WESTERN PACIFIC REGIONAL FISHERY MANAGEMENT COUNCIL

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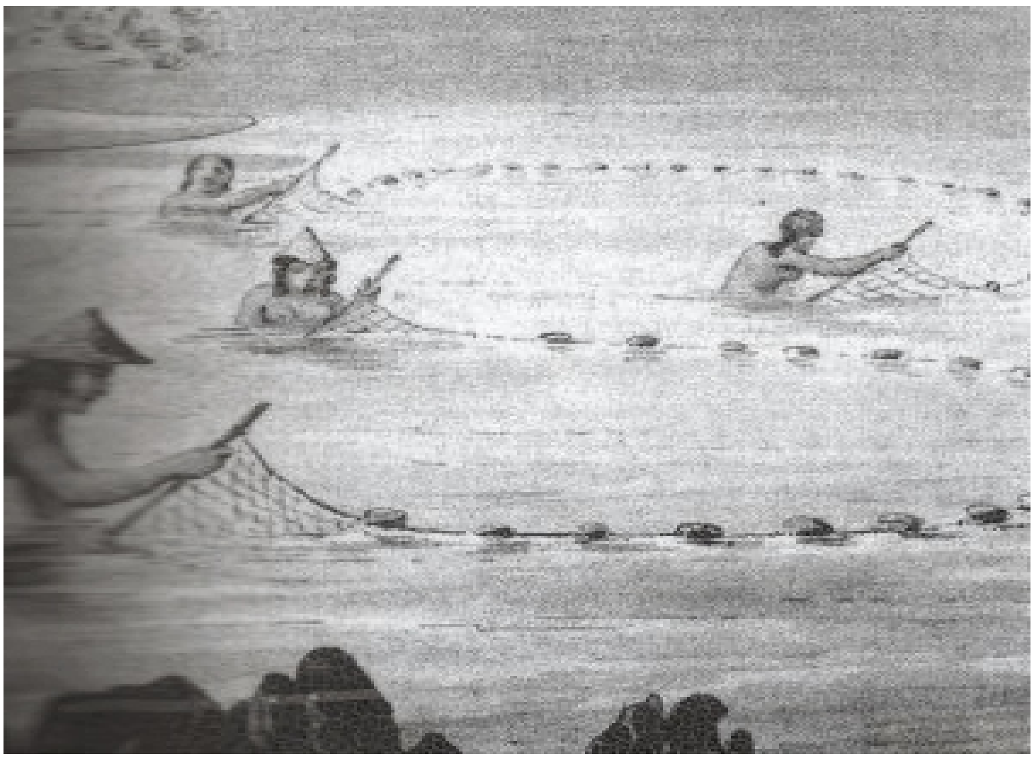
August 2003

REVIEW OF ARCHAEOLOGICAL AND HISTORICAL DATA CONCERNING REEF FISHING IN THE U.S. FLAG ISLANDS OF MICRONESIA: GUAM AND THE NORTHERN MARIANA ISLANDS



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Cover Photograph: Chamorro women net fishing.

Source: Unpublished Sketch from the Freycinet Expedition. Courtesy of the Commonwealth Museum of History and Culture

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Prepared for

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DEDICATION

This report is respectfully dedicated to the memory of Clemente Saralu Taisacan (1922-1980), the last fisherman in Rota to fish for *hachuman* using the *poio*.

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EXECUTIVE SUMMARY

Archival and archaeological studies with information on prehistoric and historic populations and cultures in Guam and the Northern Marianas are summarized by major time units: Prehistoric Period (c. 1500 BC-AD 1521), Spanish Period (1521-1898), and 20th Century. In prehistoric times, the Marianas archipelago supported an aboriginal culture whose present-day descendants call themselves Chamorro (Chamoru). The late prehistoric culture, which archaeologists term the Latte Phase (AD 1000 to1521), was based on horticulture, fishing, and collecting. Stone architecture (double rows of stone pillars and capstones, now called latte stones) was typical, as were human burial in residential sites and in caves and the use of pottery and a variety of stone, bone, and shell tools and implements including slingstones. Late in the Latte Phase, rice was added to the Oceanic repertory of tree and root crops, and pottery vessel size increased, indicating more dependence upon storage. Settlements were dispersed and of different sizes, and people used sailing canoes for inter-island travel and deep sea fishing. Population density was high relative to earlier in prehistoric times but low by Oceanic standards. This may have been due to a semi-mobile, archipelago-wide settlement system, adapted to irregular rainfall and frequent typhoons. At first contact by Europeans in the 16th century, there were probably fewer than 20,000 Chamorros.

The Pre-Latte Phase (c. 1500 BC-AD 1000) began with small beach and lagoon-side encampments where archaeologists have found red-slipped pottery and marine shell tools and ornaments. These sites lack stone architecture, human burials, a highly varied stone tool technology, and evidence of horticulture. Too few sites have been investigated to allow reliable population estimate at this time, when occupations may have been impermanent. By c. AD 1, beaches were wider as sea level continued to decline from a mid-Holocene high of approximately two meters, settlements were larger, human burial began to be practiced, and the stone artifact repertory was more diverse. Ceramic vessel forms and tempering materials changed through time, as the culture evolved in complexity and spatial extent.

The amelioration of climate during the Little Climatic Optimum (c. AD 800-1350) may have enabled the Marianas population to increase over that of the Pre-Latte and Transitional Phases because of more reliable harvests, while climatic deterioration during the Little Ice Age (c. AD 1350-1900), associated with frequent and severe droughts, may have reduced the population from its peak in the mid-Latte Phase. Possibly the drier climate had decreased the ability of the Chamorros to resist the Spanish after 1668, when formal colonization occurred and intense armed conflicts began, ending thirty years later.

The first Spanish census of Guam, in 1693 (after more than a century of European trade, numerous fatal epidemics of small pox and influenza, and toward the end of the Spanish-Chamorro wars) counted 1,631 persons. The 18th century began with a severe epidemic, and a census in 1710 recorded only 3,678 Chamorros on Guam and Rota. In 1783, the total population numbered 3,231 and in 1816, 5,389. Throughout the early 19th century, the Chamorros declined as a proportion of the total population of the Marianas, and the proportion of Filipino immigrants increased; in 1830 the Marianas population was 6,490, of which 40.8% were Chamorros. Immigrants from the coral islands to the south of the Marianas settled in Saipan and Guam late in the Spanish Period. The Carolinians maintained contacts with their home islands while working for wages as plantation laborers, meat processors, and transporters using outrigger canoes. The Carolinians retained their distinctive life-ways to a greater extent than did the Chamorros.

Marianas farming, in addition to traditional root and tree crops, variously included imported crops, especially corn, but also many tropical fruits and vegetables. People kept domestic animals such as pigs, chickens, goats, cattle, and carabao, the latter as draft animals and a food source. Paddy rice was cultivated using carabao to pull the plow, and large herds of cattle grazed the savannas claimed by the Spanish crown. Deer were introduced for sport and became a food source. Possibly the animal introductions encouraged the Chamorros to become less dependent upon seafoods for animal protein.

Beginning in the 20th century, the historical trajectories of Guam and the Northern Marianas diverged radically. Guam's government passed from Spain to the United States, while in the Northern Marianas, the Germans took over from the Spanish. The Americans expelled the 100 or so Carolinians from Guam, whereupon they moved to the Northern Marianas and continued to live as before, on the beach and pursuing an Oceanic way of life. On Saipan the numbers of Chamorros and Carolinians were nearly equal in 1912, and in the smaller northern islands the Carolinians were in the majority.

In 1914, the Japanese replaced the Germans in the Northern Marianas. By the 1930s, they had developed the islands for sugar cane production and export to Japan. Commercial deep-water fishing was also undertaken by the Japanese, some for local consumption and more for export. Thousands of Japanese, Okinawan and Korean immigrants and laborers came to live and work in the cane fields as tenant farmers on company land. Carolinians and Chamorros became small minorities within the huge population of immigrants. Many local people sold or lost their lands in an economic environment of rampant inflation. Documentation is poor regarding the use of marine resources at this time but inshore fishing by throwing net and spears may have supplemented some families' diets. A lack of native-owned sea-going boats probably restricted access to pelagic fish.

In December 1941, the Japanese attacked Pearl Harbor and invaded Guam, where they ruled until defeated by American forces, who took Guam, Saipan, and Tinian in 1944. The extensive pre-war sugar cane plantings, wartime fortifications, bombardments and battles, and massive American military construction in Saipan, Tinian, and Guam during and after the war changed forever the landscapes and capability of the islands to support local populations. On Guam, post-war immigration, mainly from the Philippines, and government work available to Chamorros gave rise to an economy based on wages and imported food and other goods. The island's population fluctuated with American military build-up and decline during the Korean and Vietnam wars and with tens of thousands of refugees from the latter. By 1980 the refugees were gone and the permanent population was 105,979.

In the Northern Marianas, the limited post-war economy practically disappeared when the American military withdrew in the 1950s. Local people who could returned to subsistence farming and fishing or supplemented their income with limited government work. The biggest growth in population occurred from 1980 to 2000, increasing from 16,780 to 69,221. In 1990, the Chamorros were 29% and the Carolinians 5% of the total. By this time Filipinos (mainly contract laborers and servants) were 33% of the population.

Overall the 20th century picture for Guam and the Northern Marianas is one of declining use of inshore marine resources as an important dietary component and markedly higher population densities after World War II. Wage economies replaced subsistence economies, most markedly before the war in the Northern Marianas and after the war in Guam. Land shortages for farming and high population densities due to high rates of immigration have precluded a return to subsistence agriculture and fishing. Some families continue to supplement their diet by fishing and farming, or by bartering for or purchasing local fish and garden produce.

An additional section of the background information reviews methodological problems with using the archaeological and paleo-environmental records when suggesting past cultural practices. It is argued that the main value of pollen and other microscopic studies of paleo-sediments cored from wetlands is as indicators of past environmental conditions. Such information can be used in models, which specify the dynamic adaptive contexts to which human groups were adapting through time in the Marianas. It is suggested that there is great potential in the further study of historical documents, archaeological data, and oral histories to yield environmental information and to reveal past cultural responses to environmental changes.

Twenty-eight archaeological reports concerning 15 areas of Guam and 18 archaeological reports concerning 15 areas of Saipan, Tinian, and Rota are reviewed for fish remains, fishing gear, turtle remains, and invertebrate remains from the Prehistoric Period. Fish remains belonging to 24 families have been identified from the Guam sites, while fish remains from 35 families have been identified from the CNMI sites. The larger number of families represented in the CNMI sites may be due to the greater range of habitats in those islands, or it may instead be due to the quality of the reference collections used to identify the fishbone. More of the CNMI archaeological fishbone collections were analyzed by the University of Otago, New Zealand.

Fishing gear recovered from archaeological excavations includes numerous shell hooks and gorges, points and shanks of two-piece or composite hooks, stone and shell weights, and bone needles, which may have been used in making and repairing nets.

No clear trends with regard to fishing during the Prehistoric Period have been discovered. At Pagat, Guam, Craib (1986) found that Pre-Latte deposits had a higher density of fish remains, although the Latte deposits yielded a greater quantity. The areal extent of the Pre-Latte deposits was much smaller than that of the Latte deposits. Gosser et al. (2002) concluded that there were no major changes in density or diversity of fish remains from Pre-Latte vs. Latte deposits in central Tinian, but that conclusion was reached after comparison of fish remains from less than one cubic meter of Pre-Latte deposits with those from just over one-half cubic meter of Latte deposits. In Rota, Davidson and Leach (1988) found that the big game fishing for marlin and *mahimahi*, which took place early and through most of the sequence, was not evident in the late prehistoric deposits of the area investigated by the Rota Airport Project, but they were unable to determine whether this was a change in fishing behavior or a change in patterns of midden deposition.

Turtle remains are infrequently reported from archaeological excavations. Only seven of the Guam reports and seven of the CNMI reports mention presence, number or weight of turtle bone. The three archaeological sites that yielded the greatest quantity of turtle bone (Pagat, Guam; Unai Chulu, Tinian; and Mochong, Rota), all show a decrease in abundance (number or weight) from the lower layers to the upper layers. Whether this represents a decrease in the harvesting of turtles during the Prehistoric Period is not known; the number of sites is too few to reach a conclusion.

Four kinds of invertebrates have been found to decrease in abundance during the Prehistoric Period in certain locations of Guam, Saipan, Tinian, and Rota. The arc clam, *Anadara antiquata*, is preferentially associated with mangroves, and the decrease in abundance after the Pre-Latte Phase is thought to be related to the relative sea level decline that took place within the last 3,000 to 4,000 years. A decrease in the abundance of the limpets, *Patelloida chamorrorum* and *Patella flexuosa*, after the Pre-Latte Phase has been variously attributed to human harvesting and to a combination of human harvesting and relative sea level decline. Corresponding to the decrease in limpets at Achugao, Saipan, is a decrease in chiton plates, as well. Sea urchin spines have been found to decline in numbers after the Pre-Latte Phase at sites in Guam, Saipan, Tinian, and Rota. Either a change in the environment or human harvesting pressure could have caused a decline in sea urchins. A third possibility with regard to the sea urchin spines is that a change in the culture meant that sea urchin spines were no longer needed as tools for manufacturing shell beads.

Writers of the Spanish Period left detailed descriptions of several reef fish and inshore fisheries including those for flyingfishes (family Exocoetidae), *mañåhak* (juvenile rabbitfishes, *Siganus* spp.), *ti'ao* (juvenile goatfishes, family Mullidae), *atulai* (big-eye scad, *Selar crumenophthalmus*), parrotfishes (family Scaridae), and *hachuman* (*Decapterus* sp., *opelu* in Hawai'i). The only one of these fisheries that declined markedly during the Spanish Period was the *hachuman* fishery. It was practiced only in Rota by the second half of the 1800s.

The Spanish Period writers documented a change in the use of turtle. During the 16th and 17th centuries, tortoise shell was an important valuable to the Chamorros. But by the late 18th century, turtles and tortoise shell had diminished in importance.

The invertebrates were only mentioned by the Spanish Period writers; there are no detailed descriptions of their use. During the 19th century, sea cucumbers were apparently exported to China, but not eaten by the islanders. Governor de la Corte estimated that thousands of pounds per year could be harvested.

Record keeping during the 20th century has been uneven. The pre-war naval governors of Guam reported almost nothing about fisheries; post-war governors reported more. However it is only within the last 25 years that the Division of Aquatic and Wildlife Resources (DAWR) of the Government of Guam Department of Agriculture and the Western Pacific Fishery Information Network (WPacFIN) of the National Marine Fisheries Service have compiled accurate data on reef fisheries.

In the CNMI, the pre-war records pertain to the Japanese tuna fishery based in Saipan. This fishery employed mostly Japanese and Okinawans. Fishing for *hachuman* (*Decapterus* sp. or *opelu*) with the *poio*, a stone chumming device, continued on Rota into the late 1960s. An interview with the son of the last fisherman on Rota to use the *poio* is included. Currently the CNMI Division of Fish and Wildlife works cooperatively with the Western Pacific Fishery Information Network in collecting and disseminating fisheries data.

It appears that the technological changes in fishing since World War II and the indirect human impacts on the reefs have contributed to declines in the reef resources. The Division of Aquatic and Wildlife Resources recently reported a 70 percent decrease in catch per unit effort (kilograms per gear-hour) of important inshore food fishes over a 13-year period from 1985 to 1998. The WPacFIN data for Guam show an increase in commercial landings of reef fishes within the last few years, but those data cannot be interpreted as a turn-around in the decrease in catch per unit effort reported by DAWR. The data are collected from different types of surveys and different fishermen. Two recent reports pertaining to the CNMI (Radtke and Davis 1995 and McCoy 1997) call for improved data collection and additional research to guide biologists in making fishery management decisions.

CHAPTER 1. BACKGROUND INFORMATION ON PREHISTORIC AND HISTORIC POPULATIONS AND CULTURES IN GUAM AND THE NORTHERN MARIANAS

By Rosalind L. Hunter-Anderson

INTRODUCTION

Micronesian Archaeological Research Services (MARS) has been contracted by the Western Pacific Regional Fishery Management Council based in Honolulu, to provide a review of archaeological and historical data concerning reef fishing in Micronesia, specifically the U.S. flag islands, Guam and the Commonwealth of the Northern Mariana Islands (CNMI). These island entities comprise a northeast-southwest trending archipelago lying between approximately 13 and 21 degrees north latitude and between approximately 144 and 146 degrees east longitude in the tropical western Pacific Ocean (Karolle 1993); Figure 1 shows the entire archipelago.

In prehistoric times, the Mariana archipelago supported an aboriginal culture whose descendants today call themselves Chamorro (also spelled Chamoru). The archaeological record indicates that this late prehistoric Oceanic culture, whose prominent archaeological characteristics are latte stones (double rows of pillar-and-capstone pairs which served as house supports), large stone mortars, plain pottery, shell and stone adzes and stone pounders, shell and bone fishing gear, and slingstones, evolved from an earlier, insular Southeast Asian base (Spoehr 1957; Hunter-Anderson and Butler 1995).

In contrast with late prehistoric sites, the earliest Marianas sites lack evidence of stone architecture, rice processing equipment, and weapons. They are located on what were small beaches. Their artifact repertory consists mainly of red slipped pottery, marine shell fishing gear and marine shell ornaments. The earliest of these sites, Achugao in Saipan, has been dated to c. 3,500 years before present (3500 BP) (Butler 1995). Preceding the earliest Lapita sites by several hundred years, Achugao manifests the oldest record of human advent in Remote Oceania (a term coined by archaeologist Roger Green [1982] to indicate islands east of the Solomons thought to have been settled by ancestors of the Polynesians). Figure 2 depicts the relative positions of the western Pacific islands; also shown is Green's Near/Remote Oceania boundary.

If the first people in the Marianas were from the Philippines, they were making open sea crossings of 2,600 km. As Craib (1999) has noted, this distance is three times longer than the 954 km "water gap" that separated the western from the eastern Lapita settlements, i.e., between Vanuatu (formerly the New Hebrides) and Fiji, and was thought to have constrained two-way voyaging (Green 1979). This gap was first crossed by Lapita voyagers some 500 years later than the one separating the Philippines and the Marianas (Kirch 1997).

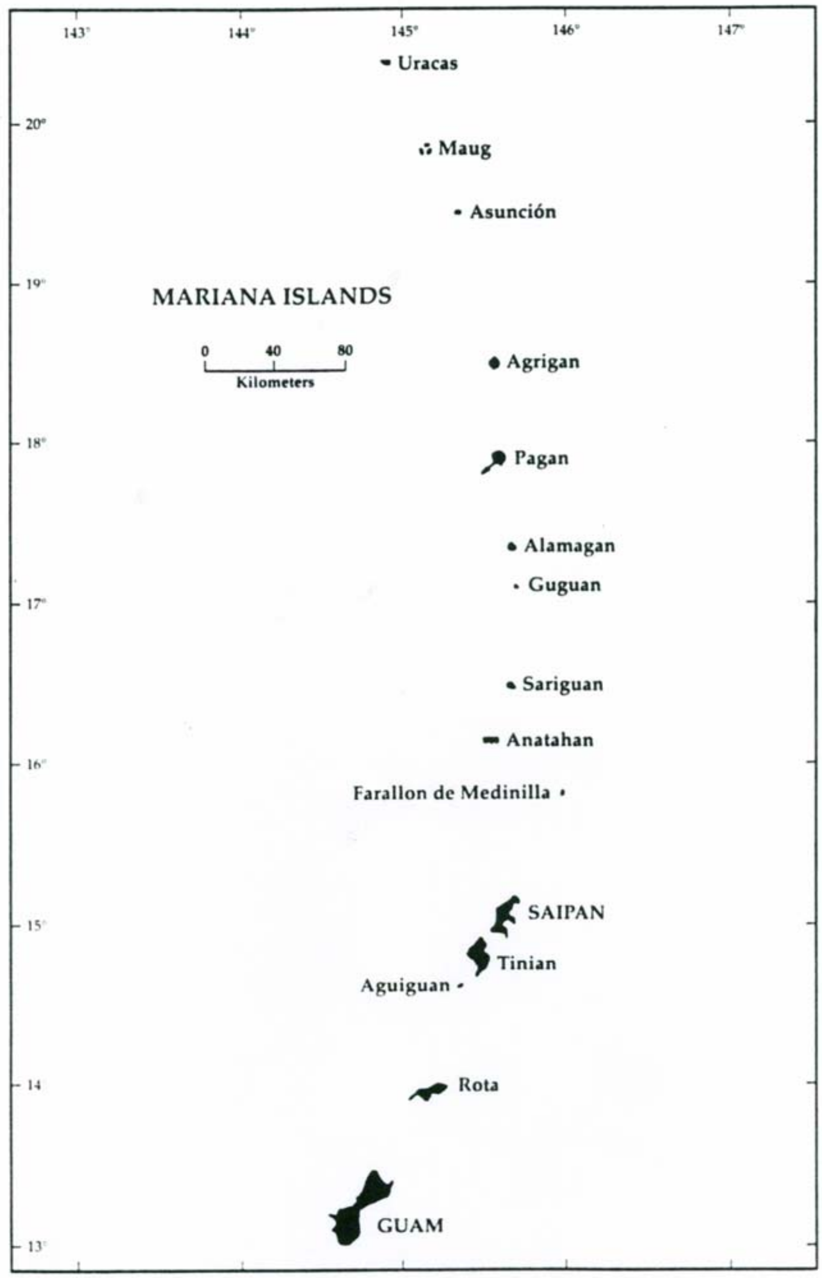

Figure 1. The Marianas Archipelago (from Russell 1998).

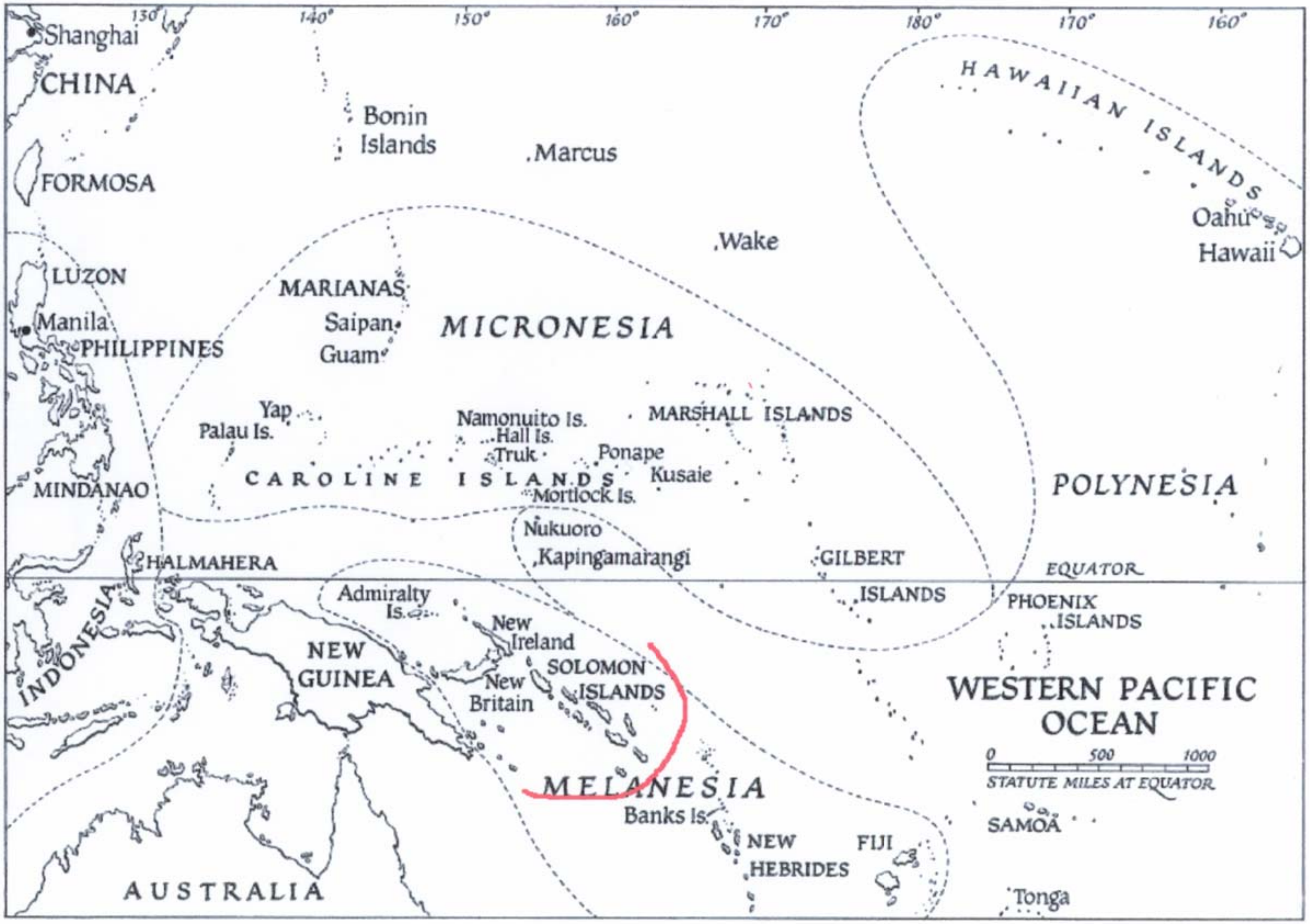

Figure 2. The Western Pacific with Near/Remote Oceania boundary in red; after Gladwin (1970:5).

Alternatively, the first human arrivals in the Marianas may have come from the southwest, via Palau and Yap or directly from somewhere in Wallacea, such as Halmahera, or even western New Guinea (see Irwin 1992:33). The earliest radiocarbon dates from Palau, c. 3000 BP (Welch 2001) are closer to the Lapita expansion into Remote Oceania (Green 1982) than to the Marianas.

A second ethnic group, Carolinians from the Central Carolines, coral islands south of the Marianas, have lived in the Mariana Islands north of Guam at least since the early 19th century (and about 100 lived on Guam until the early 20th century). Oral histories indicate that the Carolinians engaged in annual trading with the Chamorros prehistorically but that the trading voyages ceased temporarily during the Spanish conquest period in the late 17th and early 18th centuries. The Carolinians' 1849 resettlement of Saipan, which had lain empty for a century, occurred with permission by the Spanish governor and Chamorro resettlement occurred later. Details of these events can be found in Farrell (1991), Barratt (1988a), and Driver and Brunal-Perry (1996).

PREHISTORIC PERIOD

The Marianas Prehistoric Period is conventionally subdivided into two sequential archaeological expressions or phases, the Pre-Latte and the Latte (Spoehr 1957). The Pre-Latte Phase began c. 3,500 years ago (3500 BP) with human arrival in the archipelago, probably from insular Southeast Asia (Butler 1995; Haun et al. 1999; Hunter-Anderson 1990; Hunter-Anderson and Butler 1995; Moore et al. 1992). The oldest Pre-Latte sites are small and located on what were once narrow beaches, generally on the lee side of the islands of Guam, Rota, Tinian and Saipan, and at the edges of shallow marine lagoons (which have since become freshwater marshes; see below). These rare, low-elevation coastal settings along the otherwise steep island margins began to be available as the sea declined from its mid-Holocene high stand of c. two meters above present sea level (Dickinson 2001).

The archaeological materials at the earliest sites include calcareous sand-tempered pottery, shellfish remains, fish bones, cutting tools and fishing gear of shell, and beads and other personal ornaments, also fashioned of shell. Some of the pottery, called Marianas redware, is decorated with stamped and incised geometric patterns that resemble those of roughly contemporary sites in the Philippines (Hunter-Anderson and Moore 2001). Possibly the early Pre-Latte people were temporary residents, rather than permanent settlers, who sought exotic shells and other items in the remote Marianas for use in the complex trade and exchange systems in the large islands to the west.

It is unknown what land foods were collected or grown during the early Pre-Latte Phase. Bones from rails and fruit bat were found at Unai Chulu in Tinian (Haun et al. 1999), although no analysis was performed to try to determine if they had been used for food (e.g., were the bones burned or cooked, breakage patterns, had they been cut by tools or chewed by rodents, which parts of the skeleton do they represent, are more meaty parts more abundant, or were there bones only of parts useful for tools, etc.; see discussion in Weisler 2001:104-106). An early historic account of resource procurement in the uninhabited island of Urac (Uracas) in the far north (Coomans 1997:24) describes mass harvesting and processing of birds (species unstated) for storage. The extent to which such practices were part of the early Pre-Latte cultural system is unknown, but it illustrates the operation of the archipelago-wide cultural system that apparently existed in the late Prehistoric Period.

Coconut and *Ficus* nutshell charcoal at Unai Chulu suggests these species were exploited for fuel. Various parts of the coconut tree were probably used for food, wood, and fiber as well. The limited range of artifact types includes tools for working shell, fiber, and wood; fire pits and earth-oven features indicate on-site cooking. Numerous unfinished and finished shell ornaments are characteristic of early Pre-Latte sites. These items were numerous at Chalan Piao, where over 400 *Conus* beads and bead blanks were found (J. Amesbury et al. 1996; Moore et al. 1992) and at Unai Chulu, which yielded over 70 *Conus* beads (Haun et al. 1999). In addition to beads, other shell ornaments such as circlets, bracelets and rings, mostly of *Conus*, have been found at early Pre-Latte sites (see discussion in Butler and Harris 1995:243-254). In this characteristic, early Pre-Latte sites resemble the somewhat later Lapita artifact assemblages of the southern hemisphere (Clark et al. 2001).

At sites dated to c. 2000 BP, some 1,500 years after the first seaside sites were utilized, the cultural materials are more diverse in form and more numerous. Rare interior sites in Guam date to this time (Henry et al. 1999a; Hunter-Anderson 1994a). These developments may signal a shift toward permanent settlement of the larger islands. Most sites from this period (sometimes called Transitional or Early Transitional [to the Latte Phase]; see Russell 1998:101-102) are coastal, and their contents indicate a mixed fishing and farming/collecting subsistence base. Rockshelters with cultural deposits suggestive of short stays have been found in Guam's interior (Hunter-Anderson and Moore 2002). Perhaps these sites were used during resource-collecting episodes and when people tended small gardens and managed portions of the forest for timber.

As the sea level continued to decline, the saltwater lagoons diminished in size and the shift to freshwater dominance of wetlands occurred; concomitantly beaches widened and mangroves were reduced in certain areas (J. Amesbury et al. 1996; J. Amesbury 1999). The change in inshore habitats correlates with shifts in the types of shellfish remains found at archaeological sites. For example, in certain locations where the proportion of mangrove species declines, that of hard substrate species increases (J. Amesbury 1999).

Compared to the early Pre-Latte Phase, coastal sites appear to have supported larger numbers of people and more lengthy occupations, judging from the density of the cultural deposits and their larger areal extent compared with earlier sites. Artifacts found at these sites include marine shell knives and fishing gear, locally made pottery, chipped stone, and ground stone tools of basalt, such as pounders and adzes. Fire pits and postholes are present as well (e.g., Hunter-Anderson et al. 1998; Moore et al. 2001a).

A new cultural trait, human burial in residential deposits, is observed at some coastal sites during this period. The skeletons are found in prepared pits (Hunter-Anderson 1994b; Moore et al. 2001a). Objects that could be definitely identified as grave goods have not been found with the burials, although the soil used to refill the burial pit contains artifacts similar to those in surrounding soil. This is also usually the case with Latte Phase burials later in prehistory. Human interments at residential locations represent deliberate, culturally determined acts, which in many societies carry important social and political information (Tillotson 1989). It seems that new social conditions required this new mode of mortuary treatment, although the precise nature of the information being conveyed by the interments is not known (see below).

The cultural trends toward more sites and increased site variety and technological complexity eventually culminated in the Latte Phase, beginning c. 1200 BP. The term Latte comes from the stone uprights and capstones of limestone, volcanic sandstone, and basalt, which figure prominently at late prehistoric sites throughout the archipelago. The Latte Phase continued until European conquest in 1695. By this time, latte stone features were no longer made, and the settlement system had been changed to one of parish villages (see below).

Prehistoric latte stone features (or latte sets, as archaeologists call them) when found intact form a rectangle about the size of a house. Latte stones are often associated with large stone mortars called *lusong*. From latte set size and form and from early historic accounts of Chamorro houses built on stone posts (e.g., Lévesque 1995a:77-78), archaeologists and others have assumed these features represent former residences, despite the fact that associated residential debris may be virtually absent. They have been found in many different environmental settings, including sandy beaches and coves, coastal terraces, near streamside wetlands and marshes, and along valley slopes and ridges.

Both open sites (with or without latte stone features) and rockshelters were used during the Latte Phase. At some interior sites, latte sets are clustered in groups of as many as 20 or 30 although many are found singly or in pairs. Latte Phase architecture included both latte stone-supported structures and those made from wood posts. This conforms to an early historic account of a residential compound of three structures, for cooking, storing valuables (the latte structure), and sleeping (Lévesque 1995a:77-78). Postholes from wood structures have been found at non-latte stone sites dating to the Latte Phase, as well as at latte stone sites, indicating still further variability in site types and structures.

The cultural deposits at the interior latte sites are shallow and contain relatively few artifacts compared with many coastal latte sites. The sparseness of the deposits seems to indicate relatively short occupation times (Reinman 1977). Interior sites without latte stones, but which date to this time, may have pits and hearths in addition to stone and shell tools and broken pottery that resemble the artifacts at coastal sites (Hunter-Anderson 1994a). The artifactual and architectural similarities among Latte Phase sites throughout the southern Marianas (the northern islands are largely undocumented) suggest an archipelago-wide cultural system rather than several ethnic groups. Inter-island language similarities observed by the early Spanish missionaries also testify to a single cultural system.

A prominent aspect of the Latte Phase is residential interment, with the burials usually placed near or within latte stone features. This practice appears to be a continuation of the late Pre-Latte Phase "mortuary program" (Hanson and Gordon 1989) but practiced on a more regular basis. As noted above, residential interment began c. 2000 BP, at a few coastal sites.

One interpretation of burying the deceased within residential areas is to show the kin group's prior use of the burial area's associated resources, as part of a resources-claim-legitimizing strategy that also involved the erection of latte stones in such places. Hunter-Anderson argues that latte stone architecture and residential interments both evolved as inter-group competition for resources increased during the favorable conditions of the Little Climatic Optimum (LCO, c. AD 800-1350) (Hunter-Anderson 1989:42-47; Hunter-Anderson 2002a; Hunter-Anderson et al. 1994:1.23-1.24; Hunter-Anderson et al. 1995; Moore and Hunter-Anderson 2001:229).

Under relatively high human densities and related pressure to produce more food (and to maintain access to timber for building houses and canoes), the islanders might have opted to intensify their efforts, working harder on the same piece of land by adding nutrients, water, developing new crop strains, etc., in order to sustain the necessary energy flows to their plots (Athens 1977). However, given the relatively high frequency of storms and droughts in the Marianas, even during the LCO, agricultural intensification would result in unacceptably small gains for the large amount of effort expended (Ruthenberg 1980). Expansion of land holdings through takings and encroachment and threats of encroachment would be more likely to occur under these conditions. In turn, social competitive strategies, such as defensive and offensive alliances, would evolve in response to these events. Thus Latte Phase agriculture was probably not labor intensive, and also may have involved an expedient gathering/collecting component at times.

Adopting latte stone architecture and participating in defensive and offensive alliances with other groups would not have eliminated inter-group competition, which derived from land shortage. Rather these measures would function to minimize violent encounters that could exacerbate production shortfalls and interfere with routine and necessary social interactions such as marriages and birth and death rituals. The early historic literature indicates that inter-group battles in the Marianas were short and highly formalized (e.g., as described in Lévesque 1998:155), suggesting regulated "contest" type competition, not the free-for-all "scramble" type, which is too costly (in ecological terms) in this context. Formal contests ended in negotiations, with payments and feasting, and may at times have involved forfeiture of land and the absorption of defeated social units by larger, stronger ones.

Latte Phase archaeological sites often contain one or more slingstones, which are sometimes found cached in small pits. Slingstones have also been observed on the ground surface in open areas. These items may have been kept on hand in case of surprise attacks and used in small-scale skirmishes. The historic literature mentions spears and in one case also slingstones being used in formal battles. Slingstones were the main weapons used to attack the Spanish, clearly no match for guns but still capable of inflicting serious harm, as early accounts attest.

Judging from archaeological data, as well as pollen, phytolith, and food residue studies and analyses of stable isotopes in human skeletal material, Latte Phase people consumed both land and sea resources. Pelagic fish were taken—probably mostly from canoes but also using line fishing from shore in the steep-sided northern islands—and inshore fishing was done with hooks, gorges, spears, and nets. Nets have not been found at archaeological sites, but bone objects that can be interpreted as net-making or net-repairing tools have been excavated at coastal sites along with other fishing gear.

Parts of sailing canoes that would have been used for inter-island travel and fishing have not been found archaeologically, but adzes likely used to make canoes are commonplace at coastal sites. Marianas canoes were very favorably commented upon by European sailors in the early Spanish Period (e.g., see Anson quoted in Haddon and Hornell 1936:413). They found them to be swift and well designed for island sailing and landing conditions. A 1602 account by a Spanish religious describes a Chamorro man of Guam catching a marlin and bringing it to shore in his canoe, a small craft that he was able to manage by himself (Driver 1983). This account also describes the practice of drying fish to preserve them, which the missionaries who came later in the century also noted (Coomans 1997:10).

Archaeological excavations indicate that marine turtle, shellfish and invertebrates were collected by the prehistoric Chamorro. Shark and dolphin remains have been excavated as well (Hunter-Anderson et al. 1996; Moore et al. 2002). In the early 18th century, turtle shell valuables were presented at the end of inter-group conflicts (Lévesque 1998:155) and were worn during ceremonial dances (Coomans 1997:9-10). Such practices were also described in earlier times by Coomans (1997:43). Turtle shell valuables were used throughout Oceania including Micronesia. In Palau, turtle shell was (and still is) shaped into special forms of "women's money"; in Yap, turtle shell disc-bracelets were worn as portable wealth, and in Chuuk, such items adorned the chests and ears of their owners (see various reports of the Sudsee Expedition of 1908-1910, edited by G. Thilenius).

The main crops during the Latte Phase were likely taro, breadfruit, and yams; bananas, sugar cane and rice were probably important supplements, with rice a special food used in medicinal and ceremonial contexts (Hunter-Anderson et al. 1995). Breadfruit and yams occur in domestic and wild forms in the Marianas and alternate in seasons of abundance. Taro can be grown year-round, as can bananas and sugar cane. Prehistoric rice growing schedules and techniques are unknown but on Guam probably involved streamside and interior wetland edge plots and sometimes two harvests per year, as indicated for Tinian in 1673 (Lévesque 1995a:85). Cooking techniques for most foods included boiling in ceramic pots, steaming in earth-ovens, and probably roasting directly on coals. Early historic accounts mention the drying of breadfruit in slices and of birds taken seasonally at uninhabited Uracas. Presumably these practices also took place during the late Latte Phase. The dried foods may have been reconstituted by soaking and/or boiling in pots, and as indicated in an account pertaining to 1667-1673 (Lévesque 1995a:76), steaming to succulence in an earth-oven.

Wild plants probably were collected for medicine, dyes, decorations and weaving materials and for house and canoe construction. Burned pieces of wood from Latte Phase sites include *Artocarpus* (breadfruit), *Casuarina*, *Cocos nucifera* (coconut), *Ficus*, *Hibiscus tiliaceus*, *Intsia bijuga*, *Pandanus*, and several others (Murakami 1999, 2000, 2002). Fragmentary burned coconut shell is the most common type of charcoal found in fire-related archaeological features.

Clam shell and stone adzes and pumice abraders, in a range of sizes and shapes, large stone mortars, light and heavy cylindrical pounders and pestles, hammerstones used to work the shell and chert into scrapers and choppers, and bone implements all indicate that several kinds of raw materials were processed. Craib (1986) applied a functional classification of artifacts, which is applicable to Latte Phase sites. The categories are: Fishing Gear (hooks, gorges, barbs, shanks, weights, *poio* [composite fishing weight used with bait]); Weapons (spear points, slingstones); Fabricators (hammers, abraders/files, scrapers, needles/awls); Cutters/Abraders (adzes and pre-forms, knives, chisels); Processors (pestles, mauls, hand stones, mortars, stone dishes); Containers (ceramic, shell); Manufacturing Material (cores, debitage, raw material). Very large stone mortars (*lusong*) are thought to have been for husking rice with wooden pestles. Due to a lack of preservation, wood artifacts (e.g., bowls, handles, boxes, pounding slabs) are lacking at archaeological sites yet undoubtedly were present; woodworking tools such as abraders are commonly found in Latte Phase deposits.

The remains of large and robust ceramic vessels are characteristic of late Latte Phase sites, found in addition to remnants of smaller cooking pots and jars (Moore 1983). The rise in larger vessels indicates increasing dependence upon food and water storage, possibly against drought and irregular harvests during the Little Ice Age (LIA, c. AD 1350-1900) (Grove 1988; Nunn 1991; see below).

Prehistoric Population Estimates

As part of characterizing historical marine resources procurement patterns in the Marianas, it would be useful to know the approximate human population at various times in prehistory, in order to anticipate predation effects, if any. As suggested above, the earliest occupants of the Marianas may have been transients rather than permanent settlers. In these encampments the subsistence focus would have been on the sea. Geographer Tim Bayliss-Smith (1975:13) calculated that "to satisfy the energy requirements of the average person would require a minimum of 11.5 ha of productive reefs and reef flats. As an approximation we might estimate the productive zone along a coastline to average 200 metres in width, so that a fisher-gatherer community of 30 persons would require some 17.2 km as a minimum for subsistence. The coasts of Viti Levu and Vanua Levu, the two largest islands of Fiji, total about 500 km in length, implying a maximum or carrying capacity population of under 900 pre-horticultural 'strandloopers' on these two islands."

The perimeters of the southern Marianas, Guam, Rota, Tinian, and Saipan, total approximately 296 km (Bryan 1971; Karolle 1993). Using Bayliss-Smith's 17.2 km as a minimum for subsistence for 30 people, these islands as a group could have supported about 516 people focusing only upon marine resources. It should be noted that the islands' coastlines have very limited reef development due to episodic uplift (Tracey et al. 1964; Siegrist and Randall 1992). Consequently much of the island perimeters are steep cliffs and beaches are rare. These geographic factors would have lessened the ability of people to rely exclusively upon marine resources as permanent resident "strandloopers." However, if they were only temporary occupants, in effect subsidized by their home islands to the west, this constraint would be irrelevant. Under this model, predation pressure upon marine resources was light to non-existent during the early Pre-Latte Phase.

By c. 2000 BP, archaeological site contents indicate more permanent settlement and more complex resource use patterns within the islands. The human population may not have been much larger than previously but was using the islands' resources more regularly. Beaches began to prograde and freshwater marshes developed as sea level decline cut off saltwater inlets. Ultimately this would make a larger proportion of alluvial soils available for agriculture. Hunter-Anderson and Zan (1985) found a high correlation between population density and extent of alluvial soils in the Hawaiian islands. Considering this finding, perhaps the higher proportion of alluvial soils raised the Marianas "population ceiling" at this time.

The archaeological record shows an increase in sites (numbering in the hundreds compared with fewer than twenty Pre-Latte Phase sites) during the early and middle Latte Phase. This period corresponds to the Little Climatic Optimum, a period when climatic conditions were more favorable for agriculture in the western Pacific, in part due to less frequent or severe El Niño droughts (Anderson 1992). The combination of favorable agricultural conditions and lowered sea levels may have permitted the largest numbers of people ever to live in the Marianas, during the mid-Latte Phase c. AD 1200-1400.

It is not clear whether the advent of the Latte Phase cultural system was an entirely intrinsic development or involved population inputs from the west, because it is unclear whether the Marianas were ever not a prehistoric "population sink" in Pulliam's (1988, 1996) terminology. A population sink is a habitat that cannot sustain a given population without continued immigration; in a sink habitat, local reproduction cannot keep up with local mortality. A source is a habitat that sustains surplus reproduction in a given population, which produces emigrants who, in effect, subsidize the sink population, which would become extinct without the immigrants. As Pulliam (1988:660) suggests, "Attempts to understand phenomena such as the local coexistence of species [i.e., community structure], should, therefore, begin with a determination of the extent to which the persistence of populations depends on continued immigration."

Perhaps the Mariana Islands, conceived as a population sink during prehistoric times, received immigrants throughout the occupation sequence, although at differing rates over time. If the Philippines, the nearest large islands capable of producing immigrants, served as the main population source that at first solely supplied, and later occasionally supplemented, the Marianas population, several questions need to be answered. For example, were the conditions in the Philippines causing the immigration to occur, or were the conditions in the Marianas permitting the immigration to occur, or some combination of both? To further investigate the utility of this model, attention needs to be directed toward the prehistoric archaeological and paleo-environmental records of the Philippines as well as those of the Marianas.

Using Latte Stones to Estimate Population

Graves (1986) estimated "peak" Latte Phase population of Guam based upon a count of latte stone features during a 1965 survey by Reinman (1977) and assuming Reinman's survey had located c. 50% of the total. Estimating a maximum of 600 structures occupied simultaneously and using average area for different-sized latte sets, Graves arrived at 23,361.3 sq. m of residential space; this he divided by 10 sq m as a per-person allotment (after Naroll's [1962] ethnographic sample), resulting in an estimated 2,336 persons. Graves dismissed this number as too low but allowed it could represent the higher ranked persons whom he suggested had occupied latte structures while lower ranked persons had lived in non-latte houses (Graves 1986:148, Note 40).

Recent archaeological surveys have increased the number of documented latte sets on Guam to over 600. For example, in the Ordnance Annex in southern Guam, published surveys have located over 300 sets or latte stone clusters (representing at least one latte set each); see Allen et al. (2002), Hunter-Anderson and Moore (2002), Henry et al. (1998a), and Henry et al. (1999a). An additional survey in the annex, still unpublished, has located several more latte sets (B. Dixon pers. comm. 2002). Surveys elsewhere in Guam have documented even more latte sets that were not documented by Reinman.

Based on the presently known number of latte sets, which is approaching 800, perhaps a more realistic figure for a maximum total number of latte sets ever built on Guam is in the range of 1,000-1,500. Using Graves' model where 600 latte sets on average provided c. 40 sq m each; 40 x 600 = 24,000 sq m, we can propose that 1,000 latte structures utilized simultaneously provided 40,000 sq m of space. Dividing 40,000 by the 10 sq m per person allotment yields an estimate of 4,000 persons for a peak population. The figure 1,500 latte structures utilized simultaneously yields 6,000 persons.

Another way to estimate population from latte set data is to 1) assume the average size of the social unit utilizing each latte structure and 2) the number of latte structures utilized simultaneously and 3) multiply these two estimates. The actual social unit size related to a single latte structure is unknown, but assuming an average social unit of 5 persons and 1,000 latte structures yields an estimate of 5,000 persons. If the social unit were larger or smaller, or if 1,500 latte structures are assumed, the totals would change accordingly.

These exercises in population estimation from 1,000 latte structures and either living space per person or occupying social unit suggest a range of 4,000 to 6,000 persons for Guam's highest attained prehistoric population during the Latte Phase. If the peak population underwent decline during the LIA, there would have been fewer than 6,000 Chamorros at first European contact in 1521, even fewer after some three decades of fighting the Spanish in the late 17th century, and fewer still by the beginning of the 18th century.

SPANISH PERIOD

Technically, the prehistoric era ended with Magellan's landing in 1521 (see accounts by Pigafetta and others in Lévesque 1992a, also Rogers and Ballendorf 1989). It is safe to assume that written documents were not generated in the Marianas until around mid-century, when the Manila galleon trade began, bringing foreign products and people to the islands until c. 1815 (Schurz 1939).

Formal Spanish colonization in 1668 and associated evangelization attempts by the Jesuits were followed by three decades of guerrilla-style resistance on the part of the Chamorros. By the early 1700s the Spanish had prevailed, and by their policy of *reducción*, key elements of the prehistoric cultural system were lost. These losses included the building of latte stone features and ocean-going canoes. Inter-island travel and pelagic fishing were halted when the Spanish destroyed the large canoes and canoe houses in punitive raids. With the eradication of the men's house organization in coastal villages, the social as well as the practical contexts for building large canoes had been removed.

To control the remaining Chamorros, the Spanish established a series of parish villages, each overseen by a priest and a small garrison. The residents came from the surrounding hamlets and ranches (see Lévesque 1996:414 regarding this plan in 1672). Whether these outlying sites were entirely abandoned or continued to play a role in the post-conquest subsistence system is unknown. Possibly some were occupied by those who had escaped to the mountains (Hezel 1989:65, citing Brosses 1756).

Early Historic Population Estimates

Writing of the Marianas in 1669, Fr. Diego de San Vitores certified that "13,289 of these natives have been admitted to the sacred baptism within the first year of our Mission here. Of this number, 6,055 comes from the inhabitants of the Island of Guan...within 35 leagues of circumference it contains 180 places" (Lévesque 1995b:623). A Belgian Jesuit, Fr. Peter Coomans, writing in 1673, said that Guam had 180 villages, the largest of which contained up to 80 or 100 houses, or families, and the smallest ones from 6 to 10, and that the "natives number up to 12,000, and not more" (Coomans 1997:7). Coomans stated that "from 16 June 1668 until 21 April 1669, a large part of this island, a total of 6,055 people, counting adults as well as small children, were baptized and became Christians (Coomans 1997:22)." Later in the same document, Coomans claimed the entire population of the Marianas was 20,000 (Coomans 1997:24).

Lévesque (1995b:623, Note 1; Coomans 1997:22, Note 35) has argued that "the officially reported numbers were exaggerated" due to a simple arithmetic error, double-counting, and has suggested this error was "caused by blind enthusiasm." Lévesque (1995b:623, Note 1) states, "...the number for the whole of the Marianas (including Guam) was 7,234 and it was added to the number for Guam alone 6,055 to yield the erroneous 13,289."

It is also possible that the Guam number (6,055) of baptisms itself was exaggerated or inflated. The padres dispensed gifts of biscuits and bits of jewelry in order to attract potential converts to attend sermons and to receive baptism, especially children (see discussion in Russell 1998:295-296). A letter written by Fr. Salgado in 1683 in Manila, regarding the Marianas mission, confirms this suspicion:

“Nevertheless, I cannot conceal from you this fact—that, with regard to the 13 islands already discovered, the community is not as great as we, who were not established there, had supposed. There are not many more than 13,000 inhabitants all told, and—at least, until last year—only four islands were orderly. And when Don Joseph Quiroga stayed there, not even the island where the garrison was stationed was entirely subdued...so that Don Joseph and the Governor, Don Antonio Saravia have, between them, accomplished far more than their predecessors did in all those years, and up to last year, Don Antonio was still resolved to go on conquering and reducing to submission to the Divine will all the remaining islands.

“The reason why there are so few people on the 13 islands is that they are so small, and some are scarcely inhabited at all...but this information does not altogether tally with the reports of the early Missionaries who had written that they had baptized more than 30,000 natives—and indeed, where there are only 13,000 inhabitants, it is difficult to baptize 30,000...The explanation is, that the natives thoroughly enjoyed the ceremony, and being delighted with the rosaries which they were given to wear round their necks, presented themselves again and again for baptism, unrecognized by the Fathers until long after. Now that the deception has been discovered, of course, it would not do to publish this, as the Fathers would be blamed, but I assure you it is no flight of my imagination...”(Lévesque 1996:60-61).

The first census of Guam (then called San Juan Island) was taken in October 1693 (Lévesque 1997:580-581). This count was taken prior to the cessation of fighting between the islanders and the Spanish but after the "virgin soil" epidemic in 1688 and another plague in 1689 (Rogers 1995:70). In the 1693 census, 1,631 persons in six Spanish settlements were recorded. In the next census, taken in 1710, 3,678 Chamorros were counted in Guam and Rota (de la Corte y Ruano Calderón 1875, cited in Thompson 1945).

The counts of 1693 and 1710 are very low relative to a recent estimation of Guam's population in 1602, 32,000 +/- 4000 (Shell 2001:231). Shell based his pre-European contact estimate upon reports by Fray Juan Pobre (Driver 1989), who described his experiences living in Rota in 1602. Pobre's information about Guam's population was obtained from a Spanish sailor who had lived there in the previous year. According to the Pobre document, there were "nearly 400 villages with as many as 100, 200, or 300 residents. The entire island is populated...There were more than 60,000 people there" (Shell 2001:228, citing Driver 1989).

Taking the Pobre numbers at face value, Shell derived an average village size of 150 (60,000/400), which seems unrealistic given the archaeological record and the Coomans (1997) account quoted above. It is lower than, but approaches, the 50,000-100,000 given by San Vitores (cited in Carano and Sanchez 1964:104) and is considerably higher than Underwood's (1973) estimate of c. 40,000.

All these high estimates share the assumption that the pre-contact settlement system of the Marianas was sedentary, which may be unwarranted. Possibly recognizing this problem, Hezel and Driver (1988:139, Note 5, quoted by Shell 1999:292) aver that in the high islands of Micronesia, house sites, even entire villages, were "frequently abandoned in ancient times." The authors give no authority for this statement, however. Hezel also cautions that "subsistence agricultural practices required the underutilization of available land resources for various reasons" (Hezel 1989).

Assuming a sedentary settlement system and additional assumptions of high average numbers of permanent occupants in each village have combined to create the challenge of accounting for an apparently huge decline in the Chamorro population between 1602 and the late 17th century. Introduced diseases have been suggested as a cause, but it is difficult to judge their actual effects until the late 17th century, when pertinent data began to be recorded (see Underwood 1973). Undoubtedly foreign diseases killed and weakened many, but their ability to reduce Guam's population by 97%, from c. 50,000 to 1,631 in 172 years, strains credulity.

If instead the pre-contact settlement pattern was not sedentary but relatively mobile, and not limited to single islands but encompassed the entire archipelago, then much lower population estimates are feasible, and the gap between the pre-contact population and the first census in 1693 is more apparent than real. Possibly the external population subsidies during the early and mid-Latte Phase were reduced or ceased during the LIA, and population declined well below the archaeologically estimated peak range of 4,000-6,000. With these considerations, the low census counts do not appear anomalous.

According to Freycinet (1829, cited in Underwood 1976), by 1786 the native population of Guam had declined to 1,318. If so, this is a drop of 19% over 93 years from the 1693 census, not withstanding the slight increase recorded in the 1710 census. Through the next few decades, Guam's Chamorro population slowly increased. In 1783 the total population had grown to 3,231 (Thompson 1947:35). By 1816, 2,559

Chamorros were counted within a total Guam population of 5,389, and by 1830, there were 2,652 Chamorros within a total population of 6,490 (Underwood 1976:205). The Chamorros had gained slightly in numbers but their proportion of the total in Guam had declined from c. 47% to c. 41%.

The above numbers could imply that during the early Spanish Period the Chamorro subsistence system was limited by several factors, including population disruption from wars and resettlement schemes (the *reducción*) and introduced diseases to which the native population had no immunity. Another factor may have been the LIA climate, which adversely affected agricultural and wild resources productivity, thereby lowering the carrying capacity of the islands. In the tropics, colder sea surface temperatures are associated with cooler air temperatures and drought conditions, and there is some indication of more frequent El Niño (drought in the western Pacific) episodes during the LIA (Anderson 1992).

Possibly the Spanish incursions were occurring precisely when Chamorro populations had been under considerable stress and as they were entering some of the most adverse climatic conditions of the LIA. This could have resulted in a lower total population compared with the preceding LIA, when agricultural conditions were more favorable, as suggested above. The archaeological record is not mute on the subject. Coastal and river terrace sites increased during the Latte Phase (Kurashina 1987), although the paucity of radiocarbon dates does not yet permit us to accurately characterize the pace.

In one region of Guam, the south-central hills, the number and kinds of prehistoric sites increased markedly between AD 1200-1400 but then dropped off dramatically. By the 18th century this area (the Manenggon Hills project area) of approximately 1350 acres had been abandoned (Hunter-Anderson and Moore 1994). Late prehistoric abandonment of the Lost Water area of interior southern Guam is also indicated at this time (Hunter-Anderson 1994c), strengthening the idea that there was a retreat to coastal locations, at least for some parts of the Latte Phase population, late in prehistory.

An expected response to climatic deterioration in the LIA, particularly longer or more frequent periods of inadequate rainfall, is a focus upon the most reliable locales for farming, such as lower river valleys and wetlands, and shorter stays in the interior (resulting in a less visible archaeological record there), as well as more food and water storage. While the historic accounts do not contain descriptions of Chamorro settlement patterns, nor of the nutritional sufficiency of the local diet, an early account indicates that there were numerous houses "along the coast" (which may have given rise to the perception of a large population) and at least one inland town that was "large and thickly populated" (Lévesque 1992b:138). All was not well in 1565, as Legazpi's 1568 remarks (Lévesque 1992b:136, Note 1) upon his expedition's Guam encounter indicate:
“...the 600 craft which we said came alongside the ship[s] came to beg not to give. For, in all the 10 days of our stay there, we could not buy 10 fanegas [bushels] of rice; and if they brought anything it was coconuts, bananas, tamales, and other articles of the fruit

kind, of very unsubstantial and ordinary quality. This will prove to be the truth, rather than what is said in opposition thereto” (citing Blair and Robertson 1903-1907).

The hundreds of proas that came to trade with Legazpi's ships should not necessarily be taken to indicate a populous island. They could have derived from many areas on Guam as well as from Rota and Tinian, since these craft were fast and used to travel between the islands (e.g., see Driver 1983).

An account of 1673 (Lévesque 1995a:596) indicates difficulty in obtaining sustenance for the Guam missionaries at that time: "Regarding food, and everything that comes under the definition of the word, it is specially in short supply, and not rarely in poor supply." While this statement referred specifically to conditions at the Jesuit mission, surrounded by hostile Chamorros, it may show that local food was not in abundance and thus not made available to the priests, who were willing to pay for it.

Late prehistoric dietary insufficiency is apparent through studies of late prehistoric bones and teeth from Guam sites. For example, Heathcote (1994:2.190) noted such evidence in crania and teeth from an inland site at Manenggon dated to the AD 1500s, and Eakin's (2002) osteological analysis of a prehistoric coastal burial population found a high proportion of individuals with compromised health and nutritional status. Although precise dating of these interments could not be determined, the presence of elaborately thickened pottery rims at the site indicates it was occupied in the late Latte Phase (Moore 2002a:55). Possibly some of the burials with indications of poor health and nutrition date to that time. Moore's (1983) study of ceramic change through time at Tarague, Guam, and her more recent study of several ceramic collections from Guam sites (Moore 2002b) both indicate a trend toward larger, more robust vessels late in prehistory, suggesting storage had become more critical as the Latte Phase progressed.

Apparently the early Spanish colonists were able to obtain food by planting (or having someone else plant for them) local crops as well as imports such as rice, corn, lentils, chickpeas, and seeds of fruit and of garden vegetables brought by the quasi-annual Manila galleon (Lévesque 1995b:389). By early in the 18th century, prior to their expulsion in 1769, the Jesuits had established a successful farm in the Tai area, near Agana, as well as other farms on Guam (Rogers 1995:83).

Governor Tobias (1771-1774) made land available to the Chamorros and encouraged food production by the Chamorros (and the Spanish colonists, including the local militia) of various crops including cotton, indigo, cacao, sugar cane, mangoes, papayas, pineapples, and vegetables (Carano and Sanchez 1964:106-109; Rogers 1995:83). Rice was cultivated in Rota for consumption in Guam (Rogers 1995:79).

The French captain of the *Mascarin*, Julien Crozet (whose predecessor had been eaten in New Zealand), spent seven and a half weeks in Guam in 1772 observing the local lifeways as his men recovered from scurvy (Carano and Sanchez 1964:109-113). Crozet's journal, among many other details, describes the Chamorro practice of drying breadfruit for storage and concludes, "This natural biscuit preserves its quality for years, and very much better than does our ships' biscuit" (Crozet quoted in Carano and Sanchez 1964:111, citing de Rochon 1891). Crozet noted that Guam's inhabitants were all living in Agana and 21 other small coastal settlements, and that the Chamorros subsisted upon fish, grain crops and vegetables. They disdained freshwater fish and eels, and even ignored the large turtles that could be caught on Guam's beaches (Crozet quoted in Carano and Sanchez 1964:112, citing de Rochon 1891). Since they evidently had no interest in turtles at this time, we may infer they probably had ceased exchanging turtle shell valuables.

By the early 19th century, the Spanish capital, Agana (now Hagåtña), contained about half the population of Guam, and since the island "had no industry or commerce, [all the population] lived off the products of the soil" (Carano and Sanchez 1964:144). The concentration of people in Agana raises the question of how they were supplied with food. It is likely that most houses had "kitchen gardens" where medicinal and food plants (coconut trees, citrus, bananas) were planted. Farms in the "breadbasket" of Guam, Barrigada, as well as in areas near the town, probably supplied many families with breadfruit, corn and other foods. The kinds and amounts of animal protein available in Agana and elsewhere at this time are not recorded but likely included some beef, pork, and chicken. People living in coastal areas probably had access to shellfish and other invertebrates as well as reef fish. By this time pelagic fish were probably not a regular dietary item since the Chamorros lacked sea-going craft.

The archaeology of the Marianas Spanish Period is little studied although a few stone and mortar structures (forts, church buildings, bridges) survive as ruins (see Galván 1998), and some have been developed as parks (Guam Dept. of Parks and Recreation n.d.). Less obvious are the Spanish Period subsurface deposits, which lie beneath the highway along Guam's west coast. Archaeologists have found that artifacts and features from this time of cultural amalgamation tend to be mixed with late prehistoric items. The deposits are compressed and distorted by the weight of modern roads and traffic, making their excavation and interpretation difficult at best.

Guam's west coast settlements at Agana, Asan, Piti, and Umatac were the focus of commerce and government activities. These locales and the transport route along the coast that links them contain mixed cultural deposits from late prehistoric and historic times. Numerous human interments typical of Latte Phase burials (extended, prone or supine and primary, secondary, and incomplete) have been encountered within roadside deposits, especially in Agat (e.g., Hunter-Anderson 2002b). Due to the mixing and compression of these deposits, it has been impossible to distinguish the earliest historic deposits from late prehistoric ones.

It is evident from written sources (e.g., Carano and Sanchez 1964) that the later Spanish Period subsistence pattern was one of small farms and orchards near and within the villages. New crops and animals had been adopted, including corn, sweet potatoes, cassava and various fruit trees and vegetables. With meat from pigs, cattle, and deer available, and pelagic fishing essentially impossible, as well as a lack of interest in sea turtle, inshore fishing for invertebrates and reef fish and reef gleaning were the main means of obtaining marine protein.

TWENTIETH CENTURY POPULATION HISTORIES OF GUAM AND OF THE NORTHERN MARIANAS IN RELATION TO TRADITIONAL USES OF INSHORE MARINE HABITATS

Introduction

Traditional uses of inshore marine habitats have been shaped by several factors, not least the population histories embedded within the strongly divergent colonial experiences of Guam vs. the other islands in the archipelago. The history of the split is as follows. Legazpi claimed all the Marianas for Spain in 1565 and after about a century of trade led by the Manila galleons, Spain formally colonized the islands in 1668. Wars of resistance ensued but by the early 18th century the islanders had been subdued and the Spanish colony persisted until 1898. More than three centuries of Spanish rule came to an end with formal division of the archipelago by the Treaty of Paris, which was concluded at the end of the Spanish-American War. During post-war negotiations at Versailles, agreements were reached which created separate political entities of Guam and the Northern Marianas. Spain ceded the Philippines and Guam to the United States. The latter was offered but declined the islands north of Guam. However, Germany made an offer that Spain did not or could not refuse, to purchase the Marshalls, the Carolines and the Marianas north of Guam (hereinafter, the Northern Marianas) for 18 million German marks, about 4.2 million American dollars at the time (Rogers 1995:112-113).

The 1898 dual colonial configuration in the Marianas, with the Americans ruling Guam and Germany ruling the Northern Marianas, existed for more than a decade before regime change in the latter altered the players but not the geographic and political divide. Through the 20th century Guam stayed an American territory except briefly during World War II, when the Japanese controlled the island (1941-1944). The Northern Marianas were successively occupied by the Germans (1899-1914), the Japanese (1914-1944), and the Americans (1944-present). The islands north of Guam have attained a measure of self-rule through commonwealth status with the United States negotiated in the 1970s.

Different immigration rates and source populations are associated with contrasting economic trajectories in the two jurisdictions. Early in the century, German economic interests in Micronesia focused on copra, and efforts were centered on the Marshalls, not the Marianas. The German government in the Northern Marianas, under District Officer Georg Fritz, tried to develop the agricultural sector, but copra was not a major crop. At the time, the Northern Marianas served as places of refuge and wage work for Caroline Islanders (hereinafter Carolinians), just as they had done under the Spanish.

The Northern Marianas Chamorros lived mainly on Rota and Saipan and pursued a subsistence level economy whose main elements were agriculture, hunting, and fishing. On Tinian, essentially empty of permanent inhabitants, the previously wild herds of cattle were corralled and the meat systematically processed and exported to Guam and Saipan. Game on Rota and Saipan included deer; Fritz had introduced deer from Rota to Saipan in 1900 (Thompson 1932:63) (much earlier, in 1771, Gov. Tobias had brought deer from the Philippines to Guam and Rota).

The Northern Marianas remained lightly populated until their acquisition by Japan in 1914. Within two decades these garden, livestock, and refuge islands had become major producers of sugar cane. The cane was grown and processed by laborers from Japan, many recruited from the very poorest farmers of the Ryukyus (Peattie 1988). Japan's losses after World War II included the Northern Marianas, which came under American control after heavy fighting. Reconstruction and resettlement programs and eventually a commonwealth status with the United States led to the development of a small government employment sector and a wage economy associated with garment manufacturing and tourism.

Unlike the Northern Marianas and their colonial administrators, Guam's value to the United States was not commercial, although a consideration was to use the island as a coaling station (along with Cavite in the Philippines and Pago Pago in Samoa) in support of the American China trade (Rogers 1995:112). U.S. military interests in the western Pacific territory were paramount, and the entire island was considered a naval base. Guam had a series of naval governors before and after the war. After 1970, Guam was governed by a popularly elected governor, lieutenant governor, and legislature (Carano and Sanchez 1964; Rogers 1995).

Early in the First American Period (1898-1941), Guam's population was small and immigration was minimal. Local economic development for self-sufficiency was encouraged by the government, as well as production of a food surplus for sale to the small American expatriate and military communities. On the other hand, large quantities of rice were imported, matching the decline in rice plantings for the first three decades of American rule (Nelson and Nelson 1992:170).

By international treaty obligations, Guam was not fortified after the 1920s, despite signs that Japan was arming its Micronesian possessions in the 1930s (Peattie 1988). The island was attacked by Japanese forces a few hours after Pearl Harbor in 1941 and remained under Japanese control until the decisive battles of summer 1944 (e.g., see Morison 1981; Denfeld 1997).

After World War II, Guam's economy became more fully wage-based, and significant immigration from the Philippines occurred as a result of high labor demands during post-war military base construction and civil construction projects. Many of these laborers stayed and brought their families. The U.S. Congress passed the Organic Act in 1950, which gave U.S. citizenship to Guamanians (persons residing or born on Guam after April 11, 1899) and instituted the office of a civilian governor appointed by the U.S. president. Elective government since the 1970s has been associated with cyclical economic growth and recession, fluctuating levels of military activity, and the rise of (mainly Japanese) tourism.

Population histories over the 20th century in the two jurisdictions in the Marianas archipelago are reviewed below, in combination with pertinent aspects of the cultural contexts in which these histories are embedded. From this review, limited inferences are made regarding changing patterns in the traditional uses of the inshore fisheries, and additional information sources, which could help confirm these inferences, are identified.

Population and Settlement Patterns in the Northern Marianas

Under the German administration (1899-1914), the Northern Marianas native population, a mixture of Chamorros and Carolinians (people from the coral islands south of Guam, which are now part of the Federated States of Micronesia), was initially small and engaged in subsistence farming and fishing and in a minor amount of copra production for export. In 1900, the population totaled 1,938, rising to 2,401 in the 1902 census (Fritz 1989). Most people lived on Saipan, in two villages, Garapan and Tanapag, on the west coast of the island.

Table 1 (reproduced from Fritz 1989:Table 1, p. 15) shows the “German Marianas” population after the April 1, 1902 census. A considerable proportion was composed of Carolinians in these early years, about 35%. Most of the Carolinians lived in Saipan, but there were small populations in Tinian, Rota and Pagan as well. Carolinians were the majority on Pagan and on Tinian, and they comprised about half the population on Agrigan. Carolinians were a minority on Rota, perhaps because Chamorros had remained on the island, despite the Spanish policy of *reducción* that had depopulated the other Northern Marianas.

Population density in the Northern Marianas was quite low at the beginning of the 20th century, for example, c. 5.03 persons per square km in 1902 (total dry land area of 14 islands is 477.48 km^2) (Russell 1998:Table 1). If we consider only the islands mentioned by Fritz as inhabited in 1902 (Saipan @122.92 km^2, Tinian @101.76 km^2, Rota @85.20 km^2, Sariguan @4.99 km^2, Alamagan @11.26 km^2, Pagan @48.30 km^2, and Agrigan @47.37 km^2, with a total land area of 421.8 km^2), population density rises slightly to 5.7 persons per km^2. The most populous island, Saipan, with 1,631 persons, had 13.3 persons per km^2.

Table 1. Population Figures for the German Marianas

		Chamorros	Carolinians	Foreigners	Total
Saipan	Garapan	891	524	42	1457
	Tanapag	76	97	1	174
Tinian		36	59	1	95
Rota		440	49	1	490
Sarigan		7	1	0	8
Alamagan		6	2	0	8
Pagan		35	102	0	137
Agrigan		14	18	0	32
	1902	1505	852	44	2401
	1901	1330	772	30	2132
	1900	1302	700	36	1938

Note: Between 1900 and 1902 there was a population increase of 463. This was the result of immigration from Guam (385) and an increase of births over deaths (78).

In 1900 there were 112 births and 56 deaths.
In 1901 there were 89 births and 61 deaths.
In 1902 there were 83 births and 54 deaths.

Local economic self-sufficiency under conditions of low population density is exemplified in Fritz' descriptions of Chamorro settlement patterns and practices during his three year tenure:

"The second largest island, Saipan, has two settlements; Garapan with 1,601 inhabitants and Tanapag with 197. Here also are numerous individual huts, some of which are continually occupied, others only during field labor by otherwise village-dwelling natives. The other islands, those that are occupied, each have one settlement along the beach." p. 19

"...Garapan has 211 dwellings, of these 144 are inhabited by Chamorros and 67 by Carolinians. On the average, each house is inhabited by six Chamorros and nine Carolinians." p. 20

"...Besides his dwelling in the village, each Chamorro owns a rancho *lantcho* in an often distant plantation. For weeks on end, he stays there with his family not so much working, but in dreamy idleness. There he occupies himself with hunting fruit bats *fanie*, wild pigs, roosters, coconut crabs *ayuyu*, and with fishing. Only on Sundays he rides with his oxen to mass and to the cock fight in the village. These field cottages are smaller versions of the village dwellings but built with less care.” p. 24

“...Public buildings, with the exception of churches and parish houses, do not exist. The Uritau houses of pagan times, in which the bachelors conducted their provocative way of life, have disappeared.” p. 25

“...There are smiths, cabinet makers, tailors, shoe makers, tanners and silversmiths who often furnish very good work, but their main activity is to plant a piece of land with corn and sweet potatoes, which is just sufficient to supply the family.” p. 53

Fritz's account contains many details further regarding Chamorro land use at the turn of the century—gardening, herding, hunting, and the preparation and uses of agricultural and wild products. Wild pigs were tolerated, as opposed to kept on tethers or penned, perhaps a signal that they were not yet serious competitors for the islands' resources.

Fritz describes in detail some of the fishing activities of the Carolinians on Saipan but is virtually silent on their land-based activities. In 1840 they had been described as living "chiefly on turtle and fish, and cultivating a little taro and yams in small patches" (D.P. Wilson, cited in Hezel 1983:106-107). Referring to conditions at the turn of the 20th century, Fritz stated that the Carolinians would sometimes sail from Saipan to Aguiguan to dive for trepang to sell to Japanese merchants (who monopolized Marianas trade, with direct routes to Yokohama), that they caught turtle, and that they used weirs inside the reef, "a fishing technique not practiced by the Chamorros." p. 69.

Fritz also generalizes: "the Chamorro is neither a good swimmer nor diver, especially not one to get too close to a shark," and he contrasts the Chamorro methods and materials of net and rope making (hibiscus and pineapple fibers) with the Carolinian method in which coconut fiber soaked in sea water was used to make superior cables and ropes. p. 67

The contrasts between the more traditional Carolinians and the more modern Chamorros at the turn of the 20th century reflect the divergent circumstances of the two groups in their interactions with Europeans. At times the Carolinians may have been refugees in German-controlled islands, but they long had enjoyed regular exchanges with the people in the Marianas during the 19th century, and they earned wages as plantation laborers, meat processors, and messengers. Their independence within these economic relations is probably related to the mobility that their ocean-going canoes afforded them, and their tolerance of a lower standard of living than that to which the Chamorros had already become accustomed.

The 1902 census shows that Carolinians occupied small northern islands with little arable land (mainly planted to coconuts for export) and Tinian (where they were engaged in jerking beef and pork from the wild herds on Tinian and transporting it to

Guam in their canoes). The proportions of agricultural products vs. marine resources in the diets of these small populations are not known. However, it is probably safe to assume that at least in the small northern islands where beach and reef development is minimal, bottom fishing near the steep coasts contributed a significant amount of the calories and most of the protein. Oral histories and interviews could provide more information on Carolinian adaptations in these islands.

To encourage more agricultural production among all the islands' residents, the German government recognized native land titles on the basis of active use (Bowers 2001). Officially sanctioned homesteading was permitted on formerly alien-held lands, such as coconut plantations that had been owned by Japanese business interests (Spoehr 1954:77). This land distribution policy allowed Carolinians and Chamorros to acquire title to formerly "unused" lands by clearing and bringing them into cultivation.

Details of what crops were grown are not available, but it is likely that the Carolinians focused on coastal wetlands where taro could be planted and beaches from which fishing could be practiced (both inshore and from canoes). The Chamorros are likely to have opted for inland plots that included some grazing land. Most official land records of this time were destroyed during World War II, but oral histories might bring to light additional aspects of Chamorro and Carolinian land use practices during the German Period.

Regarding Chamorro land use, Fritz (1989:82) stated, "The women, especially in Rota and in the rural villages of Guam, take care of the farm. She does the heavy labor in the fields. The husband takes care of the cattle, fishes, hunts and makes the nets. So it is just that she gives the orders and, when necessary, wakes up the sleepy husband with appropriate hand movements." Although fishing is indicated in this quotation, fishing frequency and productivity are not. Geographic circumstances probably determined, at least in part, the proportion of fishing practiced in a given household or village.

The Spanish Period Chamorro and Carolinian land inheritance patterns differed, and this difference was carried into the early 20th century. Carolinian property passed through matrilineages and many plots were farmed communally. Land holdings were kept intact by maternally related women and their brothers. Among the Chamorros, in contrast, property passed from parents to children through the custom of *partido* (Spoehr 1954:65). Spoehr notes that as long as there was ample land, the tendency of *partido* to result in smaller and smaller plots over time was not a problem, implying relatively low population density. In later years, when most arable land had been converted to sugar cane production, the custom of *partido* became a source of tension in local families.

The Carolinians' use of canoe houses (*ut*) associated with specific matrilines helped the Carolinians to maintain a range of customary practices related to subsistence and community governance. These included a communal approach to procuring food and the extension of kinship networks and obligations into all aspects of life. In contrast, the Chamorros had not used canoe houses for two hundred years or more, and the aboriginal dispersed and mobile settlement pattern had been replaced by a more settled village one in which social structure was hierarchical, based upon wealth, and mediated by the pervasive involvement of the Catholic church (see Spoehr 1954).

Possibly the Carolinians' coastal orientation while they lived in the Marianas—similar to life in the atolls—precluded their adopting the fully land-based subsistence pattern practiced by the Chamorros at the time. Pre-Spanish Carolinian coastal settlements in the Marianas may have been small and impermanent at first, used mainly for trading and when fleeing storm and tidal wave damage in their home islands. Another possibility is that they stayed with Chamorro families and had no distinctive settlements of their own. In future, archaeological studies at coastal sites may be reviewed with this question in mind.

Interrupted by the Spanish-Chamorro wars of the late 17th century, Carolinian visits were resumed early in the 19th century, increased at mid-century, and continued into German times. For example, as late as 1907, people from Woleai in the central Carolines sought refuge from a bad typhoon, settling temporarily at Uleai (Oleai) on the west coast of Saipan. According to Spennemann (1999:187), 40% of these refugees had died by 1914, exposed to new diseases and weakened by starvation. In 1910-11 others came from the Mortlocks, Satawal, Losap, and Pulusuk and moved into the villages of Puerto Rico and Chalan Laulau (Farrell 1991:280; Spennemann 1999:188). Longer-established Carolinian communities existed at the coastal settlements of Garapan (Arabwal) and Tanapag (Russell 1998; Barratt 1988a).

After 1907, when Saipan was downgraded by the colonial division of the German foreign office from a district to a station office, Georg Fritz lost his job, and detailed reports on population and other matters in the Marianas ceased to be made. However, it is evident that the population grew by over 1,000 between 1906 and 1909, but the source of this growth is not documented (Farrell 1991:291). By 1912, within a total population of 3,146, Chamorros were 50% and Carolinians 48%, the latter being the majority on the smaller islands north of Saipan (Farrell 1991:293).

The population density of six islands (Saipan, Tinian, Rota, Alamagan, Pagan, Agrigan) had reached 7.6 per km^2, still low. However, on Saipan, where the Carolinians were nearly as numerous as the Chamorros, population density had risen to 20.3 per km^2 (2,500/122.92). The largest island in the Northern Marianas was becoming somewhat of a population magnet.

Germany yielded the Northern Marianas to Japan in a bloodless takeover on Oct. 14, 1914. The few Germans present were expelled from Saipan, and the military occupation continued until 1922, when an international agreement legitimized Japan's takeover of all of Micronesia except Guam. Japanese economic development of the islands began in earnest, and many Carolinian and Chamorro landowners leased their property to Japanese farmers and businesses. Many of the land plots were small, not big enough to live from; on the other hand, their owners could live from the high rents the Japanese were willing to pay. Others lived from wage work in the expanding economy (Spoehr 1954:86-87). Land alienation accelerated over time, with rising rents and prices that favored the few families with large holdings. By the eve of World War II, about one-third of the Chamorro and Carolinian smallholders had no farm land (Spoehr 1954:86,130).

Eventually all arable lands in Rota, Tinian and Saipan were transformed into sugar cane plantations and tenant farms. At the height of the sugar cane era in the mid-1930s, the majority population of the Northern Marianas was composed of immigrants from southern Japan. Chamorros and Carolinians on Rota and Saipan had been removed to marginal lands, were living on very small plots of their own, or had been transported to work at Japanese enterprises elsewhere in the Pacific. The canoe-house organization of the Carolinians on Saipan disintegrated, and canoe building and traditional navigational knowledge disappeared with the Japanization of the islands (Spoehr 1954:89).

By 1937 there were approximately 46,708 persons living in the Mariana Islands north of Guam (Bowers 2001:Table 5). The vast majority was from Japan, Okinawa and Korea: more than 20,000 on Saipan, almost 14,000 on Tinian, and nearly 5,000 on Rota (Peattie 1988:164-167). According to Bowers (2001:Table 6), pre-war (1937) population density on Saipan was 508.4 per mi^2, on Tinian 379.6 per mi^2, on Rota 231.6 per mi^2. These high densities were not supported by subsistence agriculture but by a cash economy linked with Asia.

Eleven thousand of the immigrants were directly engaged in commercial agriculture; in addition there were shopkeepers and trades people, construction workers, commercial fishers, hotel and restaurant workers, and transportation workers (Peattie 1988:335). Pelagic fishing enterprises were established by Japanese, and some islanders worked in these. The fish, mainly bonito, were processed on Saipan although much of the Marianas catch was taken directly to Japan near the point of sale and consumption. If any inshore fish were caught and consumed locally, this has not been recorded in the literature. However, oral histories among Chamorros and Carolinians might reveal patterns of inshore marine resource use during this time. As will be seen below, Carolinian men were observed spear fishing at Saipan immediately after the war.

In 1941, Japan attacked the United States at Pearl Harbor, Hawai'i and at Guam, precipitating the Pacific War and the end of the Northern Marianas boom economy. At first the islands were a storage and equipment transfer hub for the military, but after the Japanese lost the Marshalls in early 1944, the Marianas saw a significant build-up of defensive military troops. Saipan became the headquarters of the Central Pacific Fleet and of the Thirty-first Army; Tinian was a storage depot with 3,800 defenders; and there was a 4,000-man garrison on Rota (Peattie 1988:280,288,304). As economic difficulties grew, Chamorros and Carolinians were conscripted for military construction and to produce food for the troops. Their houses in Garapan were occupied by soldiers numbering over 20,000 in 1944.

The American invasions of Saipan and Tinian with their protracted preliminary bombardments followed by invasion battles caused the complete destruction of the sugar cane economy and cost thousands of dead and wounded Japanese, Koreans, Carolinians, Chamorros, and American soldiers and civilians. The rehabilitation of the islands' economies was slow and difficult. Beginning in summer 1944, U.S. military base construction on Tinian and Saipan continued after the war. These actions destroyed much of the islands' arable land, already cleared of trees for sugar cane. The spoilage of the land by the construction of bases and related facilities as well as other disruptive effects of the war made subsistence farming just about impossible for most people and resort to purchased or to donated food the only options.

In an attempt to foster local commercial fish production, in late 1944 the U.S. Navy refurbished three old Japanese fishing boats, later turned over to a Carolinian fishing cooperative. By 1950 this enterprise was on the verge of bankruptcy, due to a combination of factors including lack of management skills in the areas of commercial fishing and marketing (Spoehr 1954:161). Notwithstanding this business failure, Carolinian men viewed fishing as their primary obligation in the family, an attitude that reflects the traditional division of labor in central Carolinian cultures, in which women, who own the land, perform the agricultural work. Still lacking canoes on Saipan after the war, the Carolinian men fished inshore, using spears and nets. The Carolinian women worked their taro patches and sweet potato gardens near Susupe, Tanapag and Garapan (Spoehr 1954:125-171).

Carolinian food preferences matched pre-contact Oceanic subsistence patterns more closely than those of the modern Chamorros, who had grown accustomed to imported foods, particularly rice and corn. The Chamorros had been primarily wage earners and consumers in a complex pre-war economy. After the war and the destruction of this relatively affluent economic setting, imports were scarce and everyone's standard of living dropped markedly. The occupying American troops had left and the Japanese, Koreans and Okinawans had been repatriated. Tentatively in place was a "false economy" based on American-financed military operations and construction (Farrell 1991:488).

At first, local people, mainly Chamorros and some Carolinians, found work as clerks in stores and offices and as laborers. With their earnings they could buy imported food in the shops, whose main customers were the Americans. When Saipan's governance passed into civilian hands in 1951, the Americans largely withdrew, jobs disappeared, and so did the imports. The former wage earners had to turn to subsistence farming and fishing, with all its attendant difficulties caused by poor soils, insects, and uncertain land ownership.

In 1950 the native population of Saipan was 4,925 (Spoehr 1954:Appendix), a net gain of nearly 2,000 from the mid-1930s. The Carolinians comprised 22% of this total, a decline from the percentage of Carolinians during the early part of the century.

In the most recent two decades the population of the Northern Marianas has increased tremendously, from 16,780 in 1980 to 69,221 in 2000, reaching a population density of 145 persons/km^2. Although the majority of the population is classed as rural (as opposed to urban), the cash economy is well established, with a labor force of 42,753 in the 2000 census.

Data on ethnic origin are not available for the 1980 census but this information was tabulated in the 1990 census. In the 1990 census, the Chamorros were 29% and Carolinians 5%, out of a total population of 43,345 persons. An even larger group, people from the Philippines, comprised 33% of the total. Many were contract laborers who worked in construction and factories and as household servants. This pattern is also reflected in language data in the 2000 census, where ethnic origin was not tracked directly. In homes where a language other than English was spoken at home, mainly Chamorro was spoken in 22.4% of the homes, Carolinian in 3.8%, and Philippine languages in 24.4%.

Employment patterns in 1990 and 2000 included a very small and dwindling proportion of those 16 years and older employed in farming, fishing, and forestry, 2.8% and 1.4%, respectively. Because this census category relates to paid employment, it is not clear whether such these activities contributed to family subsistence. Perhaps some of the catch could be taken home or bought cheaply by employees. People with government jobs in 1990 and 2000 comprised 13.5% and 12%, respectively, indicating most employees worked in the private sector. Subsistence farming and recreational fishing mediated by kinship may have provided some proportion of income and food supply for some families, especially in Rota and Tinian. Casual roadside sales of produce and fish also may have been an important source of income in Saipan. Anthropological studies focused upon such “sub-commercial” fishing and marketing could yield insights into the contemporary uses of the inshore fisheries of the Northern Marianas.

This brief review shows that for the first few decades of the 20th century, Northern Marianas population density was relatively low and subsistence agriculture and fishing were commonly practiced. During the 1920s and 1930s, massive immigration from Japan and Korea and vastly changed economic circumstances transformed the landscape into vast sugar cane plantations. While the population density rose markedly, inshore fisheries use declined. Carolinian fishing skills and a sea-going orientation were lost. Chamorros rented or sold their lands and lived from the rents or from wage work while a few families were able to keep or acquire large land parcels.

Losses of arable soils from World War II and its aftermath precluded a return to subsistence farming or even commercial farming on any significant scale. Wages fell and the majority of workers were employed in the private sector. In the last three decades, there has been a relatively rapid growth in tourism and commerce, especially garment factories. The latter have fostered another wave of labor immigration, this time from the Philippines.

Overall the picture of inshore fisheries use during the 20th century is one of decline for subsistence purposes, a pattern that arose in the context of rises in population density and the displacement of local people from shoreline and interior agricultural lands. Post-war recovery of the islands’ economies included continued reliance upon imported foods with local supplementation by fishing and farming where possible. More recent information on these matters may exist but needs to be compiled.

Population and Settlement Patterns in Guam

Guam's population was always larger than the Northern Marianas population during historic times, reflecting Spanish colonial policies and the fact that the island is larger and geographically more diverse, thus capable of more reliable agricultural production, other things equal. Even rainfall on average is higher in Guam, although the island experiences El Niño droughts as do the other islands in the archipelago.

In 1816 Guam's population was listed as 5,389, of which 2,559 were Chamorros (Spoehr 1954:61, citing Chamisso in Kotzebue 1821, Vol. III:91), thus constituting less than half the total; the remainder was classed as Spanish/Mestizo, Filipinos and military (Interagency Committee on Population 1988:Table 1.1). In 1897 the population numbered 8,698, of which an unspecified proportion was composed of Chamorros and Carolinians (Underwood 1973:Table 4).

By 1 September 1901, when the first American census was conducted, Guam's population had risen to 9,676 (Carano and Sanchez 1964:199). The 1901 census did not distinguish Chamorros from other islanders. This group (categorized as "citizens of the island of Guam") numbered 9,630; the definition of this term was not formalized until 1930, however (Carano and Sanchez 1964:233). Among this group, most were probably Chamorros. The 1901 census recorded 14 "citizens of the U.S.A." (presumably military administrators) and 32 foreign nationals (Spanish, Italian, Japanese, and Chinese). According to Rogers (1995:125) there were also approximately 158 U.S. military personnel who were not included in the count.

Carano and Sanchez (1964:189) state that in 1899, among the islanders who lived in the capital of Agana were Chamorros, Filipino ex-convicts, and political prisoners deported from the Philippines "who had been deported to Guam because of their resistance to the establishment of American rule in their islands." Three years prior to this, in the waning days of the Spanish colony, 80 Filipino *deportados* had been massacred (and forty-five more wounded) by their Spanish guards as they tried to escape one night (Rogers 1995:105-106, citing Father Francisco Resano, an eye witness). Perhaps among those mentioned by Carano and Sanchez as present in 1899 were some of the wounded who had survived this horrendous event. Late in the year, with the new American governor in place, the ex-convicts, two Spanish priests and several other Spaniards departed Guam (Rogers 1995:118).

Using the 1901 census data, at that time the population density of Guam, whose area is 549 km^2, was 17.6 persons per km^2 (9676/549). Food was imported from the U.S. mainland but was deemed inadequate for the non-natives. However, subsistence farming and fishing was probably supporting a large proportion of the native population.

Population data for the years 1901, 1910, 1915, 1920, 1925, 1930, 1935, and 1940, taken from Annual Reports of the Governor of Guam, are presented by Thompson (1969:37). Three categories of persons were counted: natives, non-native residents, and naval establishment. Over the four decades covered, the population rose from just under

10,000 in 1901 to 23,067 in 1940, and the proportion of natives declined from 99.5% to 93.2% over the period, still much higher than in 1816, when they were just under half the population.

Since Spanish times, Guam's census data had been reported by municipalities (*pueblos*), a tradition that was continued by the Americans. By the 1920 census, Guam had eight separate municipalities, and the majority of the population resided in the Agana area; most of the remainder lived in coastal villages in the south. From descriptions of settlement patterns in late Spanish times, one can infer that many Agana residents stayed on their ranches north and east of town, coming into town only on weekends to attend mass and associated festivities including cockfights. Fishing is not listed as among the weekend activities but may have been at least for some. Although counted as residents of Agana, many of these people probably did not spend much residential time in town, living away from the coast at their ranches and hence had infrequent direct access to marine resources.

Old maps indicate that in the late 19th and early 20th centuries, Guam was criss-crossed with numerous bull cart and foot trails. Land transportation was via the narrow coastal road, flooded in places during the rainy season, and on overland trails. On an 1887 map (in Allen et al. 2002:Fig. III.3), some of the overland trails trended northwest and southwest and avoided the formidable mountain range that parallels the west coast. Others trended north-south within the uplands, converging at Agana. The coastal road led north from the port of San Luis d'Apra to Agana, and south to Umatac.

A 1901 map of Guam (Nelson and Nelson 1992:2) does not depict many of the trails seen on the 1887 map, only major ones. People living on the vast limestone plateau constituting the northern half of the island were connected to the capital via two main trails, which began at Ritidian and at Tarague, the major embayments of northern Guam. These two trails first ran southwestward and parallel and then converged in Dededo before entering Agana. From the west, two trails led out of Tumon Bay to meet the road into Agana. In the center of the island, shorter roads originated east of Agana and converged on the capital. The map shows no road along the northeast coast, although it is likely that minor trails linked the small eastern embayments with the northern plateau and its main trails. The northern transportation pattern that emerges from the 1901 map suggests that at this time people were living (ranching, farming) on the plateau and in the embayments, and that Agana was the main node in the system.

According to the 1901 map, the west coast road extended from Agana to Agat but not southward, creating a break between the port at Agat and the southern villages beginning with Umatac (the intervening coastal areas had long been abandoned). A coastal road began at Umatac, ran around the southern tip of the island to Merizo and Inarajan, and continued up the east coast to Malolo (Malojloj), Talofofo, and Yona, from where the main cross-island road could be taken into Agana. Smaller trails are likely to have linked southern coastal villages with nearby interior ranches although not depicted on this map. The southern transportation pattern suggests remoteness from the main center of commerce and government and a more seaward orientation of the southern and southeast coastal villages, in comparison with the ranching pattern in the north and central plateau with its links to Agana.

The southern villages face lagoons and estuaries which offered seafood year round, granted seasonal differences in abundance and access. Although its geological history has not been studied, the large Merizo lagoon and the sand bar called Cocos Island probably have been important sources of marine products for local residents for many centuries. Oral histories and archaeological research could help to confirm this.

In the early years of the American administration, the entire island was considered a U.S. naval station, and government measures were taken to make living conditions acceptable to the troops and officers. Natural disasters to which the Marianas are prone set back some of these projects. For example, a major typhoon hit Guam in 1900 and a severe earthquake occurred in 1902. Social changes were implemented as well. The first U.S. naval governor, Capt. Richard P. Leary, promulgated a set of rules for public and legal conduct, which abolished peonage and formally separated the concerns of religion and state in the schools and in government generally. In 1899, the Spanish priests, who were viewed by the Americans as representatives of a repressive system, were deported to Saipan and Manila. Intolerance of ethnic diversity was formalized in the government's expulsion in 1901 of the small Carolinian community of about 100 persons, who since 1865 had been living east of the capital in the *barrio* of Maria Cristina in Tamuning. Most of these exiles went to Saipan, joining relatives who had settled the then-empty island, with the official sanction of the Spanish government, early in the 19th century.

According to American standards, Guam lacked many amenities, and its population was unhealthy. To alleviate the health problems, which were attributed to unclean drinking water and a lack of sanitation, especially in Agana and Piti, where American personnel were concentrated, the naval government developed freshwater sources and delivery systems. Medical clinics free to all residents were set up as well. Food shortages were also a worry for the new American administration. Imports of food, upon which the population had depended during Spanish times, had been interrupted during the Spanish-American War, bringing on real shortages. Also, the naval rations were insufficient for the recently arrived Americans, who craved fresh food.

It was decided that the fish must be taught how to swim; experts in agriculture were brought to Guam to advise the local farmers, i.e., show them how to increase production through better methods. There were sound reasons for local agricultural conservatism, however. The governor's aide, Lt. William Safford, wrote in his journal of 1902-03, "[the Chamorros] say their corn and rice will become moldy or will be infested by weevils if kept long, and then all their labor of cultivating and harvesting will be wasted" (quoted in Nelson and Nelson 1992:148). Notwithstanding this local evaluation of Guam's farming circumstances, an agricultural experiment station and school were established in 1909 and 1924, respectively. Farmers continued to plant corn in preference to rice, and the rice fields around the port area were discontinued. On the rise was the production of copra, which paid cash with which farmers could purchase rice and other goods.

In 1911, Japanese business interests acquired land for coconut plantations in Tarague, and by 1914 an American firm, Atkins, Kroll, was established in competition. In 1917, the vast coconut plantations at Tarague were acquired by Atkins, Kroll. Bemoaning a shortage of labor to work in their plantation, a member of the family wrote that the trees were "located in an inaccessible part of the Island where no natives live" (C. Kroll quoted in Liston 1996:47).

It is apparent from the above that the Tarague area had been abandoned by any residents it may have had during the previous decade, after the Japanese acquired title and began to plant coconut trees. By the time Atkins, Kroll managed the enterprise, the overland route out of Tarague was rarely used; everything needed (livestock, labor, supplies) arrived by sea, and most of the copra was loaded on ships using the Tarague channel (Liston 1996:48). Later records show that there was another coconut plantation at Tarague, owned by the Flores family, who stayed at the beach for most of the year. It is not known whether they utilized Tarague's marine resources or relied more upon local beef, pigs and chickens.

In 1914 the U.S. Army Corps of Engineers (Sturdevant 1913-1914) had made a topographic map of Guam showing numerous trails and ranches throughout the island. Fenced areas define small areas of livestock corrals and agricultural fields. Oral histories also indicate that cattle grazed in the Fena district, were slaughtered at Agat, and the meat delivered to Agana and to the port town of Sumay (R. Franquez pers. comm. 2002). Farmers were encouraged to grow a variety of crops, and a thrice-weekly public market facilitated marketing their crops. Except for a few motorcars and trucks, transportation was by foot and cart pulled by cattle or water buffalo.

The Guam population was becoming increasingly dependent upon imported rice, having nearly ceased local rice production in preference to corn. In 1925, 1,841,793.6 lbs of rice were imported for the native population of 15,233 (Nelson and Nelson 1992:176), an average annual per capita consumption rate of 120.9 lbs. The rice-growing areas near Apra Harbor were not entirely abandoned, however, because in 1929 the island produced 4,096 bushels of rice, mainly from Piti according to the 15th Census of the U.S., Population-Agriculture (U.S. Govt. 1931).

In 1930, Guam's population was 18,509 and of the 49.6% who reported "a gainful occupation," there were 13 fishermen, less than 0.1% of the gainfully employed (Thompson 1969:352-353). This does not mean people were not availing themselves of inshore resources, only that fishing of any kind was not considered a way to make a living in 1930. It is more likely that inshore fishing was a supplement to the diet of those with access to the sea.

On Orote Peninsula, a *barrio* of Agat called Sumay village, was a bustling port town during the whaling era in the 1840s. Later, under the Americans the village became important as a telegraph station, a Pan American Airways station, a U.S. Marine seaplane base, and a fuel storage area. By 1930 1,209 civilians lived at Sumay, the majority of them Chamorros. Military personnel were also stationed there and at other naval reservations in the island; their numbers are not given by village in the census. Sumay village included the forested limestone plateau of Orote Peninsula where people had farms and a long shoreline that gave direct access to the shallow reefs of Apra Harbor on the north and east and to deeper waters on the south and west. Therefore, it is likely that in addition to port-related commerce, the Chamorros were able to do some inshore fishing and shellfish collection.

Oral histories collected by J. Amesbury (1996a:26-30) indicate that during this time, local people harvested bivalves, especially *Anadara* at Piti, and they fished inshore at Agana. Large sacks of bivalves were transported to Agana for sale. However, shellfish were not an important item for those with their own farms, where they had "many other things to eat." Carolinian people were more likely to collect shellfish, according to Amesbury's informants.

According to the 1940 census, 15 municipalities and districts were enumerated and the population density of Guam had risen to 40.6 per km^2. The two main trails leading out of Ritidian and Tarague no longer originated in those embayments. The two roads out of Tumon Bay still existed, however. Population was more concentrated in and near Agana (63%), and a large proportion of food was imported despite government efforts to encourage local production (Thompson 1969:133-136).

Just prior to World War II, most of the population lived in central Guam (63%), primarily in Agana; 29% lived in the south, and only 8% lived in the north. This distribution changed in later decades, primarily due to Japanese and then American military occupations. According to *A Statistical Profile of the Territory of Guam, 1920-1980* (Interagency Committee on Population 1988:23), wartime and post-war activities caused certain villages to lose all civilian inhabitants and Agana became nearly deserted. During the war, occupants of the village of Sumay at the port were evicted, replaced by Japanese soldiers. Imported food supplies practically disappeared, and most Chamorros "reverted to living off the sea and the land in subsistence farming and fishing" (Rogers 1995:171). This pattern was corroborated by oral histories (J. Amesbury 1996a).

In the post-war years sizable concentrations of military personnel occurred in and near military bases. Civilian workers also lived near the bases. About one-third of Guam's land and water resources were taken for military purposes; these included the Fena area, inland of Agat and formerly used for cattle ranching and farming; the Apra Harbor area, a rich source of inshore fish and shellfish; and most of the embayments in northern Guam. From little apparent use for subsistence purposes, the northern embayments became recreation areas for the military, and a large proportion of the reefs and shoals of Apra Harbor were destroyed by dredging and filling as the naval station and commercial port expanded.

The rebuilding of Guam in the 1950s was accomplished by thousands of laborers, many recruited from the Philippines. A large number of these people stayed and raised families, thus forming an important political component in the post-war Guam society and maintaining strong economic and social ties with Asia. Statesiders, some in partnership with local families, started retail and construction businesses, and professionals from U.S. jurisdictions were recruited to fill top public sector jobs in education and medical services. Chamorros were employed in lower-paying government jobs that nonetheless came with generous benefits, hence public sector employment was the key to economic security. American military men, many of whom married locally, retired on Guam, also helping to form a heterogeneous population in which Chamorros remained a majority but a smaller one compared with earlier times.

By 1970 the northern plateau was becoming the new population center of gravity, growth occurring especially in the villages of Tamuning and Dededo. Military activities related to the on-going war in Vietnam introduced new stresses on the island's economy, including drug dealing and addiction. At war's end in mid-decade, a huge influx of Vietnamese refugees (at times between 65,000 and 80,000) temporarily raised the island's population, taxing all basic services and creating serious disease threats (Mackie 1997). A spraying program to eliminate the threat of dengue fever and malaria caused temporary loss of fish stocks at one lagoon near East Agana Bay.

Sewage pollution from a refugee camp at Orote Pt. required closure of the beaches nearby, and large quantities of food and other materials were imported by the government to accommodate the refugees in the camps. Vietnamese were also housed among the civilian population in dozens of locations throughout the island. The large refugee population and its needs probably affected local food consumption patterns to some extent. Oral histories could reveal more information in this regard.

By 1980, the refugee camps were empty and the total population of Guam was 105,979, the north accounting for 45%, compared with 8% in 1940. The central area, including Agana, had declined to 33%, compared with 63% in 1940 (Interagency Committee on Population 1988:23). At 193 persons per km^2, the population was predominantly urban and engaged in wage work. An agricultural census for 1978 (U.S. Dept. of Commerce 1980) indicates that most farms then were small (less than 1 ha), and most owners engaged in farm work only part-time. Fishing activities are not reported in this document, but it is safe to assume that very few island residents were employed as fishermen. Knudson (1987) found that recreational and subsistence-supplemental fishing from boats and inshore occurred at Guam. The catches were distributed by informal barter and kin-based sharing, as was suggested above for the Northern Marianas in recent decades.

Late in the 20th century, Guam's population rose to 133,152 in 1990 and 154,805 in 2000 and the economy fully wage-based. In 2000, Chamorros comprised 37% of the total, Carolinians 0.1%, and Filipinos 26%. Fishing, farming, and forestry jobs occupied only 0.4% and government jobs 27% of the labor force of 57,053. The latter proportion is double that of the Northern Marianas, reflecting the larger size and complexity of government in Guam. Immigration into Guam from the Federated States of Micronesia (FSM) increased with the conclusion of the Compact of Free Association in the early 1980s, and citizens of the FSM have occupied many of the lowest-paying jobs. However, Guam's economy for the past several years has weakened, and many have lost their jobs or have had their work hours reduced. Possibly this has had the effect of increased utilization of inshore fisheries, seen in the increasing proportion of reef fish catches over the same period.

The U.S. military retains about one-third of the island, which includes beaches in the north and at Orote Peninsula and along the coast north of the naval station at Piti. This pattern has effectively precluded use of these marine habitats for subsistence or commercial purposes. Marine preserves recently established throughout the island prohibit fishing, in a government attempt to build up stocks. Some information on casual and subsistence-supplemental fishing by Chamorros, other Micronesians such as the FSM citizens, and other Guam residents is available (e.g., Callahan 1977; Jennison-Nolan 1979; Knudson 1987;Vaughn 1999), and more could be learned in future studies aimed at illuminating these issues.

In sum, Guam's historic experience as the largest island in the Mariana archipelago and the seat of colonial governments for over three hundred years included a series of drastic population and cultural changes. Early in the Spanish Period there were population losses from epidemic diseases, population additions from the Northern Marianas during the *reducción*, and after World War II there was massive immigration from the Philippines, followed by temporary surges at the end of the Vietnam War. Early cultural losses include sea-going capability and the customs associated with pelagic fishing and canoes. Inshore fishing remained an integral part of Chamorro culture until mid-century. However, introduced game and livestock had already altered the Chamorro subsistence orientation, and dependence upon imported foods accelerated under American administration, particularly after the war.

Like that of the Northern Marianas, the overall 20th century picture for Guam is one of declining use of inshore marine resources and markedly higher population densities after World War II. Post-war land takings by the U.S. military, the building of roads, power and water systems, and modern housing and commerce have all contributed to cultural shifts including dietary ones, away from locally produced foods of all kinds, including reef fish. The recent immigration of Pacific islanders into Guam and the current economic downturn may be causing an increase in the taking of reef fish, both for subsistence and for local sale or barter.

METHODOLGICAL PROBLEMS WITH THE ARCHAEOLOGICAL AND PALEO-ENVIRONMENTAL RECORDS AS INDICATORS OF PAST CULTURAL PRACTICES

Archaeology

Archaeological sites dated to the Pre-Latte Phase are rare, and therefore modern studies of this period have yielded fewer facts than has work at the more numerous Latte Phase sites. Pre-Latte sites tend to be smaller, and they are buried beneath later deposits. Late prehistoric deposits are generally thicker, better preserved, and more easily approached. Sites from the two eras are not necessarily isomorphic. For example, a small Pre-Latte Phase site might be found underneath a large Latte Phase site, or a Latte Phase site may occur by itself without a lower Pre-Latte component. Occasionally one finds a Pre-Latte Phase site without a Latte Phase component above it. Historic disturbances to prehistoric sites began with the Spanish Period, when some coastal villages developed in response to trade and government needs. Later disturbances occurred during World War II and its aftermath.

Most prehistoric sites in the Marianas have been studied as part of construction projects, rather than as the subject of a research effort. The government recognizes the cultural historic value and information potential of these sites, and laws are in place to preserve and protect them. However, the laws have not been effectively enforced, and minimal compliance has been the norm. Therefore the amount and quality of the data that can inform on past subsistence practices is limited at best, and in many cases is inconsistently reported from one project to the next.

While the archaeological and paleo-environmental records do contain information potentially useful for inferring prehistoric subsistence practices, including patterns of inshore fishing and consumption in Guam and the CNMI, caution is required when attempting to interpret these data, particularly when presented quantitatively. For example, there are no well-warranted assumptions and principles to guide our understanding of counts and weights of archaeologically retrieved fish remains and similar information on sea mammal and turtle bone and mollusks.

Direct connections cannot be made between the number, weight, or density of fish bone, sea mammal bone, or mollusks found in archaeological sites and the likely quantities of these resources that were obtained and consumed by the prehistoric islanders. A common error has been to infer overharvesting of a given species or group due to declining numbers of target species within a temporal sequence without regard to changing habitat of the species. Altered fishing strategies in response to changed social or other conditions impinging upon the harvesters are also rarely considered, but these possibilities should not be ignored.

Another potentially misleading aspect of archaeological fauna (and artifacts for that matter) is differential preservation and fragmentation patterning. A simple but probably wrong assumption often made is that abundance in the cultural deposit reflects dietary importance or the prominence of a given activity. In the case of mollusks this is clearly a dangerous surmise. Most mollusks yield relatively little meat per individual, and the ratio of shell weight to meat weight is generally high. Thus, abundant mollusk shells by count or by weight do not necessarily reflect anything but this fact. Similarly, numerous pottery sherds in a deposit might represent only two or three whole pots, deposited at the site sometime within a period of decades or even centuries.

Despite these methodological problems, counts and weights can be informative regarding the types of marine resources utilized in the past and, as indicated above, regarding marine habitat changes over time. Long-term subsistence exploitation of fish and invertebrates can be studied through analysis of their remains at different kinds of sites and through time (Dalzell 1998). Potentially, ethnographic and historical studies can inform such analyses by providing cultural-ecological contexts for observed practices, and thus enable realistic modeling of exploitative behavior in the past. From a general review of available information regarding human exploitation of coastal ecosystems (Jackson et al. 2001), it appears that truly major damages to inshore fisheries began no earlier than the 18th century, and frequently much more recently, with commercial exploitation.

An alternative avenue for pursuing the meaning of marine resources data from archaeological sites is through the study of prehistoric settlement patterns combined with known ecological relationships between the proportion of dietary sea protein vs. land area and human population size (Bayliss-Smith 1975, 1980). Thus for the rare sites dating to the early Pre-Latte Phase, which only occur along formerly narrow coastal strands, an expectation of low human density and heavy reliance on marine resources might be justified. Further to this aim, ecological niche-relevant concepts such as source and sink habitats and populations (e.g., Pulliam 1988) could be applied.

Practically speaking, useful data on marine resource remains, even of the most rudimentary kind, are often lacking in Marianas archaeological reports. In part this is due to the nature of the local archaeological projects that have been undertaken over the past thirty years. These have been either inventory surveys with limited test probes (shovel tests or one or two hand-excavated one-meter square units) or salvage projects of extremely limited areal extent. The test probes never yield quantities large enough for statistical comparison. Inventory surveys are aimed at determining how many and what kinds of sites are present within a given parcel but do not generate quantitative data on site contents. Salvage work rarely enjoys funding for spatially extensive excavations, the emphasis being upon quick and minimal data recovery and minimum reporting for compliance rather than problem-oriented research.

The technical literature generated in archaeological salvage projects is thus flawed from the point of view of the present project goals. When reported in compliance documents, marine resources data are not usually presented in enough detail and with enough consistency to correlate their frequency or density with dated layers and levels at a site by species, genus or family. Given these limitations, it is sometimes impossible to discern whether inshore and/or pelagic species were excavated at a given site locus or whether other marine resources, such as turtle, were found in association.

An additional problem with salvage project-generated data is that the remains have been retrieved from a relatively small proportion of the total site. This may be due to limited funding or from a regulatory restriction to confine investigations to the areas of "direct impact" by the construction project, for example, building footings and utility line corridors. Since past human activities can vary greatly across a single site, creating a complex pattern of deposits and features, few reliable inferences can be made from spatially restricted excavations.

In addition to time and funding limitations, there is the problematic notion of "sampling" archaeological sites. In effect this has meant that the archaeological data available to generalize about a given site have been retrieved from a small number of hand-excavated units, usually measuring one meter square and placed randomly or where it was thought buried cultural material would be relatively dense on the basis of surface manifestations. This tactic has been used at open sites where the cultural deposits occur over an area of several hundred square meters and in smaller sites such as rockshelters. This kind of "sampling" misses a significant amount of information about the total site contents, since it has long been known that surface artifact distributions are unreliable indicators of the occurrence of subsurface artifact distributions. Sampling can be useful if designed to learn about the structure of a site. Once the site structure is indicated by the sampling results, a more systematic data collection program can be designed and implemented. Unfortunately this next step has been lacking in Marianas archaeological projects.

In sum, the available archaeological data regarding the prehistoric uses of marine resources and any possible changes in these uses over time are ambiguous and need to be approached with care. We have undertaken this review with an awareness of the data limitations, and any conclusions we reach should be considered tentative.

Sediment Cores

Paleo-environmental records such as pollen and spore frequencies in sediment cores taken from river deltas and other wetlands provide information on vegetation present within catchments over time. However, the causes of apparent stability and change in these spectra (usually identified palynomorphs are expressed as percentage frequencies at various points sampled along the core) are ambiguous at best. Wetland environments and the behavior of sediments within a catchment can change due to a variety of causes, including global and regional climate oscillations and directional trends, sea level changes (sea lowering, uplift), successional processes, earthquakes and typhoons (both common in the Marianas), and altered erosion patterns due to these events. A sediment core is a summation of one or more of these processes and cannot be read as a simple accumulation of palynomorph-laden sediments over time in a stable catchment. These problems are recognized by paleo-environmental professionals but sometimes are ignored by archaeologists attempting to interpret the cores in human behavioral terms (see below).

Yet another methodological problem associated with paleo-sediment cores is their calibration, the time scale against which percentage frequencies of pollen, spores, and charcoal particles are arrayed for study and interpretation. In addition to factors such as the seismic instability of Marianas coastlines and the dynamic nature of rivers, streams, estuaries and deltas, precise calibration of the cores (hence of inferred vegetation changes) is hampered by the small number of radiocarbon dates usually obtained for a given core; either the budget did not allow researchers to date enough samples or suitable dating samples did not occur at enough places along the core. For example, four dates were obtained on a 35 meter-long core in the upper Pago River in southeastern Guam, encompassing an eleven thousand year period (Ward 1994). From these dates the analyst constructed a linear depth-age curve to calibrate the core, an average of one date for every 2,750 years. Given such a "loose" time frame, only gross trends can be discerned, and their significance remains obscure. A somewhat finer calibration of a 30 meter-long core from the lower Laguas River in southwestern Guam was obtained by Athens and Ward (1999), where ten dates encompass the last ten thousand years. From these dates a depth/age curve with more changes in accumulation rates was constructed.

Both the Pago and Laguas cores reveal a trend toward more open vegetation indicators entering the cored sediments after c. 4500 BP, including the spores of the savanna fern *Gleichenia linearis* and grass pollen. These forms are present throughout the cores, suggesting the existence of interior grasslands from at least the early Holocene but perhaps an increase in open vegetation in the mid-Holocene. Charcoal particles in the two cores first appear at 4300 BP and 4500 BP, respectively. The authors propose that taken together these observations mean that people had arrived c. 4500 BP if not before, and had proceeded to clear interior forests for agriculture, using fire—hence the charcoal particles seen in the core.

There are several ways in which this scenario of post-mid-Holocene human-caused ecosystem change is dissonant with reality. First, the archaeological record, a direct indication of human presence, shows that initial human settlement was coastal and began about a thousand years after the alleged forest clearance is said to have begun; the earliest known archaeological sites in the Marianas date to c. 3500 BP. Second, the earliest settlements are small and situated on what were narrow beaches and shallow marine lagoon edges.

The coastal locations and artifactual contents of these sites suggest a maritime subsistence orientation rather than a land-based mixed fishing and farming economy, which did characterize the late prehistoric adaptive system. Had intensive use of the interior forests for farming (assumed to necessitate systematic forest clearance by fire) been part of the earliest (Pre-Latte) adaptive system, there should be some interior camps and/or substantial settlements dating to this time period, yet none has been found despite many surveys. The earliest interior sites date to c. 2000 BP, and these sites are small rockshelters probably used during foraging.

Third, charcoal particles in the cores indicate fire, but not how the fires started, nor where. If the charcoal particles derived from local fires, active volcanoes in the Northern Marianas may have been a source of sparks that ignited local fires. A strong possibility is that following the hyper-arid mid-Holocene in the tropical Pacific, one or more severe droughts associated with the El Niño weather system created the physical conditions for catastrophic fires throughout the region beginning c. 4500 BP (see Nunn et al. 2001), leading to local extinctions of some forest species and other ecosystem changes.

With or without catastrophic drought, a possible mechanism for igniting fires given sufficient fuel is oxygen-induced spontaneous combustion. Under heat stress, respiring plants give off increased amounts of oxygen. Oxygen-rich air formed at the live bases of grass plants, such as *Miscanthus*, where detritus has accumulated could ignite once a high enough proportion of oxygen is present. This is a possible mechanism that could have maintained grasslands prior to human arrival, as well as during human times. As Nunn (1991) has pointed out, natural processes do not cease to operate because people are present!

Finally, it should be kept in mind that dating of the apparent shifts in vegetation exhibited by palynomorphs in these cores is imprecise. The frequent use of Interpolated Age (I.A.) for those portions of the core between radiocarbon-dated materials acknowledges the uncertainty in accurately tracking temporal trends in the palynomorphs observed in sediment cores for which few radiocarbon dates are available. Bulk soil dates combine carbon from more than one source and probably more than one age, making the dates a "compromise" of sorts. Athens et al. (2002) tried to overcome this problem by dating only terrestrial plant material such as stems and twigs from short-lived species. Ideally enough of such dates would enable less imprecise core calibration but such datable items are not always present in a core.

Directly radiocarbon dating pollen within soil samples along a core is another method that has been tried (Hunter-Anderson and Moore 2000:76). Pollen of different sizes in a sample from the base of an 80 cm-long core taken in a wetland in interior southern Guam was dated by AMS. Three extracts were made from the sample: the small-sized fraction gave a considerably older prehistoric date than did the medium-sized fraction, and the large-sized fraction, which contained some stems and twigs, produced a modern date. Possibly the stems and twigs had migrated downward in this core over time, or the sediments were mixed due to recent disturbance such as carabao trampling. Knowing the deposition conditions is important in correctly interpreting the results of coring, and ideally analysis should be limited to sediments known to be undisturbed. Dating experiments such as this one can help with such an assessment, much as multiple dates from stratigraphic excavations at archaeological sites.

CONCLUDING REMARKS

The above methodological problems notwithstanding, all sources of information about past environmental conditions should be investigated, but with the realization that the data can be misleading if not analyzed appropriately. With reliable environmental facts and an anthropological understanding of tropical island cultural systems, one can start to realistically model past human responses to changing environmental circumstances, some of which we already know were relatively dramatic, especially sea level fluctuations.

The historical documents pertaining to the Marianas, which vary in degree of accuracy and comprehensiveness, span nearly five hundred years. Carefully interpreted, they can be another source of information on environmental conditions and human responses to them. Although not usually quantitative, they contain eyewitness accounts of earthquakes, droughts, and tropical storms, and they sometimes directly indicate local responses and even their effectiveness.

More research into both the paleo-environmental and historic records is likely to yield a better understanding of the adaptive contexts within which the pre-European Marianas cultural system evolved. From this baseline of understanding, historic changes including shifts in the use of inshore marine resources will be better accounted for. Oral histories are a potential source of information as well, about past environmental conditions and human responses to them.

CHAPTER 2. PREHISTORIC PERIOD

By Judith R. Amesbury

FISH REMAINS AND FISHING GEAR FROM GUAM

The following review of the archaeological literature with regard to fish remains and fishing gear from Guam begins with the site of Pagat on the eastern coast of northern Guam, continues counter-clockwise with sites around the northern part of Guam (Tarague and Ritidian) and along the west coast from north to south, where most of the archaeological work in Guam has been done, and concludes with the inland southern Guam sites of Manenggon Hills (Figure 3).

The dates for the sites can be interpreted in terms of the phases of Marianas prehistory. In 1957, Spoehr proposed the terms Pre-Latte Phase and Latte Phase. Moore (1983) sub-divided the Pre-Latte Phase into Early Pre-Latte, Intermediate Pre-Latte, and Transitional (Table 2, Figure 4).

Table 2. Spoehr's (1957) Broad Phases of Marianas Prehistory as Subdivided by Moore (1983).

Spoehr's Phases	Moore's Subdivisions	Dates Proposed by Moore
Pre-Latte Phase	Early Pre-Latte Phase	Prior to 1485 BC to 500 BC
	Intermediate Pre-Latte Phase	500 BC to AD 1
	Transitional Phase	AD 1 to AD 500-1000
Latte Phase	Latte Phase	AD 1000? to Contact (AD 1521)

Pagat

The fish bone from the Pagat excavations, conducted by the Guam Territorial Archaeology Laboratory, was identified by the Department of Anthropology of the University of Otago, New Zealand, and reported by Craib (1986). Horizon I yielded 2858.6 grams of fish bone with a density of 187.20 grams per cubic meter. Horizon II yielded 1789.7 grams of fish bone with a density of 378.37 grams per cubic meter. Five radiocarbon dates were obtained from Horizon I. They range from AD 1080-1310 to AD 1520-1640 (Latte Phase and early Historic Period). The single date from Horizon II is a late Pre-Latte date (AD 770-970). It appears, then, that the Pre-Latte deposits had a higher density of fish remains, although the Latte deposits yielded a greater quantity. The areal extent of the Pre-Latte deposits was much smaller than that of the Latte deposits.

Thirteen families were identified and grouped by habitat (inshore, benthic, or pelagic). Minimum Number of Individuals (MNI) and percentage by MNI were calculated (Table 3). Inshore fishes account for 86 percent of the MNI; benthic fishes make up 9 percent; and pelagic fishes 5 percent. All except the pelagic fishes could have been taken from the immediate environs of Pagat. The inshore and benthic fishes could have been taken by angling or spearing, and the pelagic fishes by trolling.

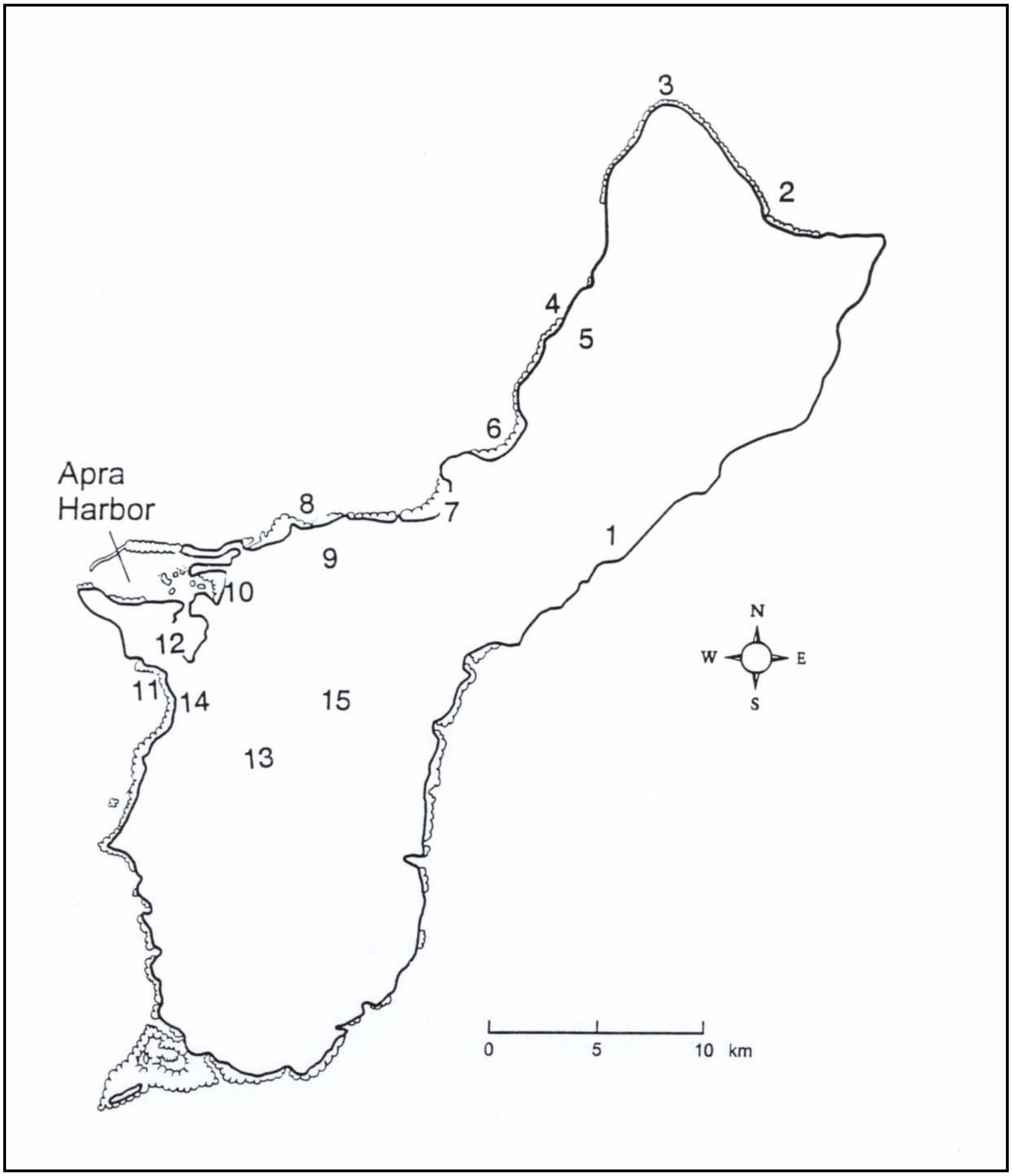

Figure 3. Guam, showing the areas discussed in the text. 1 = Pagat, 2 = Tarague Beach, 3 = Ritidian, 4 = Former FAA Housing Area, 5 = North and South Finegayan, 6 = Tumon Bay, 7 = Agana Bay, 8 = Asan, 9 = Nimitz Hill, 10 = Sasa Valley and Tenjo Vista Fuel Tank Farms, Piti, 11 = Orote Peninsula, 12 = Waterfront Annex, 13 = Ordnance Annex, 14 = Agat/Santa Rita, 15 = Manenggon Hills.

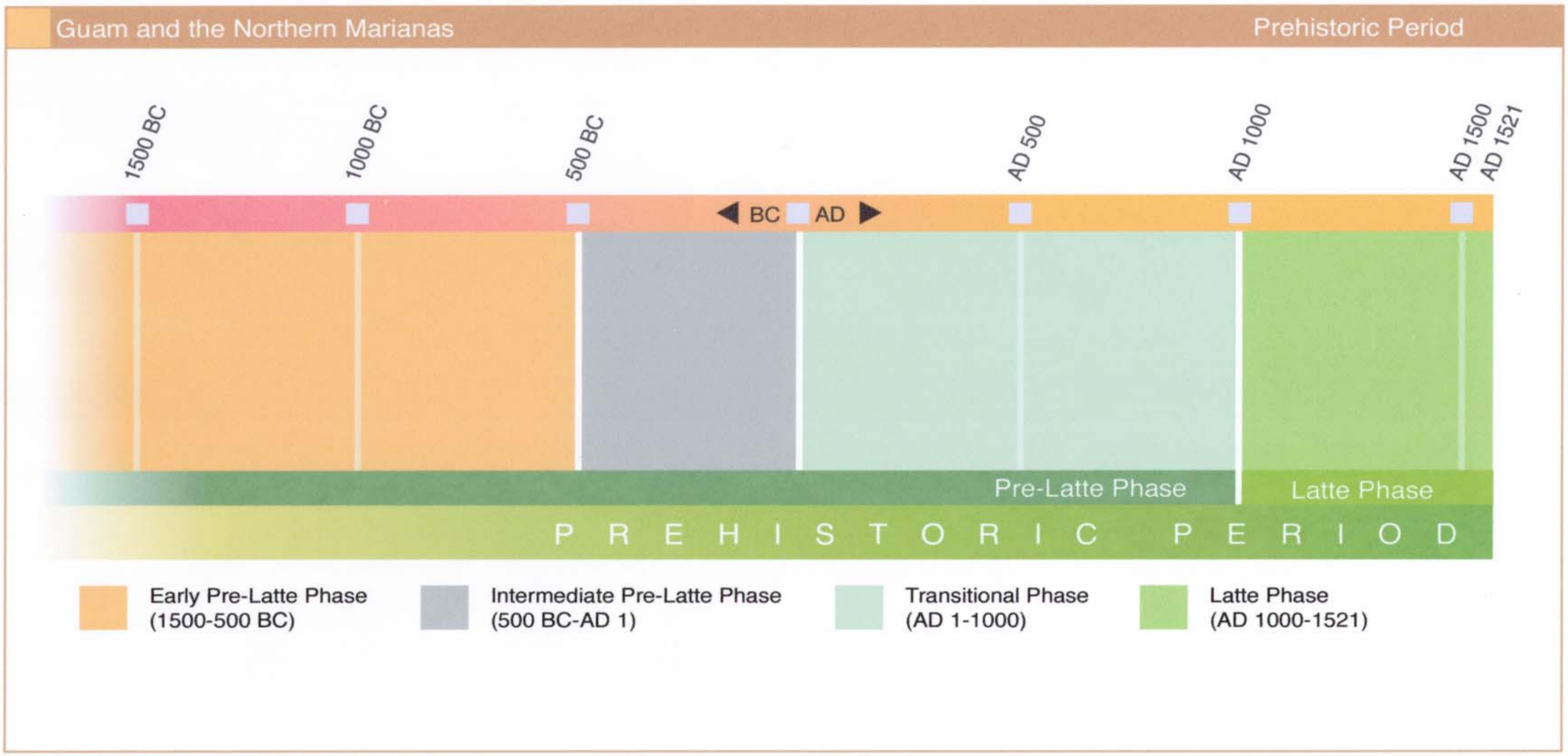

Figure 4. Spoehr's (1957) broad phases of Marianas prehistory as subdivided by Moore (1983). Illustration by Robert Amesbury.

Table 3. Minimum Number of Individuals and Percent by MNI of Fish Remains Identifiable to Family from Pagat, Guam. Data from Craib (1986).

Habitat	Family	MNI	Percent
Inshore	Balistidae (triggerfishes)	64	35
	Scaridae (parrotfishes)	42	23
	Lethrinidae (emperors)	22	12
	Labridae (wrasses)	16	9
	Acanthuridae (surgeonfishes)	12	6
	Carangidae (jacks)	1	0.5
	Diodontidae (porcupinefishes)	1	0.5
Benthic	Serranidae (groupers)	11	6
	Lutjanidae (snappers)	3	2
	Holocentridae (squirrelfishes)	2	1
	Pempheridae (sweepers)	1	0.5
Pelagic	Coryphaenidae (*mahimahi*)	8	4
	Istiophoridae (marlins and sailfishes)	2	1
Total		185	100

Fishing gear collected from the excavations includes 31 gorges (apparently *Isognomon*), 8 hooks (both *Isognomon* and *Turbo*), 14 bone points from composite trolling lures, a possible shank for a composite hook, and 14 worked pieces of limestone and shell that were classified as weights. In addition, there were 79 whole and fragmentary bone awls or needles, all from Horizon I. Craib refers to these tools as "weaving/thatching tools" (Craib 1986:222). They may have functioned in making and repairing fishing nets. A photograph of a net repairing tool, known as *haguhan* in Chamorro, is shown in Fritz (2001:72), and a net repairing needle is shown in the original illustration from Fritz's 1904 journal article (Fritz 1989:43).

Tarague Beach

Tarague Beach is located on the northeast coast of Guam adjacent to the reef flat and a natural channel through the reef. From the archaeological excavations conducted there by Kurashina et al. (1987), S. Amesbury (1987) analyzed 7,002 fish bones from 27 excavation units and eight depositional layers. More than 40 percent of the bones were vertebrae or vertebral fragments (Table 4). Mouthparts numbered 337 or 4.8% of the total. Caudal blades of surgeonfishes of the genus *Naso* numbered 11 or 0.2% of the total.

Mouthparts from parrotfish (family Scaridae) were the most numerous (n = 217 or 64.4%) of all mouthparts. The percentage of parrotfish mouthparts among the total mouthparts increased through time, from a low of 54.2% in Layer VIII to a high of 75.7% in Layer I. Other families of fishes identified by mouthparts and the number of mouthparts include the Serranidae (groupers) 32, Labridae (wrasses) 18, Lethrinidae (emperors including *Monotaxis grandoculis*) 4, Diodontidae (porcupinefishes) 2, and Hemiramphidae (halfbeaks) 2. Undoubtedly additional families were represented by the bone fragments, but only the genus *Naso* (family Acanthuridae) was identified by a part other than a mouthpart.

Table 4. Fish Bones from Tarague, Guam, Analyzed by S. Amesbury (1987). Layer I is the uppermost layer; Layer VIII is the deepest.

	Layer I	**Layer II**	**Layer III**	**Layer IV**	**Layer V**	**Layer VI**	**Layer VII**	**Layer VIII**	**Total**
Number Fish Bones	849	290	1101	1	1000	1068	1898	795	7002
Number Units	17	3	2	1	10	7	7	7	
Bones per Unit	49.9	96.7	550.5	1.0	100.0	152.6	271.1	113.6	
Vertebrae	349	179	614	1	443	271	676	285	2818
Mouthparts	103	14	50	0	36	26	84	24	337
Scaridae Mouthparts	78	10	30	0	21	18	47	13	217
Other Identifiable Mouthparts	14	3	10	0	6	6	13	6	58
Unidentified Mouthparts	11	1	10	0	9	2	24	5	62
Naso Caudal Blades					2	1	8		11

Most of the vertebrae are relatively small (modal centrum diameter = 4 mm). These vertebrae probably derived from reef fishes. A few large vertebrae with centrum diameters up to 25 mm were recovered. Although these could not be identified, their size indicates they are from pelagic fishes such as tuna, wahoo, and barracuda. Under **Tumon Bay** below is a comparative discussion of sizes of vertebrae from Tarague and other Guam and Micronesian sites.

Diameters of vertebral centra are generally proportional to the size of the fish from which they come; thus the distribution of centrum diameters from a midden sample gives some idea of the sizes of the fishes being harvested. In other words, centrum diameter can serve as a proxy for fish size. Comparison of the distributions of centrum diameters from different sites provides information of the relative sizes of the fishes harvested at the various locations.

So far, centrum diameter distributions have been recorded for three sites in Guam (Tarague, Ritidian, and Naton Beach), and these distributions suggest that the sizes of the fish being harvested at two sites (Tarague and Ritidian) are very similar, and that at the third site (Naton Beach) slightly smaller fishes were harvested. There is a notable contrast between the sizes of fishes harvested at these three Guam sites and those harvested at a site in Chuuk for which data are available.

Moore (1983:65) reported three radiocarbon dates from the South Profile at Tarague. Charcoal from Layer I yielded a date of 1150 +/- 80 BP or AD 800. Fish bone from Layer V yielded a date of 2100 +/- 270 BP or 150 BC, and fish bone from Layer VII was dated to 3060 +/- 350 BP or 1110 BC. These dates encompass both the Pre-Latte and Latte Phases.

Moore (1983:183-185) also reported on six shell fishhooks and gorges from Layers I, III, and VII, as well as two bone awls "or thatching needles" from Layer I. The bone awls may have been needles for net making and mending.

An earlier excavation at Tarague Beach (Ray 1981) had recovered numerous fishhooks and gorges of *Isognomon* and *Turbo*; 89 such items are illustrated. In addition a human bone point of a composite hook, a bone fishing spear point, and five stone sinkers were collected.

Subsequent archaeological research at Tarague (Liston 1996) recovered 253.64 grams of fish bones from 11 units at five sites. Dr. Alan C. Ziegler identified the following families: Acanthuridae (surgeonfishes), Balistidae (triggerfishes), Carangidae (jacks), Cirrhitidae (hawkfishes), Congridae (conger eels), Exocoetidae (flyingfishes), Holocentridae (squirrelfishes), Kyphosidae (rudderfishes), Labridae (wrasses), Lethrinidae (emperors), Lutjanidae (snappers), Mullidae (goatfishes), Muraenidae (moray eels), Scaridae (parrotfishes), Serranidae (groupers), as well as marine eel and shark (not identified to family). Weights of fish bones by unit and level and by family are given in Appendix C (Liston 1996:441-455).

Nine radiocarbon dates were obtained from three of the Tarague sites that yielded fish bone (Liston 1996:213). The calibrated (2 sigma) dates range from 1023-427 BC to AD 1651-1995, encompassing all but the earliest centuries of the human occupation of Guam. No attempt was made in the report to correlate the weight of fish remains with the radiocarbon dates, but that work could be done in a future analysis.

Ritidian

S. Amesbury (1989) also analyzed fish remains from the archaeological excavations by Kurashina et al. (1989) at the Naval Facility, Ritidian Point, the northernmost point of Guam. Fish bones from Test Areas 1 through 7 totaled 1,017. There were 34 bones from other proveniences. Most of the bones (n = 1005) came from Test Areas 4, 6, and 7. There were also 313 fish scales from Test Areas 3 and 6.

Six families of fishes were tentatively identified from the 30 mouthparts. They are Acanthuridae (surgeonfishes), Labridae (wrasses), Lethrinidae (emperors), Lutjanidae (snappers), Scaridae (parrotfishes), and Serranidae (groupers). Half of the identifiable mouthparts (13 of 26) were from the parrotfishes. Four mouthparts were indeterminate. A seventh family, Balistidae (triggerfishes), was identified from two spines.

Sixty-one vertebrae had centrum diameters of 12 mm or less. One vertebra and 51 fragments had centrum diameters of 19 mm or more. All of the large vertebrae derived from Test Area 4. While it is possible that these large vertebrae came from reef fishes such as large parrotfishes or humpheaded wrasses (*Cheilinus undulatus*), it is likely they are from pelagic species (S. Amesbury 1989:215). The vertebrae from Ritidian are included in the comparison of vertebrae under **Tumon Bay** (below).

Charcoal from Test Area 4, Layer 7, the layer with the greatest number of fish bones, yielded a radiocarbon date (C13 adjusted) of 660 +/- 70 BP or AD 1290 +/- 70 (Kurashina et al. 1989:180). Charcoal from Test Area 7, Layer 2, yielded a C13 adjusted date of 750 +/- 50 BP or AD 1200 +/- 50. Both areas appear to date to the Latte Phase.

Former FAA Housing Area (Guam Land Use Plan Parcel N2)

J. Amesbury (2001a) reported 33.5 grams of fish remains from five sites in GLUP Parcel N2, the former FAA Housing area, on the northwest coast of Guam. From those remains, Ziegler identified seven families (Acanthuridae, Balistidae, Holocentridae, Labridae, Lutjanidae, Scaridae, and Serranidae). Ziegler also estimated the length of the fish based on the size of 44 vertebrae; 41 indicate fish that were 10-30 cm in length, and three indicate fishes that were 30-45 cm long. No vertebra measures more than 10 mm in centrum diameter, and 31 of the 44 vertebrae measure 5 mm or less in diameter.

Ten radiocarbon dates were obtained from four of the five sites that yielded fish bones (Hunter-Anderson et al. 2001: 134). The calibrated radiocarbon ages (2 sigma) range from 810-755 BC to AD 1650-1955, covering much of the Prehistoric and Historic Periods.

North and South Finegayan, Communications Annex

North and South Finegayan are directly north and south of the former FAA Housing (above). From sites at Pugua Point and Haputo embayment in North Finegayan and Hilaan embayment in South Finegayan, Olmo et al. (2000) recovered 677 fish bones. The following families were identified by Ziegler: Acanthuridae, Balistidae, Carangidae, Coryphaenidae, Diodontidae, Fistularidae, Holocentridae, Labridae, Lethrinidae, Lutjanidae, Mullidae, Scaridae, Scombridae, and Serranidae. Most of the vertebrae indicate fishes with lengths of 10-15 cm or 25-30 cm.

Citing Davidson and Leach (1988:350), Olmo et al. (2000) suggested that the families present indicate four types of fishing: 1) nets (acanthurids, balistids, mullids, and scarids), 2) demersal baited hooks (labrids, lethrinids, lutjanids, and serranids), 3) pelagic lures (carangids, coryphaenids, and scombrids), and 4) general foraging (diodontids, fistularids, and holocentrids).

Seven radiocarbon dates were obtained, most from coconut shell. The 2-sigma calibrated results range from AD 970-1025 to AD 1935-1950, covering most of the Latte Phase and the Historic Period.

Tumon Bay

When Leidemann (1980) inventoried the materials from the Ypao Beach excavations, she counted non-human bones and teeth, but she did not distinguish between fish and other non-human animals, such as fruit bat and rat, which may have been present, though probably as minor components within the bone assemblage. She found the greatest number of non-human bones in test squares B through B6. These units also had the greatest numbers of fishhooks (19 out of the 24 total), shell adzes, worked shell pieces, and *Isognomon* fragments. She concluded that these units represented a specialized work area related to fishhook manufacture and fish preparation or disposal, and she estimated that these units dated to AD 845 or more recent times (Leidemann 1980:92).

In the *Tumon Bay Area Overview*, Graves and Moore (1985) also reported counts of non-molluscan faunal remains without distinguishing between fish and other animals. These authors found that the non-molluscan remains were more numerous in the Pre-Latte units, although they did not suggest this indicates a decline in fishing during the Latte Phase. They suggested instead "an organizational shift over time from processing and disposing fish in general domestic contexts to more specialized fish exploitation and utilization" (Graves and Moore 1985:145). That explanation would fit with Leidemann's suggestion that the Ypao Beach Latte Phase test squares B through B6 represented a specialized work area.

From seven excavation units at Sandcastle, 59.2 grams of fish bone were recovered (Moore et al. 1990). The remains that could be identified were two mouthparts of parrotfish (family Scaridae) and a spine from a triggerfish (family Balistidae). Thirty-two vertebrae were measured. Maximum diameter of centra range from 3 to 12 mm, with what appears to be a bi-modal distribution. Fifteen vertebrae measure 4 or 5 mm, and 11 vertebrae measure 9 or 10 mm.

Sixty-four percent (38.0 grams) of the fish bone came from Unit 6, which also yielded a fishhook fragment, a large unfinished fishhook and a fishhook blank, all of *Isognomon* and more than 200 grams of *Tridacna* shatter. The fishhooks, as well as most of the other *Isognomon*, most of the *Tridacna*, and most of the fish bone were from Layer II. Based on the radiocarbon date from Layer I of Unit 6, Moore et al. (1990:40) suggested that Unit 6 might have been a fishing gear manufacturing area prior to AD 1050.

From the excavations at the Pacific Islands Club (PIC), Moore et al. (1993) recovered 35.4 grams of non-molluscan faunal remains in 580 liters of soil. Included with the fish remains were rat teeth and bones, a fruit bat tooth, and unidentified small mammal bones. Identifiable fish remains included mouthparts of parrotfish (Scaridae) and wrasse (Labridae), a shark tooth, and a spine of a surgeonfish (Acanthuridae).

Since other bones were combined with the fish bone, it is difficult to say which PIC unit had the greatest quantity of fish bone, but it appears that Biofilter Trench Sample 7 did. Samples 5, 7, and 8 differed from the other PIC units with regard to the mollusks. Those three samples had higher percentages by weight of bivalves, greater diversity of families, and an unusually large quantity (more than 500 grams) of *Isognomon*, including many worked pieces. Samples 5, 7, and 8 also yielded 15 shell beads and some worked *Tridacna*. Moore et al. (1993:111) concluded that Samples 5, 7, and 8 were either older than the other PIC units, and/or they represented a different activity—the making of shell beads and tools, including fishhooks. Although there was not a large quantity of fish bone in these samples, this may be another case of fish bone associated with fishhook manufacturing and other shell working, similar to the Ypao Beach test squares B through B6 and to Sandcastle Unit 6.

The faunal remains from the Leo Palace Hotel site on Naton Beach, Tumon Bay, consisted mostly of fish bones and scales, but no total number or weight is given in the report (Davis et al. 1992). Scarids were the most commonly occurring fishes. Also identified by Ziegler were acanthurids, labrids, balistids, holocentrids, serranids, and carangids.

What is remarkable from this site is the number of fishhooks and gorges. Of 171 items, 148 were classified as fishhooks and 23 as gorges (Favreau 1992). Distributional analysis was possible with 110 of the items. Recovered from Layer II, the Latte Phase occupation, were 98 fishhooks and nine gorges. One fishhook was collected from Layer III, which was believed to be "a naturally deposited, non-cultural stratum representing a hiatus between the Latte and Pre-Latte occupations" (Favreau 1992:C-2 to C-3.) Two fishhooks were recovered from Layer IV, the Pre-Latte occupation.

Another Naton Beach project (Hunter-Anderson et al. 1998) recovered 206.7 grams of fish bone from 17 analyzed units, features, and samples. There was a strong correlation of densities of fish and mollusk remains, indicating that these items were discarded in the same places. Identifiable fish remains were attributed to the families Acanthuridae, Balistidae, Labridae, Lethrinidae, Scaridae and Serranidae.

Identifiable parrotfish remains from Naton Beach weigh 3.6 grams or 1.7% of the total. By comparison, identifiable parrotfish remains account for 13.0 of 48.6 grams or 27% of the weight of fish remains from the Neemoon, Chuuk site (J. Amesbury 1987). From Tarague (S. Amesbury 1987) there are 217 identifiable scarid remains out of 7,002 fish remains, and from Ritidian (S. Amesbury 1989) there are 13 identifiable scarid remains out of 1,017 fish remains.

Centrum diameter was determined for 1,657 fish vertebrae from Naton Beach, and a comparison was made with the vertebrae from Tarague, Ritidian, and the Neemoon site on Moen, Chuuk (Hunter-Anderson et al. 1998:138-141). The range, mean, and mode were calculated for each of the four sites (Table 5). Figure 5 shows the numerical frequency of vertebral centra of different diameters in the samples from the four sites.

Table 5. Maximum Diameter (mm) of Centra of Fish Vertebrae from Naton Beach, Tarague, and Ritidian, Guam, and the Neemoon Site on Moen, Chuuk.

Site	**Reference**	**No. Vertebrae**	**Range**	**Mean**	**Mode**
Naton Beach	Hunter-Anderson et al. 1998	1,657	1-20	3.5	4
Tarague	S. Amesbury 1987	1,319	2-25	4.4	4
Ritidian	S. Amesbury 1989	113*	2-20+	11.5	20
		61**	2-12	4.2	4
Chuuk	J. Amesbury 1987	96	2-13	6.0	6

* This number includes one whole vertebra measuring 19 mm and 51 fragments of broken vertebrae estimated to be at least 20 mm. They were counted as 20 mm each. These are the data used in Figure 5.

** This number excludes the 52 vertebrae with centrum diameters greater than 18 mm. These are the data used in Figure 6.

Figure 6 shows the cumulative percent frequency distribution of vertebral centra of different diameters from the four sites. By plotting cumulative percent frequency, the effects of different sample sizes are removed, allowing more convenient comparisons of the centrum size distributions among sites. The large Ritidian vertebrae were excluded, because it is clear from the distribution presented in Figure 5 that the Ritidian sample has a bimodal distribution consisting of smaller vertebrae (c.d. < 13mm) and larger vertebrae (c.d. > 18 mm). In order to compare the majority of vertebral centra from the four sites, these large vertebrae were excluded.

The centrum diameter distributions are almost identical at the three Guam sites (Naton, Tarague, and Ritidian); the centra from the Chuuk site are larger (possibly due to the high percentage of parrotfish remains). Among the Guam sites, the centrum diameter distributions of Tarague and Ritidian are more similar than either is to that of Naton Beach. This appears to be the result of a small peak of centra with diameters of 8 mm at the two north coast sites of Tarague and Ritidian.

The species of fish from which the vertebrae derived could not be determined, but S. Amesbury (pers. comm. 1998) suggested that a good proportion of the vertebrae with centrum diameters ranging from 3 to 5 mm may be from surgeonfishes (Acanthuridae), and the vertebrae with centrum diameters around 8 mm may be from parrotfishes (Scaridae). The vertebrae with centra larger than 18 mm are probably from offshore pelagic species, such as tunas.

The fishing gear from Naton Beach includes numerous pieces of worked *Isognomon* (Table 6). The deposits of the Phase III Pedestal and Construction Trenches, which yielded the greatest weight of worked *Isognomon*, were dated to the Pre-Latte Phase by five radiocarbon dates ranging from 1020-505 BC to AD 415-665. The Phase I Trench A deposits yielded a single date of AD 885-1035. Also recovered from Phase I Trench A were 17 fragments of bone needles or awls, presumed to have been used in weaving and sewing mats and nets.

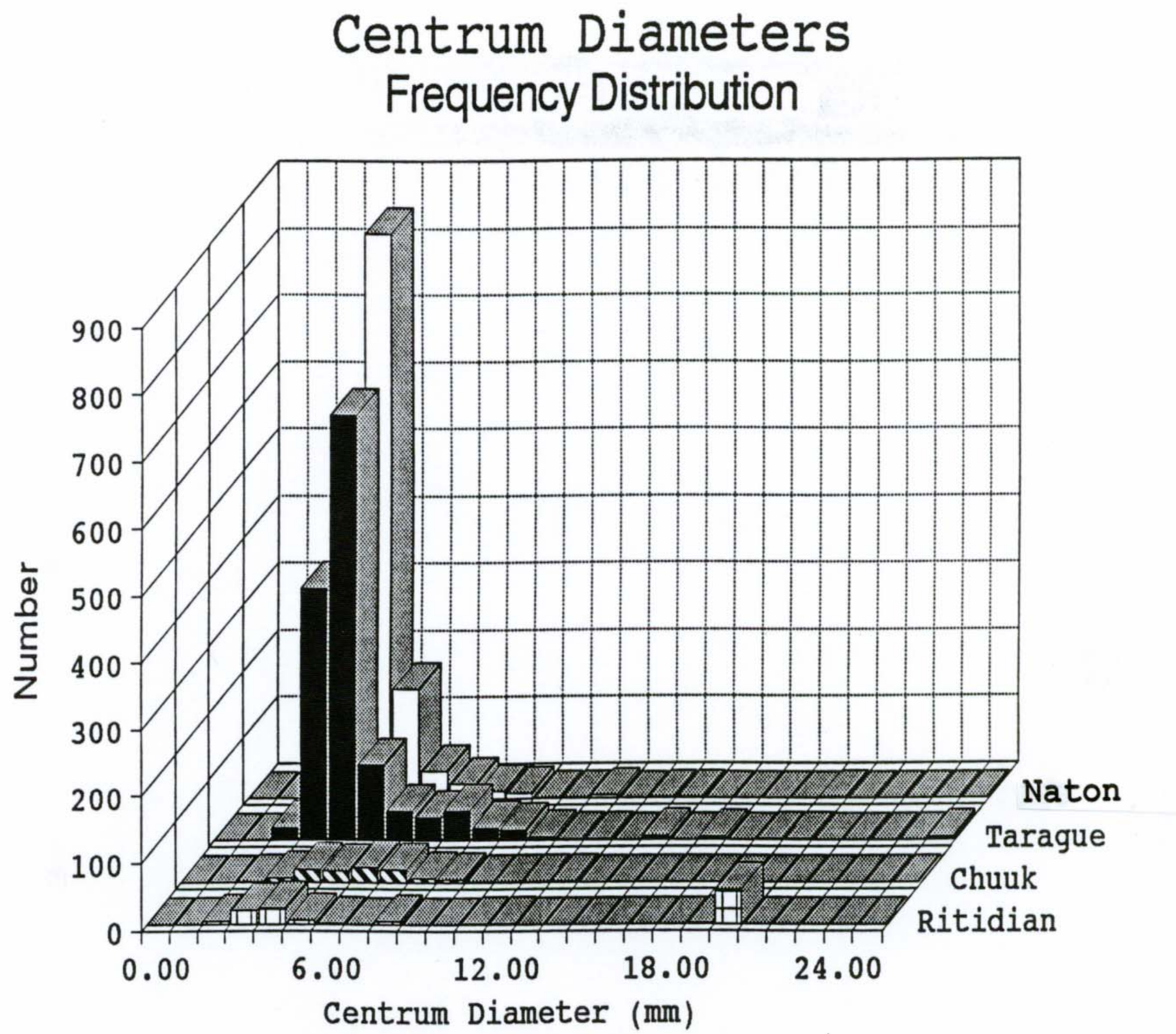

Figure 5. Frequency distribution of fish vertebral centra of different diameters in samples from Naton, Tarague, and Ritidian, Guam, and the Neemoon site on Moen, Chuuk (from Hunter-Anderson et al. 1998).

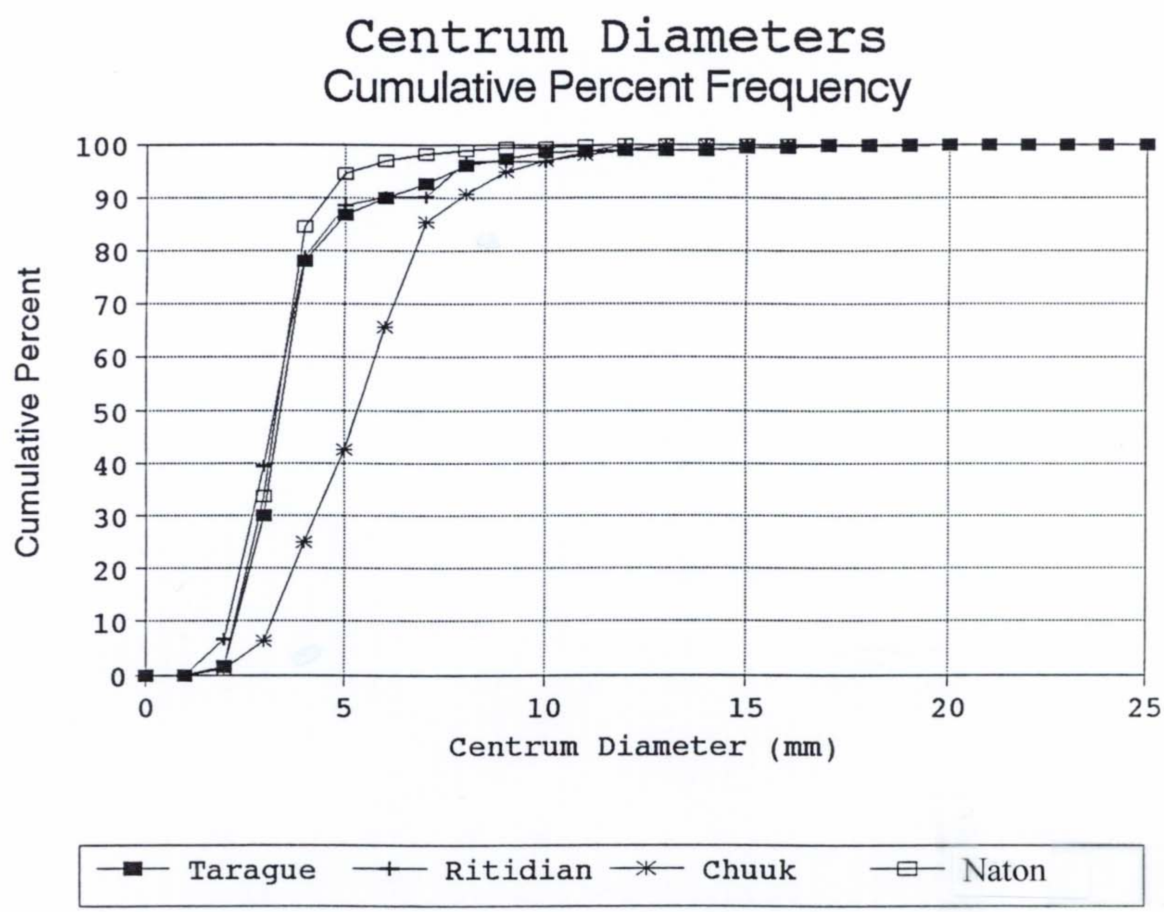

Figure 6. Cumulative percent frequency distribution of fish vertebral centra of different diameters in samples from Naton, Tarague, and Ritidian, Guam, and the Neemoon site on Moen, Chuuk (from Hunter-Anderson et al. 1998).

Table 6. Number and Weight (g) of *Isognomon* Fishhooks and Gorges from Naton Beach (Hunter-Anderson et al. 1998).

Worked *Isognomon*	**Phase I Trench A**	**Phase III Pedestal**	**Phase III Construction Trenches**	**Phase IV Burial Area**
	Number/wt.	Number/wt.	Number/wt.	Number/wt.
Fishhook	1/ 0.1	3/ 1.2	2/ 1.1	1/ 0.7
Fishhook fragment		6/ 3.0	5/ 0.9	
Fishhook shank	1/ 0.1	1/ 0.8	2/ 3.4	2/ 0.7
Fishhook shank fragment	1/ 0.3			
Fishhook blank	7/ 15.0	4/ 10.0	1/ 0.6	
Fishhook blank fragment	5/ 7.8	8/ 7.6		1/ 1.3
Fish gorge	2/ 0.9			1/ 0.4
Other modified *Isognomon*		3/ 13.8	4/ 28.1	1/ 1.6
Total	17/ 24.2	25/ 36.4	14/ 34.1	6/ 4.7

A subsequent archaeological project along Tumon Bay at the site of the Villa Kanton Tasi condominium (Moore et al. 2002) recovered 112.6 grams of fish remains, including two artifacts made of fish bone (J. Amesbury 2002a). Nine families were identified by Ziegler, though more may be represented in the unidentified fish bone (Table 7). Almost all of the identified fishes are common reef fishes, with the possible exception of the single shark (family Carcharhinidae), the large barracuda (family Sphyraenidae), and the medium or large jack (family Carangidae), which may have been taken in deeper water.

One of the fish bone artifacts is made from the caudal peduncle spine of a surgeonfish belonging to the genus *Acanthurus* or an osteologically similar genus but not *Naso* (J. Amesbury 2002a). The point of the spine is sharp, and there are two holes near the base of the spine. The spine may have been used as the hook on a two-piece or composite fishhook. The second artifact is made from the epihyal bone of an unidentified fish and may have been a pendant as there is a hole near the narrower end of the bone.

Other fishing gear recovered from Villa Kanton Tasi includes 16 *Isognomon* fishhooks (including fishhook fragments and blanks) and ten *Isognomon* gorges (including gorge fragments and blanks) (Photo 1). In addition there are 30 fragments and one whole bone needle, representing a probable minimum of 20 bone needles (Photo 2). J. Amesbury (2002a) suggested that these were probably used for making fishnets. The Villa Kanton Tasi lithics include a slingstone, which has been converted into a small sinker, and a coral anchor (Hunter-Anderson 2002c).

Radiocarbon dates from the Villa Kanton Tasi project range from AD 900-1170 to AD 1370-1380 (late Pre-Latte to mid-Latte Phase) (Moore et al. 2002:34).

Table 7. Weight (g) of Fish Remains from the Villa Kanton Tasi Project Area. This table includes two fishbone artifacts.

Family	**Burial Area A**	**Burial Area B**	**Burial Area C**	**Burial Area D**	**Burial Area E**	**West Trench**
Acanthuridae	0.4	0.2				
Balistidae	0.8					
Carangidae	0.8					
Carcharhinidae					0.3	
Holocentridae		0.6		0.2	0.4	
Labridae					1.2	
Serranidae		0.1				
Scaridae	9.0	3.2	1.8	3.2	12.2	
Sphyraenidae	8.6					
Unident. Fish	22.5	8.3	10.0	8.7	18.6	1.5
Total	42.1	12.4	11.8	12.1	32.7	1.5

Agana Bay

The San Antonio Burial Trench was located on the seaside of Marine Drive east of the Agana River. Relatively small quantities of fish remains were recovered there in the ten percent midden samples in contrast to the relatively large quantities of worked *Isognomon*, including fishhooks and gorges (J. Amesbury et al. 1991). From Grids 0, 1, 2, 3, 4, 5, and the 3-4 Extension, there are 106 fish bones weighing 6.7 grams and 20 fish scales weighing approximately 0.3 grams. If those 7.0 grams of fish remains were multiplied by 10 (because they are from ten percent midden samples), then we would expect 70 grams from the 3.075 cubic meters of soil excavated. The 100 percent collections of *Isognomon* from the same grids and volume of soil excavated weigh 925.8 grams and include 88 worked pieces of *Isognomon* comprising 11 gorges, nine gorge fragments, three fishhooks, ten fishhook fragments, one two-holed blank, and 54 additional worked pieces.

Two parrotfish beaks and a small shark tooth are the only fish remains identified, but the small sizes of the vertebrae lead to the conclusion that the fishes represented are reef fishes. Of the 34 vertebrae, centrum diameter of one vertebra measures 9 mm; two measure 6 mm; four measure 5 mm, seven measure 4 mm; 15 measure 3 mm; and five measure 2 mm.

Radiocarbon dates from the San Antonio Burial Trench range from AD 691-1147 to AD 1279-1439 (see J. Amesbury [1999] for the 2-sigma recalibrated dates). Most of these dates pertain to the Latte Phase.

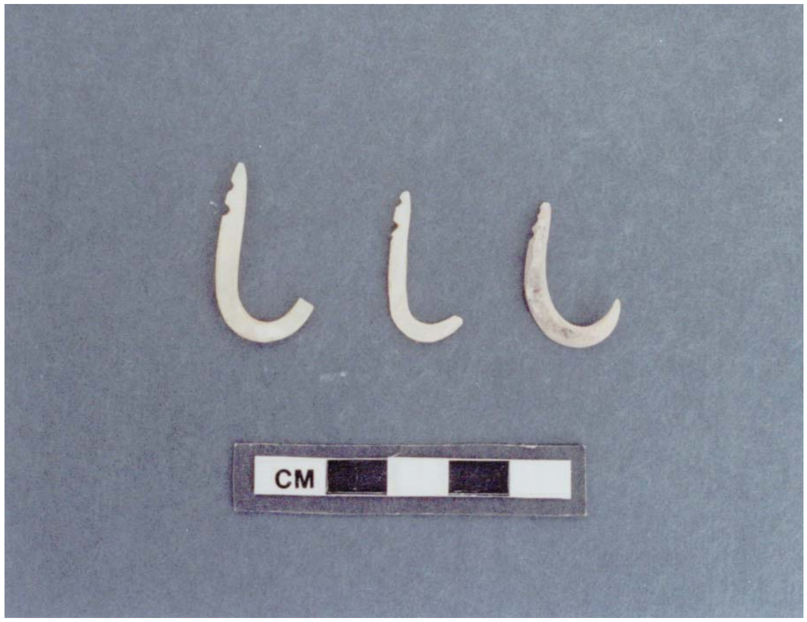

Photo 1. *Isognomon* fishhooks from Villa Kanton Tasi, Tumon Bay, Guam (Moore et al. 2002). Cat. No. 143 from Burial Area C (left); Cat No. 198 from Burial Area D (center); and Cat. No. 257 from Cushing Way (right).

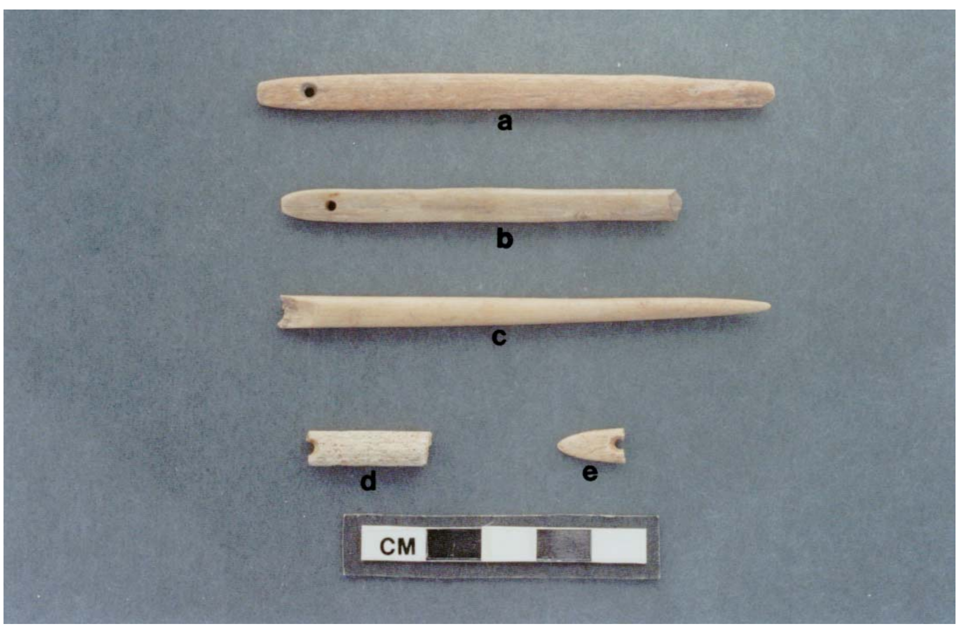

Photo 2. Bone needle and needle fragments from Villa Kanton Tasi, Tumon Bay, Guam (Moore et al. 2002). a) Cat. No. 120 from Burial Area B; b) Cat. No. 73 from Burial Area A; c) Cat. No. 61 from Burial Area A; d) Cat. No. 44 from Burial Area A; e) Cat. No. 158 from Burial Area C.

Asan

Graves and Moore (1986:146) reported, "Very little fishbone, mammal or other bone was recovered" at Asan. Counts and weights of bone are given in tables, but fish bone is not separated from other bone. Fishhooks, gorges, and blanks shown on tables for units PSI-5, 10A-D, and 11A-D total 17 (Graves and Moore 1986:58, 64-75).

Nimitz Hill

An inland cave site on Nimitz Hill contained a midden with surprisingly dense fish remains. The "Skylight Chamber" of Site 50 was so named because of several openings in the ceiling that let in daylight (Moore and Hunter-Anderson 2001). The excavation of Test Unit 2 in the Skylight Chamber proceeded by filling 10-liter buckets and lifting them with a rope to the ground surface through one of the skylight openings. The contents of each bucket were bagged and transported to the MARS laboratory for water-screening with window screen.

The 13 buckets (130 liters) yielded 155.1 grams of fish bones, teeth, and scales (J. Amesbury 2001b). Fish remains were present in every bucket. Nine or ten families are represented: Acanthuridae (surgeonfishes), Apogonidae (cardinalfishes), Balistidae (triggerfishes), Carangidae (jacks), Exocoetidae (flyingfishes), Labridae (wrasses), Ostraciontidae (boxfishes and cowfishes), Scaridae (parrotfishes), Serranidae (groupers), and possibly Lutjanidae (snappers). Ziegler, who identified the fishes, estimated that the fish lengths ranged from 10-25 cm.

On the basis of the diversity and the small size of the fishes, S. Amesbury suggested that with the exception of the Exocoetidae, the fishes were probably caught using a surround net and/or poison, such as that prepared from the seed of *Barringtonia asiatica* (*puting* in Chamorro) (J. Amesbury 2001b). The flying fish would have been caught from a canoe. If the beak fragment identified as Exocoetidae were instead from the closely related family Hemiramphidae (halfbeaks), a possibility noted by Ziegler, then the fish could have been caught in the estuarine area of a river mouth without the use of a canoe.

The mixed taxa charcoal sample from Bucket 8 yielded 2-sigma date ranges of AD 1315-1350, 1390-1675, 1765-1800, and 1940-1945. The coconut shell charcoal sample from the deeper Bucket 13 yielded date ranges of AD 1305-1368 and 1381-1477 (Moore and Hunter-Anderson 2001). It appears then that the Skylight Chamber midden began to accumulate before the end of the Prehistoric Period and probably continued into the Historic Period.

Sasa Valley and Tenjo Vista Fuel Tank Farms, Piti

During test excavations at Sasa Valley and Tenjo Vista, midden was collected from 12 historic and prehistoric sites, but only one fragment of faunal bone was recovered (Dixon et al. 1999). Marine shell made up the vast majority of the midden remains. No fish bone was reported. It was suggested that poor preservation accounted for the lack of vertebrate bones.

Orote Peninsula

From three sites at Orote, Carucci (1993) collected 604 fish bones and 548 fish scales. Most of the remains (92% of the bones and all but one of the scales) came from the Dadi Beach Rockshelter, Site 2-1302. Families of fishes identified by Ziegler include Scaridae, Acanthuridae, Balistidae, Belonidae, Diodontidae, Exocoetidae, Holocentridae, Mullidae, Labridae, and Scombridae. No fishhooks were found in the Dadi Beach Rockshelter, but a single piece of worked *Isognomon* and two abraders, one of coral and one of sea urchin spine, were collected. Ten radiocarbon dates were obtained from the rockshelter. The calibrated age ranges span AD 540-870 to 1940-1955.

Waterfront Annex and Ordnance Annex

Several recent surveys in the Navy's Waterfront Annex and Ordnance Annex have recovered very little fish bone. Henry et al. (1998a) reported two unidentified fish bones from their survey and subsurface testing of c. 2,850 acres of Ordnance Annex. Henry et al. (1998b) collected one unidentified fish bone from the archaeological documentation and testing of 15 selected cave and overhang sites in Ordnance Annex and Waterfront Annex. Henry et al. (1999a) recovered one unidentified fish bone from the survey and subsurface testing of 1,927 acres of Ordnance Annex. Allen et al. (2002) recovered 17 highly fragmented, unidentified fish bones from a survey and excavations performed within 900 acres of Ordnance Annex. No fish bone was reported by J. Amesbury (2002b) from the Hunter-Anderson and Moore (2002) survey of Waterfront and Ordnance Annexes

Agat/Santa Rita

Moore et al. (1995) recovered 45.3 grams of fish bones, teeth, and scales from five 10-liter samples taken during the monitoring of the Agat/Santa Rita Waterline. The bones are small and probably represent reef fish. Included are mouthparts from scarids and labrids and spines from balistids.

No fish bone was reported from the Small Boat Harbor project area in Agat, Guam (Hunter-Anderson 1989). It is unclear whether none was recovered or none was analyzed.

Manenggon Hills

No fish remains were recovered from the inland southern Guam Manenggon Hills sites (J. Amesbury 1994).

Except for the Skylight Chamber on Nimitz Hill and the Dadi Beach Rockshelter just south of the Orote Peninsula, archaeological sites in southern Guam have yielded very little fish bone, possibly because coastal excavations in southern Guam have not been as extensive as in northern Guam, particularly the Tumon Bay area. Nonetheless, there may be a problem of preservation in southern Guam, where the volcanic soil is acidic (Young et al. 1988). Both the Skylight Chamber and the Dadi Beach Rockshelter would have provided more protection from the elements than the open sites in southern Guam.

TURTLES FROM GUAM

Turtle remains are mentioned in the archaeological literature much less frequently than fish remains. Of course, turtles are not as numerous as fishes. However, it may be that the bones are not recognized or identified below the level of vertebrates. The same reports that were researched for fish remains and fishing gear were also examined for information on turtles. Of the 27 reports listed in Table 8, only seven mention turtle remains. Six of the seven locales are in northern Guam, although there is no reason to think that turtles would not have been taken in southern Guam also.

From Pagat, there are 210 grams of turtle bone, most from Horizon II, the Pre-Latte occupation (Craib 1886). From Horizon I, there are 15.9 grams or 1.04 grams per cubic meter (Table 9). From Horizon II, there are 194.1 grams or 41.04 grams per cubic meter.

Moore (1983) reported five turtle bones from Layer III at Tarague. Sea turtle was recovered from only one of Liston's (1996) Tarague sites—Site 7-1614.

Olmo et al. (2000) recovered three turtle bones from Pugua Point 13, North Finegayan. They were found in Feature PP 13.6, an artifact scatter with mortar concentration in a large settlement, which included four rockshelters.

A single bone from the Leo Palace Hotel site, Naton Beach, was identified as sea turtle (Davis et al. 1992). From four of the five burial areas excavated at Villa Kanton Tasi, there are 67.5 grams of turtle bone (J. Amesbury 2002a). Most (79%) of that weight came from Burial Area E.

From the Dadi Beach Rockshelter, Carucci (1993) collected two turtle bones.

Table 8. Number or Weight (g) of Turtle Bones from Guam Sites. N.r. = none reported.

Site or Area	Report	Number	Weight
Pagat	Craib 1986		210.0
Tarague	Ray 1981	N.r.	
Tarague	Moore 1983	5	
Tarague	Liston 1996	N.r.	2.07
Ritidian	Kurashina et al. 1989	N.r.	
FAA Housing	J. Amesbury 2001a	N.r.	
North and South Finegayan	Olmo et al. 2000	3	
Ypao Beach	Leidemann 1980	N.r.	
Tumon Bay	Graves and Moore 1985	N.r.	
Sandcastle	Moore et al. 1990	N.r.	
Pacific Islands Club	Moore et al. 1993	N.r.	
Leo Palace Hotel, Naton Beach	Davis et al. 1992	1	
Naton Beach	Hunter-Anderson et al. 1998	N.r.	
Villa Kanton Tasi	J. Amesbury 2002a		67.5
San Antonio Burial Trench	J. Amesbury et al. 1991	N.r.	
Asan	Graves and Moore 1986	N.r.	
Nimitz Hill	J. Amesbury 2001b	N.r.	
Sasa Valley and Tenjo Vista	Dixon et al. 1999	N.r.	
Orote Peninsula	Carucci 1993	2	
Ordnance Annex	Henry et al. 1998a	N.r.	
Ordnance and Waterfront Annex	Henry et al. 1998b	N.r.	
Ordnance Annex	Henry et al. 1999a	N.r.	
Ordnance Annex	Allen et al. 2002	N.r.	
Waterfront and Ordnance Annex	J. Amesbury 2002b	N.r.	
Agat/Santa Rita	Moore et al. 1995	N.r.	
Agat Small Boat Harbor	Hunter-Anderson 1989	N.r.	
Manenggon Hills	J. Amesbury 1994	N.r.	

Table 9. Weight (g) and Density of Turtle Bones by Horizon from Pagat, Guam (Craib 1986).

Horizon	Time Period	Weight of Turtle Bones (grams)	Density of Turtle Bones (grams per cubic meter)
I	Latte Phase and Early Historic Period	15.9	1.04
II	Pre-Latte Phase	194.1	41.04

INVERTEBRATES FROM GUAM

Invertebrates harvested by the pre-contact islanders include 1) crustaceans, such as crabs and lobsters (Phylum Arthropoda, Class Crustacea), 2) echinoderms, including sea urchins (Phylum Echinodermata), and 3) mollusks (Phylum Mollusca).

Crustaceans

The chitinous exoskeletons of crustaceans are fragile. Very small quantities of crab remains, usually no more than a few grams, are recovered from many archaeological excavations, but the remains are usually weathered so that identification is rarely possible. It is frequently not known if the remains are from land crabs or marine crabs. Also it is difficult to determine if the crab was harvested and brought to the site by people or if it occurred at the site naturally.

The unusual midden of Test Unit 2 of the Skylight Chamber on Nimitz Hill, inland southern Guam, yielded 21.7 grams of crab remains, including 6.8 grams of the marine crab *Etisus* sp., identified by Gustav Paulay, then of the University of Guam Marine Laboratory (J. Amesbury 2001b). These may be the only crab remains identified to genus in the archaeological literature for Guam, and they are proof that even inland people had access to marine crabs. However, the *Etisus* remains are from Bucket 1, the uppermost bucket, and may date to the recent past. The unidentified crab remains derived from Buckets 2, 3, 5, 7, 8, 11, and 13.

Because of the fragility of crustacean remains and the difficulty of distinguishing between land crabs and marine crabs and between naturally occurring crab remains and human food refuse, there is little unequivocal evidence for human harvesting of marine crustaceans. No doubt it occurred with fair frequency, but the evidence is perishable.

Echinoderms

The gonads of sea urchins are eaten by people (Smith 1986), and the spines have been used as tools. Since the spines are more durable than the tests, it is generally the spines that are recovered archaeologically. Craib (1986) reported that numerous sea urchin spines were collected from the Pagat excavations, but less that 10% (n = 12) showed signs of modification or use as abraders. He also remarked that the natural breakage of sea urchin spines produces a beveling which can be mistaken for shaping.

From Tarague, Ray reported 170 utilized and 234 unused sea urchin spines or fragments from three test pits (Ray 1981:210). The vast majority (149 of the utilized and 213 of the unused) derived from Pre-Latte deposits, but Ray noted that a very limited amount of excavation was done in Latte Phase deposits. The utilized sea urchin spines were classified as files; however, Ray observed that some were made into chisels by sharpening the ends at an oblique angle. Moore (1983) reported two sea urchin tools from Tarague. Olmo (1996a) reported 12 spines from Tarague, six of which appear to be modified or utilized. The six modified spines came from two of Liston’s (1996) Tarague sites: 7-1614 and 7-1627. One sea urchin spine was collected from the Electrical Trench at Ritidian (Kurashina et al. 1989).

From the former FAA Housing Area, J. Amesbury (2001a) reported 27.9 grams of sea urchin spines. Most of that weight (23.2 grams) derived from Site 8-1673, a Latte Phase pottery scatter. A smaller amount (4.7 grams) came from Site 8-1674, a Pre-Latte rockshelter, and Site 8-1677, a rockshelter with both Pre-Latte and Latte Phase deposits. Olmo et al. (2002) recovered ten sea urchin spine abraders from four test units at three sites in North and South Finegayan.

In her inventory of the Ypao Beach materials, Leidemann (1980) counted 179 sea urchin remains from the 18 farthest inland, Pre-Latte units (the 4 x 4 meter square, C24, and M23), but only seven sea urchin remains from 15 units that were more seaward and estimated to date to the Latte Phase.

Several other reports on the Tumon Bay area (Graves and Moore 1985; Moore et al. 1990; Moore et al. 1993; Davis et al. 1992; Hunter-Anderson et al. 1998; J. Amesbury 2002a) do not mention sea urchins.

No sea urchin spines or tools made of spines were reported from the San Antonio Burial Trench in Agana (J. Amesbury et al. 1991), from Asan (Graves and Moore 1986), from Nimitz Hill (J. Amesbury 2001b), or from Sasa Valley and Tenjo Vista (Dixon et al. 1999). A single sea urchin spine abrader was collected from the Dadi Beach Rockshelter (Carucci 1993).

No sea urchin spines have been reported from the Ordnance Annex (Henry et al. 1998a, 1998b, 1999a, Allen et al. 2002), but one spine was collected from the surface of a Waterfront Annex site (J. Amesbury 2002b). No sea urchin remains were reported from Agat (Moore et al. 1995; Hunter-Anderson 1989) or Manenggon Hills (J. Amesbury 1994; Wells 1994).

The two Guam sites with the highest number of sea urchin remains (Tarague and Ypao Beach) both yielded most of those remains from Pre-Latte deposits. It appears that there was a decrease in use of sea urchin spines from the Pre-Latte to the Latte Phase. Whether that was due to over-harvesting or to a change in the environment or a change in the technology is not known.

Mollusks

There are differences in the archaeological shell middens from one place to another in Guam and from one time period to another in the same place (J. Amesbury 1999). In Tumon Bay and East Agana Bay, there was a shift from collecting of bivalves in the Pre-Latte Phase to collecting of gastropods, particularly *Strombus*, in the Latte Phase. This shift was first noticed by Leidemann (1980) at Ypao Beach and by Graves and Moore (1985) when they did the *Tumon Bay Area Overview*. It was confirmed at Sandcastle (Moore et al. 1990) and the Pacific Islands Club (Moore et al. 1993).

When the results of four excavation units with analyzed marine shell from Sandcastle are arranged from the farthest inland unit to the most seaward unit, a decrease in bivalves and an increase in gastropods, especially *Strombus*, from the most inland to the most seaward unit can be seen (Figure 7). Radiocarbon dates indicate that the farthest inland unit dates to an earlier time period than the most seaward unit.

A similar pattern is revealed by the analysis of four dated samples or units from the Pacific Islands Club (Figure 8). The earliest of the four assemblages has the highest percentage by weight of bivalves, while the most recent of the four assemblages has the highest percentage of gastropods. The two most recent assemblages are almost entirely *Strombus*.

J. Amesbury (1999) presented a case for relative sea level decline as the cause for the changes in the shell middens of Tumon Bay. Certain of the shells, such as the abundant *Anadara antiquata* in the Pre-Latte deposits at Guam Hardwood (Graves and Moore 1985) and the dense cluster of *Isognomon isognomum* from non-cultural deposits dating to the Pre-Latte Phase at the Sandcastle site (Moore et al. 1990) indicated that Tumon Bay was siltier during the Pre-Latte. This raised the possibility that mangrove habitats have been present in the bay. Subsequent to J. Amesbury's 1999 article, mangrove wood was identified from Pre-Latte deposits at the Kallingal property, Tumon Bay (J. Amesbury 2001c; Moore et al. 2001a). Relative sea level decline within the last 3,000 to 4,000 years (see Easton et al. 1978; Kayanne et al. 1993; Bath 1986) would have eliminated the mangroves in the bay and changed the bay from the preferred habitat of bivalves to that of *Strombus* (see Paulay 1992).

An environmental explanation was also offered for the differences between shell assemblages from northern Guam and from southern Guam (J. Amesbury 1999). While gastropods generally outweigh bivalves in northern Guam sites, bivalves predominate in southern Guam sites. This difference is no doubt due to the geological differences between northern and southern Guam. The northern half of Guam is a limestone plateau, while the southern half is a volcanic upland (Tracy et al. 1964). A low mountain chain parallels the west coast 3 to 4 km inland in the southern part of the island. There are no rivers or streams on the northern plateau, because rainwater quickly drains into the porous limestone. The volcanic south, however, is dissected by numerous streams, which empty into bays around the southern coast. According to Paulay (1992), the rainfall runoff in volcanic southern Guam produces abundant deep sand marine habitats favorable to bivalves, and the high percentages of bivalves in archaeological assemblages from southern Guam reflect the abundance of bivalves in the waters there.

While bivalves are consistently more abundant than gastropods in southern Guam sites, there are changes in the abundance of the various bivalve species in southern Guam (J. Amesbury 1999). At Asan, Graves and Moore (1986) noted a decrease in diversity and a shift from smaller to larger bivalve species over time. The Tellinidae and Veneridae occurred with greater frequency in the farther inland excavation units, while *Anadara* and *Tridacna* occurred with greater frequency closer to the shoreline. The

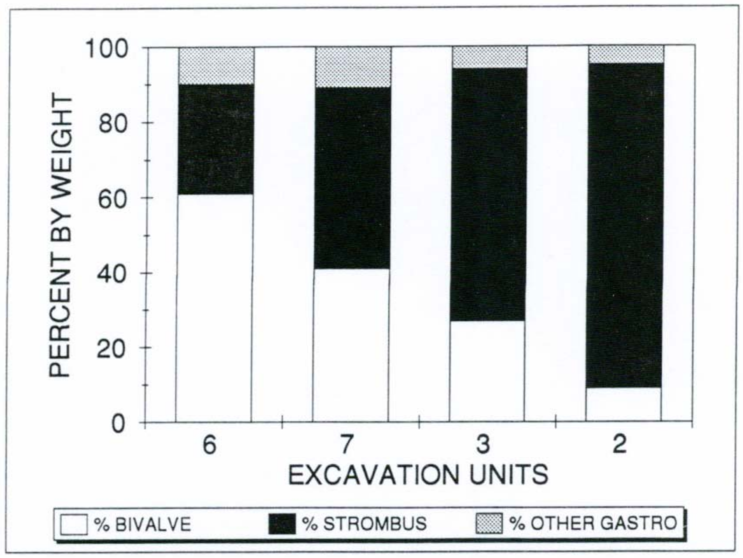

Figure 7. Percentages of bivalves, *Strombus*, and other gastropods from Excavation Units 2, 3, 6, and 7 at Sandcastle, Tumon Bay, Guam. The excavation units are shown in order of their proximity to the shoreline; Unit 6 is the farthest inland and Unit 2 is the closest to the shoreline (from Moore et al. 1990).

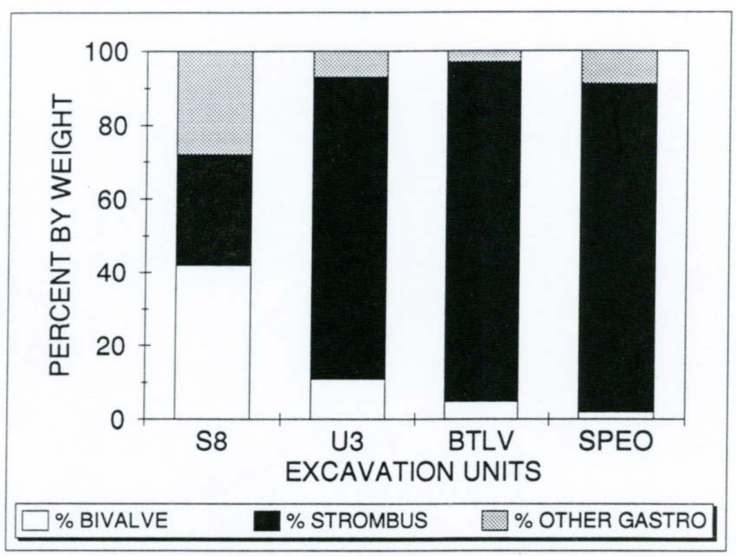

Figure 8. Percentages of bivalves, *Strombus*, and other gastropods from four dated samples or units at the Pacific Islands Club, Tumon Bay, Guam. Abbreviations stand for Sample 8, Unit 3, Biofilter Trench Layer V, and Scuba Pool Earth Oven. The units are shown in chronological order; Sample 8 is the oldest and the Scuba Pool Earth Oven is the most recent (from Moore et al. 1993).

beginning of the increase in *Anadara* in the Asan unit PSI-5 was dated to approximately AD 1500 (Graves and Moore 1986:14, 96, 151).

Similar changes occurred in the middens at Manenggon Hills (J. Amesbury 1994). A significant negative correlation was found between the age of the excavation unit and the percentage of *Anadara* by weight in the analyzed shell ($r = 0.673432$, d.f. = 18, $p < 0.1$, arcsine transformed percentages), indicating an increase in the percentage of *Anadara* through time (Figure 9). The increase was especially noticeable after about 500 years BP or approximately the same time as the beginning of the increase in *Anadara* at Asan.

If the disappearance of *Anadara* in Tumon Bay early in the Prehistoric Period is linked to the disappearance of mangrove habitats due to relative sea level decline within the last 3000 or 4000 years, the later increase of *Anadara* at Asan and Manenggon Hills may indicate an increase in mangrove habitats in southern Guam in more recent times. Pollen evidence supports this idea. The pollen samples and radiocarbon samples from Core 2 at Tipalao Marsh on the southern part of Orote Peninsula reveal an increase in mangrove pollen in the last 2000 years (Athens and Ward 1995). Ward (1995) also found an increase in mangrove pollen about 1000 years ago in the Laguas River Core 2 from southwest Guam.

All of the differences or changes in the archaeological marine shell middens discussed so far can be explained by environmental differences or changes. However, there is one case in the archaeological literature in which overharvesting was offered as the explanation for changes in shell middens. J. Amesbury (1996b), who analyzed the marine shell from Liston's (1996) Tarague sites, conferred with Paulay concerning the Tarague sequence of declining gastropods, particularly declining limpets, possibly decreasing strombs and drupes, high quantities of Turbinidae and Trochidae, and increasing bivalves. It appears that the decreases and increases in abundance of species indicate that the collecting of mollusks moved from the high intertidal zone toward the reef margin and from an emphasis on the species that are more accessible (*Patelloida chamorrorum*) and more visible (*Strombus*, drupes) to those that are more concealed (Tellinidae, Psammobiidae, Veneridae) and those that are more difficult to harvest (Turbinidae and Trochidae). Paulay suggested that the changes in abundance of species indicated increased harvesting effort. This could have been caused by a population increase or by a decrease in the availability of other foods.

The decrease in abundance of limpets is dramatic in Site 8-1588, Test Units 1 and 6 (J. Amesbury 1996b). It is less dramatic in other units where limpets occur in smaller quantities (Site 7-1614, Test Units 3 and 4, and Site 8-1529, Test Unit 1), but always decrease from Layer III to II to I. Two species of limpets are present in the excavations (*Patelloida chamorrorum* and *Patella flexuosa*). *Patelloida chamorrorum* is found in the high intertidal zone on karst. According to Paulay, it is extremely accessible and when present, it is present in great abundance. It is not necessary to get into the water to collect this gastropod, although a tool would probably be needed to pry it off the rocks. *Patella*

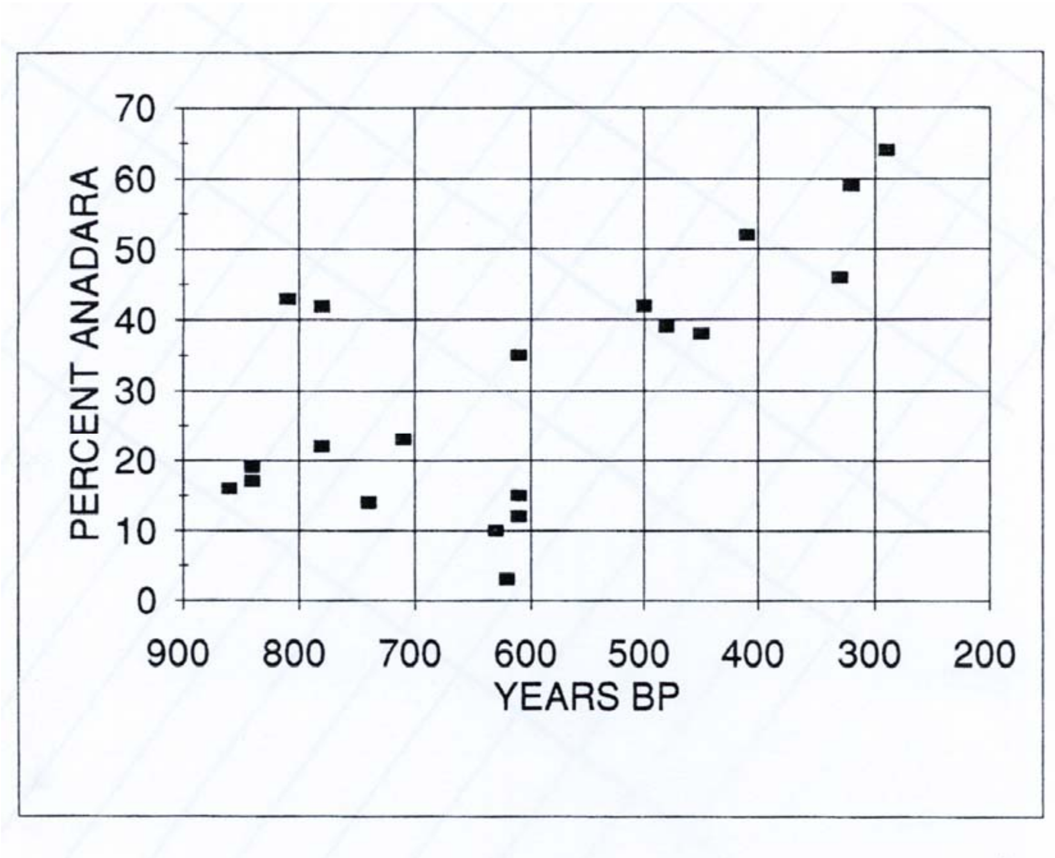

Figure 9. Relationship between radiocarbon dates in years BP and percentages of *Anadara* by weight in the analyzed marine shell of 20 midden units or features at Manenggon Hills, Yona, Guam (Amesbury 1994).

flexuosa is a lower intertidal limpet; it is still exposed, but on the reef flat rather than on the shore.

Reviewing the same Tarague mollusk data from J. Amesbury (1996b), Olmo (1996b) offered an alternative explanation for the decrease in limpets involving both environmental factors and overharvesting. Olmo suggested that relative sea level decline related to the uplift that occurred approximately 3100 years BP diminished the amount of shallow water habitat and caused a decline in the inner reef species, citing Paulay (1990) who proposed that species considered to be inner reef specialists will disappear during low sea stands. The limpets, which were adapted to the high intertidal zone, would have survived, but possibly have been overharvested due to the near absence of other inner reef species.

FISH REMAINS AND FISHING GEAR FROM THE CNMI

The three largest islands of the CNMI, from north to south, Saipan, Tinian, and Rota, are discussed. Within each island, the sites are discussed north to south (Figure 10).

Achugao and Matansa, Saipan

The Achugao Archaeological Project, undertaken by the Center for Archaeological Investigations at Southern Illinois University, investigated four parcels north and south of Puntan Achugao on the northwest coast of Saipan (B. Butler 1995). Fish remains number 446 with 75 of the specimens identifiable to family and element (V. Butler 1995). Families in order of abundance by the number of elements follow: Scaridae (25), Acanthuridae (15), Lethrinidae (14), Labridae (6), Serranidae (5), Balistidae (3), Holocentridae (2), Lutjanidae (1), Scombridae (1), Carangidae (1), Diodontidae (1) and Subclass Elasmobranchii (1). A comparison with fish remains from two projects on Rota, the Rota Airport Project and Mochong, using data from Davidson and Leach (1988), found that the three project areas are similar with regard to the inshore fishes, but differ markedly with regard to the pelagic fishes. The families Coryphaenidae (*mahimahi*) and Istiophoridae/Xiphiidae (sailfishes and marlins) are present in the Rota collections, but lacking from Achugao. This difference was attributed to major environmental differences between the two islands (V. Butler 1995).

Fishing gear recovered by the Achugao Archaeological Project includes one complete fishhook, possibly of *Turbo* shell, from an Early Pre-Latte context, two fishhook fragments of *Turbo* or *Haliotis* from Transitional contexts, and two fishhook fragments of *Isognomon* (B. Butler 1995). In addition, there are 16 pieces of worked shell, mostly *Isognomon*, including at least two fishhook blanks and six pieces that may be fragments of lures.

According to Butler (1995:35), the Achugao area was occupied by at least 1500 BC. The 2-sigma calibrated dates from the area range from 1920-1630 BC to AD 1280-1395, almost the entire Prehistoric Period.

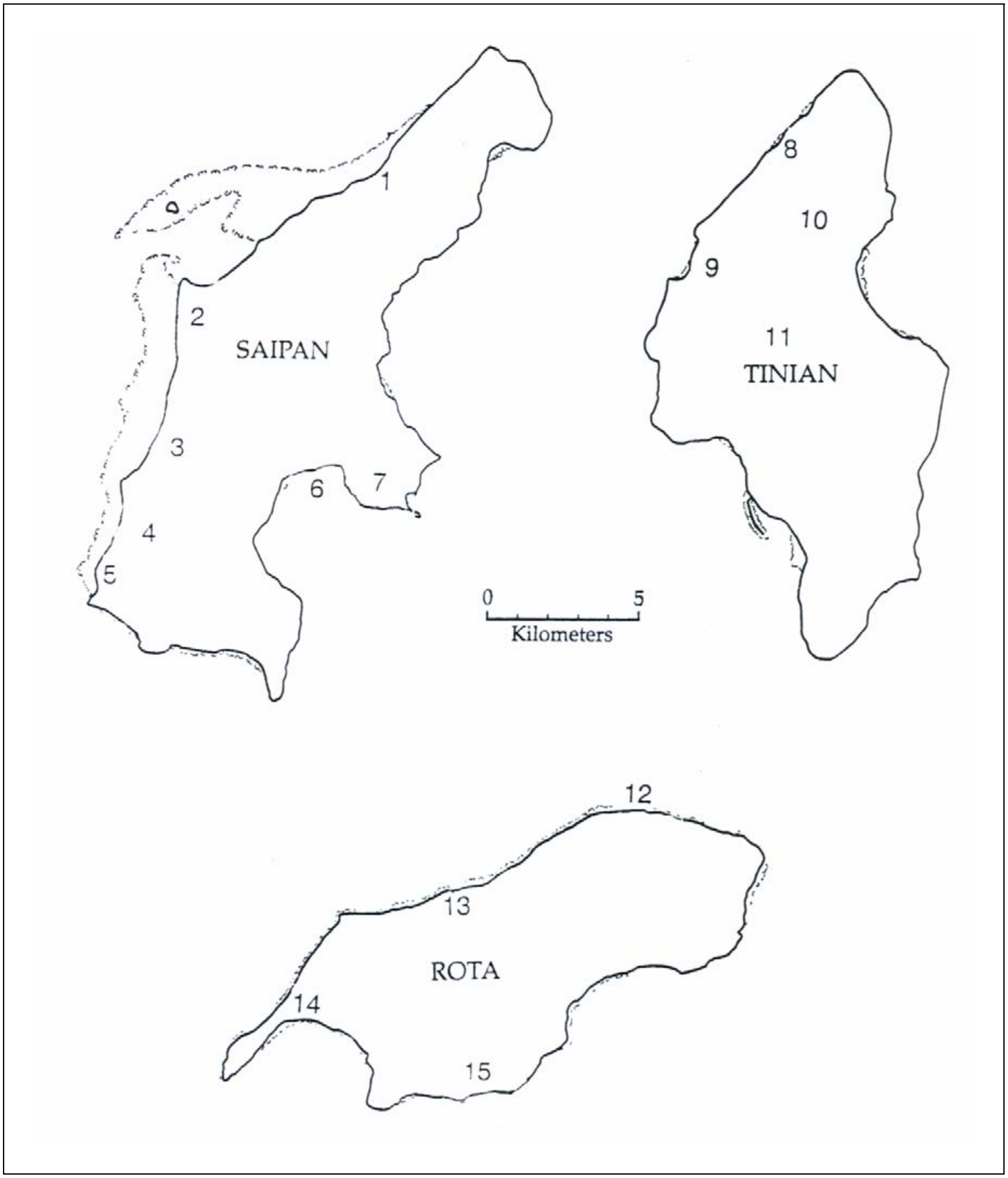

Figure 10. Saipan, Tinian, and Rota, showing the areas discussed in the text. 1 = Achugao and Matansa, 2 = Garapan to Olei, 3 = Susupe, 4 = Chalan Piao, 5 = Afetña, 6 = Laulau, 7 = Kagman Peninsula, 8 = Unai Chulu, 9 = Mulatu and Lamanibot Regions, 10 = Military Lease Area, Northern Tinian, 11 = Military Leaseback Area, Central Tinian, 12 = Mochong, 13 = North Coast of Rota including the Uyulan Region, 14 = Songsong, 15 = Southern Rota (Highway 100) (adapted from Russell 1998).

Just slightly south of Butler's Achugao project, Craib (1992) did an archaeological survey and subsurface testing for the Coral Bay Resort. Two test pits were dug, and the only bone recovered from either test pit was fish bone. In TP1, almost all the bone was found in the lower three levels within sterile beach sand below the cultural deposits, suggesting that the bone was deposited there naturally. The small size of the fish bones indicates that they came from reef fishes. A complete fishhook was also recovered from TP1. Four radiocarbon dates were obtained from samples of *Strombus* shells, resulting in 2-sigma age ranges from AD 851-1159 to AD 1315-1549.

Garapan to Oleai, Saipan

Butler and DeFant (1990) reported 14 fish bones from the Liyang site in the Garapan to Oleai area along the west coast of Saipan. Twelve of the 14 bones are vertebrae. The one mouthpart was identified as parrotfish. Also collected from the Liyang site is the shank portion of an *Isognomon* fishhook. A single radiocarbon date from the Liyang site has a "tree-ring corrected date range" of AD 689-897. Butler and DeFant (1990:79) stated, "the ceramics appear to represent the period from near the end of the Transitional Pre-Latte sequence to early in the Latte Period."

Susupe, Saipan

Archaeological monitoring and excavation of burial areas at the site of the Saipan Judiciary Center in Susupe, Saipan, yielded 22.3 grams of fish bone (Hunter-Anderson et al. 1996). From the quantitative samples there are more than 96 bones and scales weighing 6.0 grams, and from the general collections there are 39 bones weighing 16.3 grams. Families of fishes identified include Scaridae, Labridae, and Lethrinidae. A preopercle of a large reef or bottom fish was tentatively identified as Serranidae, Lutjanidae, or Lethrinidae. In addition, there are two mammal teeth believed to be from dolphins (Subfamily Delphininae). Nearly 500 grams of *Isognomon* were collected, but only one piece is worked. It is a fishhook or gorge blank. The radiocarbon dates indicate that the site was occupied from the late AD 1200s to the mid-1600s.

Chalan Piao, Saipan

From the Pre-Latte deposits at Chalan Piao, southwest Saipan, Moore et al. (1992) recovered 140 pieces of fish bone weighing 7.2 grams from the 10% midden samples of two one-meter square excavation units dug to a depth of 90 cm. In order to estimate the total weight of fishbone in the 1800 liters excavated, one would multiply by 10. Approximately 72 grams of fish bone were contained in the two units. Only two items were identified to family. One is from a surgeonfish (Acanthuridae), and the other is a spine from a stingray (Dasyatidae). No mouthparts from parrotfishes were found, unlike many other sites in the Marianas (Fleming 1986), nor any bones from large reef or pelagic fishes. The bones appear to have come from relatively small reef fishes. Four pieces of worked *Isognomon*, including a fragment of a gorge and a fragment of a fishhook or fishhook blank, were collected. In addition, a shell pendant or possible fishing lure was found. Two radiocarbon dates were obtained from composite charcoal samples. The calibrated date from the bottom of the exposed portion of Layer II is 1731-1226 BC, and the calibrated date from the top of Layer II is 1396-865 BC (J. Amesbury et al. 1996).

Afetña, Saipan

Excavations at Afetña, Saipan (McGovern-Wilson 1989), southwest of Chalan Piao, revealed three occupations of the area. Three dates were obtained from *Tridacna* shells, and a marine reservoir correction was applied. The dates calibrated according to Stuiver and Pearson (1986) range from AD 420-650 to AD 650-810. J. Amesbury et al. (1996) recalibrated the dates according to Stuiver and Reimer (1993). The revised dates are a few hundred years later; the 2-sigma dates range from AD 676-1161 to AD 901-1307 (J. Amesbury et al. 1996:56).

The faunal material from Afetña was analyzed by Leach et al. (1989), who calculated minimum number of individuals for the fish remains. Families identified and the MNI are as follow: Scaridae (31), Labridae (3), Carangidae (2), Scombridae (1), Holocentridae (1), Lethrinidae (1). McGovern-Wilson (1989) also reported two fish gorges.

Laulau, Saipan

Fish bone from the 1977 Laulau excavation (Marck 1978) was identified by Thomas Dye, then at the Bishop Museum. Sixteen bones were identified to family. Families present are Scaridae, Acanthuridae, Serranidae, Scombridae, and Lethrinidae. Two early dates were obtained: 960 BC and 940 BC. Eight fishhooks and one blank were found throughout the sequence. Marck said, "The fishhooks are of significance because of general questions in Austronesian sites as to the antiquity of their manufacture. We can now state with confidence that they were present through the Marianas sequence as it has been defined to date" (Marck 1978:55).

Kagman Peninsula, Saipan

An archaeological survey and limited subsurface testing of the approximately 400-acre Shimizu Golf Course on the Kagman Peninsula, Saipan, either did not recover any fish bone, or none was reported (Dilli et al. 1993)

Unai Chulu, Tinian

Test excavations and areal excavations were conducted at Unai Chulu on the northwest coast of Tinian (Haun et al. 1999). Non-human vertebrate remains from Strata II through VIII of the 4 x 4 meter block were analyzed. Bone fragments numbered 8,951 and weighed 1,398.1 grams. Fish remains accounted for 71.1% of the total number. Families identified include Scaridae, Acanthuridae, Labridae, Lethrinidae, Mullidae, Cirrhitidae, Holocentridae, Monacanthidae, Carcharhinidae, Dasyatidae, and Ophichthidae.

The largest number of fish bones derives from Stratum VII (Table 10). Thirteen radiocarbon dates were obtained from this stratum with 2-sigma age ranges from 1494-1468 BC to 1134-972 BC. Stratum VII is a very Early Pre-Latte deposit and represents the earliest occupation of this site and the earliest documented occupation of the island of Tinian. The next highest numbers of fish bones derive from Stratum IIIc and Stratum IIIb. Radiocarbon dates for those strata range from 2 BC-AD 259 to AD 764-1022, clustering in the Transitional Phase (Haun et al. 1999).

Table 10. Number of Fish Remains of the Most Abundant Families by Strata from Unai Chulu, Tinian (Haun et al. 1999). These fish remains are from Strata II through VIII of the 4 x 4 meter block. Strata VIII is the lowest layer. Six additional families were present in small quantities.

Stratum	**Scarid**	**Acanthurid**	**Labrid**	**Lethrinid**	**Mullid**	**Unident.**	**Total**
II	4	1	1			41	47
III	2	1	1		1	103	108
IIIa	2					29	31
IIIb	10	2	8	1	4	1124	1149
IIIc	16	5	4		4	1326	1355
IV	1					93	94
V	7	3				80	90
VI	10	19	8			406	443
VII	79	47	39	10	5	2267	2447
VIII						2	2
Total	131	78	61	11	14	5471	5766

Numerous items of fishing gear were recovered at Unai Chulu. Twenty-eight one-piece fishhooks (two complete and 26 fragmented) derived from the 4 x 4 meter block excavation. Also found in the 4 x 4 excavation were two parts of composite fishhooks (a point and a shank) and a limestone net sinker. Fishhook blanks and tabs numbered 166 (155 from *Isognomon*, nine from *Pinctada margaritifera*, one from *Turbo*, and one from unidentified nacreous shell).

Mulatu and Lamanibot Regions, Tinian

From archaeological testing at the Voice of America radio relay station site in Area A, northwest Tinian, Moore et al. (2001b) reported 19 fish bones. The only family identified is Balistidae. One large complete triggerfish spine is polished and may have been used as a needle. It would have served a different purpose from the broader, flat needles made of human bone found in Latte Phase sites, such as Pagat and Villa Kanton Tasi, Guam. Due to its provenience, it is likely that the balistid spine was used by the occupants of a pre-World War II farmstead, or possibly it was brought to the area in prehistoric times.

Military Lease Area, Northern Tinian

From a survey of the Military Lease Area (former Voice of America Areas B and C) in northern Tinian, there are 17.95 grams of fish bone (Dixon et al. 2000). Families identified are Scaridae, Serranidae, Labridae, and possibly Lethrinidae.

Military Leaseback Area, Central Tinian

Twenty-eight of 47 test units excavated during the Tinian Leaseback Area project yielded 1289 fish bones weighing 196.0 grams (Gosser et al. 2002). Eight families were identified, and minimum number of individuals was calculated. The families and MNI follow: Scaridae (29), Labridae (4), Serranidae (4), Lethrinidae (3), Balistidae (2), Diodontidae (2), Carangidae (1), Coryphaenidae (1), and unidentified fishes (35).

The authors calculated fish bone densities and correlated the radiocarbon dates with layers of the excavation. The density of fish remains for ten layers dated to the Pre-Latte Phase is 49.4 grams per cubic meter. The density of fish remains from eight layers dated to the Latte Phase is 58.5 grams per cubic meter. Gosser et al. (2002:119) concluded that there were no major changes in density or diversity of fish remains. However, it should be noted that the total volume excavated is not large. Less than one cubic meter was excavated of the ten layers dated to the Pre-Latte Phase, and just over one-half cubic meter was excavated of the eight layers dated to the Latte Phase.

Mochong, Rota

Fish bone from Mochong, Rota (Craib 1990) was analyzed by Leach et al. (1990). Neither total weight nor total number of fish bones is given, but MNI was calculated for identifiable fishes. The total minimum number of identifiable fishes is 313. Twenty-five to twenty-eight families were identified, and percentage by MNI was calculated for each family (Table 11).

Method of fishing was estimated and percentage by MNI was calculated for each method (Table 12).

Using the data generated by Leach et al. (1990), Craib (1990) commented on how the relative frequencies of the fish families vary from one horizon to the next. Horizon 3, the lowest cultural horizon representing the earliest occupation of Mochong, yielded a relatively diverse sample with 22 families and no single family dominant. Pelagic fishes account for 20% of the MNI, and inshore and benthic fishes make up 80%.

Horizon 2, representing the settlement about 800-1200 years ago, also contains 20% pelagic fishes. There is a more restricted range of families (n = 15), and Scaridae dominates the sample, making up 31 % of MNI.

Table 11. Minimum Number of Individuals of Identifiable Fishes from All Assemblages at Mochong, Rota (from Leach et al. 1990).

Family	**MNI**	**Percent by MNI**
Scaridae	68	21.7
Coryphaenidae	37	11.8
Lethrinidae	35	11.2
Epinephelidae	30	9.6
Balistidae	25	8.0
Lutjanidae	18	5.8
Holocentridae	15	4.8
Coridae/Labridae	12	3.8
Nemipteridae	11	3.5
Acanthuridae	9	2.9
Muraenidae	8	2.6
Carangidae	8	2.6
Istiophoridae/Xiphiidae	8	2.6
Acanthocybiidae	4	1.3
Coridae	3	1.0
Scorpaenidae	3	1.0
Elasmobranchii	3	1.0
Teleostomi	3	1.0
Bothidae	2	0.6
Istiophoridae	2	0.6
Tetraodontidae	2	0.6
Thunnidae/Katsuwonidae	2	0.6
Aphareidae	1	0.3
Kyphosidae	1	0.3
Platacidae	1	0.3
Diodontidae	1	0.3
Aluteridae	1	0.3
Total	313	100.0

Horizon 1 represents the protohistoric period beginning about 800 years ago. Eighteen families were identified from Horizon 1, so the trend toward a more restricted range of families continued, although more fish may have been caught.

Eels account for 4% of the sample in Horizons 3 and 2, but are absent from Horizon 1. The family Lutjanidae accounts for 7% of the Horizon 3 sample and 12% of the Horizon 2 sample, but only 1% of the Horizon 1 sample. Holocentridae and Epinephelidae also appear to have decreased through time from Horizon 3 to Horizon 1.

However not all variations are decreases. The sharks (Subclass Elasmobranchii) are absent in Horizon 3, but present in Horizons 2 (2%) and 1 (2%). Balistidae account for 4% of Horizon 3, but 15% of Horizon 1. Marlin (Istiophoridae/Xiphiidae) increased from 2% in Horizon 3 to 5% in Horizon 1.

Table 12. Likely Catch Methods of Fishes from Mochong, Rota by Families with MNI and Percentage by MNI (from Leach et al. 1990).

Likely Catch Method	**Family**	**MNI**	**Percent by MNI**
Netting	Bothidae	105	33.5
	Scaridae		
	Acanthuridae		
	Balistidae		
	Aluteridae		
Demersal Baited Hook	Epinephelidae	109	34.8
	Lutjanidae		
	Nemipteridae		
	Lethrinidae		
	Coridae		
	Coridae/Labridae		
Pelagic Lures	Acanthocybiidae	51	16.3
	Coryphaenidae		
	Carangidae		
	Thunnidae/Katsuwonidae		
Harpoons or Bait Trolling	Istiophoridae	10	3.2
	Istiophoridae/Xiphiidae		
General Foraging	Holocentridae	23	7.3
	Aphareidae		
	Kyphosidae		
	Scorpaenidae		
	Diodontidae		
	Tetraodontidae		
Basket Traps	Muraenidae	8	2.6
Opportunistic Catch	Elamobranchii	3	1.0
No Strong Opinion	Platacidae	4	1.3
	Teleostomi		

The most numerous class of fishing gear at Mochong is the fishhooks (Craib 1990). Finished hooks and preforms number 18, while fishhook blanks and tabs number 13. All were made from *Isognomon* or *Turbo*. Fifteen gorges (eight finished and seven unfinished) were recovered, all from Horizon 1. Three pieces of worked bone were identified as barbs of two-piece hooks. Four spear points with grooves at right angles to the shaft were recovered from Horizon 1. The spear points are classified as weapons, but they may have been used to procure fish.

North Coast of Rota including the Uyulan Region

In 1984 Butler investigated a portion of the north coast of Rota affected by the construction of a new road alignment between the airport and Songsong (Butler 1988). Four prehistoric villages, from west to east, Salug-Songton, Unginao-Uyulan, Teteto-Guata, and Tatgua, were identified in the vicinity of the road. The fish bones from the Rota Airport Road Project were analyzed by Davidson and Leach (1988) at the University of Otago, Dunedin, New Zealand. Neither total weight nor total number of bones is reported, but MNI was calculated for identifiable fishes (Table 13). At least 16 families were identified. Families were grouped by likely catch methods (Table14).

Table 13. Minimum Number of Individuals of Identifiable Fishes from All Assemblages from the Rota Airport Project (from Davidson and Leach 1988).

Family	**MNI**	**Percent by MNI**
Scaridae	54	29.3
Coryphaenidae	30	16.3
Istiophoridae/Xiphiidae	17	9.2
Epinephelidae	16	8.7
Thunnidae/Katsuwonidae	12	6.5
Lethrinidae	9	4.9
Holocentridae	8	4.3
Carangidae	8	4.3
Lutjanidae	8	4.3
Nemipteridae	8	4.3
Coridae/Labridae	7	3.8
Acanthocybiidae	3	1.6
Acanthuridae	1	0.5
Balistidae	1	0.5
Ostraciidae	1	0.5
Teleostomi	1	0.5
Total	184	100.0

Table 14. Likely Catch Methods of Fishes from the Rota Airport Project by Families with MNI and Percentage by MNI (from Davidson and Leach 1988).

Likely Catch Method	**Family**	**MNI**	**Percent by MNI**
Netting	Scaridae	57	31.0
	Acanthuridae		
	Balistidae		
	Ostraciidae		
Demersal Baited Hook	Epinephelidae	48	26.1
	Lutjanidae		
	Nemipteridae		
	Lethrinidae		
	Coridae/Labridae		
Pelagic Lures	Acanthocybiidae	53	28.8
	Thunnidae/Katsuwonidae		
	Coryphaenidae		
	Carangidae		
Pelagic Harpoons	Istiophoridae/Xiphiidae	17	9.2
General Foraging	Holocentridae	8	4.3
No Strong Opinion	Teleostomi	1	0.5

Davidson and Leach (1988) drew two conclusions from the analysis of the Rota Airport Project fish remains. One is that the highly specialized fishing activities observed at Mochong also prevailed for the area investigated by the Rota Airport Project. The second is that there was a change either in fishing behavior or in patterns of midden deposition in the area investigated by the Rota Airport Project. The big game fishing for marlin and *mahimahi*, which took place early and through most of the sequence, did not show up in the most recent deposits representing the late Prehistoric Period.

Although fishing was an extremely important subsistence activity for the people of the north coast of Rota, items of fishing gear are not especially numerous from the Rota Airport Project (McNamara and Butler 1988). The scarcity may be due to the fragility of the fishhooks and gorges. Fragments of finished fishhooks number 11, and there are two finished gorges. Five pieces of *Isognomon* were classified as unfinished fishhooks, and there are nine other worked pieces of *Isognomon*. Bone artifacts include three spear points, five awls (?), and a possible portion of a fishing lure. Three grooved stone items were classified as line or net sinkers (Weaver 1988). In addition, a single large *Turbo* operculum was grooved like a stone sinker (McNamara and Butler 1988).

Archaeological data recovery at the Vista Del Mar Resort in the Uyulan region along the north coast of Rota yielded 792 fish bones weighing 659.5 grams (Craib 1998). Nine fish families were identified and MNI was calculated for identifiable fishes (Table 15).

In order to have a larger sample for analysis, Craib (1998) combined the Vista Del Mar and Rota Airport Road assemblages. In the combined sample are 16 families (MNI = 201) from both Transitional and Latte Phase deposits. Craib found that the Transitional deposits yielded the widest range of fish families—all 16 families, with no single family predominating. The two most common families were Scaridae and Coryphaenidae. In the Latte Phase deposits, only five families were present, and the Scaridae dominate the sample, accounting for 86% of the MNI. With the exception of Istiophoridae/Xiphiidae, all the Latte Phase families are inshore fishes. Craib concluded that the fish bone analysis indicates a trend from a generalized pattern of fishing to a more selective approach where fewer kinds of fish were taken.

Table 15. Minimum Number of Individuals of Identifiable Fishes and Number and Weight (g) of All Fish Remains from Vista Del Mar Resort, Rota (from Craib 1998).

Family	**Common Name**	**MNI**	**Number**	**Weight**
Scombridae	Tuna	3	3	69.8
Scaridae	Parrotfish	9	18	24.5
Mullidae	Goatfish	2	7	5.6
Carangidae	Jack	2	3	4.1
Labridae	Wrasse	3	5	2.2
Istiophoridae	Marlin	2	3	1.4
Lethrinidae	Emperor	1	1	1.2
Balistidae	Triggerfish	1	1	0.7
Acanthuridae	Surgeonfish	3	5	0.5
Unidentified			746	549.5
Total		26	792	659.5

Songsong, Rota

Archaeological data recovery in Songsong, Rota yielded 34 fish bones weighing 9.68 grams (Henry et al. 1999b). The only family identified is Scaridae (n = 4). In addition, 52 items of fishing gear were collected. These include 13 fishhooks, 22 gorges, and 17 tabs. All but two were made from *Isognomon*. One fishhook was made from *Turbo* and one tab was made from *Pinctada margaritifera*. The calibrated radiocarbon dates range from 806-408 BC to AD 1207-1293.

Southern Rota

Two test units excavated during the archaeological survey of Rota Highway 100 (Dixon 2000) yielded fish remains. From the coastal rockshelter (Site RT-1-627), there are 133 fish remains weighing 8.2 grams, and from the upland rockshelter (Site RT-1-654), there are three fish remains weighing 1.1 grams. Identifiable fishes from the coastal rockshelter include Scaridae, Acanthuridae, and Labridae. From the upland rockshelter, no fish remains were identifiable. No fishing gear was recovered, and no radiocarbon dates were obtained.

TURTLES FROM THE CNMI

The archaeological reports from the CNMI that were researched for fish remains were also examined for turtle remains. Seven of the seventeen reports mention turtle (Table 16).

Table 16. Number and Weight (g) of Turtle Bones from CNMI Sites. A plus sign in the Number column indicates turtle bones were present. N.r. = none reported.

Site or Area	Report	Number	Weight
Achugao, Saipan	Butler 1995	N.r.	
Achugao, Saipan	Craib 1992	N.r.	
Garapan to Oleai, Saipan	Butler and DeFant 1990	N.r.	
Susupe	Hunter-Anderson et al. 1996	N.r.	
Chalan Piao, Saipan	Moore et al. 1992	+	
Afetña, Saipan	McGovern-Wilson 1989	N.r.	
Laulau, Saipan	Marck 1978	+	
Kagman Peninsula, Saipan	Dilli et al. 1993	N.r.	
Unai Chulu, Tinian	Haun et al. 1999	225	
Mulatu and Lamanibot, Tinian	Moore et al. 2001b	N.r.	
Northern Tinian	Dixon et al. 2000	N.r.	
Central Tinian	Gosser et al. 2002	N.r.	
Mochong, Rota	Craib 1990	114	
North Coast, Rota	Becker and Butler 1988	9	
North Coast, Rota	Craib 1998	17	43.5
Songsong, Rota	Henry et al. 1999b	2	2.16
Southern Rota	Dixon 2000	N.r.	

The two sites with the greatest number of turtle remains, Unai Chulu, Tinian and Mochong, Rota, both show a decrease in number of bones from the lower layers to the upper layers (Tables 17 and 18).

Table 17. Number of Turtle Bones by Strata from Unai Chulu, Tinian (Haun et al. 1999). The turtle bones are from Strata II through VIII of the 4 x 4 meter block. Stratum VIII is the lowest culture-bearing layer.

Stratum	**Turtle Bones**
II	3
IIIb	1
IIIc	2
IV	2
VI	13
VII	201
VIII	3
Total	225

Table 18. Number of Turtle Bones by Horizon from Mochong, Rota (Craib 1990). The turtle bones are from Test Pits 5 through 8. Horizon 1 is the uppermost layer, and Horizon 3 is the lowest culture-bearing layer.

Horizon	**Turtle Bones**
1	10
2	15
3	89
Total	114

INVERTEBRATES FROM THE CNMI

Crustaceans

Crab remains are reported from archaeological excavations in the CNMI, but usually in small quantities, so that trends in abundance would be difficult to detect. Because the remains are easily weathered and easily broken, they are rarely identified below the class level.

Echinoderms

From Achugao, Saipan, Carucci (1995) counted 389 MNI of sea urchins from Excavation Units (EU) 1-13, with the vast majority (n = 383) from EU 9-11 (Table 19). Total weight of sea urchin spines from EU 1-13 is 612.6 grams with 606.1 grams of that from EU 9-11. Excavation Units 9-11 sampled the Pre-Latte zone of red ware pottery.

Table 19. Minimum Number of Individuals (MNI) and Weight (g) of Pencil Urchin from Achugao, Saipan (Carucci 1995).

Tract and Excavation Units (EU)	MNI	Weight
Aqua Resort Club Tract EU 1-4	4	6.2
Aqua Resort Club Tract EU 5-8	2	0.3
Nansay Tract EU 9-11	383	606.1
Nansay Tract EU 12-13	0	0.0
Total	389	612.6

One radiocarbon date with an adjusted calendar date of 910 BC was obtained from EU 10. From EU 11, there are two radiocarbon dates. The one from Level 9 has an adjusted calendar date of 1135 BC, and the one from Level 10 has a calendar date ranging from 760-560 BC. The last two dates are stratigraphically inconsistent, in that the earlier date came from the higher level. Butler (1995) suggested that the Level 10 date is the suspect one, but that there is some concern about the stratigraphic integrity of the deposits. Nevertheless at least some levels of EU 10 and 11 date to the Early Pre-Latte Phase. The sea urchin data for EU 9-11 are not separated by levels.

Two urchin spine tools from Achugao were described as chisels/gouges (Butler and Harris 1995). Both derive from Early Pre-latte deposits (Levels 8 and 9) in EU 25.

No sea urchin spines are mentioned in Craib's Coral Bay Resort, Achugao, Saipan, report, but the deposits investigated for that project date mostly to the Latte Phase (Craib 1992:63). No sea urchin spines are mentioned by Butler and DeFant (1990) or Hunter-Anderson et al. (1996) in their reports concerning the Garapan to Susupe area.

Sea urchin remains, both spines and tests, were recovered from the Pre-Latte deposits at Chalan Piao, Saipan (Moore et al. 1992). Neither numbers nor weights are reported, but the remains appeared in every level. Seven modified spines and three thin slices of spines were reported. One came from a collection made by the CNMI Historic Preservation Division, and the other nine items came from Layer II of the MARS excavation. The radiocarbon dates from the top and bottom of Layer II are given above under **Fish Remains**.

McGovern-Wilson's Afetña report makes no mention of sea urchin remains in the chapter on faunal remains (Leach et al. 1989). However, there are three sea urchin spine files/abraders (McGovern-Wilson 1989:201).

Marck's Laulau excavation yielded sea urchin remains. Neither number nor weight is reported, but a chart shows which levels the sea urchin spines and crab claws derived from. These remains were present in Levels 3 through 23, but appear to have been most abundant in Levels 15 through 20 (Marck 1978:30-31). Two Early Pre-Latte dates were obtained (see above).

No sea urchin remains were reported from the Shimizu Golf Course area on the Kagman Peninsula (Dilli et al. 1993).

Haun et al. recovered 27 (Haun et al. 1999:89) or 28 (Haun et al. 1999:89, B-255 to B-256) sea urchin abraders from Unai Chulu, Tinian. The majority (n = 19) came from Stratum VII, which dates to the Early Pre-Latte Phase. O'Hare and Gosser's (2000) report on the invertebrates from Unai Chulu gives weight of sea urchin remains by stratum (Table 20). Sixty-four percent of the total weight derived from Stratum VII, and 83 percent derived from Strata VI and VII combined.

Table 20. Weight (g) of Sea Urchin Remains by Stratum from Unai Chulu, Tinian (O'Hare and Gosser 2000). Statum I is the uppermost, and Stratum VII is the deepest.

Stratum	**Sea Urchin Remains**
I/II	3.2
IIIa	0.0
IIIb	21.2
IIIc	56.5
IV	22.5
V	4.0
VI	120.1
VII	404.7
Total	632.2

At Unai Chulu, sea urchin spine frequency is correlated with shell bead frequency. Haun et al. (1999:B-257 to B-262) list 94 ornaments recovered from the 4 x 4 meter block. All but three are made from shell, and most are cone shell beads. Eighty-six of the 94 ornaments derived from Strata VI and VII combined; 81 are from Stratum VII alone. Sea urchin spines may have been used as abraders in manufacturing the cone shell beads and bracelets. The decline in sea urchin spines in the upper strata at Unai Chulu corresponds to the decline in shell ornaments recovered from the upper strata.

Several explanations come to mind. It is possible that sea urchins declined in abundance either as a result of a change in the environment or human harvesting pressures. Also possible is that cone shells declined in availability, though no one has presented evidence of the gastropods declining, only the ornaments declining. It is possible that the cone shell beads and bracelets lost their cultural significance, and were no longer made, thus the sea urchin spines were no longer needed.

Moore et al. (2001b) reported a single piece of sea urchin test from a site in the Voice of America Area A, northwest Tinian, but the fragment was thought to have been brought to the site in a load of beach sand. From the former VOA Areas B and C, Dixon et al. (2000) collected 11 sea urchin spine abraders and fragments. No other sea urchin remains are mentioned from the midden analysis. From the Military Leaseback Area, central Tinian, Gosser et al. (2002) collected one urchin spine abrader and other urchin remains from seven sites in three areas.

More than 300 whole and fragmentary urchin spines weighing 613.8 grams were recovered from excavations at Mochong, Rota (Craib 1990). The weights per horizon given by Craib on page 7-8 do not add up to the total weight on page 7-9. Therefore weights per horizon were recalculated here using the description of horizons on page 4-21. Horizon 3 not only yielded the greatest weight of sea urchin spines (Table 21), it also yielded the largest spines. All whole spines that measured more than 10 cm in length came from Horizon 3.

Table 21. Weight (g) of Sea Urchin Spines by Horizon from Mochong, Rota (Craib 1990). Horizon I is the uppermost; Horizon III is the deepest and oldest.

Horizon	**Sea Urchin Spines**
1	79.7
2	189.4
3	344.7
Total	613.8

Butler (1998) did not include sea urchin remains in the faunal analysis of the Airport Road Project, north coast of Rota, but McNamara and Butler (1998) reported eight pencil urchin files. No sea urchin remains or artifacts were reported by Craib (1998) from the Vista Del Mar Resort, Uyulan region, north coast of Rota, or by Henry et al. (1999) from the Songong Water System Improvement Project. One sea urchin spine was collected from the coastal rockshelter (Site RT-1-627) along Rota Highway 100, southern Rota (Dixon 2000).

Mollusks

The changes that took place during the Prehistoric Period at Tumon Bay and East Agana Bay, Guam, from collecting of large bivalves to smaller bivalves to *Strombus*, also took place in southwest Saipan (J. Amesbury 1999, J. Amesbury et al. 1996, Moore et al. 1992) (Figures 11 and 12). At the Chalan Piao excavations conducted by MARS (Moore et al. 1992), bivalves made up more than 90 percent of the weight of marine shell, and the genus *Anadara* (family Arcidae) accounted for more than 50 percent. Calibrated dates of 1731-1226 BC and 1396-865 BC were obtained from charcoal from lower and upper Layer 2, respectively (J. Amesbury et al. 1996)

A previous excavation at Chalan Piao, in Thomas and Price's (1980) Section C1, somewhat west of the MARS excavation, also yielded shell remains that were mostly *Anadara*. However, in an excavation unit in Section C2, a few hundred meters closer to the present shoreline, Thomas and Price found that *Strombus* was the most numerous shell in the top 40 cm. Below 40 cm, small bivalves, *Tellina* sp. and *Fragum fragum*, were the most numerous. No radiocarbon dates were reported for the Thomas and Price excavation.

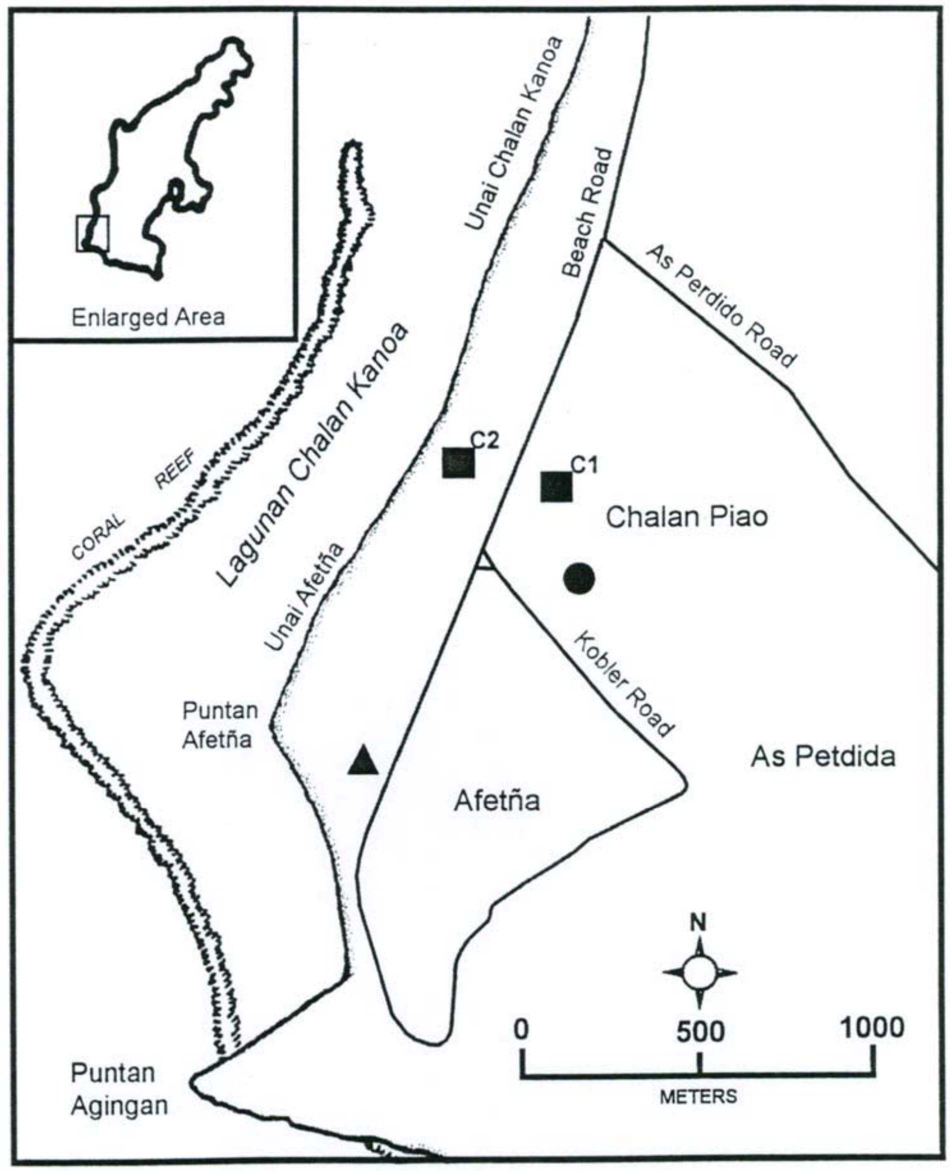

Figure 11. Southwest Saipan, showing four excavations in the vicinity of Chalan Piao. Circle = Moore et al. 1992; Squares = Thomas and Price 1980; Triangle = McGovern-Wilson 1989. Inset: Saipan.

At the Afetña excavation, also closer to the present shoreline than the MARS Chalan Piao excavation, McGovern-Wilson (1989) found that *Strombus* was the most numerous shell in the top 70 cm, while *Fragum fragum* and *Tellina robusta* were the most numerous shells below 70cm. McGovern-Wilson obtained three radiocarbon dates from small *Tridacna* shells (McGovern-Wilson 1989:70). He applied a marine reservoir correction of 450 +/- 35 years, after Bonhomme and Craib (1987:99), and calibrated the dates according to Stuiver and Pearson (1986). J. Amesbury et al. (1996) recalibrated the dates according to Stuiver and Reimer (1993). The 2-sigma age range for the 70-80 cm level, AD 868-1213 (J. Amesbury et al. 1996:56), indicates that the transition from a majority of bivalves to a majority of gastropods occurred in this area around AD 1000.

It appears, then, that in southwest Saipan, *Anadara* was harvested very early during the Pre-Latte Phase. By the Transitional Phase, *Anadara* had been replaced by the smaller bivalves belonging to the Tellinidae and Cardiidae families. Finally by the Latte Phase, *Strombus* was the most commonly harvested mollusk.

Paulay (1992) concluded that while the *Anadara*-to-*Strombus* sequence could be the result of either a change in the environment or an increase in human harvesting pressure, the most likely explanation is environmental change caused by relative sea level decline with human harvesting playing a minor role. Randall (1992) found evidence at Chalan Piao and elsewhere around the island of Saipan for a higher than present relative sea level up until about 3000 years BP.

The *Anadara* in the Mariana Islands is *Anadara antiquata* (Linné, 1758) (Paulay 1996). Tebano and Paulay (2001) reported that *Anadara antiquata* is preferentially associated with mangroves in Guam and Fiji, and that the patchy distribution of the species in the central Pacific is probably related to the patchy distribution of mangroves. Because mangroves are sensitive to sea level change (Woodroffe et al. 1985), a relative decline in sea level about 3000 BP would explain the disappearance of *Anadara* after the early Prehistoric Period. Paulay (1992) also noted that falling sea levels would kill large areas of reef, which, when covered by shallow sands, would provide a habitat favorable to *Strombus*.

At the Achugao Archaeological Project area on the northwest coast of Saipan, Carucci (1995) also found evidence for mangroves based on both mollusk and pollen data. Nansay Excavation Units 9-11 yielded greater quantities of *Anadara antiquata* than did the other excavation units. These are the same units that had the highest MNI of sea urchins (above) and whose lower levels dated to the Early Pre-Latte Phase. The shell data are not provided by level for EU 9-11.

There were also high counts of the limpet, *Patelloida chamorrorum* (family Acmaeidae), in the early deposits at Achugao, but unfortunately Carucci (1995:292-294, 301) chose to ignore the limpets, interpreting them as storm-deposited. Limpets are edible mollusks and were thought to have been overharvested at Tarague, Guam (J. Amesbury 1996b). Correlated with the high counts of limpets at Achugao were high counts of chiton plates, almost all of which were found at depths of 80 cm or below.

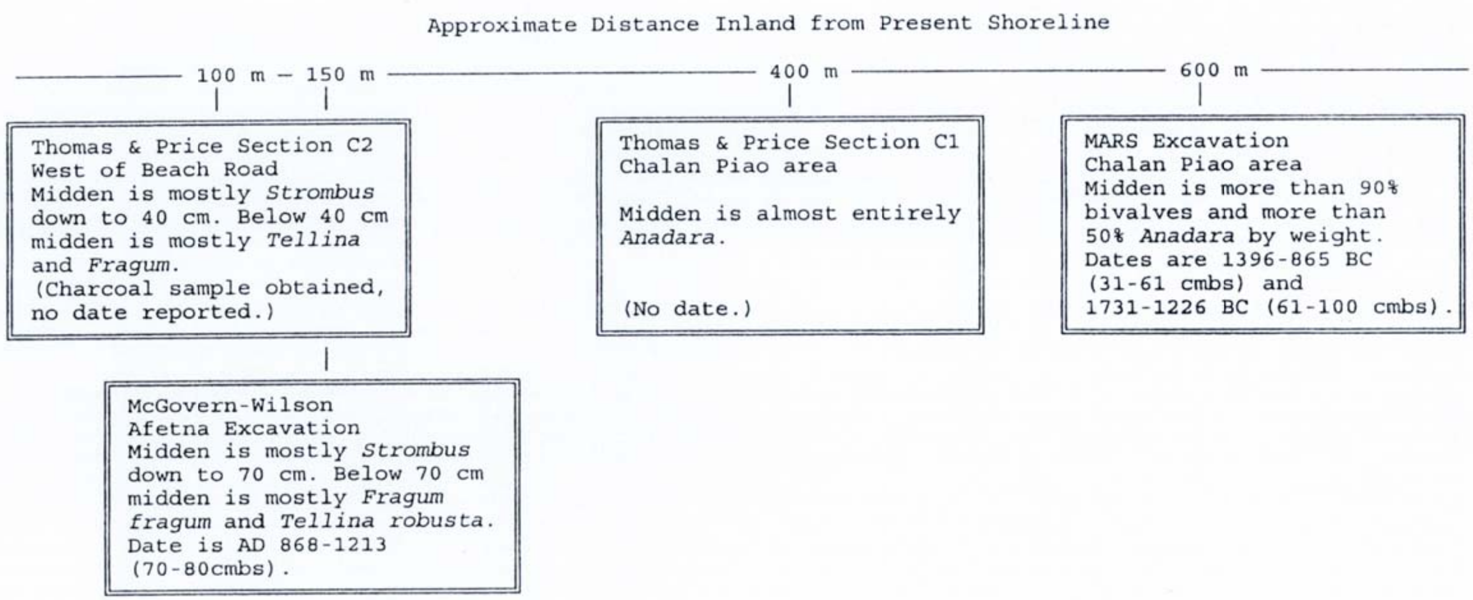

Figure 12. Comparison of marine shell midden from four excavations in southwest Saipan, showing changes correlated with distance inland from the present shoreline.

Chitons are edible mollusks belonging to the class Polyplacophora. Carucci (1995:293) mistakenly thought that chitons and limpets "probably were not food." However, he did say, " It is also possible, of course, that they appear together in high numbers because they were both collected, and they are found deeply buried because this behavior occurred early in the cultural sequence" (Carucci 1995:293). This explanation is more likely than that the limpets and chitons were naturally deposited in otherwise cultural deposits. Carucci (1988:320) had also found limpets to be more abundant in the deeper deposits than the upper deposits at the Rota Airport Road Project, but he suggested they were storm deposited there also.

A third site in the Northern Mariana Islands that yielded evidence of mangroves during the early Prehistoric Period is the Unai Chulu Site on Tinian (O'Hare and Gosser 2000). *Anadara antiquata* is most abundant in the Early Pre-Latte Component (1500-500 BC) and declines steadily over time. Also most abundant in the earliest layers is the limpet, *Patelloida chamorrorum*, but O'Hare and Gosser (2000:27) mistakenly dismissed the limpets as having "no known use." Limpets were eaten in the Marianas, as well as many other islands of the Pacific, including Hawai'i (Kay 1979:17, 44).

CONCLUSIONS CONCERNING THE PREHISTORIC PERIOD

Fishes

In describing the archaeological fish remains, different researchers work with different units of measurement. Some report number of fish remains, and some report weight of fish remains. Some report neither number nor weight, but Minimum Number of Individuals (MNI). Only one of the reports (Craib 1998) reviewed here reported all three measures.

The reports that give MNI demonstrate what a small proportion of all the fish consumed at a site end up in the archaeologist's screen. For example, the Afetña site in southwest Saipan (McGovern-Wilson 1989) was occupied, perhaps intermittently, for a few hundred years, but the MNI for fishes is 39. Depending on the size of the human community, that number of fishes may have been consumed in one month or one week. Either the fish remains were disposed of away from the habitation zone, or the fish remains were not well preserved in the ground, or they were not recovered because only a small part of the site was excavated. Probably all three of these factors help to explain the small MNI. The site with the largest MNI is Mochong, Rota, with 313 MNI from three horizons representing several hundred years (Craib 1990).

Certain fishes, for example parrotfishes, are not only more likely to be preserved, they are also easier to identify. Parrotfish beaks are probably the sturdiest elements recovered and also the easiest to identify. Six of the reports reviewed here calculated MNI by families, and in five of those reports, the Scaridae was the most numerous family. That may actually have been the case, because the parrotfishes are easy to catch with little gear, but it may be that they only appear to be the most numerous fish caught because they are the most well preserved and most easily identified. No doubt there are some families of fishes that are never identified, not because they are absent, but because the bones are not distinctive enough or sturdy enough to have survived intact, sufficient for identification

Many researchers report the fish bones as a group, but some correlate fish remains to the depth or time period of the deposits. The reports that do this make it easier to see if there has been a change from one time period to another. For example, the fish remains from Unai Chulu, Tinian (Haun et al. 1999) were counted by family and by stratum, so one can compare one stratum's contents with another's. Some reports contain sufficient information so that a researcher could correlate the fish remains with the time periods of the deposits.

Some researchers draw conclusions from too little data. For example, Gosser et al. (2002) concluded that there were no major changes in density or diversity of fish remains between the Pre-Latte Phase and the Latte Phase at the Military Leaseback Area in Tinian. However, less than one cubic meter was excavated of the Pre-Latte deposits and just over one-half cubic meter was excavated of the Latte deposits.

Some researchers have discovered changes through time, but are unable to explain the changes. For example, Davidson and Leach (1988) found that the big game fishing for marlin and *mahimahi*, which took place early and through most of the sequence, was not evident in the late prehistoric deposits of the area investigated by the Rota Airport Project. Whether that was a change in fishing behavior or a change in patterns of midden deposition is not known.

It does not appear that any definite trends in regard to the fish remains from the Prehistoric Period have been discovered with one possible exception. Some authors (Graves and Moore 1985; Craib 1990) suggest that there was a trend of increased specialization through time. This idea needs to be investigated. What would that trend look like archaeologically? Would there be more families represented in the earlier deposits and fewer families in the later deposits? This was the case at Mochong, Rota, according to Craib (1990). Would a greater percentage by weight of the fish remains in the later deposits come from one family? At Tarague, the percentage of parrotfish mouthparts among the total mouthparts increased through time (S. Amesbury 1987). Is this evidence of specialization? And if there were increased specialization through time, what would that mean in the context of the culture and environment of the prehistoric people? This is a topic for further investigation.

Turtles

The three sites with the greatest abundance of turtle bones all show a decrease from the earlier deposits to the later deposits. Craib (1986) recovered 210 grams of turtle bone from Pagat, Guam, with 194.1 of the 210 grams from the Pre-Latte Horizon II. In Tinian, Haun et al. (1999) recovered 225 turtle bones from Unai Chulu, but 201 of the 225 bones were from the deep Stratum VII dated to approximately 1500-1000 BC (Haun et al. 1999:55). From Mochong, Rota, Craib (1990) found 114 turtle bones, but 89 of those are from the deepest Horizon 3, representing the earliest occupation of Mochong, approximately 1000 BC to AD 650 (Craib 1990:5-8).

Does the decrease in turtle bones from the earlier deposits to the later deposits mean that turtles were no longer as abundant in later times? It may, but three sites are probably too few on which to base that kind of statement. It is surprising that more turtle bones are not recovered from archaeological excavations.

Invertebrates

More trends have been discovered with regard to the invertebrates, and various causes of the trends have been suggested. One of the best documented trends is the decline in abundance of the arc clam, *Anadara antiquata*, through time. This was found to have taken place at certain locations on three islands. These locations are Tumon Bay and East Agana Bay, Guam (J. Amesbury 1999), Chalan Piao, Saipan (J. Amesbury et al. 1996), Achugao, Saipan (Carucci 1995), and Unai Chulu, Tinian (O'Hare and Gosser 2000).

Since *Anadara* is preferentially associated with mangroves, a decline in mangroves probably caused the decline in *Anadara* (see J. Amesbury 1999 and J. Amesbury et al. 1996). The decline in mangroves would have been caused by the relative sea level decline that took place within the last 3,000 to 4,000 years. Paulay (1992) concluded that the decline in *Anadara* was more likely due to these environmental changes than to human harvesting.

Other mollusks that decline in abundance from the earliest deposits are the limpets, *Patelloida chamorrorum* and *Patella flexuosa*. In consultation with Gustav Paulay, J. Amesbury (1996b) suggested that this was due to human harvesting at Tarague, Guam, while Olmo (1996b) thought it was the combination of relative sea level decline and human harvesting. Carucci dismissed the limpets at Achugao, Saipan (Carucci 1995) and at the north coast of Rota (Carucci 1988) as nonfood shells of natural origin, specifically storm deposited shells. Following Carucci's lead, O'Hare and Gosser (2000) also dismissed the limpets as having "no known use" and being storm deposited at Unai Chulu, Tinian. However, the limpets were food resources in the Marianas and in many other islands of the Pacific, including Hawai'i (Kay 1979).

Carucci (1995) found that chitons were correlated with limpets at Achugao, but he also dismissed the chitons as storm deposited. He did concede the possibility that both limpets and chitons were harvested early in the prehistoric sequence. This is the explanation favored by the present authors. Chitons (known as *tágula* in Chamorro) are considered a delicacy by some Chamorros (J. Amesbury 1996a:4). It is unlikely they were storm deposited in archaeological sites, because they are adapted to surf-beaten shores (Kay 1979:583), and according to Smith (1986), "Once disturbed by an unsuccessful attempt to remove them, chitons cling to the rock with such force that they will be mutilated before they are pried free."

Sea urchin spines have also been found to decline in numbers in archaeological sites. They are most abundant in the Pre-Latte deposits at Tarague (Ray 1981) and Ypao Beach (Leidemann 1981) in Guam; Achugao, Saipan (Carucci 1995); Unai Chulu, Tinian (Haun et al. 1999); and Mochong, Rota (Craib 1990). There are several possible explanations. Either a change in the environment or human harvesting pressure could have caused a decline in sea urchins. Since the sea urchin spines are closely correlated with the cone shell beads at Unai Chulu, it may have been that a change in the culture reduced the significance of the cone shell beads, and the sea urchin spines were no longer needed for manufacturing beads. The sea urchins are rarely identified to species in the archaeological reports, but more research could be done on the habitat of the sea urchins and on the correlation of sea urchin spines to shell ornaments.

CHAPTER 3. SPANISH PERIOD

By Judith R. Amesbury

EARLY EXPLORERS

Many of the early European explorers to reach the Marianas remarked on the islanders' foods, fishing practices, and fishing gear. The years shown in the headings below are the years in which the individual was in the Marianas. In the case of secondary accounts, the years pertain to the time that the voyage or expedition was in the Marianas. The important arrivals of the 1500s were Magellans' voyage of discovery in 1521, the Loaysa expedition just five years later in 1526, and the voyage of Legazpi, who claimed the Marianas for Spain, in 1565.

Antonio Pigafetta—1521

Magellan's historian on the first expedition to circumnavigate the globe, Antonio Pigafetta, recorded the European discovery of the Mariana Islands in March 1521 (Lévesque 1992a:189-202). The stop at Guam was brief and hostile. The log of the pilot Alvo (Lévesque 1992a:221-229) shows that the Spanish arrived on March 6 and departed on March 9. The islanders came aboard Magellan's ships and took things from them. Magellan was angered by the removal of a skiff, which had been tied to the poop of his own ship. He went ashore with 40 armed men, burned 40 or 50 houses and many canoes, killed seven islanders, and recovered his skiff.

As the Europeans departed, the islanders followed them for a league in 100 or more canoes. They came close to Magellan's ships, showing the Europeans fish as if they were offering the fish to them, but instead they shot stones at them [according to Lévesque, they were using slings to throw stones, Ed. note 1, p. 200]. Pigafetta marveled at the speed and skill with which the islanders maneuvered their canoes.

In his brief description of Guam, Pigafetta provided the following information about the islanders' food and fishing practices: "Their food is from certain fruits called coconuts, and potatoes [either yams or taro, according to Lévesque, Ed. note 6, p. 200]. There are birds, bananas as long as one palm, sugar-cane and flying fish…The pastime of the men and women of the said place, and their sport, is to go with their canoes to catch some of these flying fish with some fish-hooks made of fish bones" (Lévesque 1992a:200-202).

Martín de Uriarte —1526

The Loaysa expedition, under the command of Fray García Jofre de Loaysa, left Spain in 1525 and arrived in the Marianas in 1526. One of the pilots of the expedition was Martín de Uriarte. Portions of his log are included in the report to the King by Hernando de la Torre (Lévesque 1992a:424-452). Uriarte observed, "They kill plenty of fish with fishhooks made of either wood or bone and with line which they make out of tree bark (Lévesque 1992a:438).

Andrés de Urdaneta—1526

Andrés de Urdaneta sailed on board one of the Loaysa expedition vessels, which was captained by Juan Sebastian Elcano, who had completed the voyage of Magellan after Magellan's death in the Philippines. Urdaneta later became an Augustinian friar and returned to the Marianas in 1565 with the Legazpi expedition.

In Urdaneta's first eyewitness account (Lévesque 1992a:453-460), written at Valladolid in 1537, he described the Marianas, "In these islands, there is no livestock whatever, no chickens, nor any other animals nor food supplies, except rice, which they have in abundance, as well as fish, coconut, coconut oil, and salt" (Lévesque 1992a:456).

In the second eyewitness account by Urdaneta (Lévesque 1992a:461-469), he remarked on the islanders' use of tortoise shell, "As for tortoise shells, they praise them very much for making combs and hooks to fish with…As for fish, they kill many with hooks" (Lévesque 1992a:465-466).

Secondary Account—1526

In describing the canoes of Guam, Navarrete paraphrased Herrera and Oviedo (Lévesque 1992a:481-482). Oviedo had interviewed Urdaneta and Martin de Islares in 1539. So Navarrete's information was second or third hand. Concerning trade with the Mariana Islanders, he said, "Before the *nao* [Manila galleon] anchored at the island, many canoes went aboard with water, that they carried in gourds, salt, fish, potatoes, rice, coconuts, bananas and other local fruits. They did not wish anything other than iron, nails or things with metal tips in exchange for them. All such things they called *herrero*. They appreciate tortoise shell very much in order to make combs and hooks for fishing" (Lévesque 1992a:481).

Major Estéban Rodriguez—1565

Major Estéban Rodriguez was the pilot of the flagship of Legazpi's voyage, which arrived at Guam in January 1565. Their encounters with the native people were mostly hostile, but during a truce they traded nails for food. Rodriguez wrote, "During this truce, they had come alongside to trade rice, fish, yams, bananas (a little better than those of Havana), coconuts, ginger, and other products from the land; they bartered it all for a nail" (Lévesque 1992b:93).

He added, "Their food consists of *tamales* made of rice, some toasted and others fresh; the toasted ones keep much longer. They also eat big yams and small potatoes, bananas, fish and coconuts. They make oil from the coconuts for lighting and cooking purposes. There is much ginger here, and other fruits whose names I do not know. These islanders have many canoes, big and small. One day I saw more than 500 of them alongside the ships; they all came to barter, bringing food of the type mentioned above. They called for nothing else but nails in exchange" (Lévesque 1992b:94).

In the first Chamorro vocabulary, Rodriguez provided Chamorro words for fish (*bian*), salted fish (*azuiban*), fishing net (*ragua*), and crab (*achulu*) (Lévesque 1992b:95-97).

Father Fray Martin Rada—1565

Another narrative of Legazpi's voyage is attributed to Father Fray Martin Rada (Lévesque 1992b:148-170). Concerning the food and fishing practices of Guam, Rada wrote, "No-one was found who ate or had any kind of meat, any wild or domestic cattle, any birds whatever except a few turtle doves that they kept in cages; as for the Indians we kept captive on board, they did not wish to eat any meat at all and at the beginning they did not want to eat any of our things. They have fish in quantity which they take with fish-hooks, and fish-nets, some of which are rather large implements. Some people noticed a few times, when the Indians were bartering at the ships, if some fish of any kind swam by the ship, they dove in after it and took it out with their [bare] hands, which is something wonderful to see. They are excellent swimmers" (Lévesque 1992b:164).

Secondary Account—1565

A secondary account of Legazpi's voyage by Father Juan de Medina (Lévesque 1992b:258-265) also reported on the islanders' skills at sailing, swimming, and fishing. Medina wrote, "Both men and women are fine sailors and swimmers, for they are accustomed to jump from their little boats after fish, and to catch and eat them raw (Lévesque 1992b:262).

Secondary Account—1565

Another secondary account pertaining to the voyage of Legazpi is by Father Fray Gaspar de San Augustin (Lévesque 1992b:267-281). Father San Augustin wrote, "The natives are not used to eating meat; they were unable to have those held captive aboard the ships eat meat either, except fish. They caught the fish with hooks made of bone, or something that produced the most admiration, by diving underwater to get it, as they are such awesome swimmers that only those who have seen them can believe it" (Lévesque 1992b:280).

Other Writings Pertaining to the Late 1500s

Several other writings pertaining to the late 1500s mention how the islanders bartered fish for iron. These include the following:

1) A letter from Father de Jesús to the Pope, dated Manila July 1580 (Lévesque 1992b:486-487);
2) An account of the voyage of Father Martin Ignacio de Loyola around the world (Lévesque 1992b:517-520);

3) An account of the voyage of Thomas Cavendish by Francis Petty (Lévesque 1992b:563-570);
4) The beginning of the Boxer Codex which deals with the visit of galleons to Guam (Lévesque 1992b:617-620);
5) A secondary account of the customs of the Marianas by Cristóval Suárez de Figueroa (Lévesque 1993:36-38);
6) A narrative by Pedro Fernandez de Quiros as edited by Justo Zaragoza (Lévesque 1993:39-50);
7) The story of the Carlettis, Italian traders, aboard the San Pablo in 1596 (Lévesque 1993:61-67).

THE FIRST SPANISH RESIDENTS OF THE MARIANAS

Before the end of the 16th century and at the beginning of the 17th century, individuals motivated by religious zeal jumped ship in the Marianas in order to convert the islanders to Roman Catholicism. Other Spaniards resided in Guam as a result of shipwreck. Their longer tenure in the islands allowed them to learn more of the customs of the islanders.

Fray Antonio de los Angeles—1596-1597

Fray Antonio de los Angeles, who is considered the first missionary to the Mariana Islands, jumped ship at Guam in 1596. Two men from his ship jumped into the water to bring him back, but they were unable to overtake him, and all three Spaniards remained in the Marianas until 1597.

De los Angeles wrote, "When our ships pass by, they come to barter palm mats that are very well made, coconuts and fish, for iron, of which they are very fond, not caring for gold nor silver" (Lévesque 1993:71).

"Their occupation is fishing and bartering the fish with the islands where they do not have any, bringing back as a reward what they need and is lacking in their island" (Lévesque 1993:72). (According to Lévesque, the word "islands" is used to mean "villages", Ed. note 1 on p. 71.)

Concerning the customs associated with dying, de los Angeles said, "When a sick person is about to die, they take him upon a board to the house of a friend and they give him a little raw fish to eat, and those present eat some of it also" (Lévesque 1993:72). He added, "They placed on top of the burial site a paddle or a [model] canoe, a bow and arrow, or all the fishing nets, fishhooks and knives, all of it made into bundles…They praise him for his skill at fishing and the great strength with which he used to throw spears and shoot the sling, that he would go to the Spanish ships passing by there and bring back iron, that he built canoes, gave feasts to which he invited the town people, and that he owned many tortoise shells, which they placed on the grave and which they value a great deal" (Lévesque 1993:73). He said that fishing nets and fishhooks were also offered to their idols.

Fray Juan Pobre de Zamora—1602

Fray Juan Pobre de Zamora, a lay brother of the Franciscan order of Discalced Friars, was aboard a ship in a fleet that departed Acapulco on February 4, 1602 (Driver 1983). The fleet carried the new governor of the Philippines, Don Pedro Bravo de Acuña. Governor de Acuña had learned in Acapulco of the shipwreck of the *Santa Margarita* at Rota one year earlier in February 1601, so he ordered the fleet to put in at Rota where they recovered 21 survivors. An additional four survivors were recovered from Guam.

Moved by a desire to see the people of Rota converted to Roman Catholicism, Fray Juan Pobre and a religious brother Fray Pedro de Talavera jumped ship at Rota. Fray Juan Pobre remained there seven months until October 1602 when he left on a ship bound for the Philippines.

While on Rota, Fray Juan Pobre was visited by a Spaniard named Sancho, one of the three Spanish survivors of the *Santa Margarita* that had remained in the Marianas. Sancho lived on Guam as the servant to a Chamorro master named Suñama. Islanders from Pago, Guam, brought Sancho to Tazga, Rota, where he visited for several days with Fray Juan Pobre and Fray Pedro de Talavera. At the end of their visit, Fray Juan Pobre accompanied Sancho back to the village of Guaco, Rota, where he was to meet the villagers from Pago, Guam, who had brought him to Rota (Driver 1988). As the two slept at Guaco that night, Sancho was speared in the back, and nine or ten days later, in the month of August, he died at the home of Fray Juan Pobre's master in Tazga.

In Chapter 70 of his account, Fray Juan Pobre related what Sancho had told him about the customs of the Mariana Islands (Lévesque 1993:175-188). Sancho said the islanders "use all the known nets and inventions to catch fish, and many more" (Lévesque 1993:175). Concerning flyingfishes (family Exocoetidae), Sancho reported the following:

"The common fish they catch in the islands is the flying-fish which is a very good fish (in the islands). They use many different kinds of hooks, of very hard wood, of shells, and they make them with surprising workmanship although most of them now make them with nails from the ones the ships give them and those they found in the sad ship, the *Santa Margarita*, which must have supplied the whole island. When they fish for these flying-fish, those from one town all come together in a bunch and they go out in their canoes, each one with from ten to twelve gourds; to each gourd is tied with a very slim cord a small two-pointed shell hook. One hook is baited with coconut meat and the other with shrimp or some minnow from the sea. All the fishermen throw these gourds into the sea together, everyone taking care of his own. It is by watching the gourds and seeing them wiggle that they know they have a flying-fish. There are so many fishermen because all those living on the coast of all the islands are fishermen. There are flying-fish for all of them as there are sardines in Spain. The average fish measures about one palm in length, and others about two. The first flying-fish they catch, they then eat it raw. The second one is placed as a bait on a large hook and the cord is thrown over the poop and in this manner they usually catch many dorados, swordfish, and other big fishes. They are much enemies of the sharks and they do not eat them. The Indian chiefs do not eat any fish with leathery skins nor soft-water river fishes either. I want to conclude, as far as their fishery is concerned, with two things I have seen by which the reader will be convinced that they are the most skillful fishermen and sailors who have been discovered" (Lévesque 1993:176).

The two stories that Sancho then related were one demonstrating the swimming and diving skills of the islanders and one about how his master landed a billfish, possibly a blue marlin (*Makaira nigricans*) according to S. Amesbury (Driver 1983). [This species is now known as *Makaira mazara* in the Pacific.] Sancho's master ate the first flyingfish and placed the second one on the hook. He hooked a very large billfish and spent a great deal of time playing the fish to tire it. But a large shark came and seized the billfish. When Sancho's master did not let go of the line, his boat capsized. He followed the line to the shark and fought it off, then brought the billfish back to his boat, which he righted and sailed home flying a woven mat from the masthead to indicate a successful catch. Details of the story differ in the two translations by Driver (1983) and Lévesque (1993).

In regards to the Chamorro system of justice, Sancho commented on the value of turtle shell. "When one kills another, if they are from the same town he absents himself from that town to go to another island so that the relatives will not kill him. He remains absent until from the killer's house or from that of his father or mother they take one or two palms of tortoise [shells] which is the thing that is most valued among them and with some big fish and rice they pay the father or mother or wife of the deceased for the death. Once this has been done, they send word to the exile and he can come freely and walk about fearlessly through his town and that is their form of justice" (Lévesque 1993:182).

In fact this practice of paying for a death with valuables, including tortoise shells, was carried out after Sancho's own death (Lévesque 1993:195). The native who killed Sancho, a man named Sínaro from Guaca, Rota, made a trip to Guam to take a piece of tortoise shell, a few fish, and other little things to Sancho's master, Suñama, to atone for Sancho's death. However, once the payment was made, Sínaro did not quickly return to Rota, because he feared the natives of Tazga, Rota.

THE FIRST SPANISH COLONISTS

In 1668 the first permanent mission in the Marianas was established. The superior of the mission was Padre Diego Luis de Sanvitores, a Jesuit priest who arrived on Guam on June 15, 1668 (Carano and Sanchez 1964). Along with Father Sanvitores were four other Jesuit priests, a lay brother and lay assistants. In addition to the missionaries, there was a garrison force consisting of a captain, Don Juan de Santa Cruz, and 32 soldiers. Some of the soldiers and most of the lay assistants to the missionaries were natives of the Philippines. Open rebellion on the part of the Chamorros against the Spaniards broke out in 1670, and Father Sanvitores was killed in 1672. The Spanish-Chamorro Wars continued until 1695 when the final battle took place on Aguiguan.

Brother (later Father) Lorenzo Bustillo—1668-1671 and 1676-1712(?)

An account by Father Bustillo, made in 1691 (Lévesque 1995b:497-504), described the landing of Father Sanvitores, then-Brother Bustillo, and the other missionaries in the Marianas in 1668. Their entrance into the Marianas was facilitated by General Antonio Nieto, who became Captain of the galleon *San Diego* after the death at sea of Admiral Bartolomé Muñoz just three days prior to their arrival in the Marianas.

Bustillo described a banquet with mutual giving of presents that took place between the islanders and the Spanish at the house of Chief Quipuha in Hagåtña. After eating, Nieto rewarded the Chamorro chiefs with the things they appreciated, "such as hats, clothes, tortoise shells, beads, iron hoops, knives, axes, etc." So in 1668 the islanders still valued tortoise shells, but they were receiving them from the Spanish.

Padre Diego Luis de Sanvitores—1668-1672

Father Sanvitores, in a letter to the Queen of Spain, requested that tortoise shells be sent to him (Lévesque 1995b:528-545). The enclosure to the letter is dated June 1669 and entitled, "List of the things which we will accept for the love of God." The list includes "Tortoise shells, as many as possible. These are used here as money for the payment of freight, etc." (Lévesque 1995b:535).

In a later letter, dated July 5, 1671, to Father Solano, Father Sanvitores requested that a man named Bungi be paid either with half of a large [iron] hoop or a whole small hoop. In a P.S. to the letter, Father Sanvitores wrote, "Bungi is asking for a tortoise shell. If he promises to go to Tinian, he can be given one, instead of the hoop and, since he is our friend, and that eventually we may have to give one to all the chiefs of Agadña, keeping some for those who deserve them" (Lévesque 1995c:150).

Two Accounts Pertaining to the Year 1670

Two accounts pertaining to events in Tinian in the year 1670 relate how a turtle shell was used in a Roman Catholic religious context. The second biography of Father Luís de Medina, another of the priests who arrived in 1668, edited by Father Francisco de Florencia (Lévesque 1995c:20-51) tells how Father Medina and Father Sanvitores arranged peace between two enemy villages on Tinian. On January 22, there was a procession.

"Father Luís de Medina was leading it with the Standard of the most holy Virgin, and of our Fathers St. Ignatius and St. Francis Xavier. Behind him were the catechism children, then the youths, and finally the older ones, and the old men from 7 villages. They all carried some thing in their hands, be it a fruit, or rice. There was a big [turtle] shell which, according to their custom is a sure sign of what they call *Tarioyot*, which means "gratitude". Thus they were walking along, repeating the Act of Contrition, sung out by the fervent Fr. Luís, towards the village of Sungharon, the opposite side"

(Lévesque 1995c:41)…"As for the [turtle] shell, which is, as we have said, their best sign of gratitude, it was placed as a permanent reminder of past discords at the feet of Our Lady of Guadalupe of Mexico, the patroness and protectress of the Island of Tinian" (Lévesque 1995c:42).

The same event was described by Francisco Garcia in his biography of Father Sanvitores. "Padre Medina led those of Marpo, with the Standard of the Holy Virgin, San Ignacio and San Francisco. After him followed the children who were receiving instruction in the Doctrine, and after them the youths and the older Principals of the village, each with a small gift of fruit or rice. Last of all they carried a great shell, the chief sign of friendship, which only a few days before had come to their hands on one of the rare turtles which are found in these waters. It was believed that the turtle was like a dove of peace, for it was caught at the time that peace was being adjusted, but when they lacked the *concha* [sea shell] that was customarily used at such a time" (Garcia 1985:111-112).

OTHER FOREIGN VISITORS

During the Spanish Period, the Mariana Islands were host not only to the Spanish, but also to many other foreign visitors who described the islands. William Dampier, a seaman aboard an English privateer commanded by Captain Swan, visited Guam in 1686 and published a narrative of his round-the world voyage, which includes a lengthy description of the Chamorro "*proes*" (*proas*) (Dampier1937). Captain Woodes Rogers, who commanded the British privateer *Duke* and spent ten days on Guam in 1710, described the "flying *proa*" in his diary (Rogers 1928). The English Commodore George Anson, who spent nearly two months on Tinian in 1742, also described the *proa* (Barratt 1988b). Two French expeditions of the 18th and 19th centuries are discussed below.

Captain Crozet—1772

Captain Crozet became the leader of a French expedition sent to explore the South Seas when the original leader, Marion du Fresne, was eaten by cannibals in New Zealand (Crozet 1891:54). The Crozet expedition anchored at Guam on September 27, 1772, and did not depart until November 19, 1772. They were so well received by Governor Tobias that Crozet considered Guam a "terrestrial paradise" (Crozet 1891:82). He wrote that his sailors fished for freshwater fish on Guam, while the natives preferred the saltwater fish.

"The rivers of Guam, which after all are only brooks, or torrents, abound in fish. During their convalescence, our sailors amused themselves by fishing, and caught eels, mullets, gobys and a sort of carp. All these fish are excellent, but the Indians do not eat them, preferring salt-water fish, which are generally very inferior in quality to the fresh-water ones. It is true that the abundance of meat, vegetables, and fruit is so great in Guam, and the Spanish Commandant provided us with them so generously, that during the whole stay we hardly though of getting any sea-fish" (Crozet 1891:91).

Crozet went on to describe a problem with some marine fishes. It is possible that he was referring to ciguatera poisoning.

"There is, besides, some inconvenience in a preference for salt-water fish. Among those which are caught on the coast of Guam, as in all the Marianne Islands, there are some which are very unwholesome, for they nourish themselves on the little polyps, which form the coral. It appears that these sea-insects, like the sea-galleys and sea-nettles, have some caustic property which is imparted to the fishes, and the fishes have a coralline taste which betrays their poisonous properties. The Indians know which are unwholesome, but it is better not to eat any sea-fish at all. This, however, does not hold good with the sea-turtles which are caught on the coasts of Guam. They are very good and as big as those of the island of Ascension, but the Spaniards and Indians do not eat them. I collected sufficient to form a good supply during our journey to the Philippines" (Crozet 1891: 91).

Louis de Freycinet—1819

The Freycinet expedition, which arrived at Guam March 17, 1819, was a French scientific expedition that included the zoologists Quoy and Gaimard, the botanist Charles Gaudichaud-Beaupré and the artist and writer Arago (Carano and Sanchez 1964). The expedition spent several months in the Marianas, visiting Tinian and Rota as well as Guam. Freycinet (1824) provided a lengthy and detailed account of the tools and techniques of fishing in the Marianas. He described the methods of fishing for *mañåhak* (spelled *magnahak* by Freycinet, juvenile rabbitfishes, *Siganus* spp.), *hachuman* (spelled *atchoman* by Freycinet, *Decapterus* sp. or *opelu* in Hawai'i), parrotfishes (family Scaridae), flyingfishes (family Exocoetidae), and other reef resources including eels, crabs, tortoises, mollusks, and sea cucumbers. The tools are described below, followed by the techniques for certain fishes.

Hooks and Lines, Spears

Hooks (*hagoit*) were made of shell, including mother-of-pearl, bone, and coconut shell. By the time of Freycinet's arrival, the preference was for iron hooks. Lines were made of plant fibers, including banana fiber. A special arrangement of lines and hooks used to fish for flyingfishes was known as *kinatchit gomahga*. A main line was held afloat by gourds (*tagoadji*), and lateral lines were attached to it at intervals of six to nine feet [based on "*une brasse*" equaling one fathom or six feet].

On some occasions, a fisherman used a thick stick or bludgeon, or a barbed wooden spear. The wooden spear had been replaced by one with a single or multiple iron points by the time of Freycinet.

The *Poio* or Fishing Stone

The *poio* or fishing stone (Photo 3) was a type of chumming device used to fish for *hachuman* (*Decapterus* sp., *opeulu* in Hawai'i). The stone was hemispherical and flat on top. A coconut shell cap about the same size as the stone was attached to the flat top with cords to hold the two pieces together. A plant fiber braid served as a handle, with a long cord that would allow the stone to be lowered to a depth of 8 fathoms or 48 feet. Chewed coconut meat was placed inside the coconut shell cap, and the device was used to attract fish toward the surface where they could be taken in a net. The use of the *poio* is described below under ***Hachuman***.

Photo 3. Limestone p*oio* or fishing stone recovered by Micronesian Archaeological Research Services near Marine Drive in Anigua, Guam. It has been refitted with lines and coconut shell

Nets

Freycinet described several kinds of nets and gave their Chamorro names. The most important was the *lagoa pola*, used to catch small fish from the beach. The net consisted of three rectangular mats joined together. The side mats were six feet high by three feet long, while the one in the middle was 12 feet high by 20-30 feet long. At each end of the net, a stick was tied to hold the net upright. Wooden floats were attached to the top of the net and stone weights to the bottom. The net was maneuvered in the same way as the French *seine* or *seinette*. Nets of this kind differed in the tightness of the weave, which depended on the size of fish to be caught.

For *hachuman* fishing, a net called *lagoa atchoman* was used. It was similar to the French nets known as *chaudière* or *caudrette*. The net, which measured nine feet in diameter and four and a half feet in length, was in the shape of a large bag with a circular opening. The mouth was held open by a circle of *lodogao* wood [*Clerodendrum inerme* according to Moore and McMakin 1979]. Four cords attached around the circumference of the opening came together in the center where the fisherman set the line.

A net similar to the *lagoa atchoman*, but much smaller and with a long handle was known as *lagoa popo* or *lagoa omo-soho*. This net had the same form and function as the French *truble*, and it was used especially in Tinian where the large quantity of stones and corals scattered on the coast made the use of the *lagoa pola* impractical. The net had an oval opening measuring one and one-half by two feet and was one foot deep with a five or six foot long handle.

The Chamorros also used a conical net known as *lagoa djoti*, similar to the French *l'épervier*. This worked well for certain large and small fish.

Traps and Weirs

The stone fish traps (*ghigao*) once built along the coastlines no longer existed by Freycinet's time. They had been replaced by multi-chambered weirs, illustrated by Freycinet (1824:438). The most developed of these constructions was found between the island of Apapa [probably Cabras Island] and Guam near the mouth of the Masso River. The *lagoa popo* was used to scoop fish from the reservoirs, or if the fish were large they were speared with the iron-tipped spear.

Mañåhak (*Siganus* spp., Juvenile Rabbitfishes)

Freycinet (1824:439-440) reported that *mañåhak* were caught regularly during the months of April, May, and June, and rarely in September and October but only at the time of the moon's last quarter. *Mañåhak* that appeared during the fall months were called *magnahak ababa* or crazy *mañåhak*, because they appeared only about once every 25 years.

Freycinet reported that these fishes are always prodigious in number. Two species occur in the Marianas. The smaller fish are *Siganus spinus* (Linnaeus) and the larger are *Siganus argenteus* (Quoy and Gaimard) (S. Amesbury and Myers 1982). The smaller fish appear first and then the bigger ones, sometimes on the same day or on subsequent days. Once the larger species appears, it means the run is coming to a close.

Plate 63 in Freycinet (1824) shows the *mañåhak* fishing. People are dragging a *lagoa pola* on the shore. On a mat to one side are the fish that have already been caught. The women are putting the fish into bags to transport them to the place where they will be salted.

***Hachuman* (*Decapterus* sp., *Opelu* in Hawai'i)**

Freycinet (1824:440-441) described the *hachuman* fishing as follows. This fish was caught beyond the reefs, one-half league to five leagues from land. Closer to land, one would catch none or almost none. The fishing began in August and continued until October when the fish were full grown.

The fisherman filled a *poio* with the chewed pulp of a young coconut and lowered the device on a line to a depth of six to eight fathoms [36-48 feet]. The fisherman shook the line from time to time to disperse the coconut meat into the water. The *hachuman* came in great numbers to eat the coconut. When the *poio* was empty, the fisherman took it out, refilled it, and continued the operation until evening.

The following morning, the fisherman returned to the same spot, but this time he lowered the *poio* one or two feet less deep than the previous day. He did this each day for a month and a half or two months except when bad weather prevented him. By this time the *hachuman* were coming almost to the surface. Ordinarily this fish was caught at a depth of one fathom [six feet].

The process did not need to take so long if the fisherman were satisfied with a less abundant harvest. If he did not begin the operation until September when the fish were full grown, 15 days of feeding would have been sufficient. In that case, instead of gradually shortening the cord by one or two feet, he shortened it more each day.

With the *poio* at a depth of one fathom and always in motion, the fisherman or his helpers put the large *caudrette* (*lagoa atchoman*) into the water and slid it carefully under the *poio*. The net was lifted gradually until the circle that surrounded the opening came to the top of the water. The men then took the net out of the water and threw the fish into their boat. Then they began the same maneuvers again. They could obtain a second and third catch on the same day. The fish were taken to the women who dried them in the sun with salt.

The 1943 unedited translation done for the Yale University Human Relations Area Files mistakenly translates the French to say that the fisherman could obtain two or three fish on the same day. However, the French word "*capture*" is better translated "catch" here. The fisherman was able to obtain a second or third catch, meaning a second or third netful.

In the section on fishing law, Freycinet said that an *hachuman* fisherman would sometimes throw his *poio* into the water while crossing several fishing grounds. The fish would follow his canoe, and when he arrived at his own ground, he would have a better catch. However, if the fisherman were caught doing this, he would receive the death penalty.

Freycinet (1824:440) said that *hachuman* fishing took place one-half league to five leagues from land. The league has varied with time and place from about 2.4 to 4.6

statute miles. Two sources dating to the late 1500s stated that an English sea league contained 2500 fathoms and a Spanish sea league contained 2857 fathoms, and that a fathom is six feet (Marden 1986:576-577). One of the sources added that a Portuguese sea league was the same as the Spanish. This means that the English sea league was 2.47 nautical miles, while the Iberian sea league was 2.82 nautical miles. Currently, a French league equals four kilometers (Chevalley and Chevalley 1966) or 2.16 nautical miles. Based even on the most conservative equivalent, one-half league was more than a nautical mile and five leagues were more than ten nautical miles.

Knudson (1987) estimated five leagues at 15 statute miles and felt that distance was excessive because of the difficulty of placing a small boat in the same spot that far from shore each day. However, it would be possible to place the boat in the same spot each day even at that distance from shore if the spot were over an offshore bank, and that was probably the case according to the late Richard K. Sakamoto, a Guam fisherman. In 1989 Sakamoto reported that *Decapterus* sp. were found at offshore banks such as 11-Mile Bank, Galvez Bank, and Santa Rosa Reef, as well as parts of the Guam reef system, such as Double Reef (J. Amesbury and Hunter-Anderson 1989:27).

Låggua **or Parrotfishes**

Freycinet (1824:441-442) described two types of fishing for parrotfishes. One took place at night and the other by day. The nighttime fishing occurred at the time of the new moon in the months of August thru December. After sunset, when the tide was low and the sea was calm, a canoe went out with a man in front holding a torch. The light of the torch permitted the fishermen to see the parrotfishes sleeping near the outer edge of the reef. In times past, the fishermen carried a barbed wooden spear, but by Freycinet’s time, they used the multi-prong iron spear to take the fishes.

The daytime fishing for parrotfishes involved the use of a live fish as a decoy. The live parrotfish had a line attached through its lower jaw. The fisherman carried the fish in his canoe to an appropriate place where there were natural basins formed by corals inside the reefs. The fish was put into the water and allowed to swim as far as the cord extended. The other parrotfish saw the captive fish and hurried to attack it. The fisherman then removed the decoy fish from the water and made a sliding knot near the spot where the fish was wounded. When he put the decoy fish back into the water, the other fish attacked the bleeding spot, and the fisherman pulled the noose around the attacking fish. Freycinet reported that a skilled fisherman would not catch more than six or eight parrotfish per day in this way. The live decoy could be kept in water near the shore and used for a week.

Flyingfishes

Freycinet’s description of fishing for flyingfishes (Freycinet 1824:443) is much the same as that provided by Sancho to Fray Juan Pobre (above). Both Freycinet and Fray Juan Pobre noted that in the past the fishhooks were made of shell, but by early Spanish times were made of iron.

Other Reef Resources

Freycinet (1824:443) reported that in ancient times only the lower class people (*mangatchang* or *manachang*) fished for eels, but by his time all classes did so. The eels were taken with the iron tipped spear.

In earlier times, the barbed wooden spear was used to take crabs, but at Freycinet's time, the iron tipped spear was used. He reported that during the day only male crabs could be caught, but at night the larger and tastier female crabs were caught by the light of torches.

Freycinet (1824:443) reported that the islanders had no method for catching turtles other than tipping them over onto their backs.

Shellfish that were good for eating were gathered by women from the rocks or from the sand of the shore. Mother-of-pearl shells were preferred in the past for making fishhooks.

Sea cucumbers were caught by hand and dried in the sun. Freycinet (1824:444) reported that a M. Bérard had seen a great number of sea cucumbers in Tinian, which were going to be transported to China. He said that the islanders almost never ate sea cucumbers and it was only the Spanish colonists who ate them from time to time.

SPANISH GOVERNORS

Felipe María de la Corte y Ruano Calderón—1855-1866

Felipe María de la Corte y Ruano Calderón was the governor of Guam from May 1855 to January 1866. Carano and Sanchez (1964:141) said that de la Corte was one of three 19th century Spanish governors who "stand out from the rest as having worked hard and well for the benefit of Guam." His administration consisted of a series of agricultural and economic experiments, and in his lengthy report, he concluded that the principal problem in Guam was poverty.

De la Corte (1970:143) said that the islanders did not fish beyond the reefs. He described the fishing for three seasonal fishes: 1) *mañåhak*, which de la Corte spelled *atañaja* (juvenile rabbitfishes, *Siganus* spp.); 2) *ti'ao* (juvenile goatfishes, family Mullidae); and 3) *atulai*, which de la Corte spelled *atislai* (big-eye scad, *Selar crumenophthalmus*).

De la Corte (1970:144) said the *mañåhak* "come in through the reefs at low tide in some moons of May to July and sometimes come in compact layers of five and six feet thick and many braces wide and long. The town comes out in mass to catch all they can in small nets and sometimes this lasts two or three days each moon. This fish is tasty and besides eating it fresh, they pickle it and keep it the whole year round."

It is uncertain whether the word “brace” used here is the same as the French word “*brasse*”, which equals six feet (see **Louis de Freycinet** above). In another place, de la Corte (1970:144) said that the diameter of the net used with the *poio* for *hachuman* fishing is a brace. Freycinet (1824:437) said the *lagoa atchoman* is nine feet in diameter. Using the more conservative figure of six feet, the *mañåhak* arrived in schools that were many times six feet in width and length.

The *ti’ao*, he said, “also comes in shoals, but not as big as those of the *atañaja*. They turn up around April to August.”

Concerning the *atulai*, de la Corte (1970:144) said, “Some shoals of fish like mackerel or large sardines also appear which are called *atislai* and they catch them in the same way, but they do not come in such great abundance nor every year. They are caught during the moons of June to August and are eaten like the others, fresh and pickled.”

De la Corte’s description of *hachuman* fishing (de la Corte 1970:144-145) is quite similar to Freycinet’s, except that he said the fish are fattened for one to three months. He also quantified the catch, “With this operation they sometimes catch more than a ton of fish a day, and repeat the fishing for a month, around August.” However, he added, “As this requires a certain amount of patience, perseverance and experience, only certain old men practice this, and I do not think anybody does so nowadays. This practice seems to have originated from the old natives.” This raises the question of whether de la Corte ever saw catches of a ton per day, or whether he had just been told that was the size of the catch in the past.

De la Corte (1970:145) also assigned a quantity to the sea cucumber harvest. “Some *balate* is found in the bays, of which a hundred *picos* a year could be collected of good quality. But the amount at present fished would not reach fifty.” A *pico* is a weight of 137.5 pounds, used in the Philippines. So de la Corte was saying 13,750 pounds per year could be collected.

Concerning other invertebrates and turtles, de la Corte (1970:145) made these remarks. “On the coast there are many crabs, some clams and oysters, squids, and camarons in the streams.” “There are no carey turtles or pearl shells or any other articles of value.” “There are very few shells and conch-shells on the beaches and sandbanks and none of any merit.”

Francisco Olive y García—1884-1887

Governor Francisco Olive y García’s notes (1984) pertain to the years 1884-1887. The section of his report concerning fishing is almost item for item the same as de la Corte’s. He described the same seasonal runs for *mañåhak, ti’ao*, and *atulai*, as well as the fishing for *hachuman*. The similarity to de la Corte’s descriptions leads one to the conclusion that Olive copied them from de la Corte.

Olive added that the *hachuman* fishing was still done on the island of Rota, saying "we believe this is practiced only by an occasional person, especially on the island of Rota" (Olive y García 1984:34).

Concerning turtles, Olive (1984:34) said, "There are turtles—but no tortoise shell."

CONCLUSIONS CONCERNING THE SPANISH PERIOD

The writers of the Spanish Period left detailed descriptions of several reef fish and inshore fisheries, including those for flyingfishes (family Exocoetidae), *mañåhak* (juvenile rabbitfishes, *Siganus* spp.), *ti'ao* (juvenile goatfishes, family Mullidae), *atulai* (big-eye scad, *Selar crumenophthalmus*), parrotfishes (family Scaridae), and *hachuman* (*Decapterus* sp., *opelu* in Hawai'i).

While there is little in the way of quantitative information, the general impression is of great abundance. Sancho told Fray Juan Pobre that the flyingfishes were as numerous as sardines in Spain; de la Corte said that the *mañåhak* came in schools five or six feet thick and many times that wide and long and that the *hachuman* catch was a ton per day. The only one of these fisheries that had declined by the mid-19th century was the *hachuman* fishery. Apparently that was practiced only in Rota by the second half of the 1800s. For more on this fishery, see the next chapter concerning the 20th century.

The Spanish Period writers documented a change in the use of turtle. Early writers from the 16th century and beginning of the 17th century including Andrés de Urdaneta, Fray Antonio de los Angeles, and Fray Juan Pobre de Zamora, told how the islanders valued tortoise shell. Later in the 17th century, Brother Bustillo and Father Sanvitores recorded that the islanders received tortoise shell from the Spanish. An incident in Tinian in 1670 incorporated tortoise shell in a Roman Catholic ceremony. The writers of the late 18th century and 19th century, including Crozet, Freycinet, de la Corte, and Olive, indicated that turtles and tortoise shell had diminished in importance.

Less was said by the Spanish Period writers about the invertebrates, but they noted that sea cucumbers were commercially harvested. Sea cucumbers were being exported from Tinian to China in the early 1800s, and de la Corte estimated that thousands of pounds per year could be collected.

CHAPTER 4. TWENTIETH CENTURY

By Judith R. Amesbury

DIVERGING HISTORIES

Just prior to the beginning of the 20th century, Spain lost control of the Mariana Islands. Guam was ceded to the U.S. in 1898 as a result of the Spanish-American War, and in 1899 Germany purchased the Mariana Islands north of Guam (Figure 13). The histories of Guam and the Northern Mariana Islands continued to diverge as Japan occupied the Northern Marianas for 30 years, while Guam was occupied by the Japanese for less than three years during World War II. Both Guam and the Northern Marianas have been part of the U.S. since 1944, but their governments were never reunited. At present Guam is an unincorporated territory of the U.S., while the Northern Mariana Islands are a commonwealth. This chapter covers the 20th century in Guam first, then the 20th century in the Northern Marianas.

FIRST AMERICAN PERIOD IN GUAM (1898-1941)

In December 1898, President William McKinley issued an executive order placing Guam under the control of the Department of the Navy, and in 1899 the naval government was established under Captain Richard P. Leary, the first American governor of Guam. The First American Period in Guam lasted until December 1941 when the Japanese invaded Guam.

William Edwin Safford—1899-1900

William Edwin Safford was a U.S. Navy lieutenant who spent a year on Guam from August 1899 to August 1900 as an aide to Governor Richard P. Leary. In 1902 he resigned his commission in the Navy to become the assistant curator of the U.S.D.A. Office of Tropical Agriculture (Carano and Sanchez 1964:189), and in 1905 he published *The Useful Plants of the Island of Guam*. In both that work and his diary, excerpts of which were published in the Guam Recorder from 1933 to 1936, Safford described fishing on Guam, particularly that done with the fish stupefying fruit of the *puting* tree (*Barringtonia asiatica*).

Safford (1905:81-82) wrote, "Although the natives do not devote themselves to fishing so extensively now as was formerly the case, yet many of them have cast nets with which they catch small fish swimming in schools near the beach, and a few have traps and seines. The ancient custom of trawling for bonitos and flying fish has nearly died out, but the natives still resort occasionally to the method pursued by their ancestors of stupefying fish with the crushed fruit of *Barringtonia speciosa*, a narcotic widely used for this purpose in the islands of the Pacific. The fruit is pounded into a paste, inclosed in a bag, and kept over night. The time of an especially low tide is selected, and bags of the pounded fruit are taken out on the reef the next morning and sunk in certain deep holes in the reef. The fish soon appear at the surface, some of them lifeless, others attempting to swim, or faintly struggling with their ventral side uppermost. The natives scoop them up in nets, spear them, or jump overboard and catch them in their hands, sometimes even diving for them. Nothing more striking could be imagined than the picture presented by the conglomeration of strange shapes and bright colors…"

Safford went on to describe the shapes and colors of numerous species of reef fishes collected with the *puting* fruit. He said the practice of fishing with *puting* had been forbidden by the Spanish government, because it killed many young fishes, but it was revived under the American administration. Safford (1905:83-89) also provided a list of 57 Guam fishes by their Chamorro names with scientific names and descriptions.

In discussing the invertebrates, Safford (1905:90) wrote, "The natives eat many kinds of marine animals, but they do not depend upon the reef to the extent that the Samoans and Caroline Islanders do, having become essentially an agricultural people, and few of them find it to their advantage to neglect their fields for fishing. In former times several governors found it profitable to collect and dry certain kinds of holothurians, called "trepang," or "*bêches de mer*," and ship them to Manila or Canton, but these animals are no longer sought in Guam, and are seldom eaten by the natives."

Safford (1905:90) reported that crabs were abundant, and that spiny lobsters and freshwater prawns were also valued as food.

Reports of the Naval Government of Guam—1901-1941

From 1901 through 1941, the naval government issued annual reports on Guam. During the early years of the First American Period, almost no mention was made of fishing in the reports. In 1904 Governor George L. Dyer (1904:2) wrote, "The people are purely agricultural," and in another place (1904:17), "The people are, almost without exception, small farmers, raising only corn and sweet potatoes." In 1905 (p. 16), he said, "This is purely an agricultural community."

The 1915 report (p. 18) showed that 505 pounds of preserved fish worth $45.10 had been exported to Manila in 1914. The 1918 report (p. 18) listed ten cases of fish poisoning [ciguatera] under admissions to the hospital. The 1932 report (p. 54) listed one case of the use of dynamite in fishing under criminal cases, and under criminal cases in the 1933 report (p. 61), there were two cases of fishing in a restricted zone. During these years, the Chamorro people were fishing, but apparently not for much more than their own needs and not beyond the reef.

In October 1933, a fishing school was begun "to establish fishing beyond the reef" (1934:10). The fishing school, which instructed 12 men from each seaside village for three months time, was reported on in the 1934 through 1937 reports. After 1937 there was no mention of the fishing school.

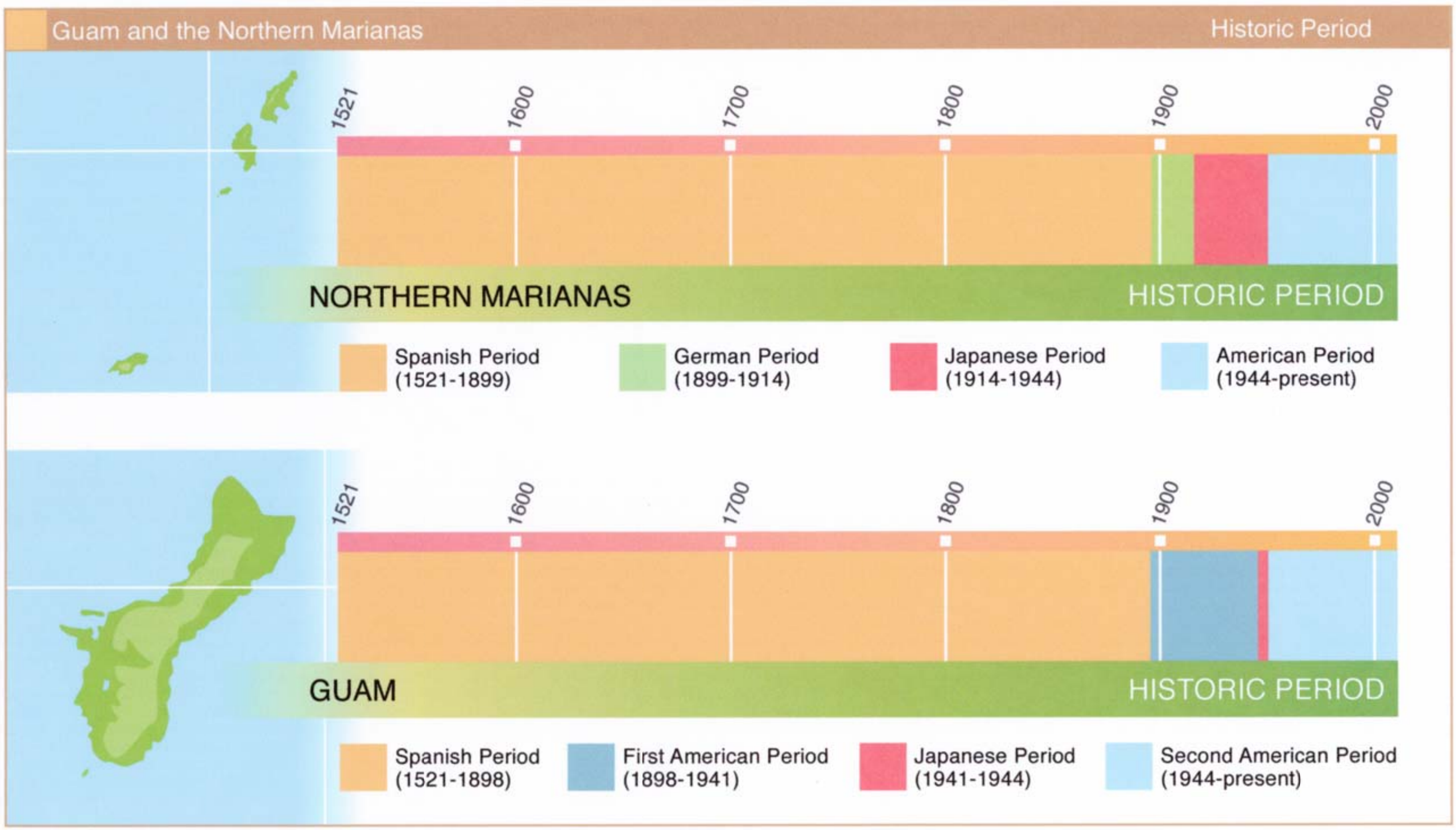

Figure 13. The Historic Period in Guam and the Northern Marianas. Illustration by Robert Amesbury.

In 1935 (p. 10), Governor George A. Alexander reported on advances in the fishing industry. A Fish Warden had been appointed who was successful in curtailing the forays of thieves into fish weirs and traps. Offshore fishing had not progressed due to a lack of suitable boats, but fishing inside the reef had improved over the year. The 1935 report (p. 74) showed that $24,344.63 worth of fish had been imported to Guam. This exceeded the value of meat imported by nearly $9,000.

In the remaining pre-war reports from 1938 to 1941, the fisheries section is entitled only "Fishweirs" and is usually only one sentence about the number of licensed fishweirs. The 1941 report lists fishing under labor performed by prisoners (p. 64) and also under recreation of enlisted men (p. 137).

SECOND AMERICAN PERIOD IN GUAM (1944-PRESENT)

After the war, the U.S. Navy resumed governing Guam until 1949 when President Truman transferred the administration of Guam from the Secretary of the Navy to the Secretary of the Interior. From 1949 through 1970, Guam had civilian governors appointed by the U.S. president. Since 1971, Guam has had popularly elected governors. Governor Carlos Garcia Camacho was both the last presidentially appointed governor and the first elected governor.

Reports of the Naval Government of Guam—1946-1950

After the war, the U.S. naval government of Guam issued monthly reports during 1946 and 1947 and quarterly reports for 1948 through 1950. These reports provide information on the number of men deriving their living principally from fishing (Table 22). Although the reports do not give information on the race of the fishermen, for the most part the naval governor's reports are talking about the Chamorro people. When they talk about a person who is not Chamorro, they frequently name the nationality or race of the individual. Guamanian was the term used to refer to Chamorros at this time.

During the years 1946-1950, Guamanians made up approximately 95 to 97 percent of the resident population. The non-resident population exceeded the resident population for all the periods in which the number of fishermen is known, but the non-residents would not have been engaged in fishing as an occupation. The naval security clearance required to enter the island prevented anyone from moving to Guam who was not employed, for example, by the U.S. military or civil service or by construction companies contracted by the military and the dependents thereof.

If we assume that the men deriving their living principally from fishing are Chamorros or at least that the percentage of Chamorros among the fishermen is the same as the percentage of Chamorros in the total resident population, between one and five percent of adult Chamorro men were earning their living principally from fishing.

Table 22. Number of Men on Guam Deriving Their Living Principally from Fishing, 1946-1950. "Guamanian" is the word used to refer to Chamorros during this time period. Statistics from the monthly and quarterly reports of the Naval Government of Guam.

Time Period	**Number of Men Deriving Their Living Principally from Fishing**	**Total Number of Adult Guamanian Males (age 16 & up)**	**Percentage of Guamanians in the Total Resident Population**
July 1946	72		
August 1946	71		
September 1946	71		
October 1946	71		
November 1946	71		
December 1946	71	5,844	97.48
January 1947	75	5,862	97.38
February 1947	75	5,871	97.38
March 1947	75	5,870	97.31
April 1947	97	5,880	97.30
May 1947	97	5,903	97.29
Third Quarter 1948	Up about 150 to 289	5,907	95.03
Fourth Quarter 1948	302	6,014	95.07
Second Quarter 1950	253 reduced to 211	6,469	95.35

The post-war naval governors' reports also provide information on the amount of fish caught (Table 23). The reports distinguish between fish caught by traps and by other methods, but they provide no information on what the other methods were or what species of fish were harvested.

Reports of the Presidentially Appointed Governors of Guam—1951-1970

The governors' reports for the years 1951 through 1954 give the number of men engaged in fishing (Table 24). This varied from 262 to 315. The total pounds of seafood harvested in the years 1951 through 1955 varied from 375,000 to 691,000.

The reports for 1956 through 1970 give various breakdowns of the catch, including shallow-water fish caught by weirs and shallow-water fish caught by other methods; the seasonal fishes, *mañåhak* (juvenile rabbitfishes, *Siganus* spp.), *ti'ao* (juvenile goatfishes, family Mullidae), mackerel (*atulai* or big-eye scad, *Selar crumenophthalmus*), and *i'e'* (juveniles of *Caranx melampygus* and other similar jacks); tuna and trolling catch; turtle, shellfish, and crustacean (Table 25). The year 1956 is the first year in which tuna or trolling catch is listed separately, probably indicating that pelagic species were not an important part of the catch until sometime in the 1950s. According to the 1968 report, the estimated minimum number of man-days fishing is 10,000. This is the only report with information on effort. No statistics on fishing are given for the years 1962, 1965, 1966, 1969, and 1970.

Table 23. Pounds of Fish Caught on Guam by Year, Month, and Method, 1946-1950. Non-fish marine food products are excluded. Statistics from the monthly and quarterly reports of the Naval Government of Guam.

Month	**Method**	**1946**	**1947**	**1948**	**1949**	**1950**
January	Traps		4,690	16,835	42,447	3,400
	Other		23,875	2,800	31,982	4,190
	Total		**28,565**	**19,635**	**74,429**	**7,590**
February	Traps		5,880	11,538	31,441	5,880
	Other		17,398	800	33,243	6,810
	Total		**23,278**	**12,338**	**64,684**	**12,690**
March	Traps		10,519	16,820	28,010	5,700
	Other		13,005	240	37,761	6,660
	Total		**23,524**	**17,060**	**65,771**	**12,360**
April	Traps		8,107	10,324	2,115	6,150
	Other		46,020	46,290	9,542	6,950
	Total		**54,127**	**56,614**	**11,657**	**13,100**
May	Traps		8,705	8,885	11,688	5,500
	Other		6,795	6,372	15,865	23,950
	Total		**15,500**	**15,257**	**27,553**	**29,450**
June	Traps		18,063	15,352	8,665	5,600
	Other		13,370	11,611	6,840	7,060
	Total		**31,433**	**26,963**	**15,505**	**12,660**
July	Traps		18,025	36,100	10,020	
	Other		15,005	28,895	10,115	
	Total		**33,030**	**64,995**	**20,135**	
August	Traps		19,627	92,417	3,875	
	Other		19,823	35,340	11,695	
	Total		**39,450**	**127,757**	**15,570**	
September	Traps		14,940	34,802	18,560	
	Other		3,445	395,979	8,280	
	Total		**18,385**	**430,781**	**26,840**	
October	Traps		5,635	39,723	12,275	
	Other		10,870	43,663	9,440	
	Total		**16,505**	**83,386**	**21,715**	
November	Traps		16,221	37,442	7,180	
	Other		9,458	42,243	8,680	
	Total	**37,386**	**25,679**	**79,685**	**15,860**	
December	Traps	5,277		25,984	2,830	
	Other	35,610		30,009	8,220	
	Total	**40,887**		**55,993**	**11,050**	

Table 24. Number of Men Engaged in Fishing and Pounds of Fish, Turtle, and Shellfish Caught from 1951 through 1955. Statistics from the Annual Reports of the Presidentially Appointed Governors of Guam.

Year	**Men Engaged in Fishing**	**Fish Caught by Traps**	**Fish Caught by Other Methods**	**Turtle**	**Shellfish**	**Total**
1951	262	376,800	258,380	15,985	39,975	691,140
1952	315					559,620
1953	312					375,279
1954	312					405,164
1955						376,000

Table 25. Pounds of Fish, Turtle, Shellfish, and Crustaceans Caught from 1956 through 1968. Statistics from the Annual Reports of the Presidentially Appointed Governors of Guam. No statistics were given for 1962, 1965, 1966, 1969, and 1970.

Year	**Shallow-water Fish Caught by Weirs**	**Shallow-water Fish Caught by Other Methods**	***Mañåhak* and *Ti'ao***			**Tuna**	**Turtle**	**Shellfish**	**Total**
1956	128,865	252,800	47,500			26,570	10,988	9,250	462,688*
Year	**Weirs**		***Mañåhak***	**Mackerel**					**Total**
1957			34,000	41,400					
1958	84,816			39,750					376,556**
Year	**Weirs**	**Other Methods**	***Mañåhak***	**Mackerel**	***Ti'ao***	**Trolling**	**Turtle**	**Crustacean**	**Total**
1959	55,090	229,000	4,125	4,000	2,575	16,300	5,790	6,636	323,516
1960	75,896	218,900	21,900	12,450	4,750	13,700	7,101	4,948	359,645
Year	**Weirs**		***Mañåhak***	**Mackerel**	***I'e'***	**Trolling**	**Turtle**	**Crustacean**	**Total**
1961	92,085		17,778	156,960	6,400	15,000	5,479	1,710	295,412
Year	**Weirs**	**Surround Net**				**Trolling**			**Total**
1963	102,200	15,000				86,000			200,000*
1964									573,000
Year	**Reef Fish**		**Rabbit Fish**	**Mackerel**		**Trolling**			**Total**
1967	51,000		22,000	61,000		114,000			248,000
1968									343,500

Mañåhak = juvenile rabbitfishes, *Siganus spinus* and *S. argenteus*
Ti'ao = juvenile goatfishes, family Mullidae
Mackerel = *atulai* or big-eye scad, *Selar crumenophthalmus*
I'e' = the young of *Caranx melampygus* and other similar jacks

* The total given in the report is less than the sum of the parts.
** The total given is more than the sum of the parts.

Annual Reports of the Division of Aquatic and Wildlife Resources—1956-present

The Division of Aquatic and Wildlife Resources (DAWR, formerly the Division of Fish and Wildlife), Guam Department of Agriculture, has produced annual reports since 1956. According to Gerry Davis, the current Chief of the Division, there were cursory efforts to collect data on fisheries beginning in the 1960s. However, the surveys done the way they are now began in 1979 for boat-based fisheries and 1982 for coastal fisheries.

The authors obtained copies of the annual reports for 1990 through 1999, the most recent year completed. The reports contain information on both offshore and inshore fishing. Offshore fishing is broken down into five methods (trolling, bottomfishing, spearfishing, *atulai* night-light jigging, and other methods). Data are collected by interviewing returning fishing parties at the three major boat ramps on island: Agana Boat Basin (four days per month), Agat Marina (two days per month), and Merizo boat ramp (two days per month). Data are collected on weekdays and weekends and mornings and evenings. Complete interviews include information on catch, participation, and effort. Expansion algorithms are used to extrapolate the total catch, participation, effort, and catch per unit effort. According to the FY1999 report, important changes have been made in the data expansion process since FY1997, and the survey design and computerized database are still undergoing evaluation and development. Composition of the catch for each method is reported by species and weight.

Inshore catch data are collected by fishermen-intercept interviews conducted four days per month to determine effort, fishing method, location, reef zone, species composition, and quantity caught for both day and night fishing. Inshore participation data are collected by instantaneous counts while driving in a continuous route around the island. The route is alternated between clockwise and counterclockwise, and the starting locations are randomly selected. The inshore harvest data are expanded using a database program for Macintosh known as the Fourth Dimension (4D). The program uses formulae described in the FY1983 report. Results are reported by method (hook and line, cast net, gill net, surround net, spearfishing with snorkel, spearfishing with SCUBA, drag net, hooks and gaffs, and other). Catch is broken down by finfish and invertebrates, and catch per unit effort is expressed in terms of kilograms per gear-hour. Composition is reported for day and night catch and for the various methods; the top ten species and top ten families are reported by weight for each method.

Todd Pitlik, who authored the inshore fisheries section of the FY1999 report, concluded, “Overall declines in annual harvests and shifts in species composition have been documented in the last fifteen fiscal years. With the recent legislative approval of marine preserves and the implementation of new fishing regulations, we can begin to manage destructive fishing methods and preserve critical areas for reef fishes to mature and reproduce. As the success of the marine preserves are documented over the next few years, the evidence needed to restrict the most destructive methods, e.g. gill nets, drag nets, and SCUBA spearfishing, will be possible.”

According to Pitlik, commercial SCUBA spearfishermen have reported that certain species of reef fish including the Humpheaded Wrasse (*Cheilinus undulatus*) and the Humpheaded Parrotfish (*Bolbometopon muricatum*) have become increasingly rare due to the use of bangsticks. Gill nets also pose a problem. Because they are inexpensive, they are sometimes abandoned in the water. An abandoned gill net removal/study was approved for FY2000.

According to Trina Leberer, DAWR Fisheries Supervisor, there was a 70 percent decrease in catch per unit effort (kilograms per gear-hour) of important inshore food fishes over a 13-year period from 1985 to 1998.

Western Pacific Fishery Information Network (WPacFIN)—1981-present

In 1981 the National Marine Fisheries Service's (NMFS) Southwest Fisheries Science Center (SWFSC) started the Western Pacific Fishery Information Network (WPacFIN) to work cooperatively with the Pacific islands fisheries agencies to collect and disseminate fisheries statistics. These statistics are available through the WPacFIN web site (http://wpacfin.nmfs.hawaii.edu) and the administrative reports produced by the Honolulu Laboratory, SWFSC.

Figure 14 shows the estimated commercial landings of reef, bottom, pelagic, and other fishes over a 22-year period from 1980 through 2001. The variations from year to year may be due to a variety of factors, including the following: 1) fish abundance and availability, 2) harvesting effort, 3) gear type, and 4) data collection methods. Harvesting effort involves the number of people fishing, amount of gear used, and amount of time spent. Other things, including weather conditions and economic conditions, affect harvesting effort.

This graph shows an increase in commercial landings of reef fishes within the last few years (particularly 1998-2001). The increase may represent a turn-around of the decrease in catch per unit effort from 1985 to 1998 reported by the Division of Aquatic and Wildlife Resources (above). However, DAWR Fisheries Supervisor Leberer cautioned that the measurements are not comparable, because the data are collected from different kinds of surveys. The commercial landings in pounds of reef fishes are estimated from vendor receipts, while the catch per unit effort data come from inshore creel surveys. The inshore creel surveys are set up to allow for statistical analysis. In contrast, the vendor participation is voluntary, and the vendor coverage varies. The increase in estimated commercial landings could be due to better vendor coverage. It could also be due to increased effort. Leberer pointed out that a decline in catch per unit effort is more serious than a decline in pounds, because harvesting effort has already been taken into account. The two types of surveys (vendor receipts survey vs. inshore creel survey) involve different fishermen also. The vendor receipts survey involves primarily boat-based fishermen. The fishermen interviewed in the inshore survey don't usually sell their catch to stores.

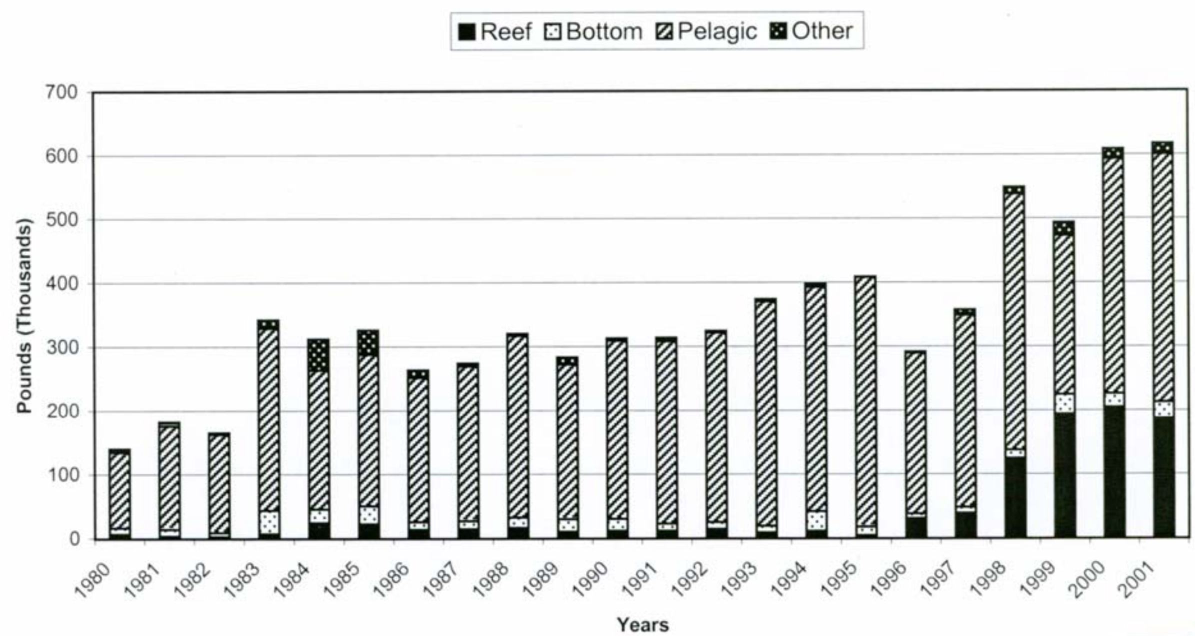

Figure 14. Estimated commercial landings of reef, bottom, pelagic, and other fishes in Guam over a 22-year period from 1980 through 2001. Based on the statistics provided by the WPacFIN web site (http://wpacfin.nmfs.hawaii.edu).

Interview with Richard K. Sakamoto—1989

In March 1989, Steven Amesbury interviewed Richard K. "Kuni" Sakamoto. Sakamoto came to Guam in 1966 under a contract with the Division of Fish and Wildlife (now Division of Aquatic and Wildlife Resources) to provide training in small boat fishing methods, particularly bottomfish handlining and *atulai* jigging, and to survey the waters around Guam for fishery resources. The exploratory fishing phase began in January 1967.

Some, but not many, *Decapterus* sp. (*opelu* in Hawai'i) were caught during the exploratory fishing operations. A Chamorro speaker from Guam told Sakamoto that the local name for this fish is *hachuman*. Sakomoto said *Decapterus* occur in various areas around the island of Guam, such as Double Reef, and also at offshore banks, such as 11-Mile Bank, Galvez Bank, and Santa Rosa Reef. In 1989 Sakamoto said his impression, from talking with local fishermen, is that *hachuman* used to be more abundant around Guam. However, they still occurred in Guam in 1989, because Sakamoto's friend Masao Tenbata had recently caught *Decapterus* at Double Reef. Sakamoto said that repeatedly chumming an area where *hachuman* occur causes the fish to return to this area.

Sakamoto also carried out exploratory deepwater bottomfishing in various areas around Guam. In particular, he fished repeatedly at a site known as Haputo Pinnacle on the west side of Guam, to the point that catch rates declined significantly. According to S. Amesbury, more recent reports by bottomfishermen on Guam indicate that the stocks of bottomfish at Haputo Pinnacle have not recovered since Sakamoto's fishing in the late 1960s.

GERMAN PERIOD IN THE NORTHERN MARIANAS (1899-1914)

The Northern Mariana Islands were purchased by Germany in 1899 and remained in German hands until 1914 when the Japanese took the islands.

Georg Fritz—1899-1907

Georg Fritz spent eight years on Saipan as the District Officer of the German Mariana Islands from 1899 to 1907. In addition to acting as a capable administrator, Fritz wrote a history and ethnography of the Chamorro people entitled *Die Chamorro*, which was published in 1904 in the German journal *Ethnologisches Notizblatt*. The English translation by Elfriede Craddock (Fritz 2001) affords us a look at the customs of the turn-of-the-century Chamorros and, to a lesser extent, the Carolinians of the Northern Marianas.

Concerning fishing, Fritz (2001:68) wrote, "Naturally, fishing provides the main source of food for the island inhabitants. However, fishing takes place only inside the reef. Only the Carolinians sometimes go on the high seas to visit Aguiguan 25 sea miles away from Saipan, and dive for trepang (*balate*) which they sell to the Japanese. They also catch turtle (*haggan*) and utilize weir traps inside the reef, a fishing technique not practiced by the Chamorros."

Fritz (2001:68) reported that the Chamorros used mainly nets, and he described three types of nets. The *talaya* is a round throw net, four meters in diameter, with lead weights around the perimeter. The fisherman throws it in such a way as to completely surround a school of fish seen from the shore. He then pulls the net to shore. If a large fish is netted, the fisherman jumps into the water and kills the fish by biting it. The fisherman can throw the net a distance of about eight meters.

Fritz provided four Chamorro names of fishes caught with the *talaya*. Three of the four are identified in the editor's notes as follows: *kichu* (*Acanthurus triostegus*, convict tang), *guili* (*Kyphosus cinerascens*, rudder fish) and *laiguan* (*Valamugil seheli*, mullet). According to Amesbury and Myers (1982:123), *laiguan* refers to the large individuals of at least four species of the family Mugilidae (*Chelon engeli*, *Crenimugil crenilabis*, *Liza vaigiensis*, and *Neomyxus leuciscus*). The fourth fish that Fritz said is caught with the *talaya* is *ti'ao* (juvenile goatfishes, family Mullidae).

The second net described by Fritz (2001:68-69) is the *lagua*. It is five meters long and 1.7 meters wide, with lead weights on the bottom edge and on the top edge, floats of light wood, such as hibiscus or breadfruit. The sides are fastened to poles. This description is similar to Freycinet's (1824) description of the *lagoa pola.*

A group of 12 to 15 women and young men gather to use the *lagua*. One person stands at each side with the poles. One person holds the net in place while another one stretches the net in the direction of a school of fish. The remaining participants rush toward the net, shouting and splashing to drive the fish toward the net. Then they grab the weights along the bottom edge and raise them in order to catch the fish in the net. Fritz said the net was sometimes made of locally spun cotton but more commonly from imported net twine. Daytime fishing with the *lagua* is called *lalago*; nighttime fishing with the *lagua* is called *gumade*.

The third net Fritz described (2001:69) is the *chentchulo*, a surround net up to 200 meters longs and three meters wide, made of imported hemp. Up to 40 participants take the net in two boats to a good location, preferably a small bay. Each boat takes half the net and goes in opposite directions, letting the net slide into the water. After the entire net is in the water, both boats row with haste to the shore, and the crews pull the net and catch onto the beach. Fritz (2001:70) gave the Chamorro names of eight fishes caught with the *chentchulo*.

Sometimes at low tide, a closed in area of rocks is built as a trap near the reef. At high tide, the *chentchulo* is stretched around the wall, and the fish are caught in the trap. They are grasped by hand or speared with the two-pronged iron spear (*fiska*). Daytime fishing with the *chentchulo* is called *chentchulo haane*; nighttime fishing is called *chentchulo-painge*.

Fritz (2001:70) also described a kind of fishing called *lumulai*, which takes place during full moons. This fishing is done with an iron hook (*haguet*). The hook is baited with small fish or crabs and hung in a hole on the reef.

Another type of fishing, called *sumulo*, takes place at night during low tides using torches (*haéf*, the dry sheath of the coconut flower). The fish or crabs are grabbed by hand or speared.

Fritz (2001:71-73) said that two of the types of fishing described by Freycinet, the *hachuman* fishing with the fishing stone and the *låggua* fishing with a decoy fish, take place only on Rota. Fritz (2001:73) described the use of fish poison, also described by Safford (1905), and the use of fish weirs (*gigao*), described by Freycinet (1924). Turtles, he said, are taken by hand, and sometimes a female turtle is used to lure other turtles.

Fritz (2001:68) reported that women and children dig for clams and snails. He provided six Chamorro names for mollusks. Crabs, he said, are caught by hand, and lobsters are speared with the *fiska*.

JAPANESE PERIOD IN THE NORTHERN MARIANAS (1914-1944/45)

Japan controlled the Northern Marianas beginning in 1914. Saipan and Tinian were taken by the U.S. in 1944, but Rota continued to be occupied by the Japanese until the end of World War II.

Reports to the League of Nations—1920s and 1930s

During most years of the 1920s and some years of the 1930s, the South Seas Bureau produced an *Annual Report to the League of Nations on the Administration of the South Sea Islands under Japanese Mandate*. The islands under Japanese mandate included the Northern Marianas, the Carolines, and the Marshalls. All of the reports contain information about fishing; however, only the reports made during the 1920s have the information divided by island. The reports made during the 1930s give statistics on fishing for all the Japanese mandated islands combined.

Table 26 presents information from the reports to the League of Nations on the quantity and value of fish caught off Saipan during the 1920s. By 1926, tuna (bonita and tunny) accounted for more than 90 percent of the total quantity and value of fish caught. No information about the race of the fishermen is available with regard to these statistics. However, the reports state that there was no discrimination by race in the granting of permission to fish and that locally recognized fishermen were allowed to continue to fish without permission (1926:63).

In 1916 Regulations for Fishing Industry in the South Sea Islands were promulgated. In these regulations, it was provided that as a rule persons desiring to engage in the industry should obtain permission from the authorities, but fishermen recognized by local usage were allowed to continue their business without it. It was stated that with regard to acquisition of the right of fishing, no discrimination was to be made between natives, Japanese and foreigners, and all persons who had obtained permission were free to engage in that business.

The 1930 report (p. 82) gives 23 as the number of persons on Saipan engaged in fishing with permission, and the type of fishing is listed as miscellaneous fishing as opposed to fishing with fixed nets, artificial rearing of fish, collecting of tortoise shells, collecting of nilotic-top shells [*Trochus niloticus*], or collecting of sea-slugs. The report does not give a racial breakdown of the fishermen.

Evidence that some natives were involved in the fishing industry is found in the statistics on subsidies granted to encourage fishing (Table 27). In 1922 the Director of the South Seas Bureau was empowered to grant subsidies for expenses needed for purchasing fishing implements or boats, for engaging the service of technical experts, and for the manufacture of marine products. The statistics on subsidies granted are not divided by islands; they are for all the Japanese mandated islands together. They are divided by race. Japanese fishermen receive more than 80 percent of the money granted each year.

In evaluating Japanese fishery developments in Micronesia during the period of the Japanese Mandate, Nishi (1968:12) concluded, "Commercial fisheries were Japanese enterprises whereas the American aim is to train Micronesians to develop their own commercial fisheries." Citing Bowers (1953), Orbach (1980:15) stated, "All of the labor for these industries, however was imported from Japan and Okinawa." The industries referred to are fishing and sugar production.

No doubt the Chamorros and Carolinians of the Northern Marianas were engaged in reef fishing during the Japanese Period. However, the fishery activity reported to the League of Nations was primarily a tuna fishery employing Japanese and Okinawans.

Table 26. Quantity and Value of Fish Caught Off Saipan during the 1920s. Quantity is given in kilograms for every year except 1923 when it is given in *Kwan*. Value is given in *Yen*. Only the totals were given for 1927-29. Statistics from the *Annual Reports to the League of Nations on the Administration of the South Sea Islands under Japanese Mandate.*

Fish		**1923**	**1924**	**1925**	**1926**	**1927**	**1928**	**1929**
Bonito	Quantity Value	750 2,250	9,097 6,065	14,805 6,348	44,843 17,937			
Tunny	Quantity Value	334 888	1,537 1,025	1,402 749	2,314 1,235			
Horse Mackerel	Quantity Value	495 990	570 304	2,610 1,392	1,481 665			
Mackerel	Quantity Value	5 14	45 30	787 210	690 369			
Gray Mullet	Quantity Value	76 152	16 15	127 46	150 80			
Shark	Quantity Value	26 26	1,522 324	1,023 273	2,348 313			
Other	Quantity Value	3,560 5,357						
Mackerel-like	Quantity Value		352 234	386 228				
Sawara	Quantity Value				94 51			
Total	Quantity Value					34,377 13,167	25,417 21,029	46,417 16,833

Bonito = skipjack tuna (*Katsuwonus pelamis*)
Tunny = probably yellowfin tuna (*Thunnus albacares*)
Horse Mackerel = scad mackerel or *muroaji* (*Decapterus muroadsi*), round mackerel or *maruaji* (*Decapterus maruadsi*), and jack mackerel or *maaji* (*Trachurus japonicus*) (Anon. 1977)
Mackerel = Japanese mackerel or *masaba* (*Scomber japonicus*) and spotted mackerel or *gomasaba* (*Scomber tapeinocephalus*) (Anon. 1977)
Mullet = family Mugilidae
Shark = more than one family
Sawara = *Scomberomorus niphonius* (Masuda et al. 1984)

Table 27. Subsidies Granted to Encourage Fishing in the Japanese Mandated Islands (the Northern Marianas, Carolines, and Marshalls) during the 1920s. Statistics from the Annual Report to the League of Nations on the Administration of the South Sea Islands under Japanese Mandate.

Year	Japanese Recipients	Amount (*Yen*)	Native Recipients	Amount (*Yen*)
1923	9	4,750	3	512
1924	12	5,090	5	715
1925	9	5,019	1	375
1926	9	4,348	6	816
1927	7	4,155	5	590
1928	4	4,112	0	0
1929	7	3,844	3	600
Total	57	31,318	23	3,608

Hans G. Hornbostel—1931

In an article published in the *Guam Recorder* in 1931, Hans G. Hornbostel confirmed that the fishing stone, the *poio,* originally described by Freycinet (1824:436), was still in use on Rota. Hornbostel's description of *hachuman* fishing varied little from Freycinet's. Hornobstel's article verifies Fritz's (2001) statement that this ancient type of fishing was preserved on Rota.

AMERICAN PERIOD IN THE NORTHERN MARIANAS (1944-PRESENT)

From 1944 to 1947, the U.S. Naval Military Government administered the Northern Marianas. From 1947 to 1976, the Northern Marianas were part of the Trust Territory of the Pacific Islands. In 1975 the voters of the Northern Marianas chose to join the U.S. as a commonwealth (U.S. Government 1975:6), and in March 1976 the U.S. Congress and the President approved the Marianas Commonwealth Covenant (U.S. Government 1976:7, 20). The government of the Northern Mariana Islands was separated administratively from the Trust Territory government effective April 1, 1976 (U.S. Government 1977:1, 14), and the new Northern Marianas Commonwealth government was installed January 9, 1978 as Dr. Carlos S. Camacho took office as the first governor of the CNMI (U.S. Government 1978:5).

Trust Territory of the Pacific Islands—1947-1976

Beginning in 1948, the U.S. government produced an *Annual Report to the United Nations on the Administration of the Trust Territory of the Pacific Islands*. From 1948 through 1951, the reports were prepared by the Department of the Navy. In 1952 and 1953, they were prepared by the Department of the Interior. Starting in 1954, the reports were prepared by the Department of State. The reports continued to contain information about the Northern Mariana Islands after they were no longer a part of the Trust Territory.

The quantity and value of fish caught in the Northern Marianas is shown in Table 28. The 1977 report (p. 58) divides the catch into tunas and reef fishes (280,261 pounds) supplied to local and Guam markets and sharks (119,420 pounds) exported to Korea.

Table 28. Quantity and Value of Fish Caught in the Northern Marianas from 1948 through 1977. Quantity is given in pounds; value is given in dollars. The fiscal year ended June 30.

Fiscal Yr	**Island ***	**Tuna (lbs.)**	**Tuna Value ($)**	**Other Fish (lbs.)**	**Other Fish Value ($)**	**Total (lbs.)**	**Total Value ($)**
1948	Saipan					138,642	27,268
1949	Saipan					100,000	18,000
1950-56	No statistics						
1957	Saipan	5,360	2,144	10,748	4,299	16,108	6,443
1958	Rota Saipan	 5,000	 2,100	10,400 6,000	3,120 2,500	10,400 11,000	3,120 4,600
1959	Rota Saipan	 2,000	 500	26,000 376	7,800 130	26,000 2,376	7,800 630
1960	Rota Saipan	1,000 510	300 164	12,600 25,514	2,520 9,547	13,600 26,024	2,820 9,711
1961	Rota Saipan					27,000 35,440	9,250 10,632
1962	Rota Saipan					10,000 87,279	3,150 20,709
1963	Marianas					56,423	12,047
1964	Marianas					31,386	15,416
1965	Marianas					29,869	7,620
1966	Marianas					58,800	15,640
1967	Marianas					52,000	11,345
1968	Marianas					36,000	7,589
1969	Marianas					19,625	4,970
1970	Marianas					110,445	28,600
1971	Marianas					104,389	40,758
1972	Marianas					87,000	51,330
1973-75	No statistics						
1976	Marianas					61,639	44,111
1977	Marianas					399,681	

* The heading used in the Trust Territory reports is “District” not “Island.” Saipan District is all of the Northern Marianas. However, there is reason to think that Island is what was meant, because some reports list Rota and Saipan separately. Later reports give the totals for the Mariana Islands. However, what is meant is the Northern Marianas, because Guam was not a part of the Trust Territory.

Commonwealth of the Northern Marianas—1978-present

Since 1978 the CNMI has been governed by popularly elected governors. Richard B. Seman is Director of the Division of Fish and Wildlife, which is in the Department of Lands and Natural Resources. Michael S. Trianni is the Fisheries

Supervisor. The Division works cooperatively with the Western Pacific Fishery Information Network (WPacFIN) to collect and disseminate data on fisheries.

Figure 15 shows the estimated commercial landings of reef, bottom, pelagic, and other fishes in the CNMI over a 21-year period from 1981 through 2001. This graph can be compared with the one for Guam (Figure 14). Only in the year 2000 did Guam commercial reef fish landings exceed 200,000 pounds, while in the CNMI commercial reef fish landings exceeded 300,000 pounds in 1989 and exceeded 200,000 pounds in 1990, 1994, and 1998. It should be noted that the variations from year to year are due to several factors in addition to fish abundance: effort, gear, and data collection methods.

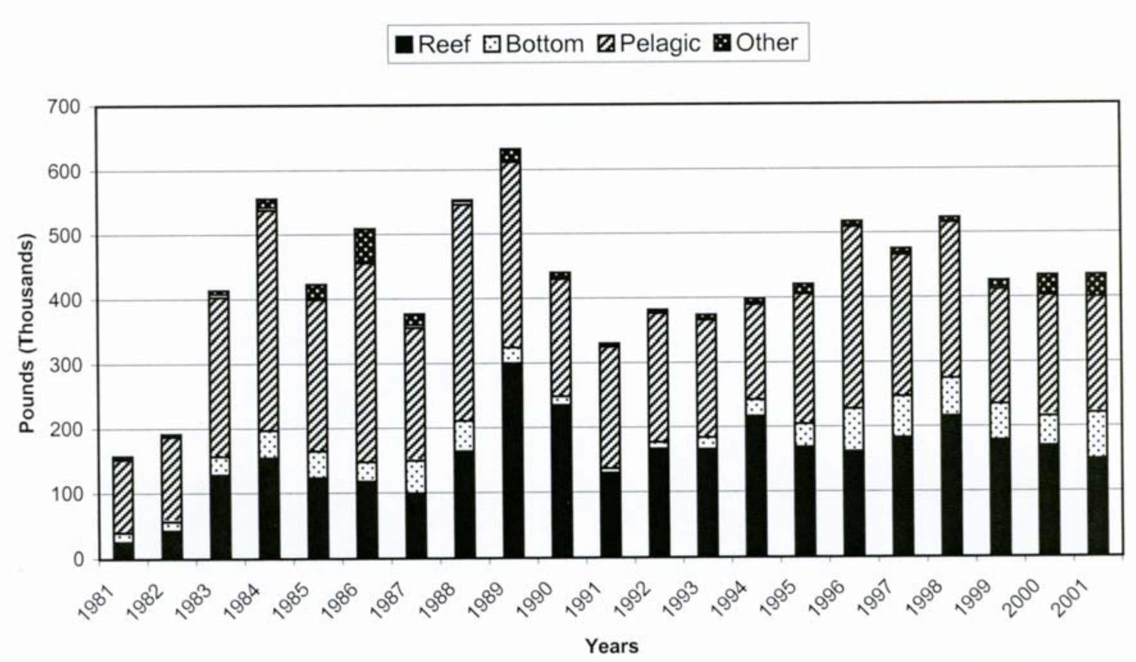

Figure 15. Estimated commercial landings of reef, bottom, pelagic, and other fishes in the CNMI over a 21-year period from 1981 through 2001. Based on the statistics provided by the WPacFIN web site (http://wpacfin.nmfs.hawaii.edu).

An *Analysis of Saipan's Seafood Markets* was prepared for the Division of Fish and Wildlife by Hans Radtke and Shannon Davis in 1995. The authors found that the Saipan sales data indicated that a fairly steady volume of reef fishes had entered the markets between 1983 and 1993. With the exceptions of 1989 and 1990, when the volume was higher than usual, the volume varied between 100,000 and 140,000 pounds (Radtke and Davis 1995:III-4). No data were available on the subsistence catch, but the authors estimated that to be 1.7 times the commercial catch. The demand for seafood in Saipan is greater than the local fishing industry supplies. Imports of fresh and frozen fish make up a substantial part of the total seafood consumed. Radtke and Davis concluded that there is sufficient demand to support an expanded fishing industry. They also noted that there are concerns on the part of the commercial fishermen, the retail market managers, and others that the reef resources may be over harvested. Their recommendations included the following: 1) improvement of the data collection and analysis component of the Division of Fish and Wildlife; 2) development of the harvester/distribution network; and 3) fishery management and development, including consideration of a community based limited entry system connected to individual quotas.

Mike McCoy's (1997) report on the traditional and ceremonial use of turtle in the CNMI was undertaken in response to a request brought before the Western Pacific Regional Fishery Management Council in 1994 and 1996 by the Carolinian community in Saipan for the use of turtles for cultural and ceremonial purposes. The report includes sections on the biology of the green sea turtle (*Chelonia mydas*) and on the archaeological and historical record with regard to the use of turtle. McCoy suggested the following approach, which would involve the participation and education of the CNMI residents. "The capture of turtle(s) for ceremonial use would take place in the northern islands on a traditional canoe voyage as part of an exercise to census and tag as many juvenile turtles as possible. The recipient of the turtle(s) at the ceremony would be afforded the opportunity to tag and release the turtle, thereby emphasizing both its importance to the culture and the current necessity to increase the local turtle population before they can be utilized again as a food item" (McCoy 1997:4). Although McCoy's suggestions appear to be well thought out, they have not been implemented to date.

Interview with Estanislao Taisacan of Rota—2003

In August 2002, J. Amesbury met Estanislao "Stan" Taisacan of Rota, who said that his father was the last fisherman in Rota to use the *poio* to fish for *hachuman* (*Decapterus* sp., *opelu* in Hawai'i). Amesbury interviewed Stan in two long distance phone calls in April 2003.

Stan was born in 1954, and he has lived in Rota all his life, except that he attended George Washington High School in Guam. He returned to Rota in 1973 and worked for the government for 24 years, including 12 years for the Division of Fish and Wildlife in Rota. He retired from the government in 1997.

Stan's father was named Clemente Saralu Taisacan. He was born in Saipan but moved to Rota in the late 1920s. Clemente's father was Chamorro and his mother was Carolinian. Saralu is the Carolinian maiden name of Clemente's mother. Clemente was born February 11, 1922, and died December 16, 1980.

Clemente's fishing partner was Tobias Songao Maratita, Stan's mother's stepbrother. Tobias Maratita built a canoe that he and Clemente used for fishing. The canoe was carved from a seeded breadfruit tree (*Artocarpus mariannensis*). The canoe was lost during Typhoon Karen in 1962. After that, they used a rowboat built of marine plywood.

Clemente made his own nets with nylon string. He made the *talaya* (throw net) and the *lagua' hachuman* (*hachuman* net). The *lagua' hachuman* had a six to eight foot radius and a rim of bamboo. The net was eight to ten feet deep from the rim to the bottom. Stan's friend in Rota still has the stone *poio* used by Clemente.

Clemente did all kinds of fishing. The *hachuman* fishing was done each year from about March through June. The fishermen would chew up young coconut of a certain stage of ripeness to use as bait. Using the *poio* and shortening the line a little each day, they fed the fish in a certain spot every day for about a week. After a week, as soon as the canoe reached the spot, the fish would be splashing around near the surface where they could be easily netted. The fishermen could fill the canoe, which Stan estimated was about 16 feet long, 2 feet wide and 2 feet deep. After netting the fish, the fishermen would have to paddle back with their feet over the sides of the canoe, because the canoe was so full of fish.

They fished for *hachuman* in the bay south and east of Songsong. From the East Harbor, they would paddle out only five to ten minutes or maybe 20 minutes. If they fished from the West Harbor, they would paddle out 30 minutes. Stan said the fishermen had to be consistent about the time of day they fished, for example, 6-7 am or 3-4 pm. They could mark their spot in the water by tying an old coconut to a white stone from the beach. The coconut floated beneath the surface of the water.

The fishermen used a glass-bottomed box to look into the water. Stan said they looked for a certain kind of unicorn fish found at that distance offshore. If they saw the unicorn fish they knew that the *hachuman* were near. The fishermen began by lowering the *poio* to a depth of about 90 feet, but by the end of one week, they were lowering it to a depth of 40 feet.

Stan helped his father with the *hachuman* fishing, which they did until the late 1960s (about 1967 or 1968). He said they sometimes slept on the beach to watch who was going out and to guard their fish (the fish they were feeding). Stan said it would be considered a crime for another fisherman to steal their fish from the water where they had been feeding them.

The catch was shared with family members and salted and dried or pickled to preserve it. Prior to the 1960s, only a few places on Rota had iceboxes. Electricity was available on Rota by the late 1960s, but it was shut off at 8 pm. It was not until the 1970s that everyone on Rota had 24-hour-a-day electricity.

CONCLUSIONS CONCERNING THE TWENTIETH CENTURY

Up through the end of World War II, the economy in Guam was mainly subsistence agriculture. The Chamorros were engaged in reef fishing, but this was mostly for household consumption or sharing with extended family and neighbors. It is doubtful that the amount of reef fishing that took place adversely affected fish stocks.

Beginning in the 1920s, the Northern Marianas economy was based on the sugarcane plantations, which employed mainly Japanese and Okinawan labor. During the 1920s and 30s, the Japanese had a tuna fishery based in Saipan, which also employed Japanese and Okinawans. The Chamorros and Carolinians of the Northern Marianas survived by farming and reef fishing, but little is written about these activities. Oral histories may provide more information on the subsistence activities of the Chamorros and Carolinians during the Japanese Period in the Northern Marianas.

The *hachuman* (*Decapterus* sp., *opelu* in Hawai'i) fishing, which had yielded large catches during the Spanish Period, was practiced until the late 1960s in Rota, and some *Decapterus* were caught near Guam in the late 1980s. It is possible that the traditional *hachuman* fishing with the *poio* was discontinued because it no longer had the cultural or legal protection it once had. There would be no point in the fisherman feeding the fish for a couple months or even a week if another fisherman could take the fish.

During the second half of the 20th century, changes in technology no doubt changed the impact of reef fishing. The changes in technology include the use of monofilament line, the use of snorkel and SCUBA gear with underwater flashlights and bangsticks, and the use of gill nets, which are unselective and also relatively inexpensive, so that they are sometimes abandoned in the water. In addition, there have been other human impacts on the reefs not directly associated with fishing. Examples are water pollution, including oil spills in Apra Harbor, Guam, and the silting of the reefs in southern Guam due to rainfall runoff after land clearing.

The changes in fishing technology and the indirect human impacts on the reefs have contributed to declines in the reef resources. According to Guam's DAWR, there has been a 70 percent decrease in catch per unit effort of important inshore food fishes over a 13-year period from 1985 to 1998. In contrast, the data for Guam provided by WPacFIN show an increase in commercial landings of reef fishes within the last few years. However, the data are not comparable, because they are derived from different kinds of surveys. The increase in commercial landings may be due to an increase in vendor coverage or an increase in effort.

Two recent reports concerning the CNMI, the *Analysis of Saipan's Seafood Markets* (Radtke and Davis 1995) and McCoy's (1997) report on the traditional and ceremonial use of turtle, call for improved data collection and additional research to guide the biologists in making decisions about fishery management and the management of sea turtles.

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