BELAUAN ETHNOGEOGRAPHY OF MARINE ENVIRONMENTS

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PREFACE

This thesis describes the indigenous geographical and environmental knowledge that is used by Belauans to locate and exploit marine resources. It is a result of six months' residence in a Belauan village during which I learned the essentials of the subject from a number of men and women with expert knowledge of marine environments and resources. Most of my teachers were older villagers recognized for their expertise in matters of traditional marine resource use.

While my command of the Belauan language was adequate for informal conversation, more formal "sessions" required the use of an interpreter. This occasionally caused problems because of the difficulty in matching the schedules of a typical young English-speaking Belauan who holds a daily job with the government or local school, and an older fisherman whose rhythms of sleep, work, and free time are largely governed by phases of the moon and tides.

Throughout the text I have used the Belauan spelling for all placenames with the exception of the capital city, Koror, which is the widely used anglicized spelling for Oreor. I have provided English glosses for a few Belauan placenames that may be more familiar to the reader in English form.

To aid the reader in pronouncing Belauan terms and placenames I have included the following orthographic notes:

Belauan vowels are generally pronounced according to the following system:

"a" = ä, as in f<u>a</u>ther

"e" = ā, as in d<u>ay</u>

"i" = ē, as in <u>ea</u>sy

"o" = ō, as in b<u>o</u>ne

"u" = ü, as in z<u>oo</u>

The letter combination <u>ch</u> in Belauan words is not pronounced as in English, but instead denotes a glottal stop, sounding like a catch in the throat, as in the beginning of each syllable in the English expression "uh oh."

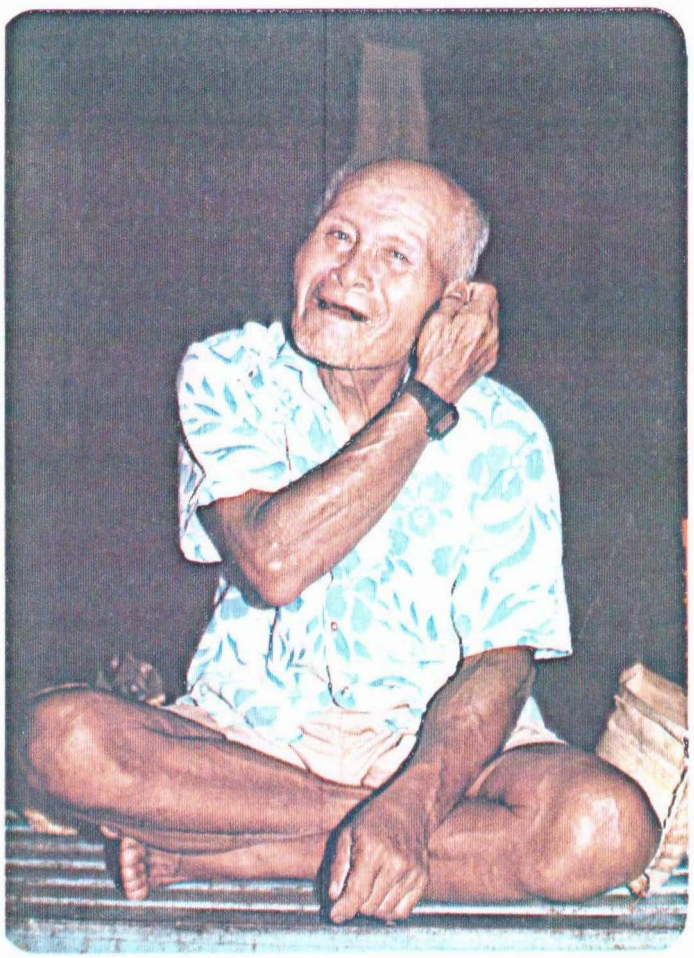

Plate I. Humio Kyota, master fisherman of Ngeremlengui.

I. BACKGROUND AND INTRODUCTION

Geographic Setting of Palau

On the far western side of the Pacific Ocean, some 7 degrees above the equator lies the compact cluster of islands known as Belau (Palau) (Figure 1). These islands are located some 550 miles east of Mindanao and a slightly greater distance north of the Vogel Kap Peninsula of New Guinea, and form the westernmost flank of the Caroline Islands of Micronesia. Capping the crest of a submerged mountain range, part of the Palau-Kyushu ridge, the approximately 125 mile long archipelago comprises a complex of numerous reef and island types. (This discussion does not include the Southwest islands of Sonsorol, Pulu Anna, Meriil and Tobi, which are politically a part of Belau but are geographically and culturally separate.)

By far the largest island of Belau is Babeldaob, an old and much eroded andesitic lava formation, with an area of 153 square miles. To the north are the small atolls of Ngeangel (Kayangel) and Ngeruangel. The capital city, Koror, occupies a mixed volcanic and limestone island of the same name immediately south of Babeldaob. Farther to the south are two upraised coral platform islands, Beliliou (Peleliu) and Ngeaur (Angaur), as well as a large area of drowned karstic limestone formations known as

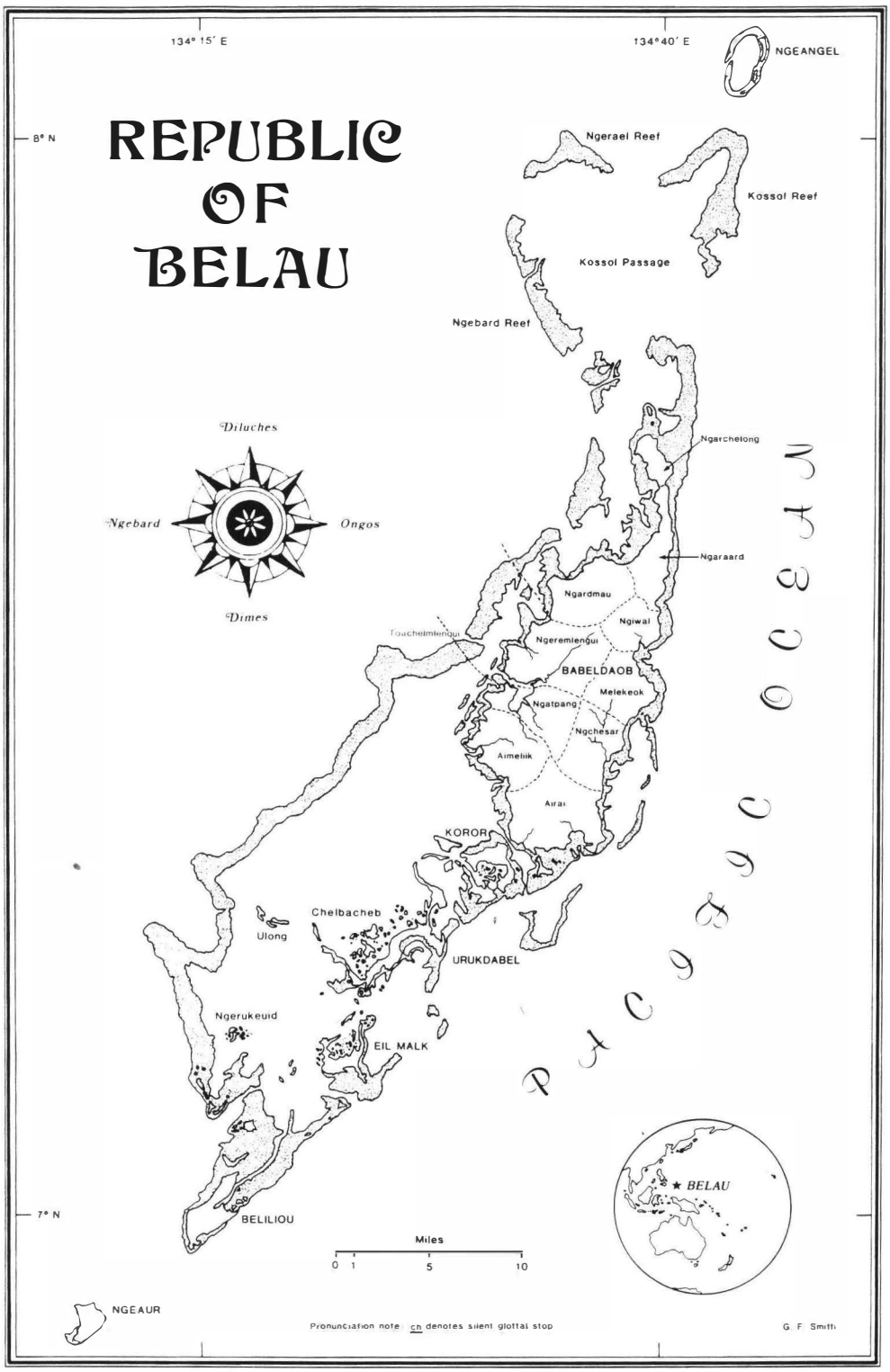

Figure 1. Map of Belau Islands. Shaded areas are coral reefs.

Chelbacheb, or the Rock Islands. This complexity of island forms found in Belau is the result of geological forces that have tilted the substrate causing subsidence in the north and uplift in the south (Tayama, 1952: 269).

In total, the Belau group consists of over 300 islands, most of which are very small; only 7 are inhabited today. Nearly all the islands as well as a large lagoon are surrounded by an extensive barrier reef. In addition, fringing reefs border the edge of many islands while numerous patch reef formations are found in the lagoon.

The nearshore zone of Belau consists of numerous and diverse habitats, including mangrove forests, sea grass beds, broad sand flats, rich zones of living coral, and semi-pelagic deep lagoon waters, all of which support a vast array of marine organisms. The biotic diversity so typical of tropical coral reef areas is greatly enhanced by Belau's location in the heart of the Indo-Pacific bio-geographic province. The abundance of sea life provides numerous resources that have played and continue to play an important role in the livelihood of the people of Belau.

Context of Marine Resource Use

Living in a region with relatively limited terrestrial resources, Pacific island peoples have long looked to the sea for a major part of their sustenance. The original islanders no doubt arrived already familiar with the tools

and techniques necessary for exploiting tropical coastal waters, and marine resources surely played an important role in early human adaptation to Pacific island environments (Bellwood, 1980).

Through the millennia, islanders have derived their principal source of protein from the resources of nearshore waters. Fishing in the Pacific has always been primarily a male activity, though women and children play an important role through reef gleaning, collecting small fish and invertebrates from shallow water reef top environments. Where extensive reef and lagoon areas exist, islanders have often found little need for exploiting pelagic resources of the open sea.

Many traditional Pacific island fisheries are essentially coral reef fisheries, and these have some unique qualities. First of all, coral reef ecosystems are very productive, and standing crops of fish are 20 to 30 times greater than in temperate marine environments (Stevenson and Marshall, 1974: 149). Secondly, the species composition of reef fauna is extraordinarily diverse, thus providing a broad range of resources including numerous kinds of molluscs, crusteceans and other invertebrates, as well as fish (see Salvat, 1980). However, the nature of coral reefs is such that the standing crops of reef fauna represent a large proportion of the total nutrient pool of the entire ecosystem, making reef fisheries especially sensitive to over-harvesting (Grigg, 1978).

Aware of this, Pacific islanders traditionally used a variety of techniques to manage and conserve reef and lagoon resources (Johannes, 1978; Klee, 1980). For example, in Belau such traditional conservation measures included systems of marine tenure, various laws or restrictions (bul) regulating harvests and harvest sites, food preservation techniques, and a variety of cultural and religious tabus (after Klee, 1980: 253-257). In addition, traditional subsistence strategies were such that harvest efforts were spread over a very wide range of resources, theoretically minimizing the impact on any particular portion of the ecosystem.

The modern context of Pacific island fishing has changed considerably. Many traditional conservation measures have been abandoned and exploitation intensified as purely subsistence harvesting has given way to a more commercial focus. This shift has led to a gradual narrowing of the range of resources exploited (Angot, 1960). Change has also taken the form of technological improvements, including modern diving masks, underwater flashlights, spearguns, and nets, all of which have increased the efficiency of island fishermen.

The commercialization of island marine resources is, of course, not a new development. Indeed, by the early nineteenth century, European traders had initiated the organized exploitation of such products as trepang (sea

cucumber), sea turtles, and various mollusc shells in Belau and other Pacific areas (Salvat, 1980; Shineberg, 1971; Tetens, 1958).

Modern markets now exist for a much wider range of resources, especially for fish and shellfish for both local consumption and export. In Belau, commercial marketing is today organized around a central cooperative wholesale agency in Koror, through which individuals or village fishing cooperatives can sell their catch.

Despite the increased commercialization of resources, reef fisheries such as that in Belau remain largely decentralized, small-scale industries still relying on many traditional techniques. This can be attributed in part to persistent cultural patterns, but is also due to the great diversity of resources and habitats, and to morphological features of reef environments that mitigate against the use of large scale industrial fishing techniques (Salvat, 1980). The typical contemporary reef fishery in the Pacific is thus a mixture of subsistence and commercial exploitation carried out by small groups and individuals using techniques that often have a strong continuity with traditional proven methods and strategies.

The Research Question and Theory

The one aspect of Pacific island fisheries that has probably changed the least through time is the ability of islanders to successfully exploit the many resources

of the nearshore sea. Harvesting resources with such seeming ease is more impressive still in light of the fact it is essentially a hunting and gathering activity that takes place in an environment where aquatic properties of buoyancy, light refraction and limited visibility and oxygen seem to conspire against man and his terrestrially evolved senses (Hewes, 1948). Successful resource exploitation can be viewed largely as a matter of solving the particular problems presented by a given environment (Jochim, 1981), and the marine realm obviously presents certain unique problems to resource users, especially with regard to the location of resources and resource sites.

Yet, for the experienced Pacific islander the sea is hardly an alien environment and the problems it presents have been solved to the extent that the harvest of marine resources often appears to present few challenges and little risk of failure. Indeed, one observer in a Belauan village in the early 1970s noted that "the securing of fish is the most regular and predictable of subsistence activities" (Klee, 1976: 211).

This raises the central question of this thesis, that is, what solutions or strategies have islanders devised in response to the problems presented by the peculiar nature of resource utilization in the marine environment? In other words, it is a question of how to better understand the ability of Pacific island resource users to so

successfully and consistently locate and exploit marine resources.

Some factors seem immediately obvious, but with further consideration can be ruled out as being of major importance to the question at hand. Of course, the resources of reef environments are plentiful and varied, but fishing and collecting efforts in the Pacific seldom take the form of a haphazard search for any available prey; instead, specific strategies and deliberate preparation are involved, based on specific desired resources. Technology is also an obvious factor in successful resource exploitation, and islanders have certainly developed a wide array of implements for use in the marine harvest. But technology is really just a tool and therefore can only help to manifest and enhance, but not account for, the abilities of the marine artisan. Instead, the answer to the question must be sought through an examination of the extensive knowledge of resources, natural history, and environment possessed by the experienced resource user.

The depth of marine knowledge held by Pacific fishermen (and women) is indeed impressive (see Johannes, 1981: vii-viii). This knowledge derives not only from an individual's lifetime of observations, but also benefits from many previous generations and their experiences with the sea. Pacific island marine lore is the accumulated product of innumerable individuals with a lifetime of experience

exploiting resources of the local marine environment. Backed with this store of knowledge, the modern resource user is able to solve problems through a keen familiarity with the behavior of resources, as well as with the particular environmental and geographic phenomena of the local underwater environment. In other words, the islander is able to tap into a large body of accumulated natural history lore in order to better "connect" with particular resources.

Pacific marine knowledge can be thought of as being organized around three highly interrelated facets: the behavior of resources, celestial and seasonal phenomena and cycles, and geographic features and processes. None of these stand alone for they are but differing perspectives of the same integrated body of knowledge, yet each emphasizes a different aspect of the natural history information available to the resource user. To answer the question of how to understand the ability of islanders to readily locate and exploit marine resources, it is most appropriate to examine the geographical facets of marine environmental knowledge.

This paper explores the geographical facets of Belauan marine knowledge through an examination of the geography and ecology of nearshore environments as perceived by Belauan resource users. The data are in the form of an indigenous geographical system of specific recognized environments and features that serves as an organizational

framework for a body of natural history lore dealing with the location and exploitation of marine resources. This geographical system and its related body of resource information constitute the marine ethnogeography of the Belauan resource user. It is this ethnogeography that is the most important factor facilitating the location and exploitation of marine resources.

According to Knight (1971), ethnogeography is the way that a people perceive their environment, its features and processes, and includes the systems of spatial organization that are mentally imposed on the landscape. It is a cultural interpretation of environment that strongly reflects the realities of resource use patterns, and includes the environmental knowledge that provides the rationale for various resource use strategies. The spatial component of ethnogeography, that is, the spatial organization perceived to be evident in the environment, including culturally differentiated habitats, zones, and other geographic features, provides an important framework within which resource use strategies are carried out. The perceived system of spatial organization and related environmental knowledge combine to form a very functional interface between people and resources (Knight, 1971: 51).

A culture's ethnogeography derives from accumulated experiences through generations of interaction between people and their environment, and is passed down through

processes of enculturation (Knight, 1971: 48). It is not a static system however, for it may be continually modified and refined in response to new experiences and changing needs and patterns of resource use due to new technological, economic, or environmental conditions. An ethnogeography is thus an adaptive system that facilitates resource use while providing continuity with a culture's past experiences, as well as a means for cultural integration with new or changing conditions.

Ethnogeography is related to the larger field of ethnoscience that has been the focus of study primarily by anthropologists. Ethnoscience is basically concerned with the emic, or insider's, view of nature as held by members of a particular culture. Major emphasis has been on the ways that cultures perceive and conceptually organize natural phenomena within their environment, and studies have thus often been concerned with the way a culture classifies environmental information rather than the content of the information itself (Crick, 1982). Many geographers using an ethnoscientific approach have also been largely concerned with "terminologies and taxonomies" (Murton, 1975), but there is a growing recognition that the value of the empirical content of ethnoscience, or indigenous knowledge, is also of great importance (Knight, 1975; Brokensha, et al., 1980).

Several marine related studies within the rubric of ethnoscience have recently focused on the ecological and adaptive value of the content of indigenous marine knowledge (Johannes, 1981; Akimichi, 1978; Kirch and Dye, 1979). In addition, some researchers have advocated the study of indigenous marine knowledge as a means of gaining new scientific information, as well as for practical applications in marine resource management (Johannes, 1980; Pollnac and Sutinen, 1979).

This paper is concerned with the classificatory system of Belauan marine ethnogeographic knowledge, but instead emphasizes its practical content and the logic and rationale that this knowledge provides the resource user for finding and choosing locations and strategies for the exploitation of marine resources.

The material presented here describes aspects of the various marine geographical zones and features as perceived by Belauans. The information was collected through discussions and interviews with a number of knowledgeable Belauan resource users. As often as possible information learned from one person was cross-checked or corroborated by asking similar questions of others. In addition, I made frequent reconnaissance trips to the reef to observe firsthand the various environments, and I also accompanied Belauans on fishing and collecting excursions whenever possible.

The Study Area

The research was carried out between October 1, 1983, and March 30, 1984, while residing in the village of Ngermetengel, one of two villages in Ngeremlengui State, on the west-central coast of Babeldaob Island. This village (commonly referred to simply as Ngeremlengui by most residents and other Balauans) is the principal community of the state, and has a population of approximately 300.

The interior of Ngeremlengui is generally hilly and covered with thick stands of tropical semideciduous forest interspersed with areas of grasslands dotted with pandanus trees. The eastern portion of the state includes a long section of the Ngermeskang River, the largest river in Belau. There is also a central area of more rugged relief, including the mountain Etiruir, which at 709 feet is the second highest in Belau. The interior is today little used except for some occasional pigeon hunting. Reflecting the marine focus of the Balauan way of life, the population of Ngeremlengui is located wholly on the seaward margins of the state.

Rainfall is high, more than 150 inches per year, providing plentiful water for crops of taro, tapioca, and sweet potato. There is a marked variation in the pattern of rainfall that accompanies the seasonal shift from

southwesterly monsoonal winds (ca. May through October) to northeasterly trades (ca. November through April). While there is no truly dry season, the months of February and March generally have the least rainfall, while the wettest period is in late summer.

The seasonal shift in wind direction strongly affects the harvesting of marine resources. For Ngeremlengui and other west coast areas the southwest monsoonal winds blow directly on shore creating rough water and generally poor fishing conditions. On the east side, the situation is reversed, with poorest conditions during the winter period when northeast trades blow directly in from the sea.

The coastal waters for which Ngeremlengui holds traditional tenure rights comprise a complex of environments including mangrove forests, fringing reefs, a deep lagoon with numerous patch reefs, and a large offshore barrier reef (Figure 2). Through the barrier reef at Ngeremlengui runs a large deep water channel that is the principal route for ships entering the lagoon along the west side of Belau. The former strategic value of this pass is evidenced by a rusting battery of Japanese artillery located on a hill above the village of Ngermetengel. Along the southern edge of Ngeremlengui is a large bay that is the flooded remnant of an ancient volcanic caldera. This southern coast supports mangrove forests, but there are no reefs here due to the estuarine nature of the bay.

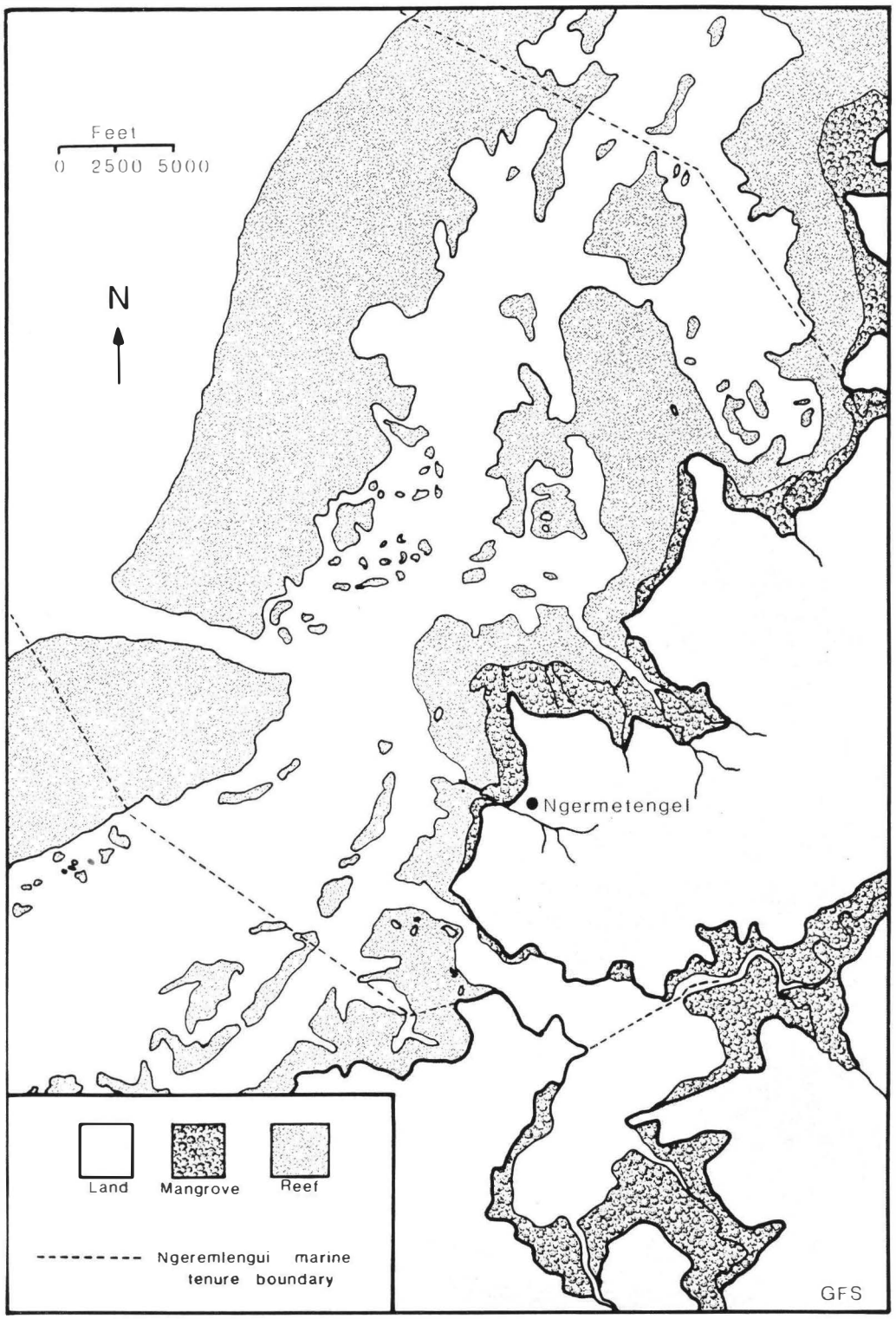

Figure 2. Map showing marine areas and western land portion of Ngeremlengui.

This study benefitted greatly from the previous field work of two researchers in Ngeremlengui. Robert Johannes, a marine biologist, studied local fishing and marine knowledge having to do with the behavior and reproductive cycles of fish and other resources (1981). Earlier, Gary Klee, a geographer, lived at Ngeremlengui and studied traditional methods of time reckoning for successful resource use, and recorded information derived from local knowledge of cyclic, celestial, meteorological, biological, and oceanographic phenomena (1973; 1976). The present study focuses on a different aspect of Palauan environmental knowledge and is thus complementary to these previous works.

II. BELAUAN ETHNOGEOGRAPHY OF MARINE ENVIRONMENTS

The following sections describe the various environments and features of the marine zone as perceived by the Belauan resource user. The environments are grouped in several larger associations according to a basic morphological division of the nearshore zone (i.e., fringing reef environments, lagoon environments, etc.). Each environment or feature is described in terms of its (1) location, (2) basic physical features, (3) associated resources, and (4) the kinds of activities, strategies and techniques most likely to be used at that location. Several plates and two diagrams are included to aid the reader in understanding the nature and location of environments discussed in the text.

The discussion begins at the edge of land with the environments of the mangrove forest and moves progressively seaward across reef and lagoon to the open ocean beyond. Following this is a short section describing a related system of marine placenames that serves to further differentiate and identify the environments and sites of the nearshore zone.

KEBURS: MANGROVE FOREST ENVIRONMENTS

As is true for much of the island of Babeldaog, nearly all of the coastline of Ngeremlengui is bordered by

mangrove forest. In addition, there are extensive inland mangrove areas bordering the lower reaches of the Ngermeskang River and Ngermeduu Bay, the large estuarine bay at the southern boundary of Ngeremlengui. Along the coast the submerged tidal woodlands of the mangrove zone range in width from a few feet to over 0.3 miles.

In Belau the general designation for mangrove forest is keburs. A variety of resources are located in keburs and many of these are distributed throughout the forest area. A major obstacle to the exploitation of resources within keburs is the limited access to many areas of the forest due to the thick tangled growth of prop roots and branches typical of the mangrove zone. It is therefore not surprising that the several environments of keburs recognized in the Belauan ethnographic system are differentiated primarily according to the factor of access.

While marine life comprises the majority of resources exploited in keburs, there are also a number of mangrove tree species that have traditionally been used for building materials. Mangrove trees are favored by Belauan builders because of resistence to insects and the lasting quality of the wood. Those mangrove trees harvested for building wood include mekekad (Lumnitzera littora), tebechel (Rhizophora mucranata), churur (Sonneratia caseolaris), kodenges (Bruguiera conjugata), and buit (Ceriops roxburghiana). Another mangrove tree, meduulokebong, or cannon-

ball tree (Xylocarpus granatum), was traditionally used only for outside construction, its wood being considered tabu for use on home interiors.

The following sections describe the various environments of keburs as identified by Belauans; these are all areas which in some way afford access to the resources of the mangrove forest.

KEBOKEB--At island's edge, where land and mangrove meet is the border zone known as kekokeb. This is an intertidal zone with the landward edge defined by the reach of high tide waters and the seaward side bounded by thick mangrove forest. Kebokeb is a narrow zone with much sparser vegetation than most areas of keburs. Although particular characteristics of kekokeb vary according to the topography, soil and plant cover of adjacent land areas, the zone generally consists of shallow mud deposits and intermittent patches of shrubs and trees. At low tide, portions of kebokeb emerge leaving dark mud patches pockmarked with shallow puddles of water interspersed between clumps of arching prop roots and mangrove trunks.

This quiet protected inner margin of the mangrove is most importantly a site for collecting chemang, or mangrove crab (Scylla ssrrata). Twice each month kebokeb is invaded by these crabs seeking sheltered sites for mating and molting. Moving with spring tides around each new and full moon phase, numbers of chemang leave their

burrows on the fringing reef and travel through the mangrove to the soft muds of kebokeb. Individual crabs are said to make this journey once each month, at either each new moon or each full moon phase. The migrating crabs include both individual males and mating pairs with the female being "carried" beneath the male. While some chemang may find shelter elsewhere in the mangrove, most are said to move inland to kebokeb where they occupy or excavate shallow burrows in the mud. Mating and molting will then take place over the next few days.

The ideal time to collect mangrove crab at kebokeb is five days after a new or full moon. The crab fisherman goes to kebokeb at low tide and locates burrows by looking at the water puddles on the surface of the mud. These puddles are usually formed by sea water left in the shallow depressions atop crab burrows by a receding tide.

An experienced fisherman can tell if a burrow is inhabited by watching the surface of the puddle. If a crab is present there may be a telltale movement on the surface said to be produced by the crab "exercising" in an effort to hasten the hardening of the new shell following a molt. This folk theory is apparently based on the observation that captive crabs, often kept alive for days but bound tightly to prevent movement, harden more slowly than those in the wild.

Another sign, tiny air bubbles on the surface of the puddle, not only signifies the presence of chemang, but can tell the experienced fisherman whether the burrow conceals a single crab (bubbles in the center) or a mating pair (bubbles near the edge).

Today, chemang are a valuable resource. Not only are they a prized food for many villagers, especially for feasts, but they also bring high prices through the wholesale market in Koror. Crab fishermen in Ngeremlengui now feel that the number of mangrove crabs is declining, but do not feel that their own activities are the cause. Instead, they blame another major predator of the crab, the ius, or estuarine crocodile (Crocodylus porosus). There may indeed be substance to this claim since the crocodiles, once shot with rifles whenever seen by Belauans, are now enjoying a constitutional respite thanks to a ban on firearms adopted by the Republic of Belau in 1981. Many Belauans say that the numbers of ius are now rapidly growing.

As mentioned above, there are a number of mangrove trees prized for lumber by Belauan builders. Kebokeb is considered the best site for obtaining large specimens of many of these trees. One reason for this is that the landward margins of mangrove forests are generally more species diverse than the often monotonous stands of particular mangrove types, especially Rhizophora, in more

seaward locations (Merrill, 1981: 50). Also, it may be assumed that soil and light conditions are more conducive to large tree growth in the ecotonal zone of kebokeb.

One tree that provides a particularly excellent quality lumber is not a mangrove species but grows just landward of kebokeb areas bordering the Ngermeskang river. This tree, ngmui (Urandra ammui, Kanehiro), is soft when harvested but after curing and milling becomes extremely hard and strong. It is cured by burial in estuarine mud flats, called uliul, for periods of up to one month.

LALOU--The outer seaward fringe of keburs, where mangrove meets the sea, is know as lalou. This border zone can take two forms depending on the dominant tree species fronting the reef flat. The most common are tebechel (Rhizophora mucranata) and the related bngaol (R. apiculata) (Plate II). These typical mangrove trees form a dense wall of vegetation, 15 to 30 feet high, with a green bushy upper zone atop a thick exposed wall of reddish brown prop roots (raod) that extend down to the water in various stages of growth. The other less common form of lalou is where groves of churur (Sonneratia caseolaris) face the reef flat (Plate III). This is a very distinctive mangrove tree with a single stout trunk and open understory but with a large system of gnarled looking conical riser roots protruding up through the mud and water supplying oxygen to the root system below.

Plate II. Lalou, or the seaward edge of the mangrove forest, here dominated by trees of the genus Rhizophora.

Plate III. Seaward edge of mangrove (Lalou) dominated by churur trees (Sonneratia caseolaris).

In either case, an important feature of lalou (in fact, a defining feature according to one Belauan) is a narrow zone of open water that lies immediately adjacent to the lower trunk and roots of the mangrove but beneath the overhanging crown of upper branches. This shadowed zone plays an important role in melongakl, a style of fishing specifically associated with lalou. The technique of melongakl involves climbing up into the overhanging branches of lalou and taking fish with a handspear as they pass through the shadowed zone below. Melongakl fishing is best during the latter stages of a rising tide or the initial stage of a falling tide since a number of fish species will enter the mangrove to feed at high tide then pass back out as the tide falls. Fish are easily sighted passing through lalou because of the improved visibility in the shadowed water zone.

Melongakl fishing is apparently much less popular today than in former times. With modern motor boats making a variety of fishing areas more readily accessible, this sedentary style of fishing is said to be "too boring." One young Belauan who still occasionally fishes melongakl style claimed that a "Sony Walkman" (portable stereo) is a definite aid.

Another strategy traditionally used at lalou was a form of turtle hunting. Melob, or green turtles (Chelonia mydas), are known to occasionally come to lalou during

a night-time high tide to feed on the tender tips of raod, the hanging aerial roots of Rhizophora mangrove trees. Knowing this, the turtle hunter would go to lalou and wait in darkness, listening for the sound of a surfacing turtle. With the sound as cue, a torch would be lit and the turtle speared before retreat was possible. This method is apparently no longer practiced because of the decline in numbers of turtles probably due to overhunting (see further discussion under Uis).

ONGDUOLL--Open mud deposits on the outer fringe of keburs and along small channels leading into the mangrove are known a ongduoll (Plate IV). The name ongduoll derives from ngduul, a mangrove clam, and literally means a place for collecting these clams. The mud patches of ongduoll occur at various locations along the outer fringe of keburs but are more commonly associated with the mouth and channel bottom of small non-navigable drainage channels known as demetaoch. Ngduul clams are embedded in mangrove muds throughout keburs, but are extremely difficult to collect in most areas because of the extensive roots. A defining characteristic of ongduoll is the openness and accessibility of these root free mud deposits.

Mangrove clams, along with many other semi-sedentary resources, have traditionally been harvested by Belauan women. To collect ngduul, women go to the ongduoll at

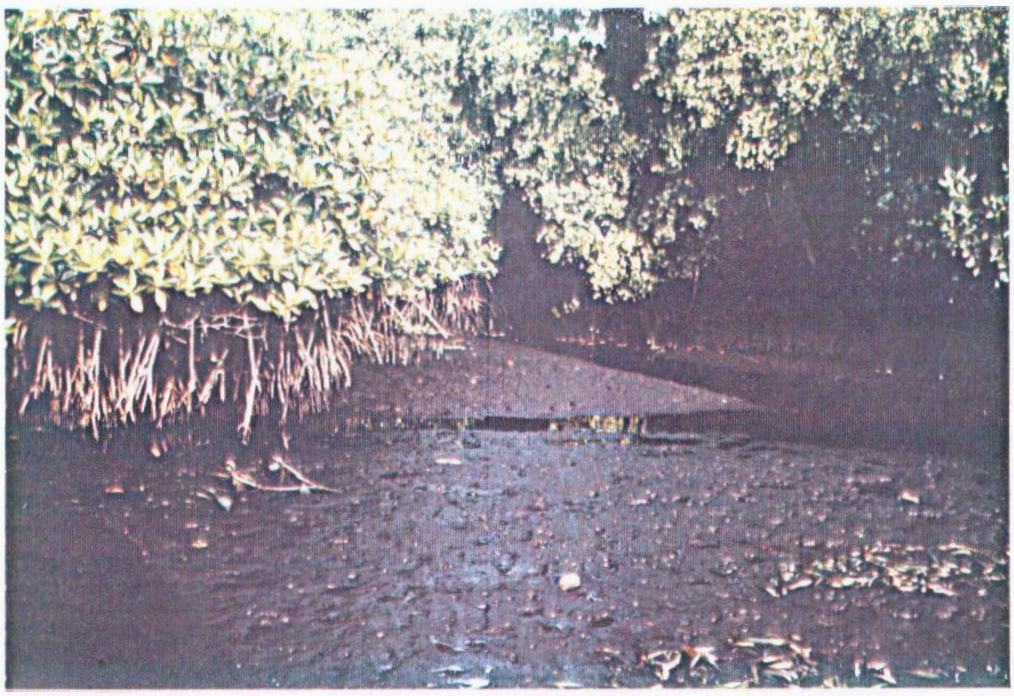

Plate IV. Ongduoll, open mud deposits along small channel bottom and outer edge of the mangrove forest. This is primarily a site for collecting ngduul, a mangrove clam.

low tide and, after partially disrobing, wade into the exposed mud. Moving slowly, through the knee to hip deep deposits, women locate the clams by feeling with their toes, after which the ngduul are lifted to the surface with a foot or dug out by hand.

Individual ongduoll are specific named sites with long histories of exploitation and most are well known to the more experienced "gleaners" among the women of the village.

TAOCH--Channels through the mangrove large enough to accommodate boat transportation are known as taoch. These may be man-made channels or natural estuarine outlets for freshwater streams. In either case, their principal function is that of transportation routes through keburs.

One resource associated with taoch is cheduib, an unidentified clam found in the mangrove forest along the margins of fresh water channels. This clam is not as desirable as ngduul but is fairly easy to collect as it is found on the surface of muds among the roots of the mangrove margins of taoch.

KEREKER: FRINGING REEF ENVIRONMENTS

Kereker is a general term applied to the entire surface flat of the fringing reef, Belauans sometimes speak of going to the kereker for fishing or collecting various

resources, but there is actually a much more detailed division of environments in this reef top domain (Figure 3). Unlike mangrove environments, access is not an important factor in the exploitation of resources here, and thus plays little role in defining the various zones of kereker. Instead, it is water depth, based on the surface configuration of the reefs, that provides the basic criterion for the differentiation of environments. While these environments can easily be distinguished visually due to depth differences, it is not the visual component that is the rationale for the division of kereker. More important from the resource user's point of view is the influence of reef topography and depth on the location of various resource habitats and the movement of fish on and off the reef flat.

There are a wide variety of resources located on kereker and these have traditionally been the focus of relatively heavy exploitation owing to the ease of access to this landward reef zone. In addition to many species of reef fish there are also a number of shellfish and other resources traditionally collected by Belauan women and children. Resources and strategies used for their exploitation are discussed in the following sections describing the different environments of kereker. The reader may refer to Figure 3 and Plate V, as well as other plates, while reading these sections.

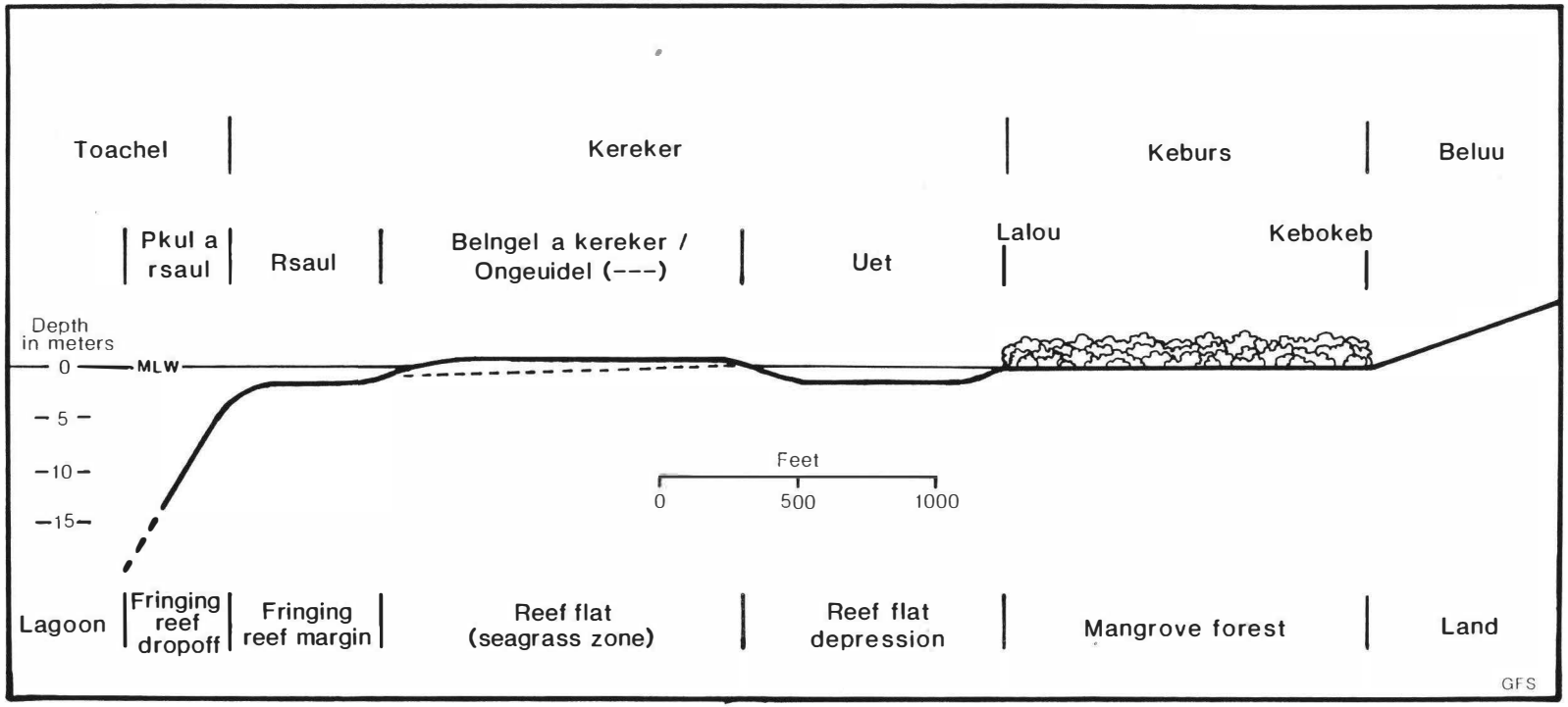

Figure 3. Schematic cross-section of typical Ngeremlengui reef showing relative location of various reef zones. (Scales are approximate.)

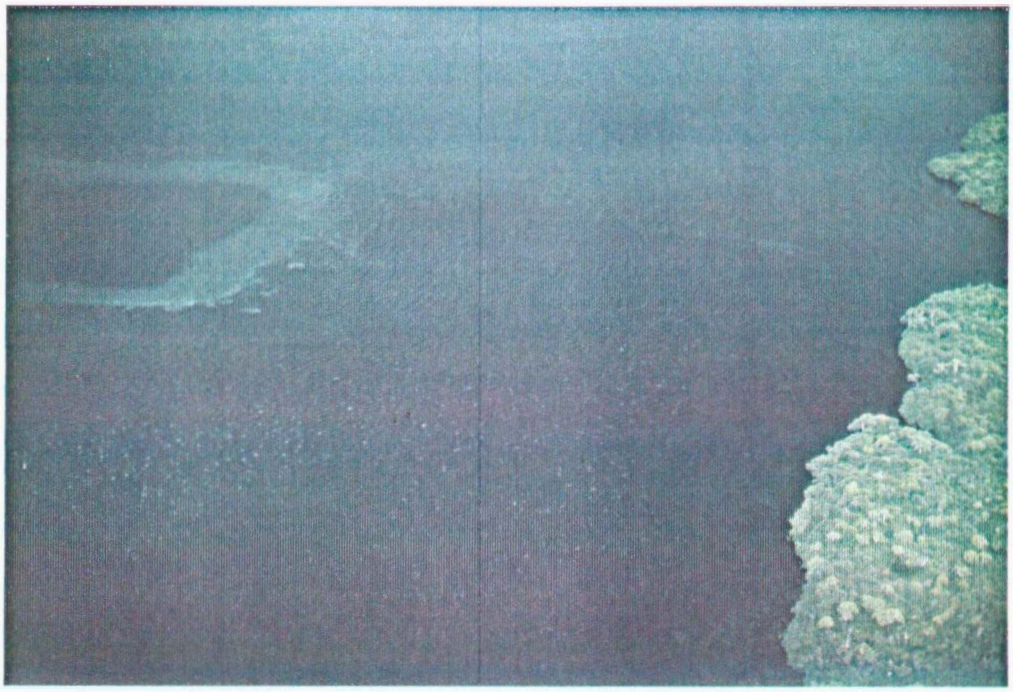

Plate V. Aerial view of a section of kereker, or fringing reef flat. Greenery at right is keburs, or mangrove forest; dark water next to the mangrove is uet, a landward depression on the reef flat; light speckled reef flat area is belngel a kereker, the highest portion of the fringing reef; light band at left is rsaul, or fringing reef margin, here bordering a deep water embayment known as metkerel; dark water landward of this embayment is a reef top drainage depression, or ongeuidel.

UET--The deepest portions of the inner reef flat are known as uet. These depressions in the reef platform remain water covered even during very low tides (Plate VI). At such times, when most other parts of the reef flat are emerged, uet retain depths of 1 to 4 feet. Uet are most often located along back portions of kereker and are readily recognized, especially at low tide, as large pools separating the mangrove from the shallower environments of the seaward reef flat.

Since the uet depressions are never exposed they offer a stable environment for living corals. Numerous coral heads and microatolls are common to most uet areas, as are tall sea grasses growing up to the low tide surface level. The coral heads of uet are important because they provide sheltered habitat for many reef fish. Traditionally, strict conservation laws (bul) prohibited the removal of corals from uet in an effort to preserve good fishing sites near to the village. Today in Ngeremlengui, however, the easily accessible corals of uet are often harvested for construction or road repair material, so that those uet closest to the village are now largely bareen of coral.

Numerous species of reef fish comprise the major resource of uet. Though many of these fish are also common to other reef areas Belauans say that those of uet are generally smaller than their counterparts elsewhere are are also better tasting. Belauans say that this may be due to the "easier life" in the semi-protected environment

Plate VI. Low tide view of uet (foreground), a landward reef flat depression. Note ongduoll (mud deposit) at left near mangrove, and belngel a kereker, the exposed high portion of the reef flat, at upper right.

of uet, or that the fish of uet may be juvenile members of reef fish species. Some of the common species caught in uet are melemau (parrotfish, Scarus spp.), itotch (thumbprint emperor, Lethrinus ramak), temakai (grouper, Epinephelus spp.), meas and kelsebuul (rabbitfish, Siganus spp.), chudech (snapper, Lethrinus ramak), budech (yellow cheeked wrasse, Choerodon anchorado) and terekrik (ox-eye scad, Trachurus boops).

While numerous fish feed on the reef flat at high tide and move to the safety of deep water in the lagoon on a falling tide, many will remain in the uet during all tidal phases. Thus, during very low tides uet form isolated reservoirs with concentrations of fish on an otherwise largely exposed reef flat.

Common methods of fishing in uet include underwater fishing with a diving mask and speargun or handheld spear. Another method is to use a throwing spear from atop a bamboo raft floating over the uet. A nighttime version of this is meluich, the Belauan term for the "lamp and spear" method of fishing. Floating over the uet at night on a raft, the meluich fishermen hold a lamp or lantern over the water to attract fish to the surface; the fish then are taken with a handspear.

At low tide a fisherman might walk in uet, fishing with a throwing spear. A cast net known as bidekill might also be used, but in many uet areas this is not an effective

method. The bidekill is a circular net with weights attached along the outer edge. It is thrown so that it spreads out over the fish, entrapping them as the weighted edges sink. The problem in uet is that the coral heads and tall sea grasses tend to interfere with the operation of the bidekill so that fish are often able to escape from beneath the net.

BELNGEL A KEREKER--The term belngel a kereker literally means the middle of the fringing reef flat, but it more accurately describes those reef flat areas that are fully emerged during spring low tides. Belngel a kereker, the highest points on the reef flat, are broad low rises of very minor relief, usually covered with a blanket of short turtle grass and dotted with small conical sand mounds, of biogenic origin, known as blkes. Belngel a kereker usually lie just seaward of uet (see Figures 5 and 6) and often form a line of individual rises parallel to the reef edge and separated from one another by slightly deeper areas called ongeuidel (see Figure 7).

Because of frequent emergence there is little or no coral growth in this zone, but there is a surprising range of resources including many invertebrates common to other areas of the kereker and that are apparently adapted to occasional periods of subaerial exposure. These are resources traditionally collected by women and children and include kim, small tridacnid clams; chibuchel, a favored

sea urchin (Tripneastra gratilla); and various molluscs such as buich (cowrie, Cypraea mauratiana) and sang (spider conch, Lambis lambis). In addition, several popular types of sea cucumber, including cheremrum, molech, irimd and ngimes (unidentified Holothurian spp.) are all collected here. Also harvested at belngel a kereker is a chiull, a type of sea worm said to be a very effective bait for drop line fishing.

Numerous species of reef fish are also found at belngel a kereker. Some of these merely transit the area while enroute to or from the uet or other favored reef environments, but a number of fish also stay to feed in the turtle grass beds. Belauans consider these fish very tasty and they are consequently in great demand. Most popular are several species of rabbitfish: meas (Siganus cansliculatis), beduut (S. argenteus), kelsebuul (S. lineatus) and reked (S. sp.). Beduut and kelsebuul command some of the highest prices paid for any fish by the wholesale marketing organization in Koror.

The shallow depth and lack of corals and tall grasses in belngel a kereker make this a good area for bidekill, or cast net fishing, especially for schooling species such as rabbitfish and mekebud (herring, Herklotsichthys punctatus). A throwing spear can also be used in the shallows of a changing tide as fish are easily sighted in the low water. (I observed only young boys fishing this way.)

ONGEUIDEL--Shallow water covered areas separating the emerged portions of the reef at low tide are called ongeuidel (Plate VII). These are broad low depressions between belngel walls set in specific ongeuidel sites so as to trap fish leaving the reef flat on falling tides. As Johannes (1981: 15) notes, these are no longer in use today probably because of the significant amount of labor required for their maintenance and the availability of the equally effective kesokes net.

LEMAU--Lemau are deep, circular, steep sided pits in the reef flat commonly known as blue holes, the term deriving from the typical blue color of the deep water found here. The term lemau may in fact derive from the Palauan word melemau, meaning blue. These are relict karst features of varying diameter and depth formed by solution processes in the emerged reef limestone during pre-Holocene periods of lowered sea level (see Hopley, 1983: 202-206).

Lemau are not a ubiquitous reef feature--in fact only three are located in Ngeremlengui's waters--but they do provide particularly good fishing sites. As the tide begins to fall and fish seek the safety of deeper water, many will enter a lemau rather than move off the reef flat to the lagoon. Thus, at low tide the waters of lemau offer the fisherman a concentration of reef fish within a relatively constricted area.

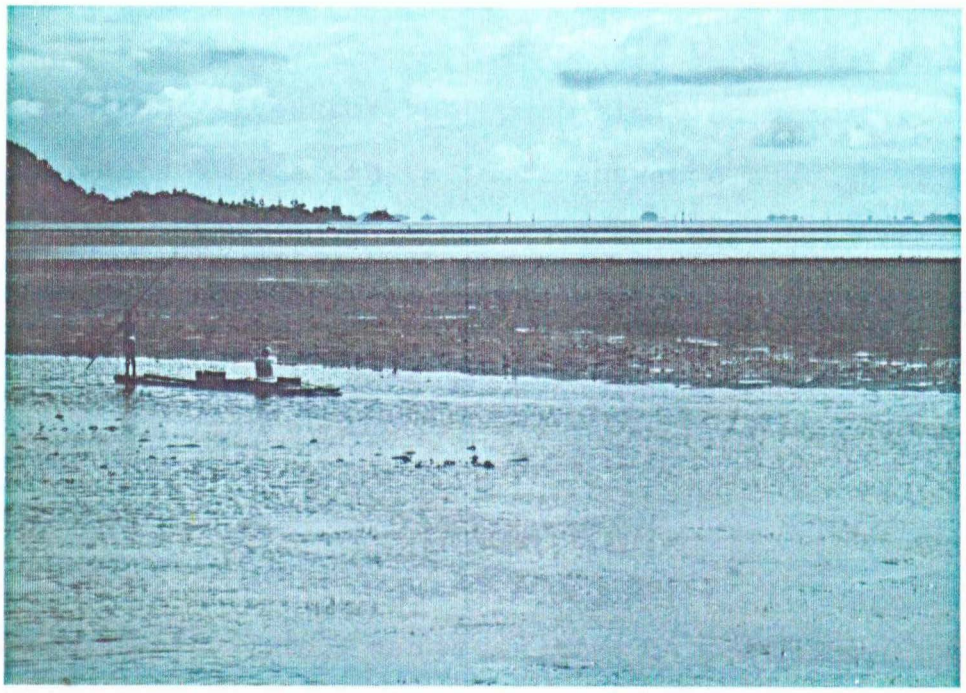

Plate VII. Low tide view across alternating ongeuidel, water covered fringing reef drainage depressions, and belngel a kereker, the exposed high portions of the reef flat.

Speargun and handspear fishing is effective among the corals of the rim and upper walls of lemau, while drop line fishing is used for the deeper waters. Meluich, or lamp and spear fishing, is also effective in lemau.

Because of the regularity of fish movements into the limited area of lemau, fishermen said that these would be excellent sites for bub, portable fish traps resembling large cages with a single small entrance through which fish enter but cannot exit. However, they said that bub are not set here because of the popularity of lemau fishing sites, and the fact that many people can "no longer be trusted" to respect the ownership of the fish within a trap.

RSAUL--Along the top of the outer margin of the fringing reef flat is a narrow zone called rsaul (Plate V). This reef margin is readily identified from the air as a light colored band paralleling the reef edge. Rsaul is slightly deeper than landward portions of the reef flat and is thus not subject to exposure except during extreme spring tides. It is a zone of healthy coral growth with globose, branching, and microatoll forms all present. Intermittent sand patches contribute to the light appearance of rsaul especially in contrast to the dark turtle grass beds of the landward reef flat and the deep blue waters of the adjacent lagoon.

The major significance of rsaul in terms of fishing derives from the numerous species that pass here when moving on and off the reef with changing tides. Various reef fish species habitually enter and exit the reef at specific locations along rsaul known as medalachei. These, the prime fishing sites of the reef edge, vary greatly in character. As mentioned previously, some fish transit the reef by way of low routes, through ongeuidel and across rsaul into the embayments called metkerel. Others follow routes over reef edge promentories or protrusions known as metuker. The experienced Belauan fisherman knows the location of many of these routes as well as the times, or tidal levels, that fish can be expected to pass.

The fish routes that cross rsaul are excellent sites for underwater fishing with a speargun or handspear. Certain medalachei offer good spots for the V-shaped kesokes net during spring low tides. There are also good sites for bub, portable fish traps, though traditionally the use of these at rsaul was restricted in the interest of conservation. Beng, stone fish wiers, were also formerly built at some rsaul locations.

PKUL A RSAUL--Pksul a rsaul, or "edge of rsaul," is the dropoff zone at the outer edge of the fringing reef. This is a generally stepp sloping outer face that descends from rsaul into the deep waters of the lagoon. It is not really considered a feature of kereker but instead as a

border between kereker and the lagoon. The upper wall of pkul a rsaul is largely covered with living corals occasionally interrupted by narrow detrital chutes. At lower depths sloping patches of coral detritus and sand alternate with areas of living coral.

The numerous corals and reef crevices at the upper slope of pkul a rsaul provide extensive habitat for numerous fish, making this an excellent zone for underwater spear-fishing. This technique is especially good on changing tides at medalachei when fish move up and down the reef slope along specific routes. The rocky recesses of the upper slope also yield such resources as bukitang (octopus) and cherabrukl (Spiny lobster, Panulirus sp.), while the lower slopes of pkul a rsaul provide good sites for drop line fishing.

DEBOCHEL--Debochel are shallow channels leading across the fringing reef flat from estuarine stream channel mouths. These are geologically relict features originally formed as stream drainage channels during periods of lowered sea level. Today, the major significance of debochel is their use as navigable routes across the reef at low tide. I was not told of any resources or fishing activities specifically associated with debochel, though I occasionally observed cast net fishing here during low tides for mekebud (herring, Herklotsichthys punctatus) and rabbitfish (Siganus spp.). Johannes (1981: 192) also mentions

debochel as a site where female chemang (mangrove crabs) may be found in sandy burrows.

TOACHEL: LAGOON ENVIRONMENTS

The deep water lagoon is known to Belauans as toachel. While the term is generally applied to the entire lagoon area, it more accurately describes only deep waters where no bottom is visible. The toachel provides a major highway for boat travel up and down the coast of Babeldaob, but besides this, it is also a domain for the fisherman, composed of several differentiated features, again, based on the criterion of water depth. Other than toachel, the recognized features of the lagoon are all variations of lagoonal patch reefs, localized reef structures rising to various heights from the lagoon floor (Plate VIII).

The deep waters of toachel are used for trolling for a variety of open water species including tekuu (yellowfin, Thunnus albacares), tekrar (sailfish, Istrophorus platypterus), ngelngal (spanish mackerel, Scomberomorus commersoni), desui (rainbow runner, Elagatis bipinnulatus) and cherobk (big head jack, Caranx ignobilis). Some of these are more readily identified with off reef pelagic environments, however the exceptionally deep lagoon at Ngeremlengui (over 150 feet deep in places), and its direct connection with outer waters via a large intrareef pass (Toachelmlengui) provide a semi-pelagic environment

Plate VIII. Aerial view of toachel, or deep water lagoon, at Ngeremlengui, showing light colored landward patch reefs known as melkesokel.

inhabited by many deep water species. The best times for trolling are on a rising or a high tide since fish are said to rise and fall in the water column in tandem with the tides. At Ngeremlengui, trolling in the semi-protected waters of toachel becomes a more important activity during the annual period (ca. May through October) of onshore southwesterly winds, when rugged conditions make fishing outside the reef impossible.

Another common technique in toachel is drop line fishing. Actually there are two different forms of this depending on the depth of the fishing site. In areas where the lagoon bottom or reef slope is visible omdesakl, or cast line fishing, is used. Hand casting the line away from the boat is claimed to be a protective strategy to ensure that fish will not be threatened by the sight of a vessel immediately overhead. Where the bottom cannot be seen fishermen are not concerned with this and a simple drop line technique, meliod, is used. In either case, preferred fishing sites are areas with significant rock or coral relief since this provides the greatest degree of sheltered habitat for fish. The experienced fisherman knows the location of many such sites even though some lie well out of sight in the deep waters of toachel.

Nighttime dropline fishing is said to often be better on clear moonlit evenings when the lunar light is able to overcome the glow of bioluminescent plankton that tend to accumulate along the submerged fishing line, thus

outlining its presence. While fishermen told me that the glowing line would "spook" their intended prey, Johannes (1981: 54) mentions another problem--that barracuda may mistake the glow for prey and snap the line in an attempt to feed.

MELKESOKL--Belauans differentiate between three kinds of patch reefs within toachel. The first of these is melkesokl, lagoon reefs that rise to within the tidal zone and are located relatively nearer to the fringing reef (Plate VIII). The surface dimensions of these range from a few square yards to approximately 0.5 square miles. The larger of these may have significant depressions on the reef top similar to the uet of the fringing reef flat. These depressions (chiis) are good spearfishing sites.

Unlike other reefs of toachel, portions of the surface area of melkesokl may be exposed during spring low tides and thus offer possible sites for the placement of kesokes nets. The side slopes of melkesokl are similar to pkul a rsaul with extensive fish habitat provided by the living coral cover. Similarly these are good areas for spearfishing and for drop line fishing, using omdesakl near the upper slopes and meliod farther out on the lower slopes.

LUKES--Near-surface patch reefs similar to melkesokl but located closer to the barrier reef are known as lukes

(Plate IX). The difference between the two patch reefs is more than just locational, however, according to Belauans. Lukes are said to be slightly deeper so that they are never exposed at low tide. One effect of this is that the kesokes net cannot be used here. Another difference cited by Belauans is that fish of lukes tend to be larger than their melkesokl counterparts.

In other respects the two reef types are quite similar with lukes offering spearfishing sites as well as good dropline fishing along the outer slopes.

OUMERAR--The third type of lagoon patch reef recognized in the Belauan system is oumerar, submerged reefs that do not approach surface waters but are nonetheless visible. Depth of oumerar vary greatly, from only a few feet to many fathoms below lowtide surface level, but a feature common to all is robust coral growth. Some shallow oumerar can be fished with a speargun, but by far the most common method is dropline fishing.

Belauans identified oumerar as a favored resting site for the mesekiu, or dugong (Dungong dugon), a sea mammal whose numbers have been severely depleted in Belau due to over-hunting. Mesekiu are said to feed at high tide on the roots of a certain turtle grass (char) found on the kereker, and especially on uliul, or mud flats, in the large estuarine bay near the mouth of the Ngermeskang river. After feeding, as the tide falls, dugong are said to go to oumerar to sleep until the tide rises once again.

Dugong were once taken with spears at shallow oumerar sites. Today they are totally protected and are only occasionally seen.

CHELMOLL: BARRIER REEF ENVIRONMENTS

Seaward of the lagoon lies the large and complex barrier reef structure generally referred to in Belau as chelmoll. At Ngeremlengui, this reef is more than a mile wide and exhibits a typical system of biological and morphological zonation that includes seaward algal pavements, rubble and detrital deposits, reef top living corals and extensive sand covered flats.

In the Belauan ethnogeographic system, chelmoll includes the reef top area from the edge of the lagoon, seaward to the outer edge of an algal paved ramp just beyond the zone of breaking waves. Within this area are recognized a series of reef environments and features differentiated according to biological and morphological zonation, water depth, and the common migration routes used by fish. (See Figure 4.)

Reef fish constitute the primary resource of chelmoll, though two important molluscs, the trochus and giant clam, are also collected here.

NGERAUL--Sanded flats and slopes covering the leeward portions of chelmoll constitute the area known as ngeraul.

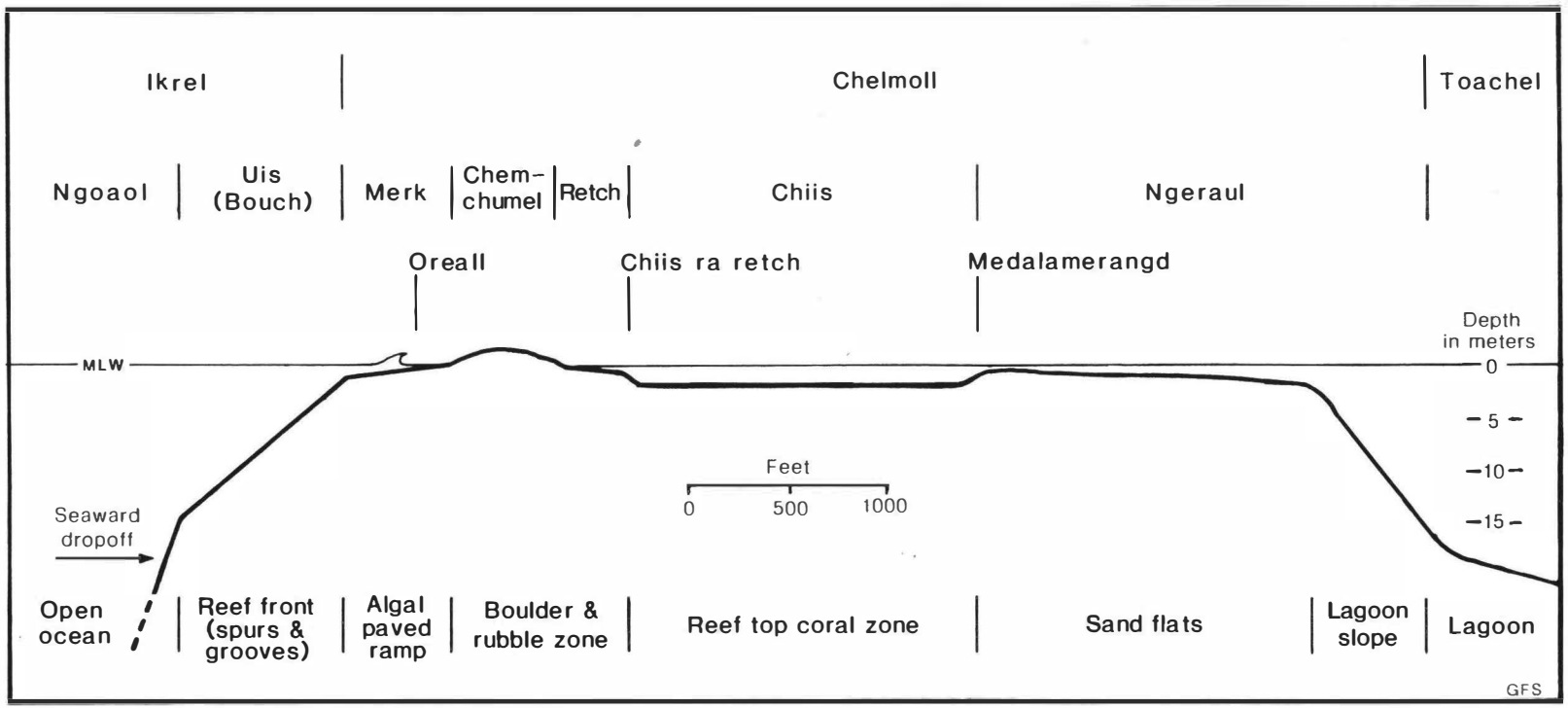

Figure 4. Schematic cross-section of typical Ngeremlengui barrier reef showing relative location of various reef zones.

Plates IX and XI). This is a large zone, in places covering half the lateral area of the reef top, stretching across from the reef flat coral zone and extending down sanded leeward slopes into the lagoon. It is an environmentally complex zone including deep water areas with massive coral colonies, shallow water flats studded with half-buried corals and rocks, sea grass darkened flats, and large monotonous areas of barren sand.

The complexity within the single zone of ngeraul, especially the inclusion of areas of divergent water depth, seems inconsistent with the Belauan marine geographic system that normally discriminates between even minor depth differences. Sand appears to be the obvious defining feature of the ngeraul environment, but I am unsure as to what, if any, resource use rationale may support this as a criterion for the designation of this zone. I quizzed several fishermen about this enigmatic aspect of ngeraul but none knew of an explanation. One older gentleman, however, theorized that when the original Belauans were naming the environments of chelmoll they must have begun on the seaward edge and simply run out of names by the time they reached ngeraul!

Near to the lagoon are the deep water areas of ngeraul where massive coral colonies protrude through prograding sands sloping into toachel. Deeper corals here offer good

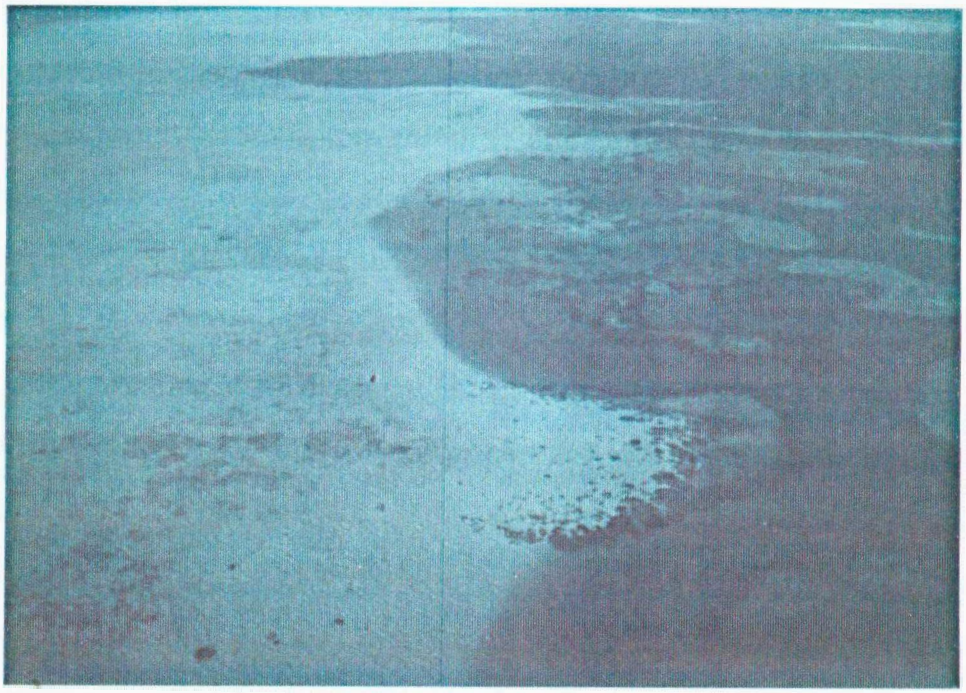

Plate IX. Aerial view of leeward portion of ngeraul, the sanded flats and slope of the barrier reef. Lukes, or seaward lagoonal patch reefs, are visible at extreme right.

sites for omdesakl, or cast line fishing, while those within diving range provide spearfishing grounds.

Between some coral colonies on the upper slopes of leeward ngeraul are occasional sand chutes known as rames (Plate X). These are similar to the medalachei of the fringing reef margin in that many reef fish use rames as pathways when moving on or off the reef flat during changing tides. For this reason, rames are favored sites for bub, or portable fish traps, as well as for spearfishing.

Seaward of the lagoon slope are the shallow water sand flats of ngeraul. Despite the often barren appearance of the area a number of fish species are taken here. Two of the most popular fish caught on the flats of ngeraul are uii (golden jack, Gnathonodon speciosus) and oruidel (jack, Caranx melampygus), both of which come here to feed on small prey at isolated, partially buried coral colonies, and can often be found crossing the sand flats between these coral areas. At high tide, uii and oruidel are caught by trolling and casting. Both can also be taken with an iebed net, a long surround net used to encircle the fish.

A thoroughly modern style of fishing known as oltoir is played out on the sand flats of ngeraul. Oltoir literally means "to chase," which is a very apt description of this high speed fishing technique. Cruising through

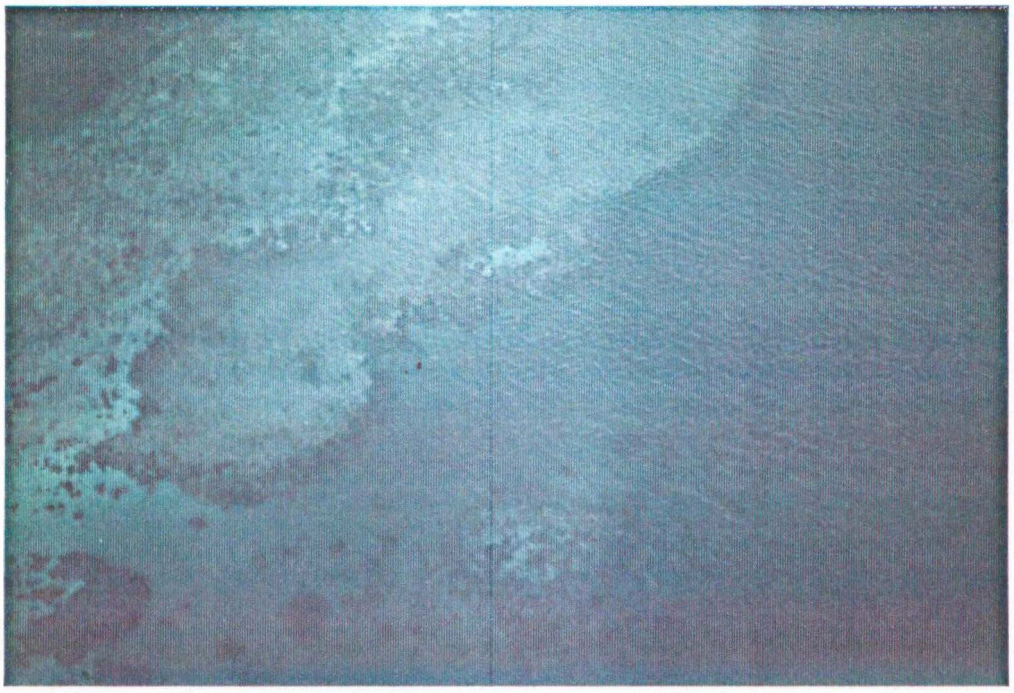

Plate X. Aerial view of coral colonies along the leeward slope of ngeraul, the sanded portion of the barrier reef. Sand chute at lower left is a rames, a frequently traveled route for many fish moving on and off the reef with changing tides.

ngeraul in a preferably high powered motorboat, a team of fishermen search the water for any large reef fish crossing the sand flats. When one is spotted a high speed pursuit begins, with the driver of the boat guided by a spotter standing at the bow. The fish is chased until it seeks refuge at one of the buried coral colonies of ngeraul, at which point one or more of the fishermen, armed with a speargun, leap from the moving boat and search the coral crevices for their hiding prey while the boat continues to rapidly circle the area, discouraging escape. Given the price of gasoline, oltoir is hardly a cost effective method of fishing, but is nonetheless greatly enjoyed, especially by young fishermen.

MEDALAMERANGD--At the seaward edge of ngeraul is medalamerangd, the border between the sand flats and the living coral zone of the reef top. Medalamerandg, literally "front of coral," is a highly visible line with the bright sands of ngeraul contrasted by the dark bordering corals (Plate XI). This is the only reef feature that is differentiated according to purely visual criteria. The term medalamerangd technically refers only to the borderline of the two reef top zones, but it can be more loosely applied to the general border area.

Many reef fish pass through medalamerangd when moving between the reef top coral zone and deeper waters beyond ngeraul. Because of this, bub, the portable fish traps,

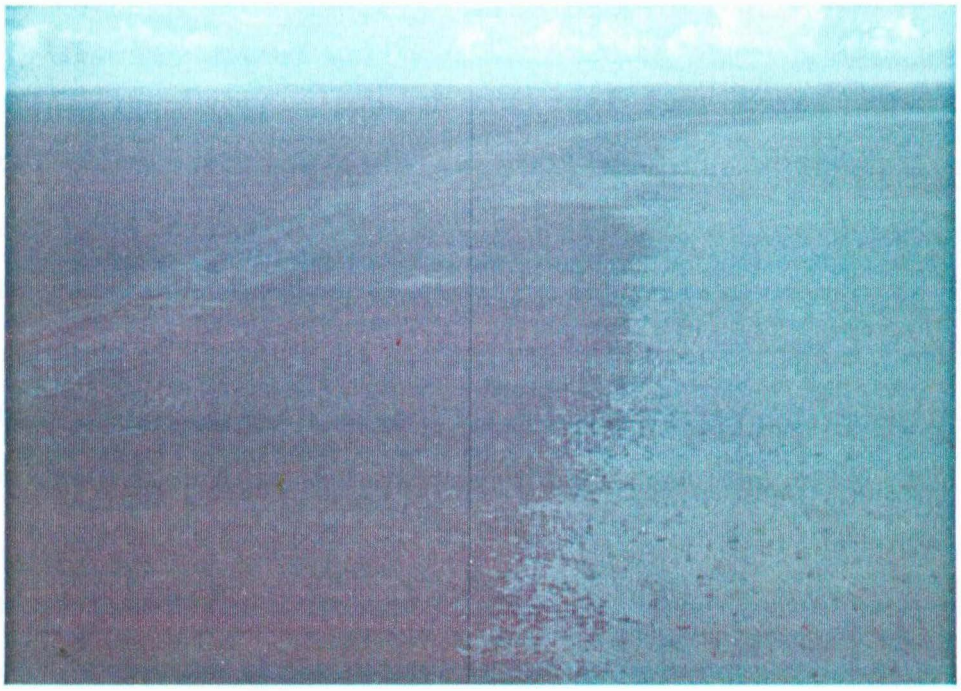

Plate XI. Aerial view of barrier reef showing medalamerangd, the highly visible borderline separating the sand flats of ngeraul and the dark coral areas of chiis.

are often placed here. The best locations for bub are on sandy bottomed sites among the coral patches just seaward of medalamerangd. According to fishermen, the top of the trap must be no higher than surrounding corals or fish will be reluctant to enter. The movement of many fish through medalamerangd also provides good spearfishing.

CHIIS--Depressions on the reef flat coral zone that retain water at low tide are called chiis. These are large areas of varying but generally minor low tide depth separated from one another by small reef rises, known as delul a merangd. Because of constant water cover chiis exhibits robust coral growth, predominantly of branching varieties but with globose, and microatoll forms also present.

Chiis is one of the most important environments of chelmoll for the Belauan fisherman. The extensive coral cover provides shelter and habitat for numerous fish, some of which remain here even through periods of low tide. Chiis are similar to the uet of the fringing reef, offering concentrated pools of fish in contrast to the exposed reef top areas.

The many fish of chiis make this a productive area for spearfishing. Sometimes on falling tide a iebed net is used to surround an area of fish within the chiis. As the water level continues to fall to its lowest point it becomes easy to spear the fish corraled within the net.

Nighttime fishing is especially good in chiis since many fish are inactive at night and seek sheltered resting sites among the corals and rock crevices. With an underwater flashlight, fishermen search for sleeping prey which are then easily dispatched with a speargun or handspear. This method is easiest at lowtide and is best on dark nights as many fish are more active during periods of moonlight. Using this method, fishermen are able to take large catches in a short time, so this is a very profitable form of fishing. It is not unreasonable, however, to speculate that commercial harvesting in this manner might eventually have serious impacts on the fishery stocks of chiis.

Another important resource found here is the otkang, or giant clam (Tridacna spp.). These beautifully colored clams are a favored treat for some Belauans; especially liked is the large central muscle which is often sliced and eaten raw. Easily harvested from the coral beds of chiis, otkang were traditionally conserved for use at feasts or during times of storm when fishing was more difficult. Today they are harvested much more often and are sometimes the focus of commercial exploitation for sale through the wholesale market in Koror.

RETCH--Seaward of chiis is a mixed zone of barren reef rock and coral rubble known as retch, sometimes also

referred to as debeaut. Retch lies immediately leeward of the major reef rubble zone known as chemchumel (see next section), and separates this area from the reef flat coral zone of chiis. A generally shallow zone with only a few small living corals present, retch varies in surface texture from roughly pitted, algal covered limestone with scattered reef rock rubble to a carpet-like cover of small broken coral detritus. It is actually a leeward extension of the main rubble zone, but with thinner deposits and smaller sized wave-tossed material (Plate XII).

In some places along the leeward edge of retch, shallow depressions, actually seaward lobes of chiis, protrude inward providing areas of living coral. These features, known as chiis ra retch, offer the best fishing sites of the retch zone, of which Belauans consider these a part despite the more direct physical continuity with chiis. Chiis ra retch are shallower and exhibit less coral growth than more leeward portions of chiis, but some fish nonetheless seek shelter here through low tides. As with chiis, these are areas best suited for either speargun or handspear fishing.

Spearfishing is also used in other portions of retch though this zone is not considered particularly productive. A few herbivorous fish species come here at high tide to graze on coralline algae, and some fish can be found sheltered among the scattered reef rocks. Still, the

Plate XII. Young Belauan fisherman in the leeward rubble zone of retch. Note the smaller size of rocks and debris as compared with the main rubble zone of chemchumel (Plate XIII).

majority of fish found in retch are there only during changing tides while in transit between the inner reef flat and deeper reef front waters. Fish migrations here are not as predictable however since routes tend to be more random, perhaps because the reef floor in retch does not provide many distinctive features, such as depressions or channels, usually associated with fish pathways.

CHEMCHUMEL--Beyond the retch, and just inside the zone of breaking waves, is chemchumel, an area composed of wave tossed rubble, rocks and large boulders (Plate XIII). This is a discontinuous outer reef zone that ranges in width from 50 to 200 feet and is the highest zone on the reef top, often at least partially exposed at low tide. In addition, chemchumel is the site of scattered very large reef rocks (chiloil) that rise above even highest tidal levels and have traditionally served as important landmarks used for locating specific reef sites and fishing grounds.

One of the principal resources of chemchumel is semum, or trochus (Trochus niloticus), a conical mollusc annually harvested for export markets. Because of past overharvesting the collection of trochus is today legally restricted to a short summertime season in Ngeremlengui, thus limiting the product's once important value. The trochus season is nonetheless greatly enjoyed by many

Plate XIII. View of chemchumel, the main rubble zone and highest part of the barrier reef. The wave and wash zone, oreall, is shown at right.

villagers for it is a time of good weather and calm sea, perfect for family picnics and excursions to the outer reef where even small children can join the collecting efforts during the extreme low spring tides of summer. At such times, the trochus shells, which are sold for use in the manufacture of buttons and jewelry, are easily collected on and among the exposed rocks of chemchumel.

During neap low tides when chemchumel is only partially exposed, reef fish can be found in the shallows among the rocks. Fishermen work their way through the zone on foot, taking fish with a multi-pronged spear called taod. Cherabrukl (spiny lobster) are also found among the rubble of chemchumel.

MERK--Seaward of chemchumel is a wide algal covered flat known as merk. This gently seaward sloping ramp rises from the crest of the reef front up to the rocky zone of chemchumel (Plate XIV). Merk is the reef zone that receives the brunt of ocean wave energy, with a breaker belt located on the upper portion of the ramp. The area of breaking waves, and especially of the wave produced foam, is known as oreall, the shallowest zone of merk (Plate XIII).

Though generally flat surfaced, there are scattered depressions or holes found on merk. These are not natural features according to the older fishermen, but are the

result of fishing with dynamite charges, using the explosives to stun fish in the general vicinity of the blast. Although dynamite fishing is still occasionally, though illegally, used in Belau, fishermen say that most of the craters at merk were produced during World War II when the extensive use of dynamite for fishing was encouraged by hungry Japanese soldiers. These holes provide some of the only suitable habitat for small coral growth on merk.

Merk offers productive fishing, especially for a number of herbiverous species that feed on umd, the encrusting coralline algae covering the reef surface. Common fish taken here include chum (unicornfish, Vaso unicornus), cherangel (orangespine unicornfish, Naso literatus), chesengel (surgeonfish, Acanthurus mata), chotord (parrotfish, Scarus gibbus), ngiaoch (parrotfish, Scarus harid) and komud (rudderfish, Kyphosus cinerascens).

At times, large schools of fish feed on the reef surface of the merk, grazing head-down and signalling their presence with up-raised tails that break the water surface in the troughs of passing waves. These fish are best taken with a iebed net, used to surround the feeding school. Fishermen say that schools of grazers found on the merk today are smaller than in former years, probably because of more intense fishing pressure. Sizable schools nonetheless still exist. I witnessed a three-man iebed operation

on the merk that netted over 600 pounds of chum in less than two hours.

Some fish prefer to feed in oreall, the zone of breaking waves and foam on the upper ram of merk. The iebed net can be used here as well as the bidekill, or cast net. Belauans are wary of fishing here at low tide, however, because this is the tie that chai, or barracuda (Sphyraena barracuda) come into feed in this white water zone. These carnivores have been known to attack the moving feet of fishermen working in oreall.

MEDOBECH--Not a zone, but an important reef top feature, is medobech, shallow, often sandy bottomed channels that lead off the reef flat into deeper water. Medobech pass through the rocky zone of chemchumel (Plate XIV) and also are well developed on the reef top edges along toachèlmlengui, the deep intrareef channel connecting the lagoon at Ngeremlengui with the outer ocean. Here, the medobech form narrow sandy corridors through the higher living coral zone.

The importance of medobech derives from their use as pathways by fish moving on and off the reef. Similar to the rames of the leeward sandy slope and the medalachei of the fringing reef margin, medobech provide the experienced fisherman with excellent and predictable sites for productive spear and net fishing.

Some of the first fish to move up through medobech on an early rising tide are small reef sharks seeking prey in the shallow channel waters. At such times it is not unusual to have sharks pass practically underfoot while walking on the reef flat. These sharks can be easily speared, but in general sharks are not a popular food fish in Belau, and are usually ignored.

IKREL: OUTSIDE REEF ENVIRONMENTS

The barrier reef domain of chelmoll ends at the seaward edge of merk, where the reef begins to slope down into the deep waters of the outer ocean. The entire area from the reef crest to beyond the horizon is known as ikrel, literally meaning "outside." Within the domain of ikrel there is but a twofold division of environments, the visible upper reef slope and the open ocean. These are discussed in the following sections.

UIS--The upper slope of the reef front, from the reef top edge down to the crest of the steep seaward dropoff, is uis. This is a zone of vigorous coral growth over a typical "spur and groove" system of alternating ridges and channels known to Belauans as bouch (Plate XIV). The robust corals and surge channel butress morphology of uis reflect the high energy nature of the reef front zone. This is also reflected in the plentiful and varied resources exploited here by Belauan fishermen.

Plate XIV. Aerial view of various zones on the outer portion of the barrier reef. The light colored band extending diagonally across center of photo is the algal paved ramp, merk; to the right are the rubble zones, chemchumel (site of grounded ship) and retch (site of navigation marker (sandy channels through chemchumel are medobech); the dark area at right is the coral zone, chiis; at left is the striped zone of uis, with the alternating dark coral ridges and sandy bottomed channels of bouch; the dark area at extreme upper left is the deep ocean zone, ngoaol.

Numerous large fish, both reef fish and pelagic types, are taken at uis using a variety of fishing methods. Reef fish are hunted with spearguns at low tide among the corals of uis. The best spearfishing sites are in the channels of the bouch where many fish move up and down the reef front slope. Older fishermen say that prior to the introduction of the speargun shortly after World War II, Belauans used a special long handled spear (chorus), up to 20 feet in length, for taking fish in the channel bottoms while holding on to overhead corals or rocks on the ridges of the bouch. They claim that, many times, more than one fish could be impaled with a single thrust of the spear. Today, Belauans use modern style spearguns built with local wood and scrap parts.

The most productive spearfishing is at night when numerous reef fish are inactive and can be found sleeping in the uis. Some fish, such as kemedukl (bumphead parrotfish, Bolbometopon muricatus), prefer to rest in the channels of bouch and offer easy targets for the night fishermen. In addition, many fish sleep among the corals on the sides and top of bouch ridges but will often retreat to the channel bottom when startled by a fisherman's flashlight. Teams of fishermen take advantage of this behavior with some working the ridges to "drive" fish to the channel bottom where others can easily spear them.

Precautions are taken when spearfishing in uis at night because of sometimes numerous sharks. For example, fishermen aim carefully in an attempt to kill their prey instantly so that the fish will not fight against the spear and attract sharks with their struggle. They also attempt to remove speared fish from the water as soon as possible. It is nonetheless sometimes necessary to change fishing sites in uis because of sharks. Older fishermen claim that sharks have become more of a problem since the introduction of the underwater flashlight. They say that fewer sharks were attracted previously when a torch or lamp was used above the surface to illuminate an area of water in which several divers could work.

Uis also offers productive trolling for a variety of fish including chai (barracuda, Sphyraena barracuda), ngelngal (spanish mackerel, Scomberomorus commersoni), keskas (wahoo, Acanthocybium solandri), chersuuch (dolphinfish, Coryphaena hippurus), cherobk (jack, Caranx ignobilis), desui (rainbow runner, Elagatis bipinnulatus) and tekuu (yellowfin, Thunnus albacarus). Trolling at uis is best on a calm day at high tide when water conditions are clear. In addition, a number of fish can be caught at uis using dropline methods.

Another important resource here is uel, or sea turtles, including melob, or green turtle (Chelonia mydas), and ngasech, or hawksbill (Eretmochelys imbricata). These

turtles are wide ranging in their habits, often moving to reef top flats at ngeraul or kereker at high tide where melob feed on turtle grasses and ngasech eat rurot, a type of holothurian. At low tide the turtles return to deeper water in the lagoon and at uis where they may rest on the bottom until the next high tide. Fishermen say that turtles at uis are more numerous and are the largest to be found so that today this is the best site for turtle hunting. Previously, preferred sites were on the kereker and in lagoon waters but due to over-hunting, turtles are no longer numerous in these more accessible areas. Over-hunting is a problem despite a number of laws regulating the harvest of sea turtles. The main problem is a lack of enforcement though Belauans say this was not the situation during prewar years under the Japanese administration when seasons and size limits were vigorously enforced and turtle populatons were much more stable.

Uis is also considered the best site for collecting cherabrukl (spiny lobster), which are found secreted in recesses and crevices of the reef rock. Significant yields of trochus are also taken at uis.

NGOAOL--The open ocean beyond the barrier reef is known as ngoaol. Traditionally, Belauan fishermen have been least familiar with this zone since most fishing needs have always been met within the more productive and varied

environments of the reef and lagoon ecosystems. Ngoaol nonetheless provides trolling grounds which have been used, though not intensively by Belauans. Of course ngoaol is more accessible today with modern motorized boats, though fishing here is costly in terms of fuel.

Fish species of ngoaol are more diverse close to the barrier reef, with all those trolling species mentioned under uis also found here. Farther out, catches are limited to such pelagic species as katsuo (skipjack tuna, Katsuwonus pelamis) and tekuu (yellowfin, Thunnus albacarus).

Of course, fishing close to the reef is preferred, but when water clarity there is poor, better conditions are often sought farther out. Again, the best fishing is said to be on a rising or high tide, when fish move up in the water column to feed.

III. NGKLEL A CHEI: REEF AND LAGOON PLACENAMES

In addition to the above described system of marine environments there is a related set of placenames that are assigned to specific areas and features throughout the reef and lagoon system. These placenames augment other aspects of marine ethnogeographic knowledge by providing the detail necessary for reckoning and specifying marine locations.

Placenames exist for a wide variety of features, from large reef top areas to individual submerged rocks. In mangrove areas named features include individual ongduoll, taoch and demetaoch, sections of kebokeb, and prominent points along the seaward border of the forest. On the kerekęr individual uet are named, as are prominent reef edge configurations, and individual medalachei. Deep water fishing grounds in the lagoon also bear specific names, as do all lagoonal patchreefs. Similarly, on the barrier reef placenames exist for reef edge features, areas along the reef front, prominent rocks in chemchuml, and reef top areas such as chiis.

Perceptions and events from a culture's past are often reflected in the placenames of an area and this is true for the marine areas of Belau. In the waters of Ngeremlengui some placenames preserve names and events

that may otherwise be long forgotten. For example, a particular barrier reef front area is known as Omruchel ra Adelbeluu, or "Adelbeluu's spearfishing site." Although no one I spoke with in the village could readily remember who was Adelbeluu, numerous fishermen know exactly the place that was his favored fishing site.

Other reef features are named for their obvious shapes, such as the reticulate lagoonal reef called Bersoech, or "snake," and the reef edge rock Tolukelbad, named for its resemblance to tokul, ceremonial women's plates crafted from turtle shell. Still other placenames derive from observed resources, such as the lagoonal reef cluster Blil a Meai, or "home of barracuda."

Today, numerous reef and lagoon placenames at Ngeremlengui have become enigmatic, their origins and meanings lost to time and linguistic change. On the other hand, new placenames are evolving. For example, an area on the kereker at Ngatpang State, south of Ngeremlengui, is today called Deram, adopted from English and named for an abandoned oil drum on the reef flat.

The real functional value of reef placenames derives from their use as aids for navigating and locating specific resource sites. Formerly, Belauans used triangulation techniques with known visible reef features and island landmarks, during day or night, to locate specific areas throughout the reef and lagoon systems, including deep

water fishing grounds. Today, the need for such elaborate knowledge has been somewhat eliminated by a system of modern navigation markers erected on a number of Ngeremlengui reefs. Still, placenames continue to play an important role by providing more exacting detail for locating specific reef and lagoon places.

Although most fishermen are familiar with many reef and lagoon placenames, extensive knowledge of these is held by only a few of the older men. Even these experts can no longer recall placenames for a number of areas, especially in the deep water lagoon zone. Some placenames have thus been irretrievably lost, and there is the possibility that many others will be lost with the passing of the current older generation in Belau. This would be unfortunate for although these names hold perhaps only limited functional value in the eyes of many young Belauans today, they nonetheless represent part of a rich cultural imprint on the seascape of Belau. Appendix A includes a key map and list of some 125 marine placenames collected during my fieldwork in Belau. This represents but a partial list of placenames from the waters of Ngeremlengui.

IV. DISCUSSION AND CONCLUSIONS

The previous sections have described the geographic system of marine environments and features as perceived by Belauan resource users. Each of the environments is geographically distinct and is associated with specific resources and resource strategies. Also described is a system of marine placenames that serve to further distinguish reef and lagoon features and places. This ethnogeographic system of perceived environments and associated resource knowledge form a practical body of information that facilitates successful resource exploitation.

The various marine environments of the Belauan system are differentiated according to ecological criteria that define different resource habitats and determine the location of resources. The primary criterion for environmental differentiation is water depth. Indeed, Taurengel, one of the elders I interviewed, when speaking of the Belauan ethnogeographic system, never used the concept of marine environments or zones, but instead spoke only of "different levels of the sea." Levels of the sea, or water depth, is of course, a reflection of reef and lagoon topography, and it is this that is the most basic, though not the only, factor underlying Belauan marine environmental differentiation. For example, depressions in the reef

top flat create permanent reservoirs that support coral growth and provide distinct habitat for particular resources. Topography is also important in determining the routes of fish movement on and off the reef during changing tides, thus accounting for the importance of such features as ongeuidel.

Topography does not account for the differentiation of all environments. For mangrove areas the most important factor is one of access to resources which is often made difficult by the impenetrable nature of mangrove forest. And there is also the complex environment of ngeraul, where sand cover appears to be the distinguishing criterion, but for reasons that remain enigmatic.

However differentiated, these environments are part of a very functional and practical system that combines knowledge of the various geographic zones and features with knowledge of resource behavior and habits to provide the resource user with a basic locational blueprint for determining sites and strategies. In essence, the system partitions the marine environment into distinct segments; each with particular physical characteristics and resource associations. And it is a flexible system that serves the needs of resource users from several different perspectives. It may be used to locate sites for the exploitation of specific desired resources, to determine the resources available at a specific site, or to determine

appropriate strategies and techniques for exploiting the resources of a particular site. In this way, the Belauan marine ethnogreographic system serves as a functional interface between people and the resources of the marine environment, and thus is a key to understanding how islanders are able to so successfully and consistently locate and exploit marine resources.

Despite its considerable functional value, marine ethnogeographic knowledge is no longer widely known and used in Belau. Older resource users still view the environment according to this traditional scheme, but the system is little understood by most young people. This is due in part to lack of experience with age, but probably more so to the changing social institutions and values in Belau. Young people, educated in public schools, no longer spend much time in tutelage with their elders learning the traditional ways and knowledge of Belauan culture. The result is a sort of culture gap that, among other things, threatens the survival of cultural knowledge that has been accumulated and passed down for many generations, but today is only known extensively by elders.

The passing of island knowledge such as that outlined in this thesis would be unfortunate from several perspectives. For instance, if commercial harvesting of marine resources intensifies, fishery stocks may well decline, especially in more accessible or easily exploited reef

environments. A sensible response to this might be to exploit an expanded range of environments and resources in order to spread harvest efforts and impact more evenly throughout the nearshore ecosystem. The application of marine ethnogeographic knowledge would be of obvious value for this.

Another argument for preserving traditional marine knowledge derives from its potential contribution to informational needs for tropical marine resource management. Coral reef fisheries are exceptionally diverse and as yet little understood, such that they "present biologists with the most complex fisheries management problems in the world" (Johannes, 1981: x). The detailed natural history and biological information known to the experienced inland resource user has much potential for helping to bridge this information gap that plagues reef resource managers. In addition, marine ethnogeography offers insights into the realities and patterns of resource use that may help to understand the "context in which biological information may best be employed in managing [resources]" (Johannes, 1981: 77). Marine ethnogeography also holds potential benefits for remote sensing applications such as for coastal zone management or resource assessment. And aside from its functional values, Belauan marine ethnogeography represents part of a rich cultural heritage that deserves

to be preserved if for no other reason than its historical and cultural benefits for future generations in Belau.

Belauan marine ethnogeographic knowledge is not in danger of total loss however, for its essentials are at least known to several young fishermen who today provide for their families and earn their livelihood with the resources of the sea. What is often lacking, however, is the depth and detail of knowledge that is now held by relatively few older resource users. The ethnogeographic information in this thesis is merely a scratch on the surface of what is known by those remaining experts in Belau; to fully record that knowledge would no doubt take many years and fill many volumes, and would be a job best carried out by interested Belauans.

It was my experience during the course of fieldwork that when young Belauans were present during discussions or interviews they often expressed a sincere interest and pride in the traditional knowledge of the elders, knowledge that they had apparently been little exposed to previously. It would be very appropriate if some of these young people would follow that interest and pride by taking up the study of traditional marine lore in order to record and make the knowledge available to others. A possible way to encourage this would be through a program, supported by local government or some other interested agency, to sponsor young Belauans to act as local "ethnogeographers," working

with elders, learning and recording traditional environmental knowledge and science.

It would also be appropriate if schools in Belau could incorporate such things as local geographies and marine and other environmental lore into the school curriculum. At Ngeremlengui the local school already offers a "Belauan Culture" program through which students learn crafts from knowledgeable members of the village. Such a program has much potential, but in its present state is somewhat limited. As Humio Kyota pointed out, the crafts that are taught, spear- and basket-making, are still so common in the village that students might easily learn these at home, yet there are numerous other aspects of Belauan culture, often less tangible than spears or baskets, that are no less valuable for young Belauan students to be exposed to. An expansion of the range of topics in a "Belauan Culture" school program would be a good way to bring together young people and elders to share traditional skills knowledge, and values. Programs such as those suggested here could be an excellent means for preserving, disseminating, and building on traditional lore, thus helping to ensure the continuity of the valuable cultural knowledge that until now has served Belauans so well.

APPENDIX A

NGEREMLENGUI MARINE PLACENAMES

(Refer to Figure 5 for the location of the following numbered placenames.)

1. Klairamasech
2. Chiss ra Meaiua
3. Chiis ra Bersoech
4. Chiis ra Meaiua
5. Meaiua el Chiloil
6. Tekerekl
7. Chiis ra Tekerekl
8. Omruchel ra Adelbeluu
9. Chiis ra Omruchel ra Adelbeluu
10. Ngetcheiuel
11. Chiis ra Ngetcheiuel
12. Mecherong
13. Chiis ra mecherong
14. Sond
15. Choikeam
16. Chiis ra Choikeam
17. Chiis ra Sond
18. Ngerutetachel
19. Choiiull
20. Bersoech
21. Telchelel a Bersoech
22. Choirakl
23. Lukes Metal
24. Metkerel ra Besebes
25. Mokemedukl

26. Chodekel
27. Lukes Ngiraumuei
28. Oruelukes
29. Bechebuch
30. Chedelchudech
31. Osmochel Bul
32. Tolukelbad
33. Isaius
34. Tngerulakerdeu
35. Telchelel Osmochel Bul
36. Toachelmlengui
37. Tmolcheumes
38. Ieisb
39. Tngerulachang
40. Lemolm
41. Kaeb
42. Eouelmetuker
43. Telchelel Ngetngot
44. Ngetngot
45. Miich
46. Ngedeb
47. Butelcherei
48. Maclelcherei
49. Ngerkiuongel
50. Chiss ra Ngerkiuongel
51. Ngellik
52. Medes
53. Ortelebudel
54. Kloulukes
55. Metengel a Did
56. Mochiuis
57. Badeluel
58. Lusech
59. Mesakt

60. Lemau ra Mesakt
61. Bablobaus
62. Eoulobaus
63. Telchelel Ngetbungel
64. Chongermedochel
65. Lukesuruidel
66. Uchidalech
67. Mokad
68. Ngersengauol
69. Tenget Remeduu
70. Ngesbasech
71. Oriaul Libuchel
72. Hngerulamochol
73. Oleuang
74. Uchuu
75. Chiis ra Uchuu
76. Ngemolei
77. Lukesrachouais
78. Blilameai
79. Kesbelau
80. Ngkesetchouais
81. Chulubuli
82. Uet ra Ngesuch
83. Ngesuch
84. Taoch ra Ngesuch
85. Kuat
86. Kirs
87. Uet Ochadua
88. Uet Lukesbad
89. Uet ra Tkulabad
90. Metkerel Ngaratiruu
91. Bechorsauol
92. Uet ra Bkau
93. Metkerel Obuokel
94. Utoi

95. Ngetbengul
96. Uet ra Tubechad
97. Uet ra Rderoech
98. Sebungel
99. Uet ra Sebungel
100. Metkerel Rechucher
101. Metuker Rechucher
102. Omdiil Meas
103. Kereker ra Pkulangril
104. Lemau ra Ngetaoch
105. Kereker ra Tuchosn
106. Ongduoll ra Todai
107. Uet ra Sechelas
108. Ongduoll ra Omuadelruul
109. Ongduoll ra Obuokl
110. Ongduoll ra Ebei
111. Ongduoll ra Ngeluong
112. Kereker ra Aiuns
113. Metkerel a Esau
114. Metkerel Omoachel
115. Uet ra Esau
116. Uet ra Oaul
117. Omeklusech
118. Uas
119. Kereker ra Ngesbokel
120. Kereker ra Uchulameradel
121. Kereker ra Lild
122. Metkerel ra Uchuraksid
123. Metkerel ra Tukeermiich
124. Uchuraksid
125. Ngermeduu

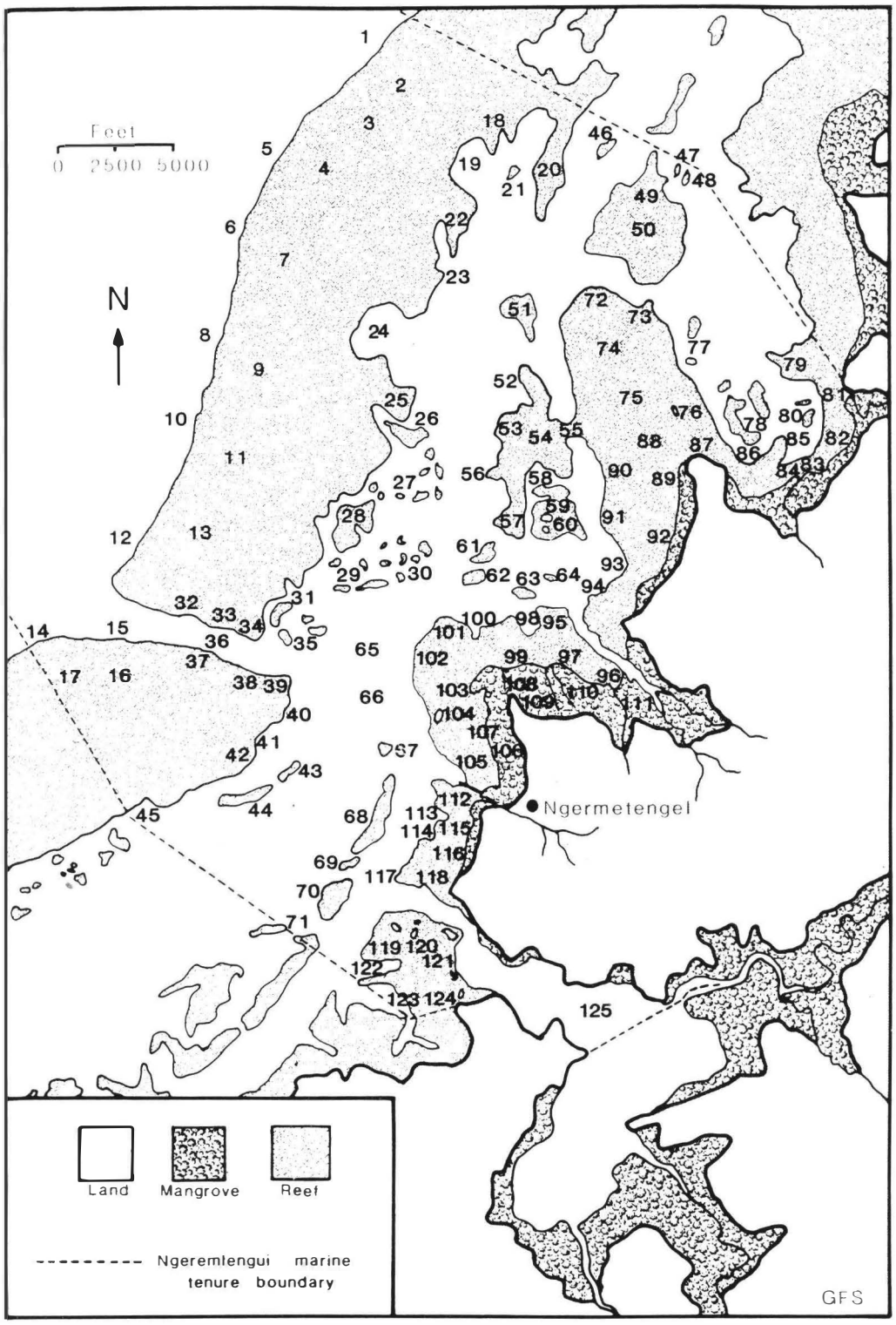

Figure 5. Map showing the location of Ngeremlengui marine placenames listed in Appendix A.

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