwi, Aur landowner and periodic resident
Maddison – William Maddison, Majuro resident, fisherman
Mote – Terry Mote, RMI Headstart, of Jabot
Muller – Richard Muller, Majuro resident, fisherman
Pero – Anjen Pero, of Namu
Piomon, L. – Lewis Piomon, of Bikini and Kili
Piomon, R. – Ringo Piomon, of Kili
Rilometo, B. – Bill Rilometo, MIMRA employee
Rilometo, J. – Juanita Rilometo, RMI Ministry of Education
Ross – Jerry Ross, owner/operator Bako Divers
Skelton – Posa Skelton, (seaweed identification) International Ocean Institute, Australia
Tayag, – Antonio Tayag, of Mejit
Tartios – Alkon Tartios, of Maloelap
Tobin, J. – anthropologist, conversation 1964
Tobin, L. – Leigh Tobin, dive master, boat operator with experience with Kili-Ejit-Bikini Local Government and Rongelap Local Government

Appendix 3 Past Recommendations Relating To Sea Turtles from Reports on Marshall Islands Natural History

Recommendations contained in: Thomas, P. (1989). Report of the Northern Marshall Islands Natural Diversity and Protected Areas Survey, 7-24 September 1988.

- a ban on the taking of all hawksbill turtles
- provisions for marine turtle habitat protection through the establishment of reserves and sanctuaries
- provisions for the development of Regulations…for local restrictions on the harvesting of green turtles and eggs to be set in conjunction with, or at the request of, Atoll Local Councils or proposed Conservation Committees and traditional landowners, including moratoriums on all harvesting activity where populations have been noticeably depleted in recent years.
- provision for the monitoring of marine turtle populations and the scientific estimation of sustainable harvest yields
- establishment of restricted fishing zones off all major nesting areas (e.g. Bikar, Jemo, Enewetak islet at Rongerik atoll; and Enego islet at Erikub atoll), other sites could be included as further investigations are undertaken.
- discouragement and very heavy penalties for distant water and local fishing vessels found to be exploiting marine turtles for commercial gain
- provision for heavier penalties for the violation of the conservation provisions of the Marine Resources Act by Marshall Islanders including the confiscation of boats and equipment
- provision for a public education on the need for marine turtle conservation
- investigation of the feasibility of a joint MIMRA and proposed Conservation Service "head start" program for marine turtles
- accession of the Marshall Islands to the CITES convention and a ban on the taking of turtles for commercial purposes and on the commercial trading in turtle products

Recommendations contained in: Puleloa, W. and Nena Kilma (1992) The sea turtles of the northern Marshalls. A research expedition to Bikar and Erikub atolls and Jemo Island. Manuscript report of expedition in July-August 1992:

- Expand the turtle database in the Marshalls archipelago by continuing the tagging of sea turtles, particularly at Bikar atoll.
- Continue to protect and monitor the three major turtle nesting sites of Bikar atoll, Erikub atoll and Jemo island.
- Make eradication plans to reduce the population of *Rattus exulans* at Bikar atoll.

Recommendations contained in: Pritchard, P. (1977). Marine turtles of Micronesia. Chelonia Press, San Francisco, California, after a one-month survey in Micronesia, March-April 1976:

- Urge the strictest possible enforcement of both U.S. Endangered Species Law and the Trust Territory Code as they relate to sea turtles.
- Conduct tagging and beach patrols on the islands reputed to have good or even surviving nesting populations of green turtles.
- There is no justification therefore for "cultural variances" from either Federal or TT law in the Marshall Islands District because there is no evidence that turtle capture in the Marshall Islands is a culturally important activity, and now motorized vessels and modern navigation equipment are available reducing remoteness of turtle beaches to serve as adequate protection.

Recommendations Contained in: Hendrickson, J.R (undated) South Pacific islands, marine turtle resources. A report prepared for the South Pacific Islands Fisheries Development Agency, Food and Agriculture Organization of the United Nations, manuscript prepared after 1972 survey of Micronesia:

- It is of the greatest importance to do everything possible to work toward estimates of actual population size in assessing the marine turtle resources of each area where they occur.
- A long term survey and inventory of the marine turtle resources…should be undertaken. Nesting and feeding areas should be mapped.
- Tagging activities should be carried out wherever it is possible to visit turtle breeding beaches, and a reward system for tag returns should be instituted.
- Turtle surveys of outlying areas…should be combined with other work on reef, lagoon and land resources.
- Take all possible steps to educate the public concerning the law, and then enforce it so far as possible through the local police agencies in all islands. Solicit newspaper and radio cooperation and give publicity to convictions.
- Do *not* attempt to promote private turtle farming ventures at this stage.

Appendix 4. Persons Contacted/Interviewed During the Project

	Affiliation
Dr. James Maragos	US Fish and Wildlife Service, Honolulu
Vanessa Pepi	Ailingnae survey participant
Dr. Silvia Pinca	CMI
Bill Puleloa	State of Hawaii Dept. of Land and Natural Resources
Don Hess	CMI
Dr. Dean Jacobson	CMI
Florence Edwards	MIMRA
Terry Keju	MIMRA
Danny Wase	MIMRA
Virgil Alfred	Formerly MIMRA
Nicole Baker	RMI EPA
Deborah Barker	RMI EPA
John Bungitak	RMI EPA, and Jaluit Conservation Area
Julian Alik	RMI EPA
Ben Chutaro	Mili atoll
Jorelik Tibon	Department of Transportation and Communication
James Matayoshi	Mayor, Rongelap atoll
Izao Eknaelang	Rongelap, Rongerik
Jack Niedenthal	Bikini atoll liaison
Marie Maddison	WUTMI Advisor
Satoshi Yoshii	Marshalls Dive Adventures, Majuro
Brian Vander Velde	Natural resources consultant
Nancy Vander Velde	Natural resources consultant
Dennis Alessio	Majuro, about Ailuk, Aur
John Kawakami	Majuro
Orlando DeBrum	Likiep atoll
Joe DeBrum	Likiep atoll
Tony DeBrum	Llikiep atoll
Mike Trevor	Majuro atoll
Kevin Hart	Ailinlaplap atoll
Bingham Henry	Ailinlaplap atoll
Matu Jack	Ailinlaplap atoll
Joraur Watak	Ailinlaplap atoll
Rimi Riketa	Ailinlaplap atoll
Carter Horiuchi	Ailinlaplap atoll
Ben Kiotak	For Wotje and Erikub atolls
Steve Kolinski	NMFS, Pacific Islands Regional Office
Dr. Scott Eckert	University of North Carolina
David Huskins	University of Akron
George Balazs	NOAA Fisheries, Honolulu
Dr. Robert Morris	Veterinarian, Kailua, Hawaii