BACKYARD FISHING

ON THE

SOUTH COAST OF MOLOKA'I

A THESIS SUBMITTED TO THE GRADUATE DIVISION OF THE
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By

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ABSTRACT

On Moloka'i, the ways and means by which a community of local islanders defray the costs of everyday living center around the methods and technologies they employ for harvesting fish of the local nearshore zone. This thesis is an empirical examination of Moloka'i fishermen's activities in the nearshore coastal zone. It is a human-geographical study based on personal observations and participation in the fishing activities and life experiences of fishermen. It presents a series of alternate community-derived nearshore management strategies offered as options for enhancing current State fisheries regulations.

This work documents the management and use of local Hawaiian fisheries through careful examination of the personal actions, expertise, and beliefs of fishermen. It is at once a record of the special local fishing practices and management activities and a survey of a rural community's perceptions of and ideas about the future use and maintenance of fringing reef fisheries of Moloka'i. It is intended to provide insights into the subtle connections between human behavior and one facet of the relationship to the physical environments within which rural Hawaiian fishing communities create a livelihood.

This is an account of the actions and ideas of a community of fishermen whose contribution to our understanding of the coastal zone has been largely ignored in modern times. Therefore, it is the purpose of this work to: a) increase the small body of contemporary research based on local knowledge about the use and management of tropical nearshore seascapes, b) gather a body of information to complement existing studies based on the personal knowledge and experiences of a community of Hawaiian island fishermen, c) encourage community participation in scientific research projects and decision making, and d), to build a record of the special fishing and resource management techniques used to sustain a rural lifestyle that seems to be rapidly disappearing.

We know quite a bit about global geography but very little about local geographies. Every society has local geographers and geographies, mostly unknown beyond traditions that bind and separate. To become better global geographers we need to become better local geographers.

- B. Q. Nietschmann

Ed and Diane

Table of Contents

List of Illustrations

List of Illustrations (continued)

Chapter 1

INTRODUCTION AND BACKGROUND

Geographical Setting

Moloka'i is the fifth largest of the major Hawaiian island group with an area of approximately 261 square miles (Figure 1). It's roughly rectangular shape results from the coalescence of two separate shield volcanoes. In the west Puu Nana reaches an elevation of 1,381 feet and dominates a dry scrub land environment. Eastward, the younger and deeply dissected shield mountains rise to an elevation of 4,970 feet at Kamakou peak.

The eastern rainforests offer stark contrast to the relatively barren drylands to the west. In the northeast, the three spectacular amphitheater-headed valleys of Pelekunu, Wailau, and Halawa lie between ridges that rise from coastal seacliffs to over 3000 feet. At the center of the northern coast lies the Kaulapapa peninsula, a basaltic shield volcano originating from the Kauhako crater.

To the south lies a coastal plain composed of the sediments carried down from the upland shield areas. It lies within a narrow strip of coastline comprised of colluvium, alluvium, sand, mudflow, and organic deposits. Keawe, saltbush, and red mangrove thickets cover the coastal strand along the water's edge.

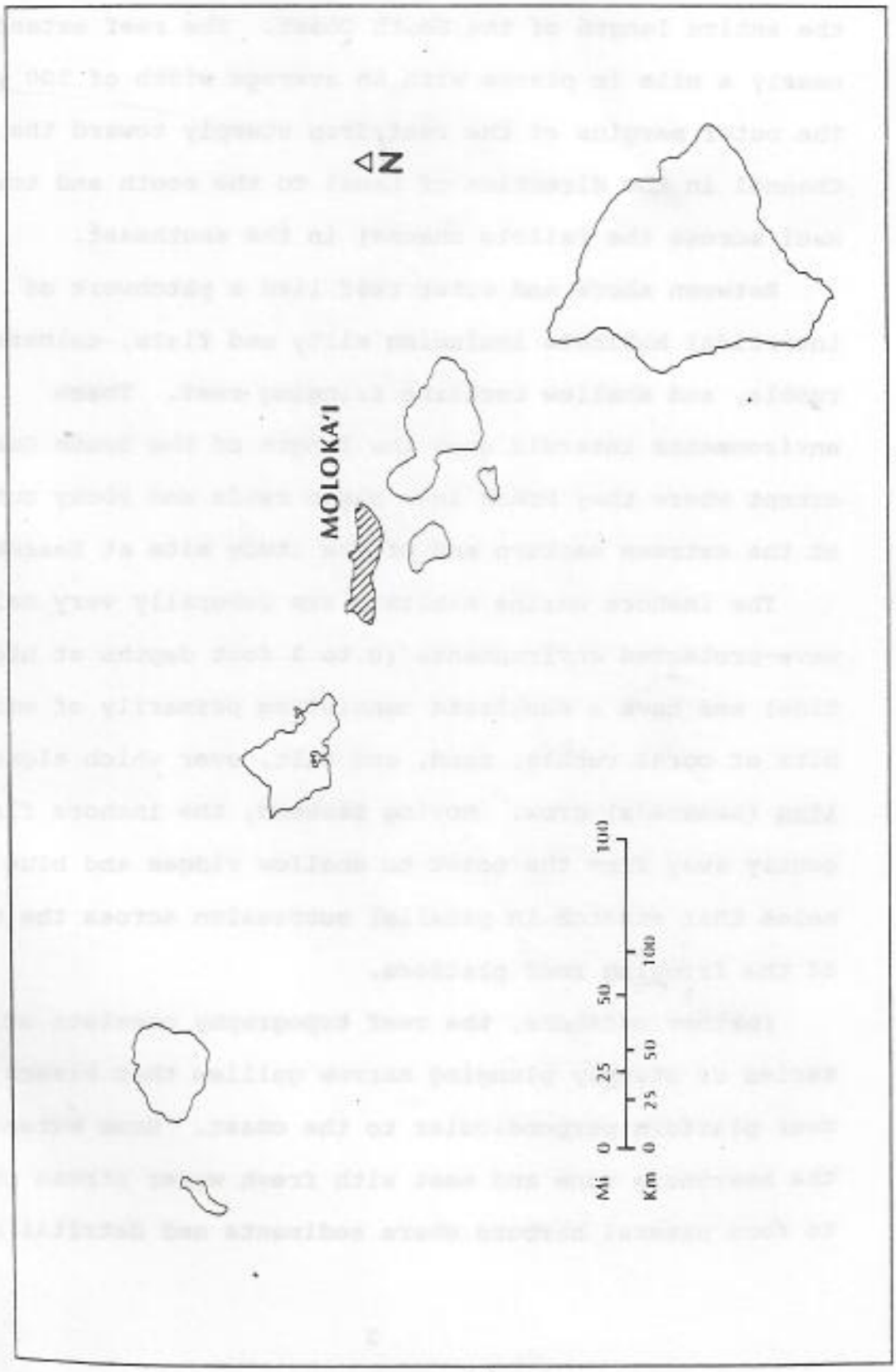


Figure 1 - The Hawaiian Islands

Seaward, a broad band of fringing reef extends beyond the entire length of the South Coast. The reef extends nearly a mile in places with an average width of 500 yards. The outer margins of the reef drop steeply toward the Kalohi Channel in the direction of Lanai to the south and toward Maui across the Pailolo channel in the southeast.

Between shore and outer reef lies a patchwork of intertidal habitats including silty mud flats, calcareous rubble, and shallow coraline fringing reef. These environments intermix over the length of the South Coast except where they break into patch reefs and rocky outcrops at the extreme eastern end of the study site at Keaina bay.

The inshore marine habitats are generally very calm, wave-protected environments (0 to 3 foot depths at high tide) and have a substrate consisting primarily of small bits of coral rubble, sand, and silt, over which algae, and limu (seaweeds) grow. Moving seaward, the inshore flats dip gently away from the coast to shallow ridges and blue holes that stretch in parallel succession across the center of the fringing reef platform.

Further offshore, the reef topography consists of a series of steeply plunging narrow gullies that bisect the reef platform perpendicular to the coast. Some extend into the nearshore zone and meet with fresh water stream channels to form natural harbors where sediments and detrital debris

are deposited. Along the coastal strand, coconut groves, housing developments, and ancient Hawaiian fishponds point to the location where intermittent streams and underground freshwater springs create brackish inshore waters.

The marine fauna of the South Coast is typical of tropical species found to the west and south of the Islands of Hawaii. Biologically diverse, Hawaiian reef species are uniformly represented throughout the island chain. At a generic level, these fish exhibit very little endemism but considerable differences at the species level. This is largely due to the free swimming larval stages of the majority of Hawaiian faunal species, and the homogeneity of environmental conditions in the State's coastal marine habitats.

The Socioenvironment

Publicly and privately owned lands and fishponds are distributed in an irregular pattern among the small coastal settlements of Kaunakakai, Kawela, Kamalo, Ualapue, Kaluaaha, Pukoo, and Wailua. The largest and most noteworthy settlement within the region is the town of Kaunakakai. Developed during the 1920's and 30's, it originally provided housing and services for the island's pineapple workers who labored on the now diminished Del Monte plantations at the western end of the island. With a

population exceeding 1000 individuals, Kaunakakai is Moloka'i's administrative center and is the location of the island's largest port facility.

Moloka'i resident population of 6000 people and has changed little in nearly three decades. The majority of local islanders are of Hawaiian ancestry followed by those who claim Filipino, Japanese, Caucasian (Haole), Chinese, or other ethnic backgrounds (Atlas of Hawaii, 1980).

"Living off the land" is an essential part of the Moloka'i island lifestyle (Canaan:1981). Moloka'i fishermen are resourceful, opportunistic, and inventive when it comes to maintaining their personal freedom and lifestyle. The traditional practice of reciprocal exchange of food and labor is pivotal to this way of life. Perrells (1971:45) states: "[Moloka'i islanders] put a great deal of time and energy into exchanges which are carried on primarily to help create and maintain social ties." The continuing natural resource productivity of both the terrestrial and marine environments of the southeast end of Moloka'i has sustained this way of life.

For the island's coastal residents, lifestyle is closely tied to the availability and relative abundance of nearshore and intertidal zone fisheries. Islanders who choose the fishing way of life in the rural coastal areas of the State of Hawaii must reconcile changing environmental conditions

and natural resource availability with efforts to make a living. They devise and implement various survival strategies and techniques for making a living by maintaining relationships of a unique human and environmental character -- "socioenvironment" of place. Essential to these relationships for Moloka'i is the use and management of its fishery resources.

Organization of the Thesis

The first chapter opens with a discussion of the geographical setting, popular nearshore fisheries, and the human geographical relationships to fisheries on the south coast of Moloka'i. For purposes of clarity, a list of popular fish species is presented in Appendix C.

The second chapter begins with a theory-and-method statement detailing the research problem, context, and process. Next, the design and approach of the work fall under a "Research Background" section. A discussion of the formal research methodology is contained in two subsections labeled: "Elements and Structure, and "Strategies and Techniques." The former describes the goals and purpose of the research, and the latter presents the various techniques of information collection and analysis.

Chapter three describes several local nearshore fishing activities. They are classified and described by type of fishing gear, methods and strategies for use, and their functional impacts on local shallow marine fisheries.

In Chapter 4, several local nearshore fishery conservation and management practices observed during the field research period are described. These precede a collection of nine community planning and management ideas suggested by fishermen to correct problems created by local fishing practices. The implications of the research are discussed in Chapter 5 in terms of the relationship between the fishing community of Moloka'i and the nearshore marine environment.

Chapter 2

THEORY/METHOD STATEMENT

Why this Research?

There is need for descriptive regional geographies dealing with human relationships to place based on natural resource use in Pacific island environments. We understand little about how people who live in these (usually) underdeveloped environments make successful daily adjustments to their situation in order to make a living. Interestingly, this is particularly true for contemporary rural Hawaiian coastal environment of Moloka'i.

Recent human-geographical research in coastal maritime environments has employed subregional examinations of the relationships of people to place (Holthus, 1985; White, 1984; Smith, 1984; Johannes, 1981a, 1981b, 1984; and, Spoehr, 1984). Our understanding of the social and environmental linkages to resource use has become more complete through efforts to examine what can be called the "socioenvironment."

White (1984) formulated rural community management schemes for nearshore marine environments in the

Philippines, Indonesia, and Malaysia. Smith (1984) recorded the marine ethnography and marine resource use of Belauans by cataloging their strategies for finding and harvesting fish. Holthus (1985) successfully integrated the collective knowledge of a community of fishermen with modern western management techniques into a practical set of reef resource management strategies for Phonpei sland, Federated States of Micronesia. Each study represents a community-based approach to geographical research in the form of balanced examinations of society and environment as developed by Spoehr (1984), Acheson (1981), Nietschmann (1979), Johannes (1981a, 1981b, 1984), Cordell (1978), and McKay (1978).

These studies successfully demonstrate the usefulness of empirical analyses in human-geographical research. They focus on the ethnogeographical, socioeconomic, and human-ecological behavior characterizing nearshore marine resource use. Their authors emphasize the locally unique social relationships and cultural adaptations within their respective environments as the primary focus of research.

This thesis represents a study of how a people use and manage their nearshore fishery resources. It employs a methodology which emphasizes researcher acceptance and trust from a community so that resource use issues and problems that exist in the community can be more deeply explored. It also offers a spatial representation of the extent of

fishing practices for a section of the south coast of Moloka'i while revealing how fishermen relate to their environment and choose to maintain their preferred way of life. The thesis describes the local pattern of fishing activities and the perceived effect they have on local fishery resources, and what fishermen think about the consequences of their actions. It is therefore an empirical exploration of the shared experiences of the researcher and the fishing community of Moloka'i.

Research Question

How are (and may) nearshore marine fisheries be used and managed on Moloka'i's South Coast? How can a geographical study be conducted to develop an integrated social and environmental understanding of small scale fisheries use in the rural coastal zone of Hawaii?

Problem Statement

Moloka'i islanders rely to varying degrees on resources that flow through extended family networks (Perrells, 1971). The traditional practice of gift-giving between families represents the popular semi-subsistence lifestyle. It is an

inward looking lifestyle based on self-reliance and a close-knit community identity.

To Moloka'i fishermen, the fishery is much more than a means of living. Rather, fishing supports a desirable lifestyle grounded in the fishing activities, harvest characteristics and local society that describe the fishing way of life. Today, the economic, cultural, and environmental aspects of fishing on Moloka'i are changing rapidly and, for many, have become increasingly difficult to support and maintain.

In some instances, getting fish before it's too late has led to "getting your fish before someone else does;" a kind of "tragedy of the commons" that has threatened to erode local fisheries stocks as well as human relationships. Human actions designed to personalize fisheries appear to have often polarized an already highly individualistic and hard-working group of fishermen.

Moloka'i fishermen and their families agree that individual greed is the principal cause of the irresponsible use of local fisheries. Greed appears as the root cause of activities that lead to over-fishing and a poor social climate for implementing fisheries management plans offered by the State.

Fishermen complain about the difficulty in finding various species of fish once plentiful and easy to catch.

Conflicts within the fishing community occur over how and where "off-islanders" and "locals" may fish. Competition for fish between locals also creates tensions.

Fishermen worry about the upland use of herbicides, pesticides and the effects of siltation on Moloka'i's fringing reefs. The use by some of ecologically harmful fishing practices continues to negatively impact local fishery stocks, the coastal environment, and ultimately the island fishermen themselves. The spread of mangroves through ancient fishponds hastens their decay severing cultural relationships to the island's past.

The State of Hawaii in conjunction with the Department of Land and Natural Resources has developed and passed laws and regulations for dealing with the negative effects of local fishery misuse. In controlling for problems related directly to the resource, the State has failed to give equal attention to the underlying social relationships attached to fisheries in Hawaii. Fluctuations in market prices and demands for fish and the perception that outsiders are increasingly invading local fishing grounds force fishermen to select for the most efficient (and sometimes destructive) fishing methods and strategies. Given this incentive for maximizing harvests, some fishermen have decided to alter their gear and methods in ways that negatively impact both the habitat and the resource.

The establishment of informal rights to certain fisheries and fishing areas over time has led to the creation of discrete "Use Zones." Social tensions have recently heightened because fishermen feel their individual rights to local fisheries are threatened. Animosities created by local challenges to territorial claims are further complicated by the unrestricted access of local off-island and out-of-state fishermen to the limited fringing reef habitat and fisheries.

Literature and preliminary field research indicated that a variety of problems lead to community conflicts over resource depletion on the nearshore fringing reefs on the south coast. Most often, these conflicts centered on what were considered to be destructive fishing practices by local fishermen. This topic provided the starting point for examining the local environmental and social processes that underlie nearshore fisheries use on Moloka'i. The concept of "over-fishing" became the issue around which formal and informal interviews were conducted.

Methodology

This researcher employed a strategy of participant-observation in gathering specific management problems and ideas for solving them suggested by local fishermen.

Because the perceptions and patterns of use by local fishermen are a central focus of the research question, the field work became a task of testing information gathered in numerous interviews against observations made during actual harvesting activities and personal excursions into the study area. A secondary focus of this research was to experiment with the participant-observation strategy in order to create a reusable set of human geographical research techniques for studying contemporary Pacific island fishing communities. By listening and working daily over five and one-half months with a broad crossection of islanders, the research centered upon collecting and categorizing the various described and observed accounts of local fishery use.

Research Design

The basic design of the research methodology represents an interactional-inductive research approach designed to evolve as the field research procedure unfolded. It is a research procedure inspired by Becker (1960, 1970), Lofland (1971), Schatzman and Strauss (1973), and Charmaz (1983). In a geographical context, place is socially constructed, a preferred location where lifestyle is preserved and activities carried out that support that way of life.

The research project began with a literature review and initial visit to the research site. Second, an original research question was formulated. The problem of "over-fishing" was chosen as the original problem for initiating the research inquiry. Third, a four-month period of participant-observation provided specific information and an extensive personal knowledge of the research site and resource use situation. Gathering information involved tape-recording the testimonies of local fishermen on their individual use and knowledge of fishing. Interview questions were designed to probe the problems fishermen experienced in making a living and what they understood to be the cause of those problems. The purpose of this strategy was to aquire a broad understanding of the local fishery-use situation based on commonly held beliefs about the effects that local fishing activities had on fringing reef fishery resources.

Strategies and Techniques

A survey of literature in human ecology, qualitative sociology, and cultural and physical geography, offered a set of practical tools for conducting the field research project. Key elements of the literature review were the Moloka'i Coastal Resource Atlas (1984) and the Narrative

Inventory Report (forthcoming) prepared by the U.S Army Corps of Engineers, Pacific Ocean Division, Honolulu. These works aided in analyzing the spatial extent of fishery use within the study area.

Several strategies were used for the purpose of gathering information in the field. Unexpected or chance discussions between fishermen and the researcher often produced valuable explanations and insights. Consultation with professionals in Honolulu in local, state and national level positions helped in the solicitation of Moloka'i community support for the research effort and enhanced the involvement of key local and Honolulu-based members of Hawaiian Coastal Zone Management agencies. Interview information was gathered by the use of notepad and tape recorder on land or while at sea on numerous fishing excursions.

Local fishermen were approached through a network of referrals. This strategy provided for a substantial degree of familiarity with the fishing community. A number of simple fishing techniques had to be learned as a condition of joining with fishermen in their activities and gaining their trust. Observations of fishing activities were augmented by snorkeling regularly in various popular fishing sites. Joining in the use of the nearshore zone also

allowed for the reconnaissance of the range of nearshore habitats and fisheries within the study area (Figure 2).

When possible, the location of capture, gear used, and any tenurial associations that could be made were also noted, including discussions or observations regarding community concerns and the locational patterns of fishery use.

Interviews

Information regarding fishery use and management is privileged knowledge, therefore the exact locations of fishing areas and the names of fishermen will not be disclosed. This confidentiality was promised unconditionally to local fishermen who were interviewed.

A traditional structured survey format was not used for this research. Instead, information was gathered from individual conversations and personal observations. Questions were asked during two formal public meetings and many informal social gatherings. Almost all of the questioning was done on a one-to-one basis, except during fishing activities and the two formal public meetings held by the Fisheries Division of the Department of Land and Natural Resources in July of 1986 and April of 1987.

Additional information was collected during public and private meetings with local legislators and State fisheries

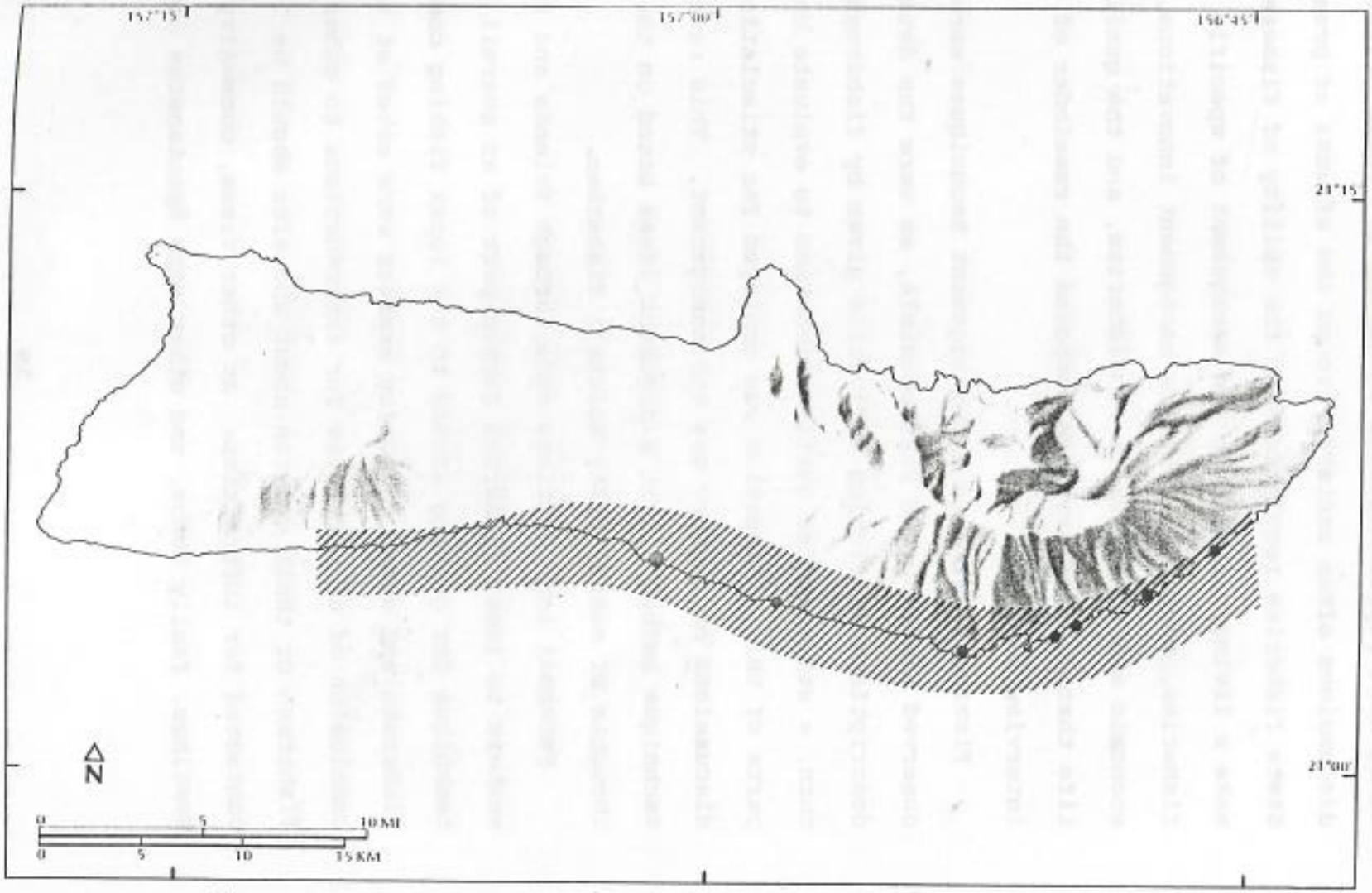


Figure 2 - The Study Area and Principal Coastal Settlements

management representatives on Moloka'i. These private discussions often centered around the effects of present State fisheries regulations on the ability of fishermen to make a living. Local use and management of specific fisheries, possible fisheries management innovations, the economic and social value of fisheries, and the quality of life that fishing provides composed the remainder of interview topics.

Fishing strategies and management techniques were observed and recorded when possible, as were the detailed descriptions of fishing activities given by fishermen. In turn, a strategy for getting fishermen to evaluate certain parts of this information was employed for stimulating discussions on fishery use and management. This research technique helped elicit management ideas based on the thoughts of nearly fifty Moloka'i fishermen.

Personal introductions made through friends and family members to local fishermen formed part of an overall technique for gaining access to the local fishing community. Fishermen and other community members were asked at the conclusion of an interview for introductions to other fishermen or their opinion about who else should be contacted for information. At other times, community meetings, family luaus, and other more spontaneous social

events provided rich opportunities for many informative exchanges and fortunate personal associations.

As the research progressed, it became necessary to contact a larger group of fishermen because the time alloted for research was growing shorter and the desired number of fishermen contacted had not yet been achieved. A series of research questions were posted as public notices outside markets, banks, the library and post office in the main town of Kaunakakai. They served as public requests for information about the nature of local fishery use (within the study site).

These questions were also reproduced as a call for ideas in short newspaper columns in the Molokai Dispatch (Appendix A) and the Molokai News (Appendix B). A contact telephone number was given and confidentiality guaranteed since no names were solicited. This "letter to the community" was a request for information about local fisheries use. This tactic produced a more wide-spread introduction and explanation of the intentions of the researcher. It presented an explaination for the research process more efficiently (though not as effectively) than by the "word of mouth" strategy originally chosen.

Fishermen's Perceptions, Beliefs, and Attitudes

A great deal of the research effort went into gaining a personal understanding of the attitudes and perceptions the community. An equal amount of time was spent on how members of the community viewed their personal actions as fishermen and the use of local fisheries by others. Fishermen's perceptions and beliefs provided a rationale for choosing the participant-observation approach and in the refinement of interview questions. A collection of representative interview questions developed in the field are listed in Appendix D. Fishermen's viewpoints have been analyzed elsewhere for solving problems related to over-fishing, management, conservation, and the use of coral reef resources in the tropical Pacific (Johannes,1981a,1984; Juliano et al.,1982; Kenchington and Hudson,1984; and White,1984).

It has been stated above that Moloka'i fishermen value the south coast's nearshore fisheries for a variety of reasons. Local fisheries provide a source of food, primary and supplemental income, recreation, and community identity. These social benefits are either economic or aesthetically abstract, and underlie the local lifestyle. They are ranked as equal in importance by local fishermen.

Chapter 3

MOLOKA'I NEARSHORE FISHERIES USE

This chapter includes an examination of the spatial and technological linkages to nearshore fisheries for Moloka'i's South Coast. Descriptions of strategy, method, and location are given for the area's fishing activities. Adverse impacts on the fishery are presented for each activity.

The spatial distribution of local fishing methods is represented in a series of eighteen maps indicating the spatial range of the six most commonly practiced types of fishing activities. Their purpose is to illustrate the relative locations in which certain fishing strategies and technologies are used. They show critical divisions and boundaries between the various use zones which are defined by the physical environment (water depth, reef-flat topography, local floral and faunal populations) and the socioenviroment (individual claims to reef space, boundries established by State laws and regulations, and the effects of secrecy) of the region. The maps are referenced periodically throughout the chapter. A comprehensive list of popular "target" species indicating the fish normally harvested is presented in Appendix C. Discussion of the

state regulations on the existing local fishery use of gear sets the stage for the analysis in the next chapter.

Fishermen establish and maintain fishing rights to specific sea areas (Acheson,1975). They form discrete boundaries that delimit resource-extraction areas or use zones that also represent discrete social space though not social groups. This social space or "socioenvironment" can be identified by examining the spatial extent to which individual technologies are used.

Fishing the South Coast nearshore fisheries is limited in places by the dense shoreline vegetation, private beachfront property rights, and the often dangerous ocean channels between the islands of Maui and Lanai. There is however, relatively easy access to the fringing reef from Kaunakakai harbor. Shallow draft boats can motor directly from the settlement over the reef flat margins at high tide. Called the "highway" by local fishermen, it is most often used by gill net fishermen.

Moloka'i fishermen have made exclusive claims to South Coast fisheries based on two main factors. First, explicit claims are made based on the proximity of one's household to adjacent coastal areas (the so-called "backyard" fishermen). Second, implicit or informal claims to certain fisheries have become established by individuals over time in several specific reef locations. In both cases the implicit or

explicit formation of boundaries within a thirty-five mile stretch of fringing reef represents a form of fisheries management instituted by local fishermen to restrict access to the source of their livelihood.

Coastal fisheries are critical to the survival of island residents because of limited employment opportunities and the chronic underdevelopment of the island's sub-regional economies in agriculture, commercial fishing, and the visitor industries. There is continued reliance on traditional resource exchange networks, gift-giving relationships, and multiple occupations among immediate and extended family members. These adaptive strategies are a particularly strong source of sustenance and identity to the fishing community. They have a more intimate relationship with the nearshore environment than the ranchers and farmers of Moloka'i, and expect fishing to provide a major (if not the entire) means of support for the household or small, family-run business.

Certain fish species are more highly valued by fishermen than others. The most popular fisheries include ten different Families of fin-fishes, and species of lobster, crab, and local octopus. These marine products are very popular because they bring a consistently high market price at Honolulu fish auctions and because they are highly valued as food.

Popular reef-dwelling fish dominate both catch categories and are referred to here as the "target fishery." Target fisheries include both territorial inshore species and the migratorial deep water species of the outer reef margins. Most move back and forth across the southern fringing reefs with the tides at relatively predictable locations and times. Fishermen take advantage of the tides, topography, and the habits of fish which are the most significant factors in determining where fishing pressures will be focussed.

Moloka'i fishermen view their nearshore fringing reef environment as both refrigerator and bank. By individually establishing claims to fishing areas certain local fishermen may control access in what they consider to be an unregulated "free-for-all." To local fishermen, the situation appears to have created a tendency for fishermen to "take what you can get before someone else does."[1]

Gear Description and Classification

The fishing activity is a hunting and harvesting process employing technologies designed to fit the changing natural conditions of weather, tides, and the movements of fish. There are four distinct classifications of gear and methods applied by Moloka'i fishermen based on technology type, use

strategy, and individual management considerations. They are categorized here as: Active-discriminant, active-indiscriminant, passive-discriminant, and passive-indiscriminant activities. Methods are categorized as "active" if the fishermen actively pursue or "hunt" a catch. Passive activities involve the use of technologies which exploit the behaviour of fish where the catch essentially traps or ensnares itself.

A method or strategy is termed here as discriminant based on two basic criteria: (1), that the gear is especially designed for a specific species of fish or small group of "target" species, and (2) that the gear allows for the removal or physical exclusion of "non-target" species. Gear in this category allows the fisherman to catch fish live and in a relatively undamaged state, and also to release unwanted fish in the same condition. Fishermen using these sorts of technologies usually fish for specific or targeted species.

Indiscriminant methods do not allow for preliminary separation of "target" from "non-target" species. "Non-target" fish include commercially poor, illegal, undersized species. Other marine technologies that are destructive to gear or which may entangle these fish in nets (e.g., sharks and rays) are also included in this category. Therefore, indiscriminant methods represent the reverse of discriminant

methods in that they are non-specific in their capture of species, and do not normally allow for the live removal of fish. If not dead, fish caught in this category are almost always damaged or crippled in ways that will certainly cause death soon after release. Fishermen using these kinds of technologies are not necessarily concerned with catching a particular species, so long as they do catch fish of both monetary and subsistance value.

The six most common methods of catching fish on Moloka'i are described in the following section. They can be grouped into these four major categories; Active-discriminant (Spear fishing, Throw netting, Surround netting), Active-indiscriminant (Drag netting); Passive-discriminant (Bull penning), and Passive-indiscriminant (Gill netting). A map key representing three distinct sections of the South Coast labled Palaau, Kawela, and Manae (East End) is presented to aid in discussions on the fishery use zones within the study area (Figure 3).

Spear Fishing

Spear fishing (Figure 4) best represents the Active-discriminant category involving the use of a barbed spear shot from a gun or sling.[12] Spearfishermen have a great deal of choice in what they can and will catch. Their

choices are limited only by the diversity of desirable free-swimming or stationary species available in a chosen location. Spear fishing on Moloka'i is done both for recreation and for subsistence purposes.

Spear fishing activities are conducted chiefly in waters from eight to thirty feet in depth. The fringing reefs of South Moloka'i provide an especially rich collection of environments for this type of fishing. Numerous reef channels, rocky crevasses and small coralline caves are home to a host of crustaceans and fin-fishes that are targeted for the catch. These areas vary in their proximity to the shore. Except where several very deep marine channels extend far into the nearshore zone, spear fishing is generally done within the outer margins of the fringing reef.

Success in spear fishing depends on the individual's familiarity with the nearshore terrain and environment, skill level in locating and capturing fish, personal physical condition, and the ability to withstand long hours in often turbulent waters. Hypoxia, or the build-up of CO_2 in the bloodstream leading to "shallow water black-out, and hypothermia, a severe lowering of internal body temperature, are the main dangers associated with this activity. They add to the preexisting risk of shark attack brought on by the attractiveness of speared fish.

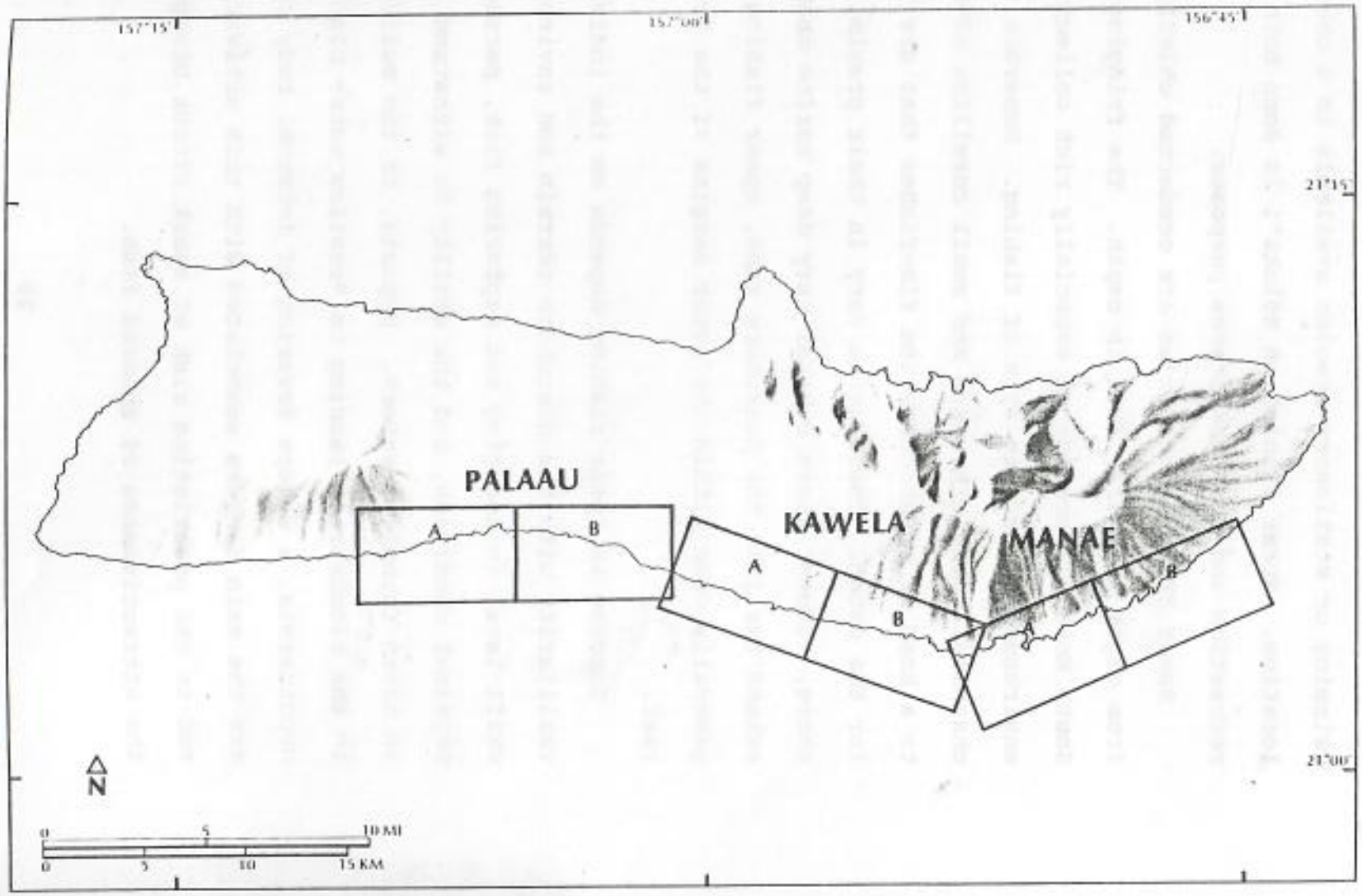


Figure 3 - Fishery Use Zone Map Key

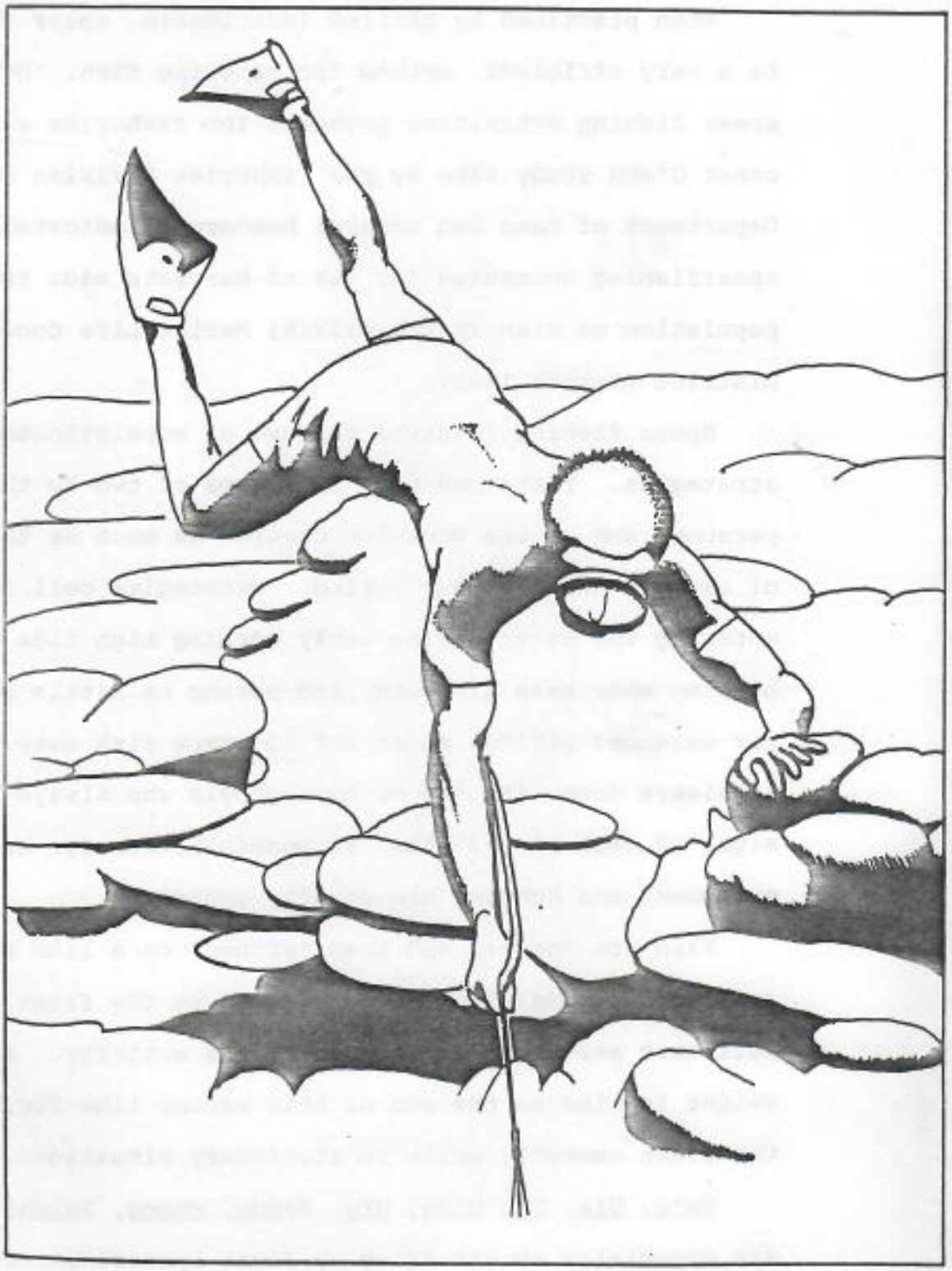


Figure 4 - Spearfishing

When practiced by skilled individuals, spear fishing can be a very efficient method for catching fish. Data on spear fishing activities gathered for fisheries at a south coast O'ahu study site by the Fisheries Division of the Department of Land and Natural Resources indicated that spearfishing accounted for 26% of harvests made from a known population of fish in the Waikiki Marine Life Conservation District (Sakuda,1986).

Spear fishing involves the use of sophisticated hunting strategies. Fishermen work in groups of two to three persons, and on one occasion covered as much as three miles of reef in one two-hour period. Strategies call for entering the water during early morning high tide periods, hunting when seas are calm, and moving as little as possible for extended periods so as not to scare fish away. Spearing is always done with two or more people who always keep in sight of each other. The responsibilities for handling equipment and hunting are equally shared.

Fish are speared and then "strung" on a line attached to a float. An additional line secured to the float is used to pull this assemblage along during the activity. A small weight is tied to the end of this second line for anchoring the float assembly while in stationary situations.

<u>He'e</u>, <u>Ula</u>, <u>Uhu Ulua</u>, <u>Uku</u>, <u>Nenue</u>, <u>Moano</u>, <u>Palani</u>, and <u>Kala</u> are especially sought-after by local spearfishermen. Target

species that are territorial and therefore remain relatively stationary in the nearshore habitat mingle with fish of diurnal habits that swim back and forth from deep to shallow areas via the numerous reef channels.

The middle and the outer margins of the reef-flat are the most favorable for spear fishing (Figures 4.1, 4.2, and 4.3). The outermost edge of the reef is seldom used for spearing. It lies in the "breaker zone," or place where waves break on the fringing reef. The additional threat of strong currents keeps this area free of most spearfishermen.

The State of Hawaii has set restrictions on spear fishing based on size (usually seven and nine inches) and weight limits (one pound) for various species of fish. Children under the age of fourteen may use spearguns only when accompanied by an adult (DLNR, 1985:22).

At all times crustaceans are prohibited from being taken by spear as are certain other species of fin-fishes during closed seasons. Restrictions also apply to the taking of any federally protected species including the Hawaiian monk seal and sea turtles.

Violations of the State regulations occurred during observations of several spear fishing activities and most often involved the taking of lobster and lobster with eggs by hand during the closed season (June, July, and August). Other violations were reported to have taken place during

Figure 4.1

Palaau Spear Fishing Zone

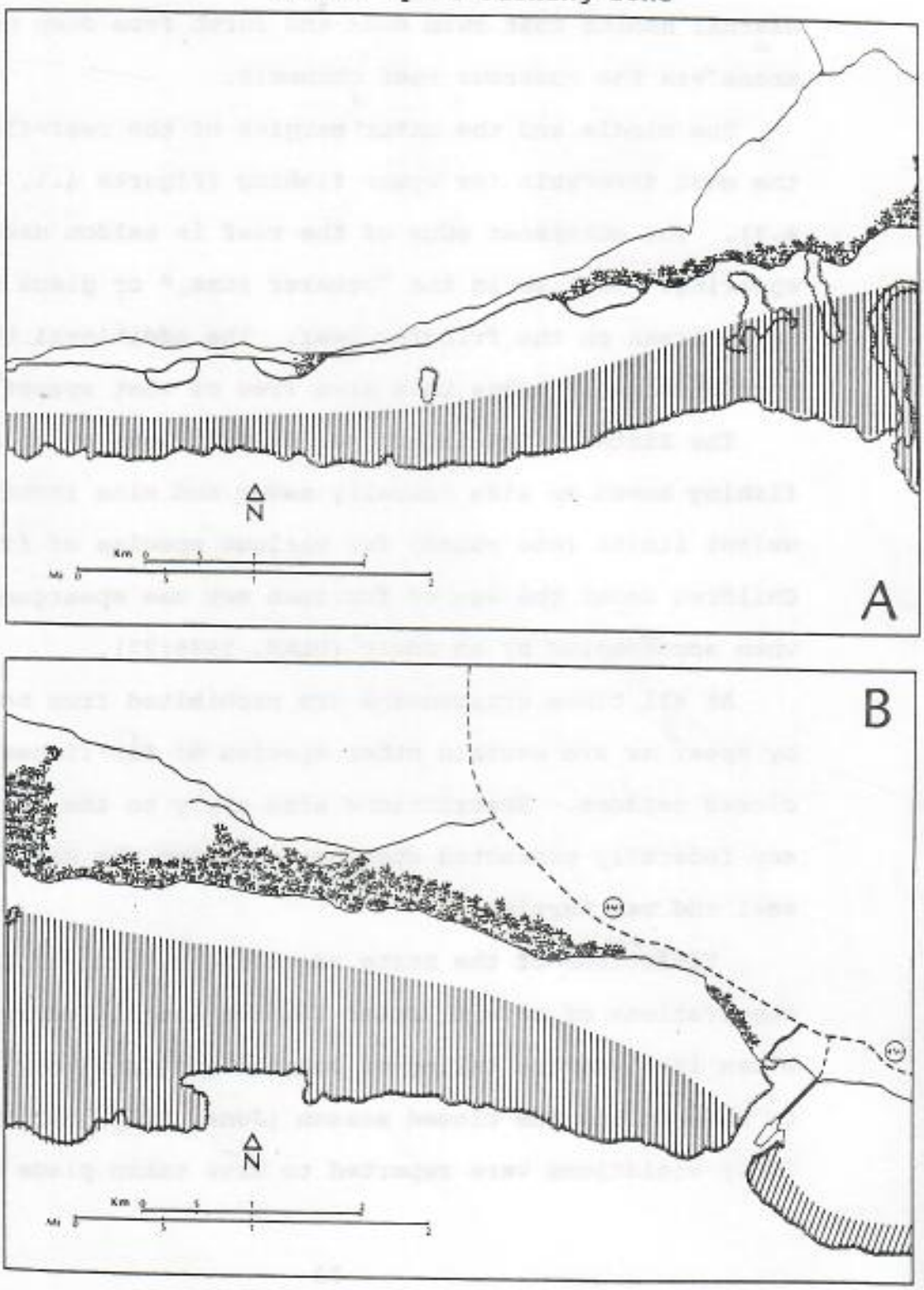


Figure 4.2

Kawela Spear Fishing Zone

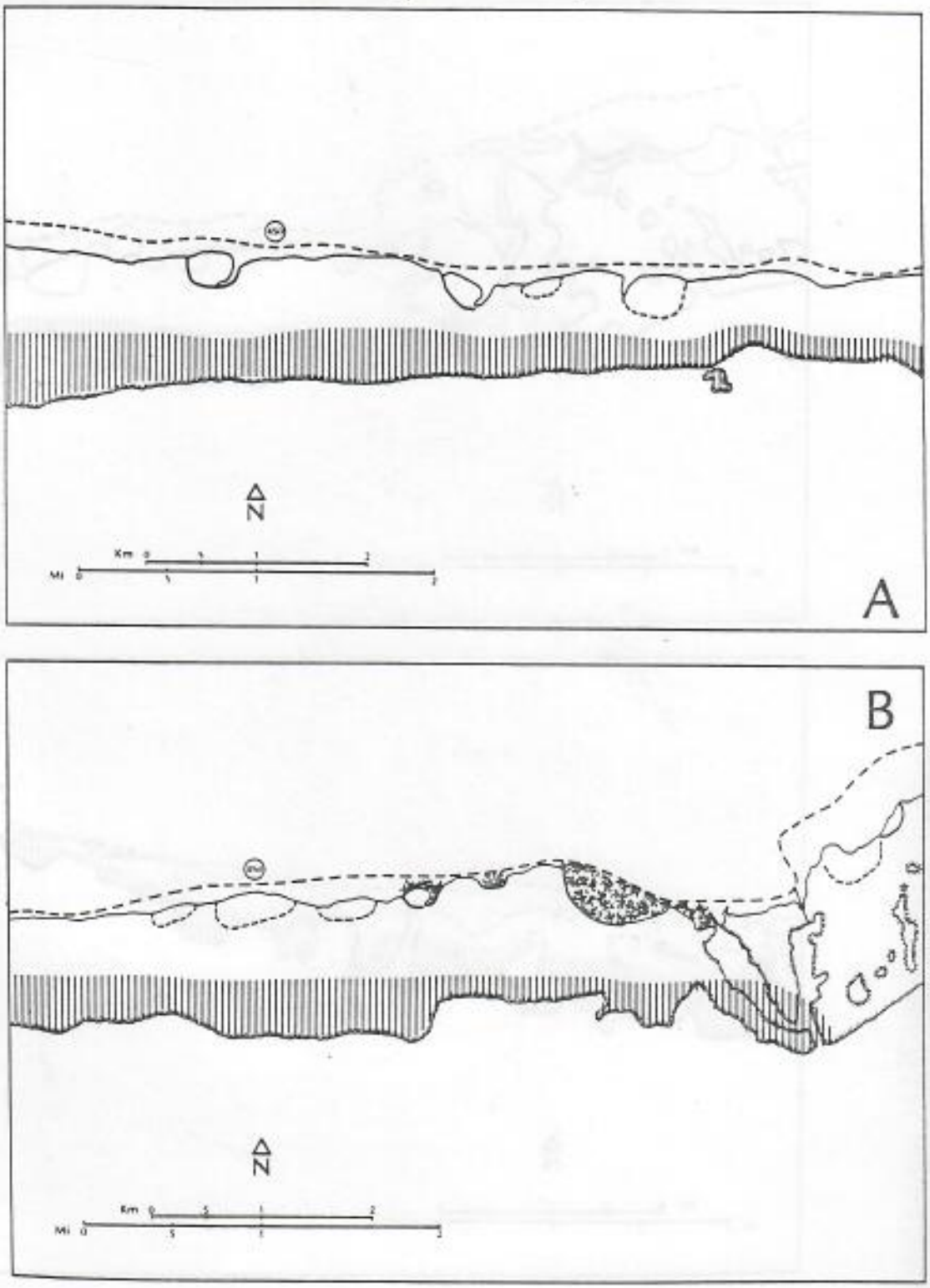
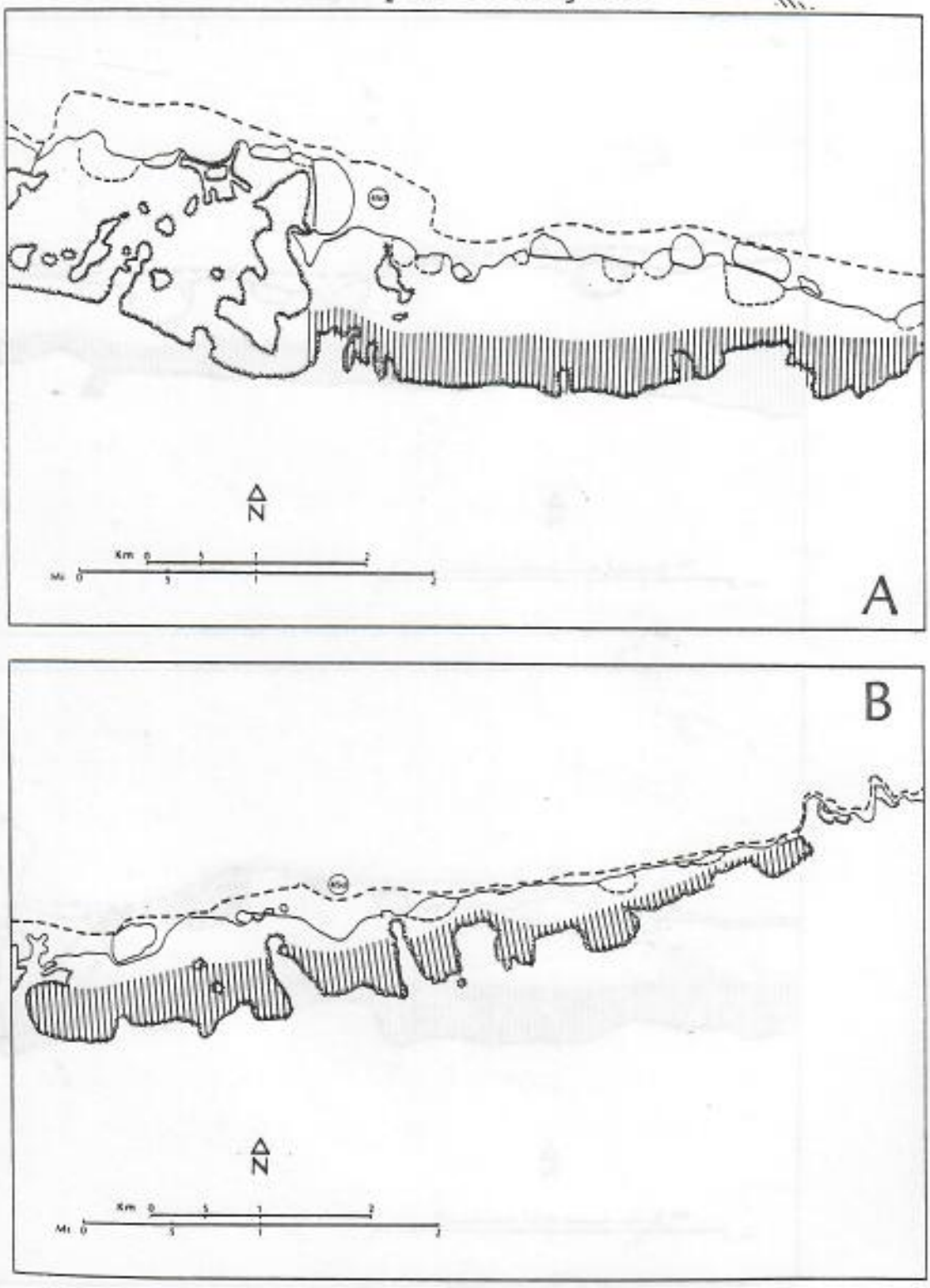


Figure 4.3

Manae Spear Fishing Zone



local fishing tournaments. Tournament prizes are awarded for the most fish taken by weight, and according to several fishermen, included "even very tiny fish weighing less than one pound."

Throw Netting

Throw netting (Figure 5) is another active-discriminant activity practiced in waters close to shore and along reef flats or rocky shorelines. Where the fringing reef gives way to rocky coastline (as in the eastern margin of the Manae section), throw netting is carried on from low cliffs during periods of favorable tidal and weather conditions (Figures 5.1, 5.2, and 5.3).

Fish ponds and coastal mangrove habitats also offer very good opportunity for this type of fishing. The generally brackish waters provide nutrient rich environments for juveniles and small species of fish. Throw netting is primarily a subsistence-related fishing activity.

Throw nets used by local fishermen are circular in shape and made of woven nylon cordage with an average "eye-size" of one and one-quarter inch diamonds or squares. The net is thrown with two hands from the waist in a manner that allows it to fall through the air in a roughly circular shape above a small school of fish. A series of leaden weights attached

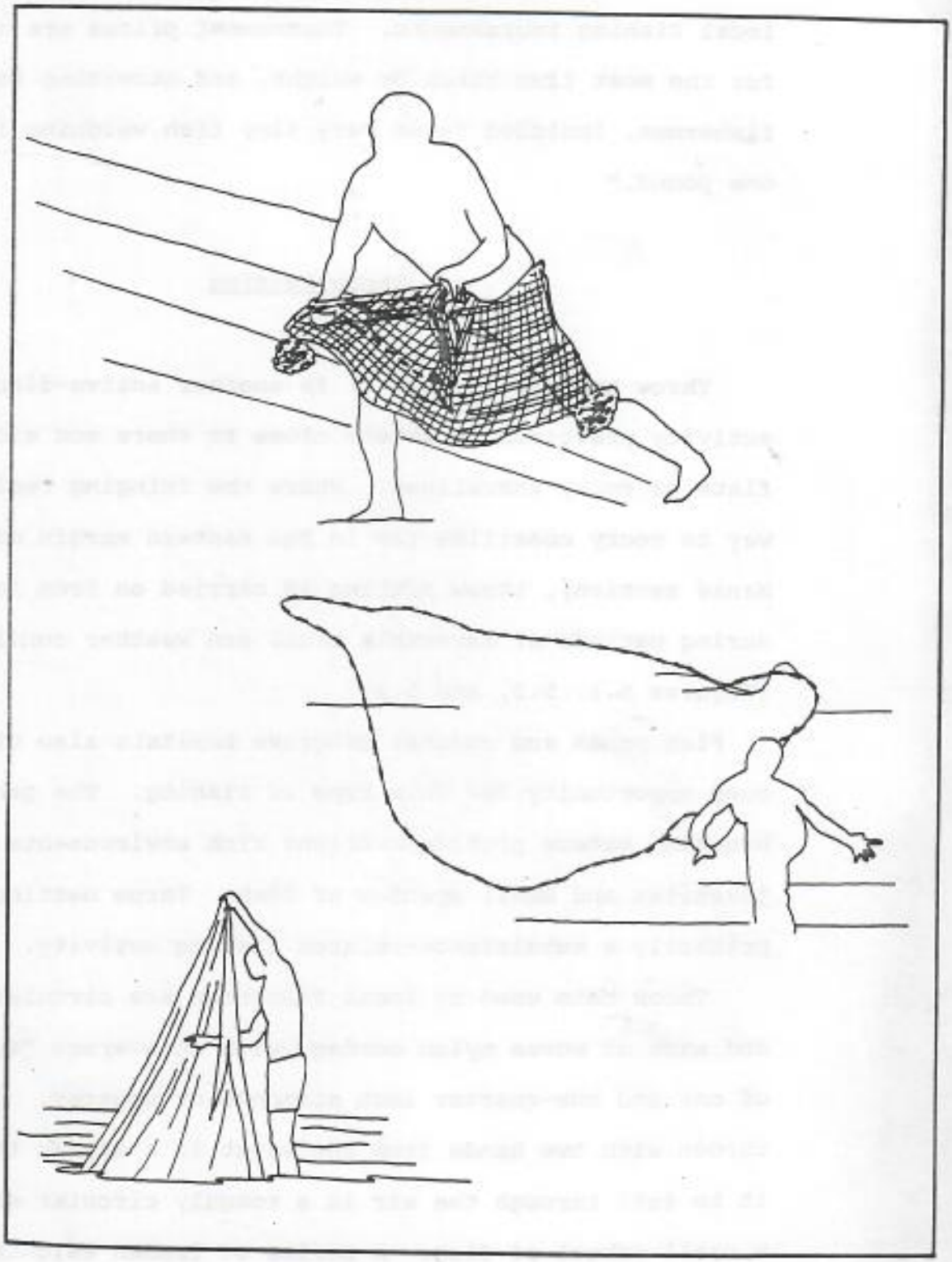


Figure 5 - Throw Netting

to the circumference of the net causes it to sink, thereby engulfing and entrapping the school. The fisherman then draws the net up from its center to collect the fish which are placed in a small creel or in a nearby cooler.

Skill in using the thrownet lies in a fisherman's ability to spot fish beneath the reflective surface of the water. Overcast days and calm conditions give the greatest advantage and the fisherman must be careful not to be seen. by the fish. Fishermen walk slowly just beyond the swash zone or stand motionless for hours on low rocky cliffs and wait for schools to pass.

Fishermen pursue particular schools of fish species selectively. Fish are taken live and are not damaged by the process of capture and removal. 'Ama'ama, awa'aua, young weke(oama), kaku, papio, and o'io that feed in the shallower coastal areas are typical of species taken. In the well aerated waters off rocky points fisherman harvest aholehole, kala, palani, nenue, 'ama'ama, red weke, and moi.

The State has set a one and one-half inch stretched mesh size for throw nets to be used for subsistence. Commercial use mesh size is set at two inches.

Figure 5.1

Palaau Throw Netting Zone

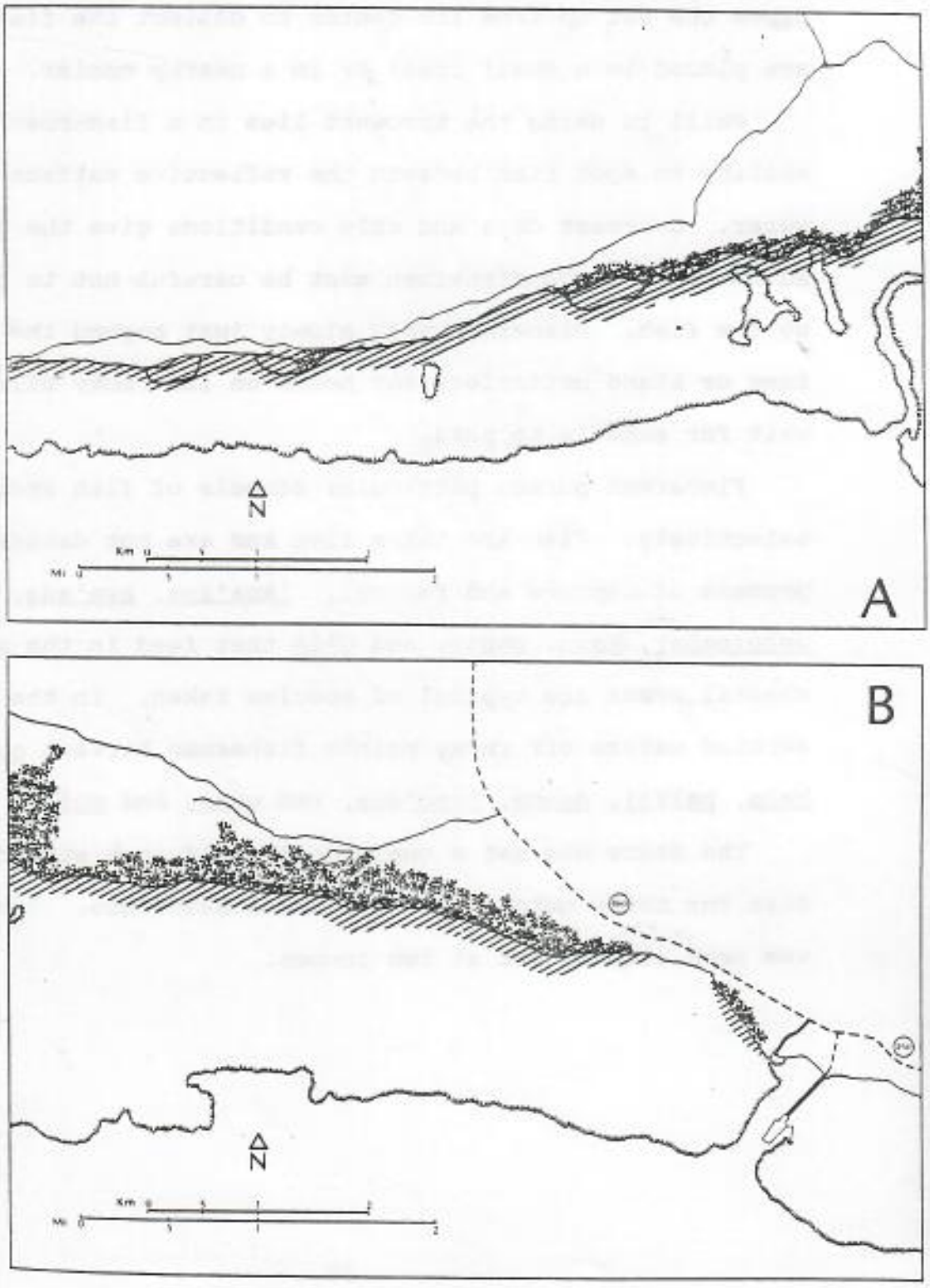


Figure 5.2

Kawela Throw Netting Zone

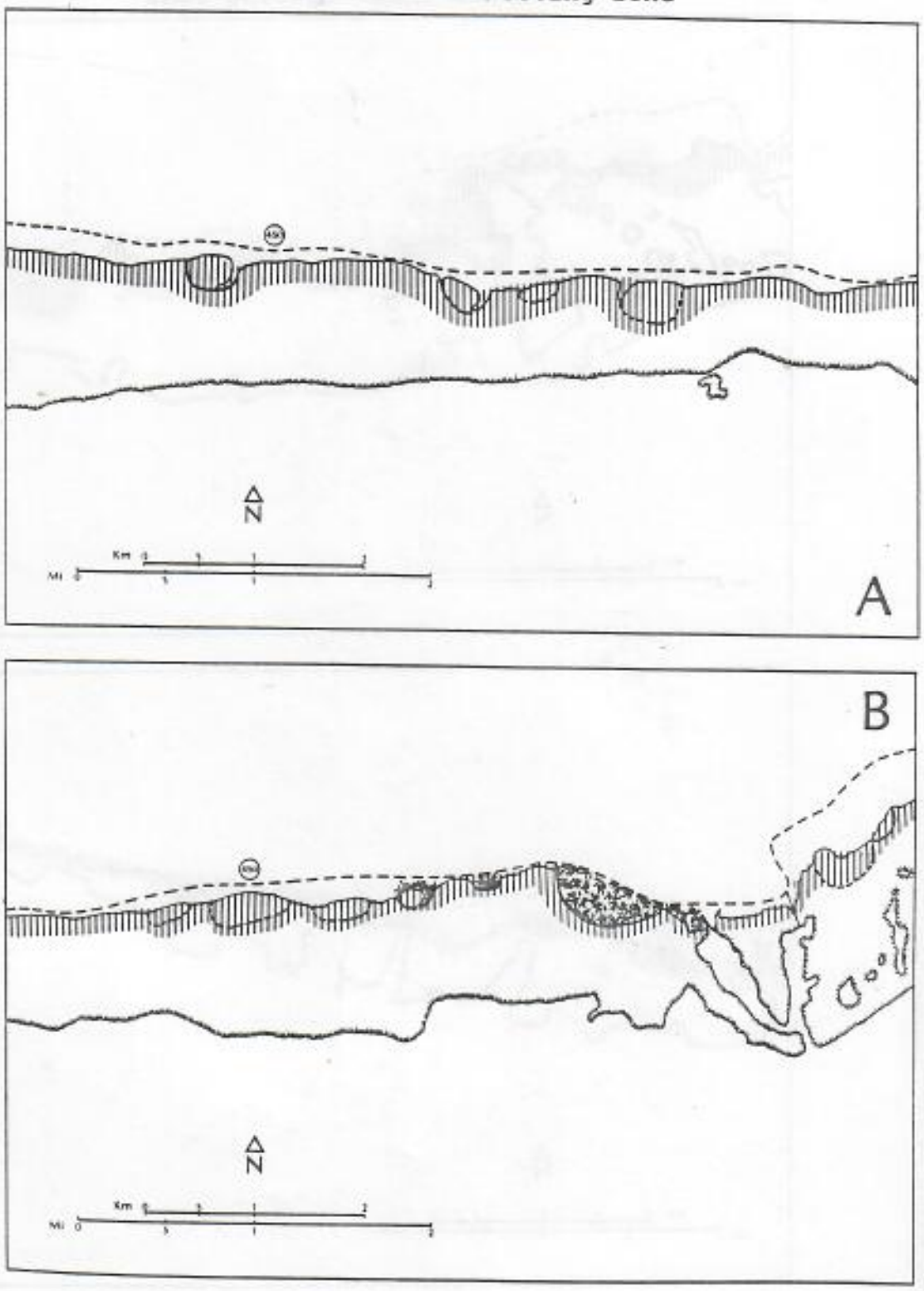
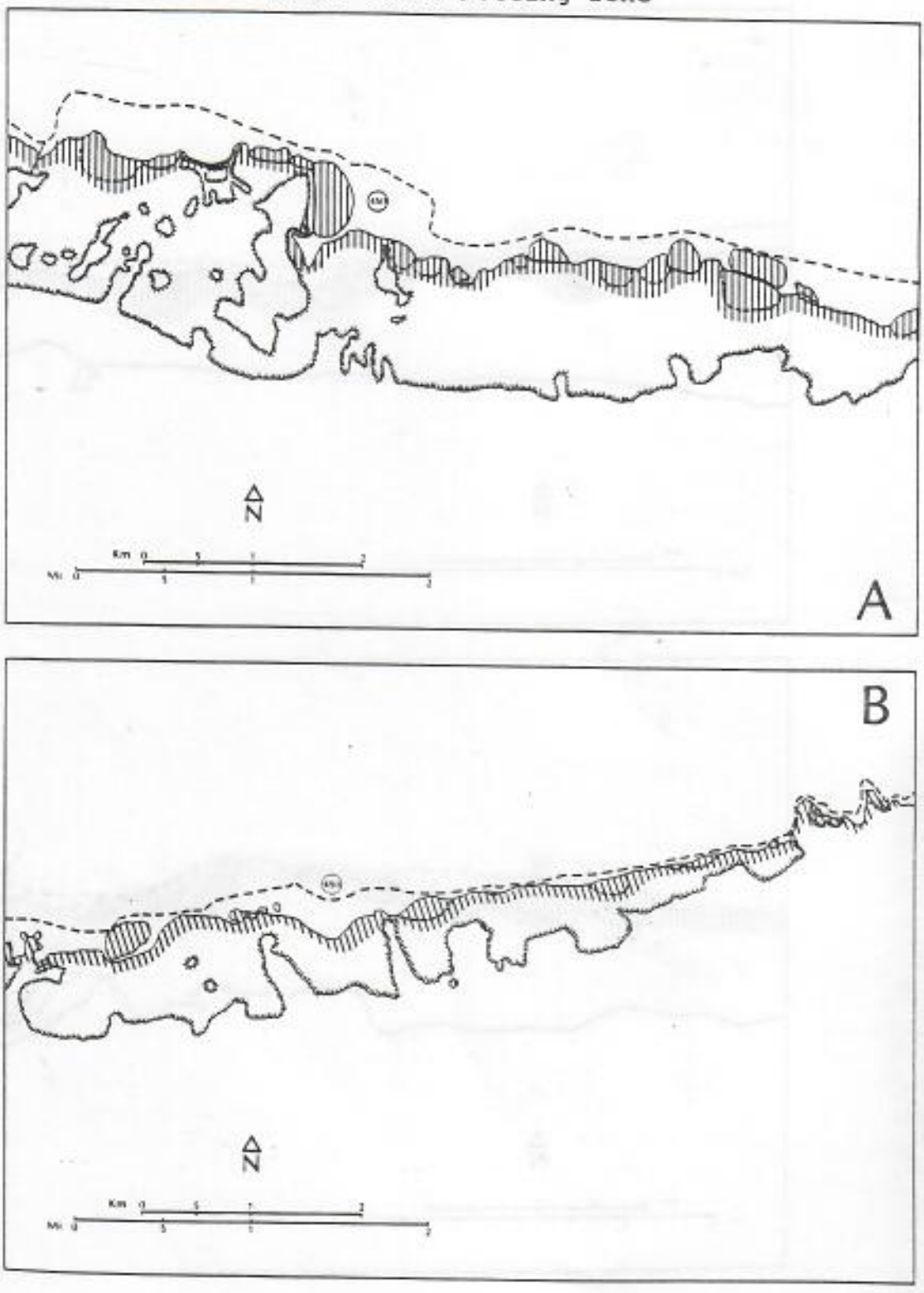


Figure 5.3

Manae Throw Netting Zone



Surround Netting

Surround netting (Figure 6) is classified under an active-discriminant category practiced in the channels and off-shore areas of the South Coast (Figure 6.1, 6.2, and 6.3). Designed for the capture of schooling fish, it is carried out either by a single individual entering the water from the shore, or by several fishermen from a boat in the deeper outer reef and channel areas. A popular and efficient method of fishing, it is most often practiced in teams of two on the South Coast.

Surround net fishing can be either a subsistence or a commerical activity. As the name suggests, nets are set to encircle and ensnare schools of fish. They are made of either monofilament or woven nylon net materials. Several lengths of netting (10-12' x 100') are used as gill nets when fishing for akule, opelu, and other schooling species of high market value. Floats attached to one side of the nets and lead weights to the other allow the nets to hang vertically in the water. Nets can then be maneuvered by snorkelers to surround a school of fish. The use of "scare devices" i.e. pounding the water surface with sticks (pai-pai) or by hand for driving fish into a surround net is not prohibited for any netting activity.

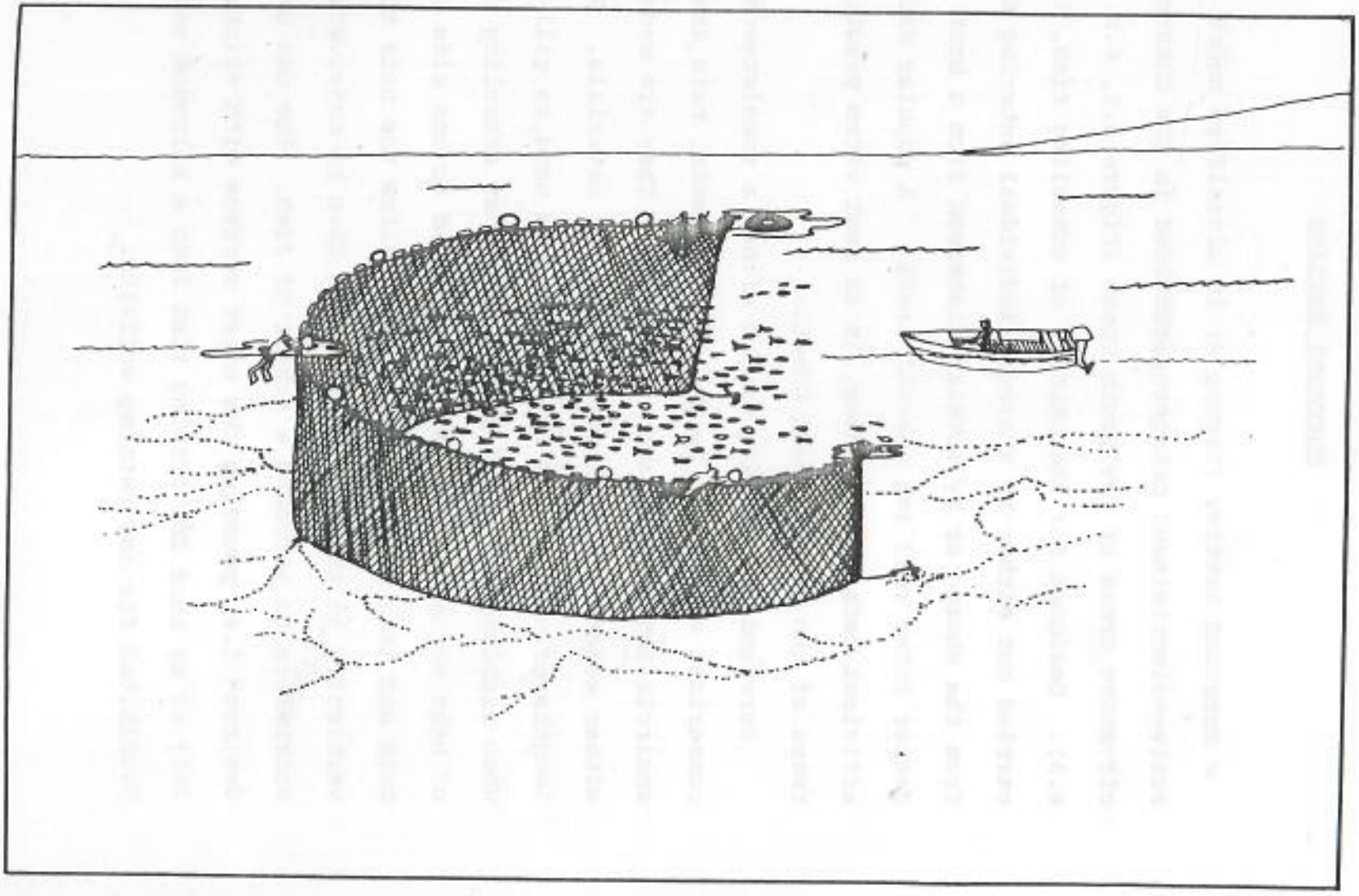
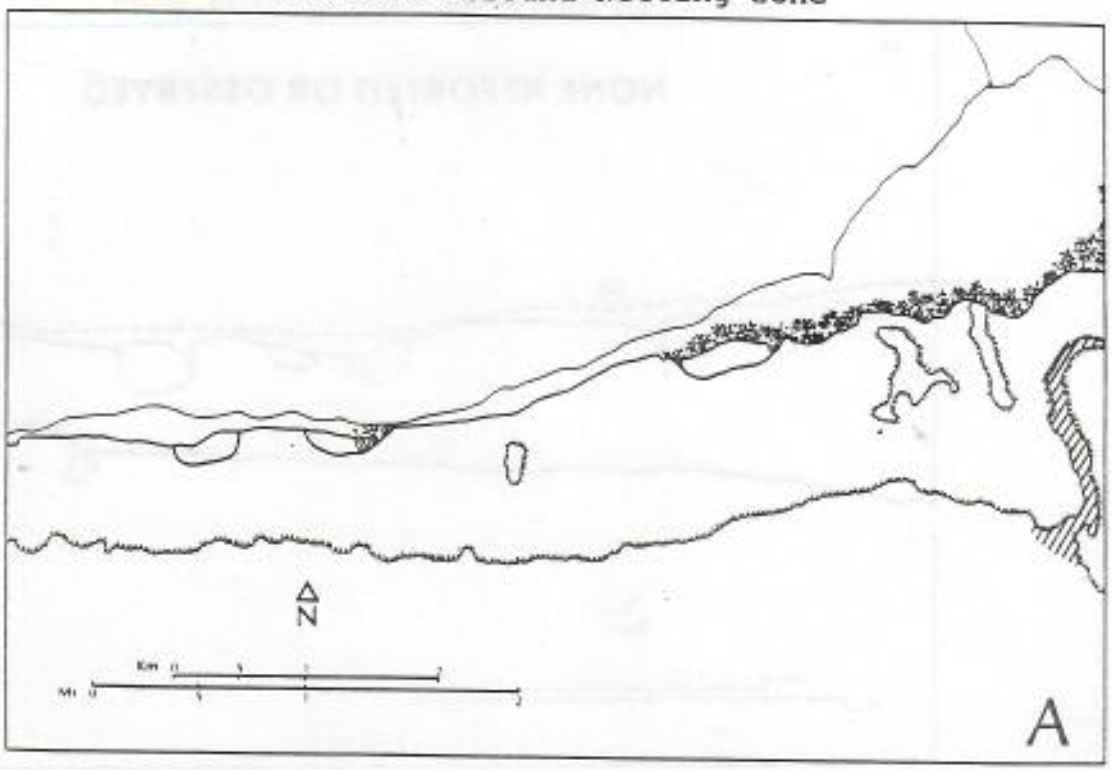


Figure 6 - Surround Netting

Figure 6.1

Palaau Surround Netting Zone



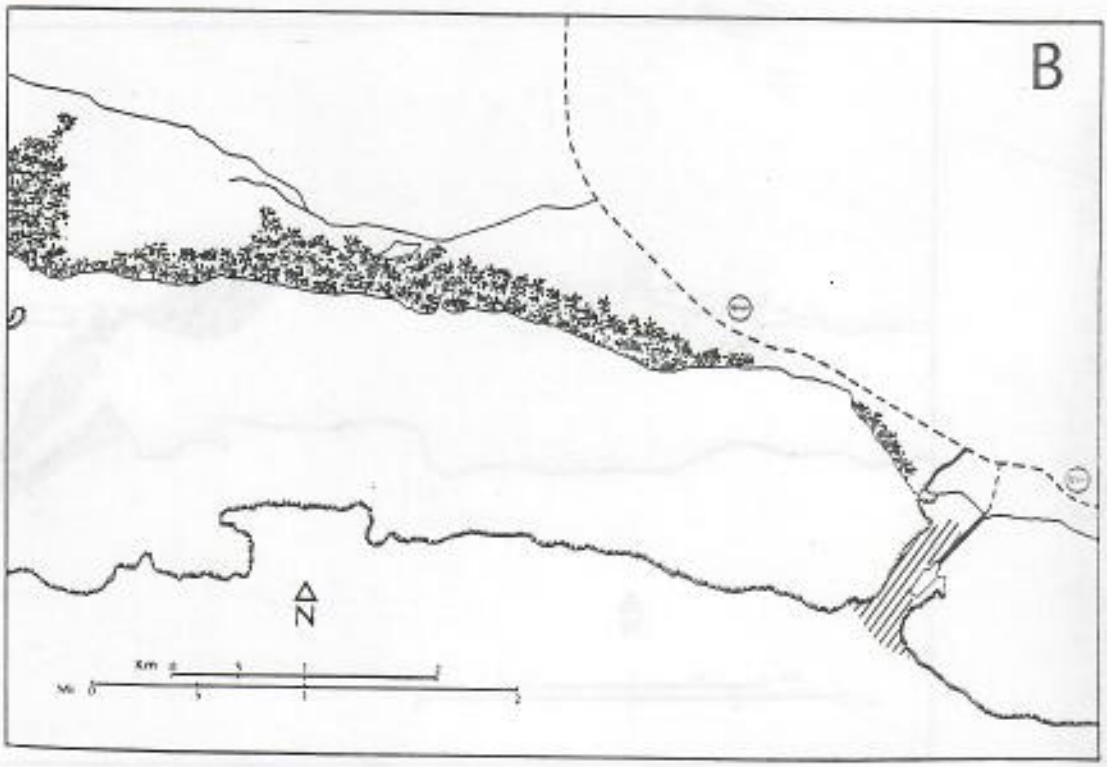
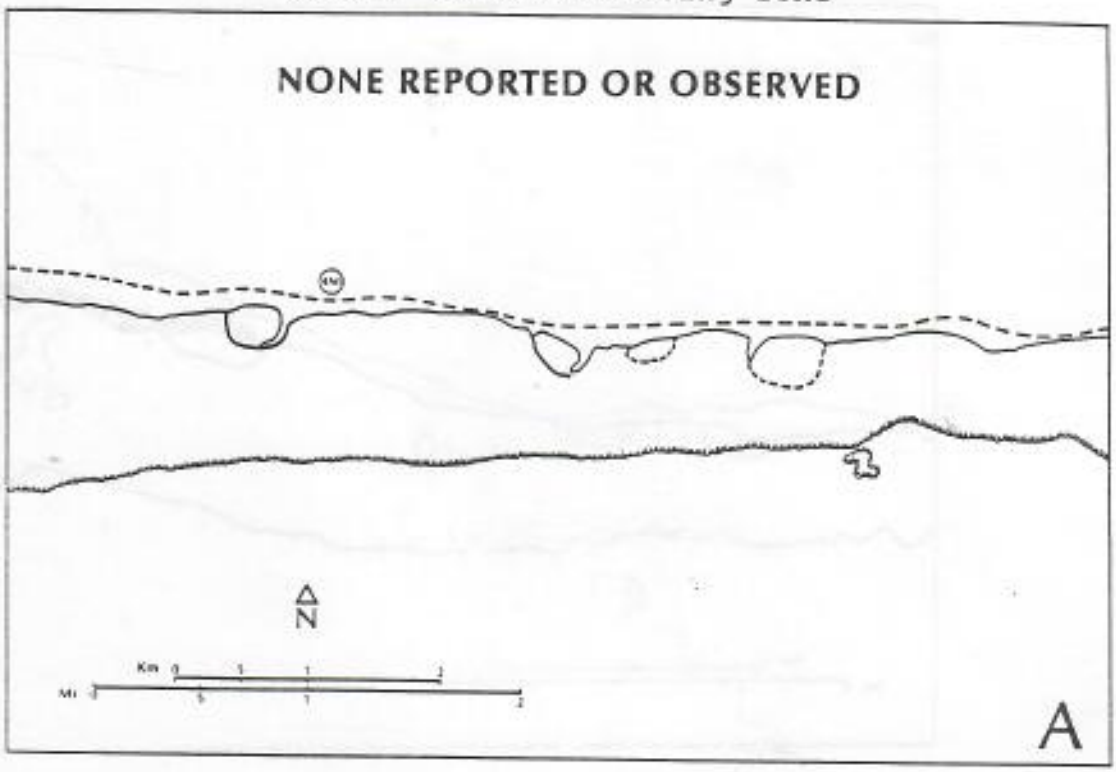


Figure 6.2

Kawela Surround Netting Zone



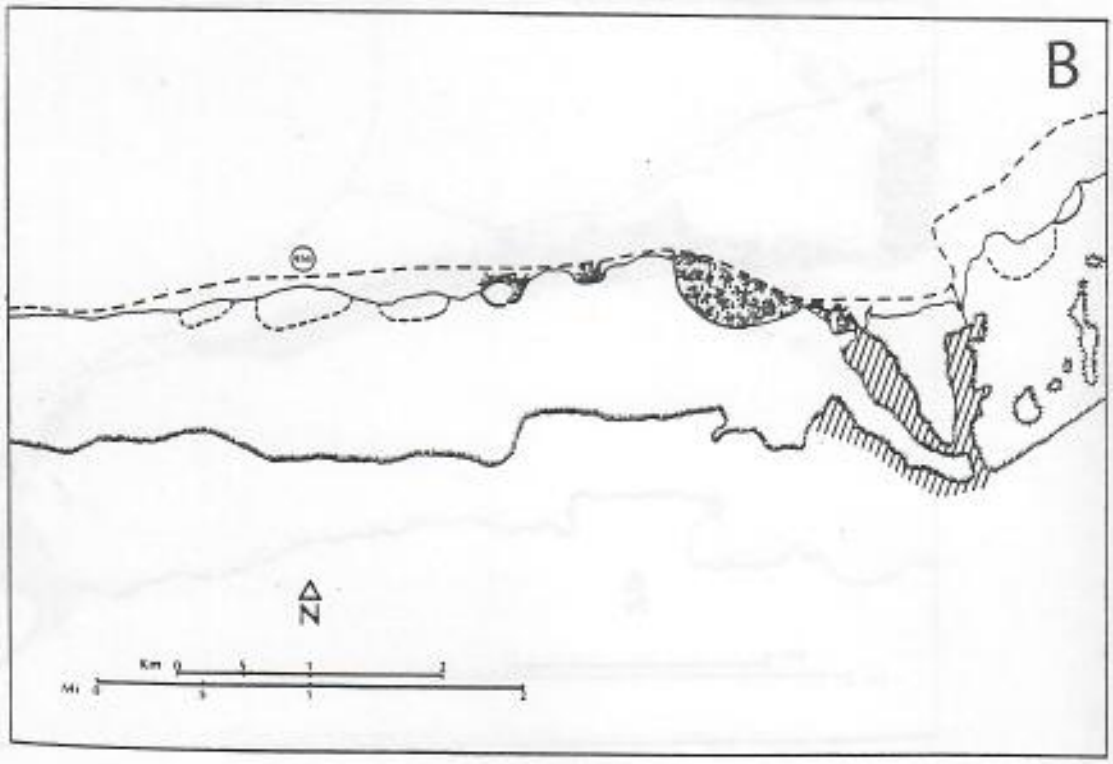
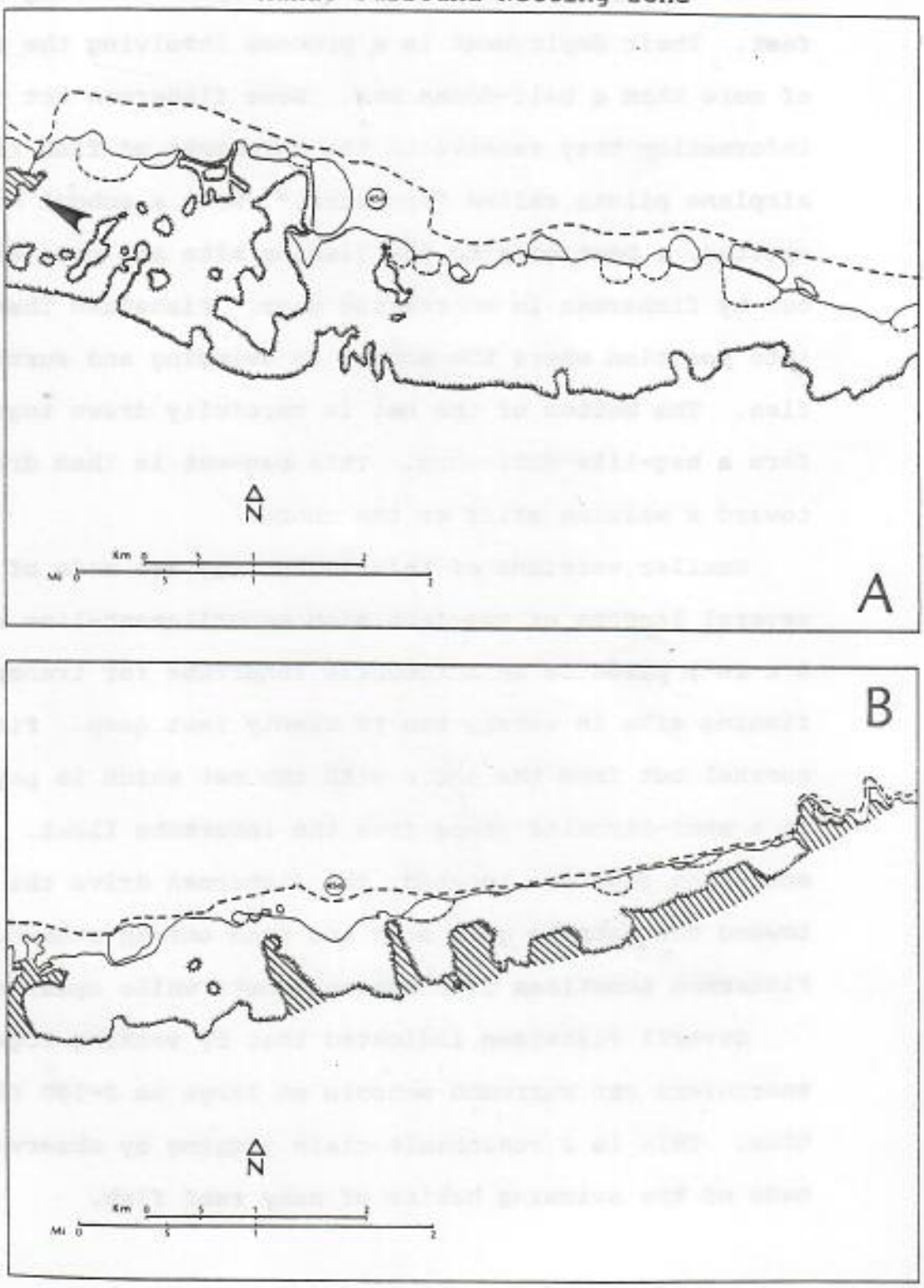


Figure 6.3

Manae Surround Netting Zone



Large-scale surround net activities are most often commercial operations performed in depths exeeding twenty feet. Their deployment is a process involving the efforts of more than a half-dozen men. Some fishermen act on information they receive on the movements of fish from airplane pilots called "spotters." When a school has been spotted, a boat goes to the fishing site and nets are paid-out by fisherman in snorkeling gear. Fishermen then move into position where the school is swimming and surround the fish. The bottom of the net is carefully drawn together to form a bag-like enclosure. This bag-net is then drawn toward a waiting skiff or the shore.

Smaller versions of this technology are made of one or several lengths of two-inch mesh monofilament-line net (4-5'x 20') piled in an automobile innertube for transport to a fishing site in waters ten to twenty feet deep. Fishermen snorkel out from the shore with the net which is payed-out in a semi-circular shape from the innertube float. When schooling fish are located, the fishermen drive the school toward the nets to gill some and then entrap others. Fishermen sometimes used surround nets while spear fishing.

Several fishermen indicated that by working together, snorkelers can surround schools as large as 2-300 fish at a time. This is a reasonable claim judging by observations made of the swimming habits of many reef fish.

Fishermen use surround netting for harvesting schools of fish that swim within the deeper nearshore waters off rocky coasts and in the deep channels that form natural harbors in the fringing reef zone. Akule, opelu, nehu, moi, kala, palani, papio, weke, omilu, o'io, and kaku, represent the fish most often taken in surround nets. Depending on the price of fish set in Honolulu, a large haul of these fish can bring large monetary returns to a lucky group of fishermen.

Present DLNR restrictions for surround net activities apply to all net technologies. They include: a) a minimum net mesh size of two inches (stretched measure) and, b) nets may not be left unattended for a period of more than 12 hours.[13]

Drag Netting

Drag netting (Figure 7) is an active-indiscriminant activity. Like throw netting it is carried on in nearhsore areas in unobstructed silty habitats of the reef-flat along the South Coast. Therefore, drag netting is performed in shallow nearshore zone environments away from rocky coastline areas (Figure 7.1, 7.2, and 7.3).

Drag netting activities were observed twice during the research period. Like throw netting, it is an activity

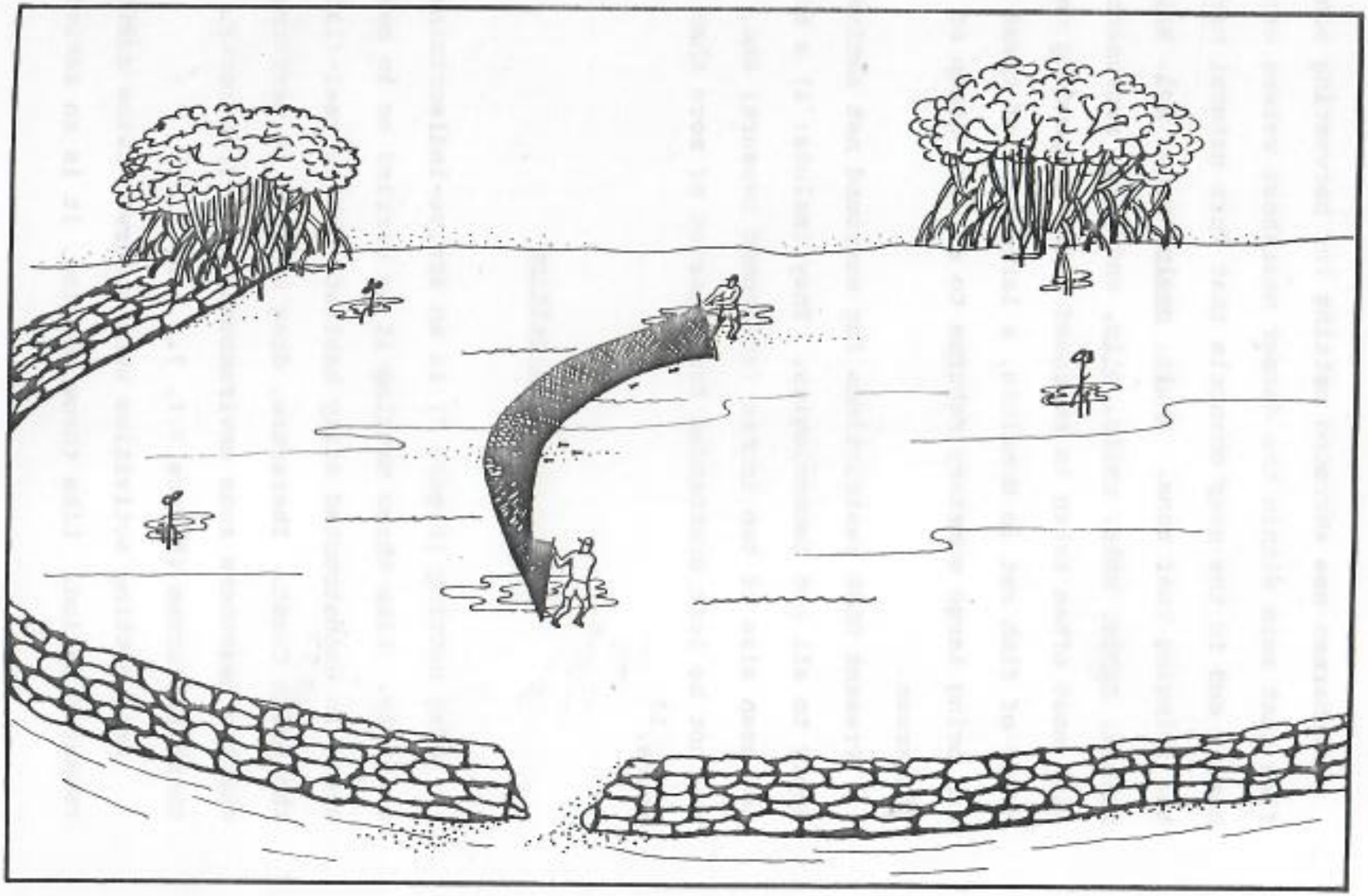


Figure 7 - Drag Netting

Figure 7.1

Palaau Drag Netting Zone

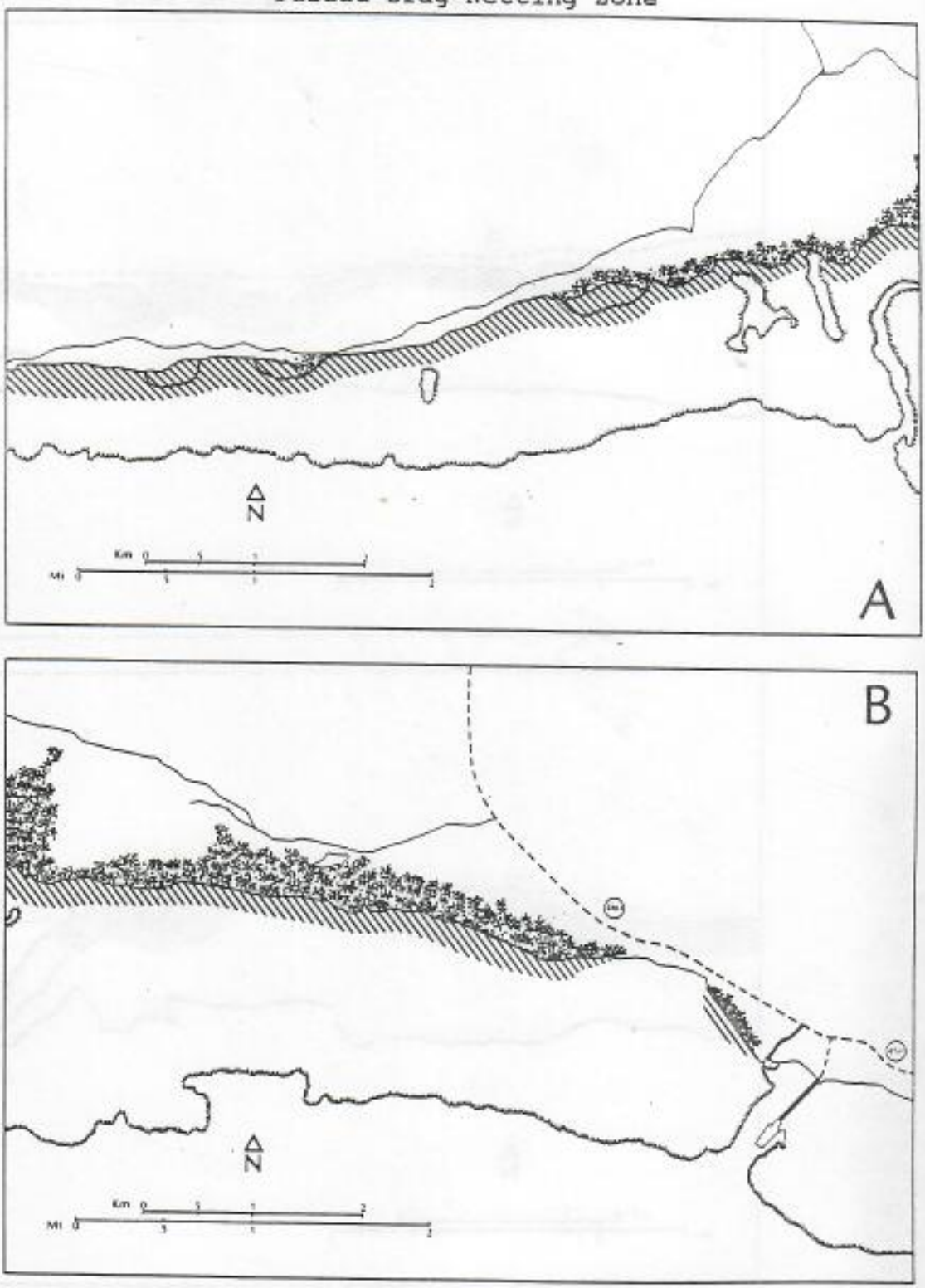
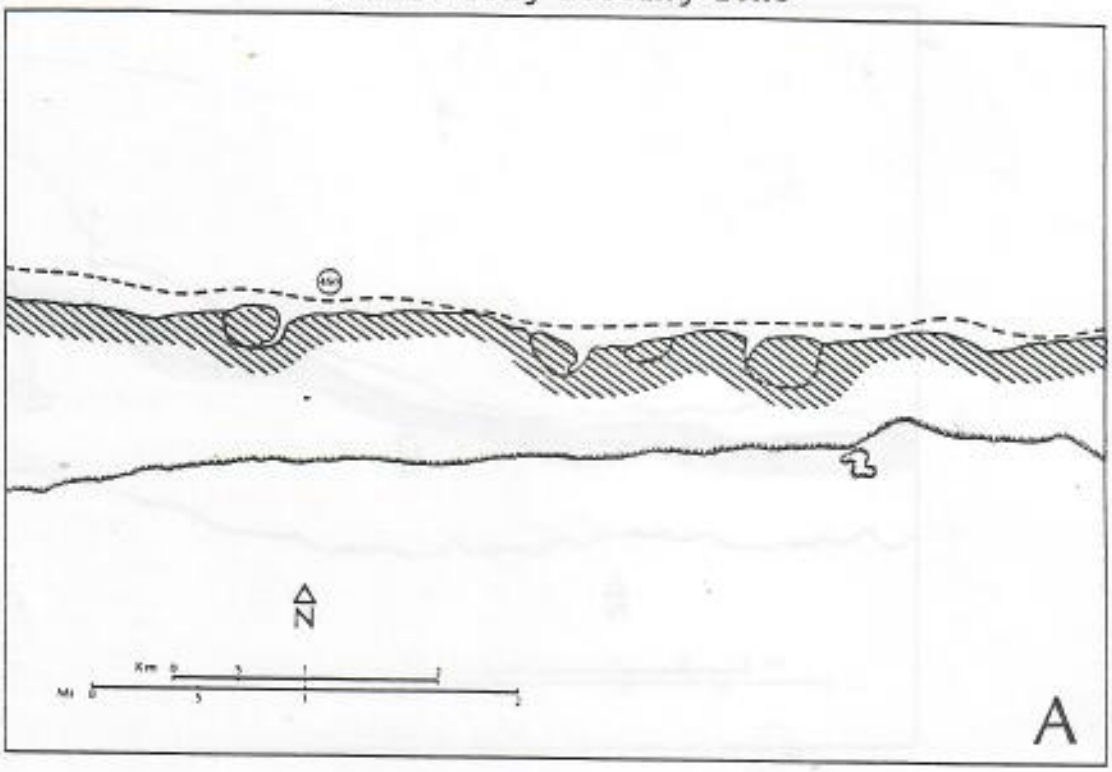


Figure 7.2

Kawela Drag Netting Zone



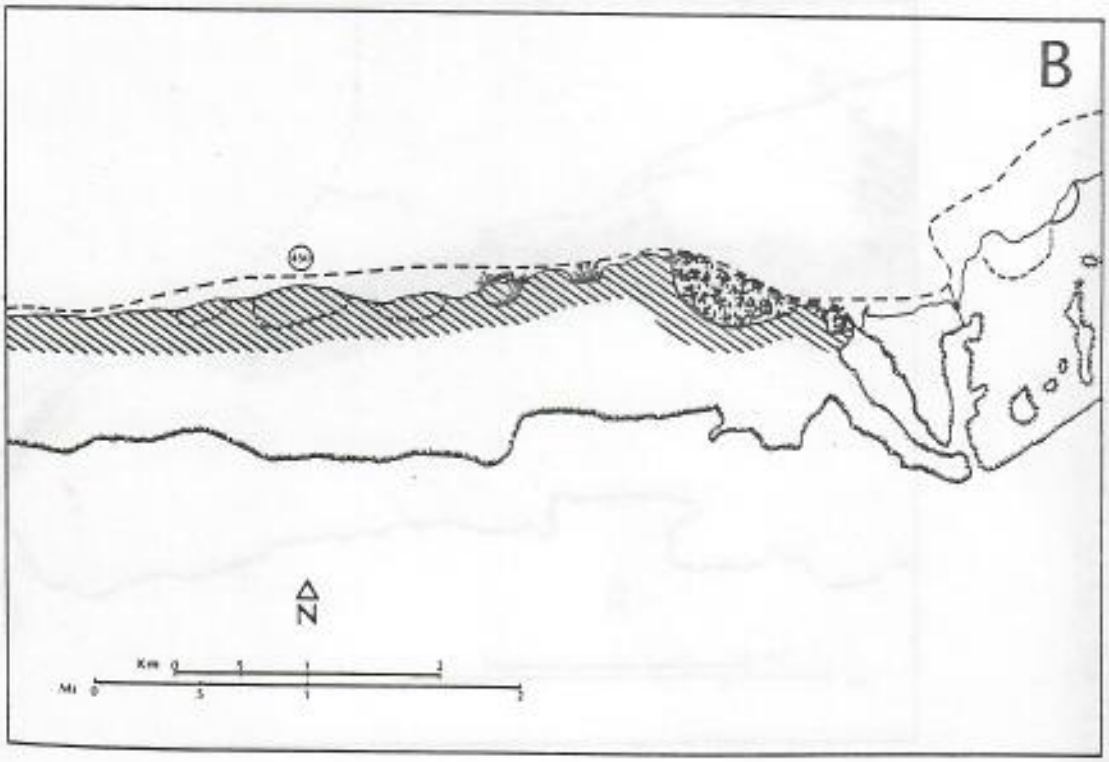
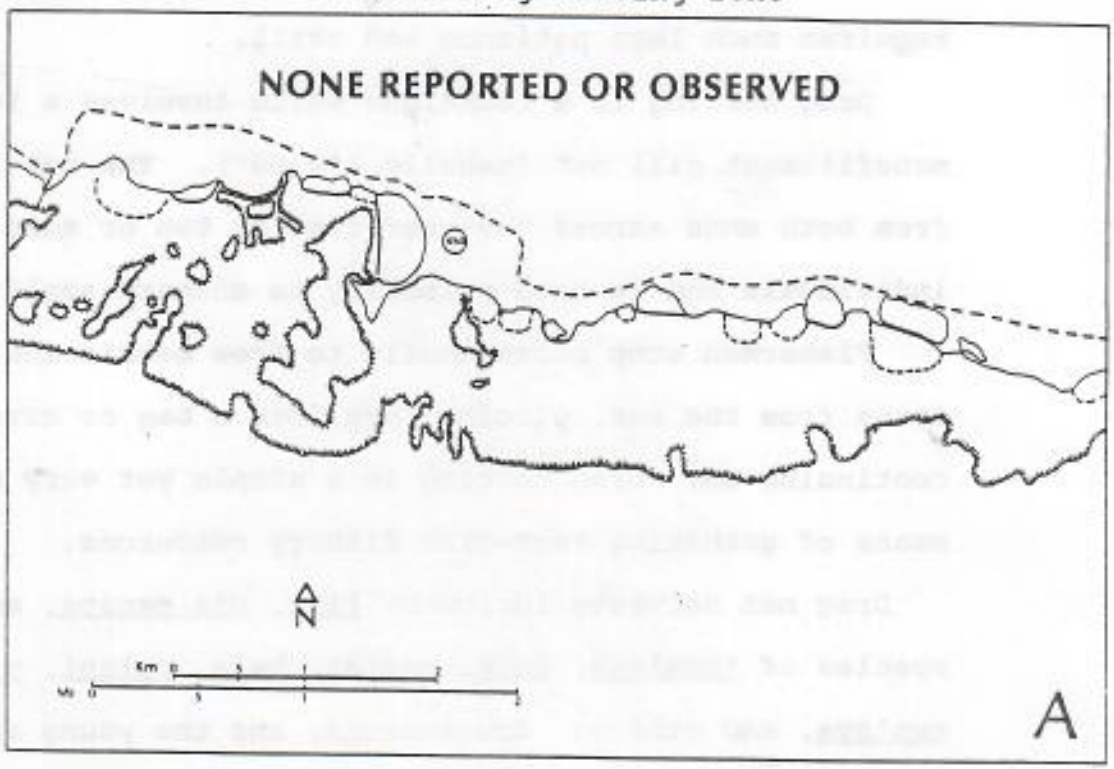
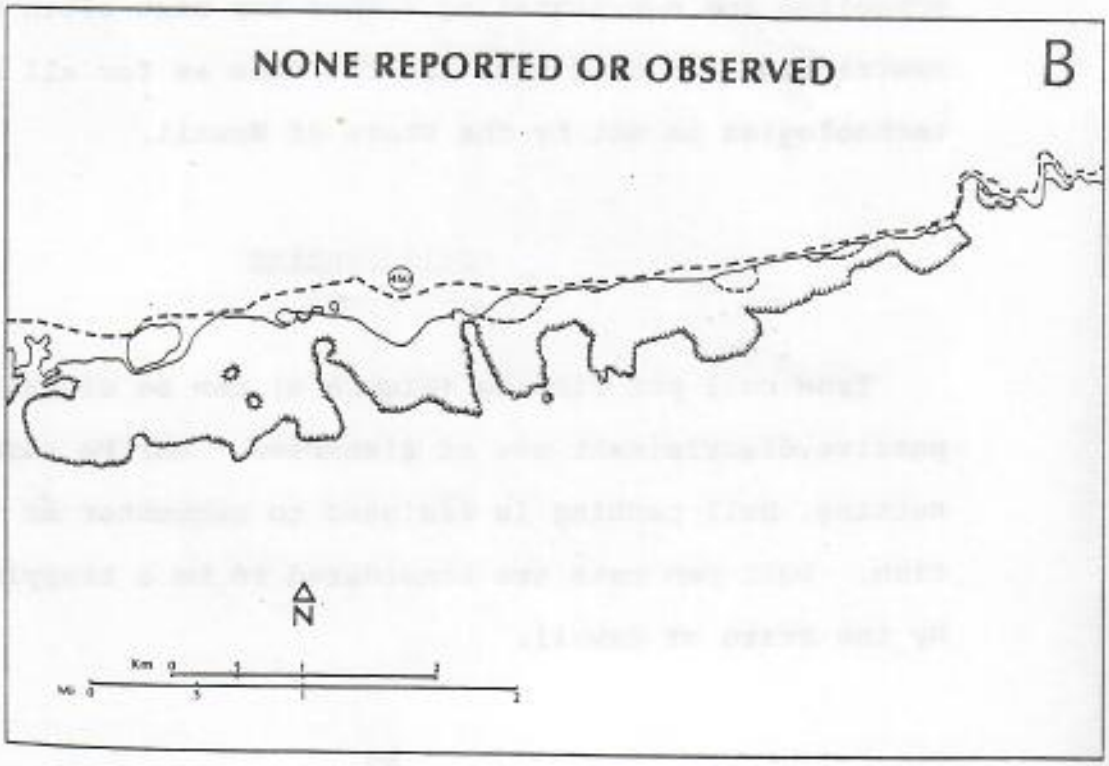


Figure 7.3

Manae Drag Netting Zone





practiced in the shallow (waist-deep) reef-flat waters, and involves two people. Unlike throw netting, drag netting requires much less patience and skill.

Drag netting is a technique which involves a length of monofilament gill net (usually 4'x 50'). The net is drawn from both ends across the reef-flat by two or more individuals and is used primarily to ensnare small fish.

Fishermen stop occasionally to free debris and edible items from the net, placing them into a bag or creel before continuing on. Drag netting is a simple yet very efficient means of gathering reef-flat fishery resources.

Drag net harvests included: limu, ula papapa, and young species of 'ama'ama, weke, manini, kala, palani, o'io, awa'aua, and others. Crustaceans, and the young and small schooling and non-schooling fishes are most often taken. Restrictions on drag nets are the same as for all net technologies as set by the State of Hawaii.

Bull Penning

True bull pen fishing (Figure 8) can be classified as a passive-discriminant use of fisheries. Unlike surround netting, bull penning is designed to sequester or "pen" fish. Bull pen nets are considered to be a trapping device by the State of Hawaii.

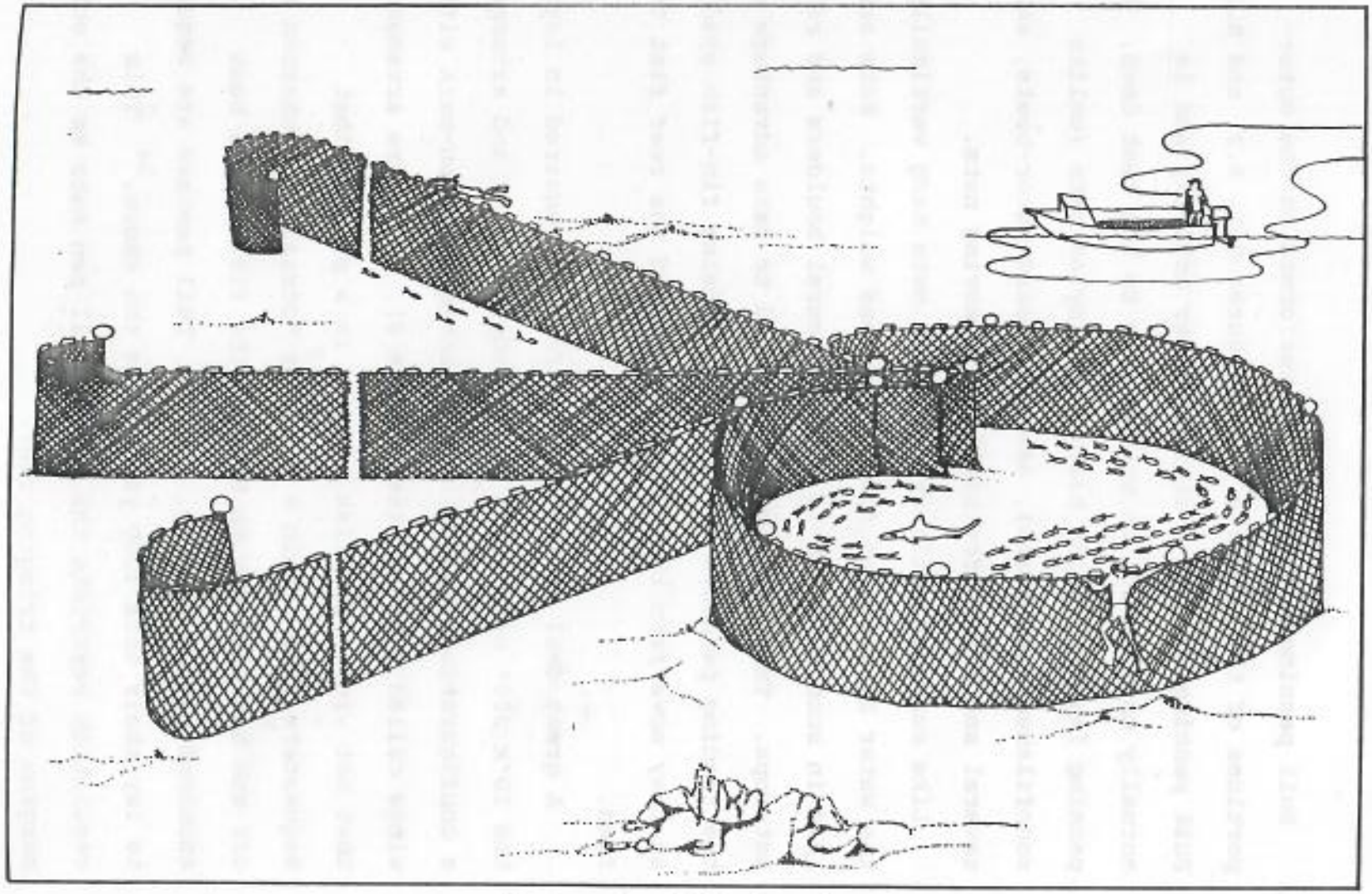


Figure 8 - Bull Penning

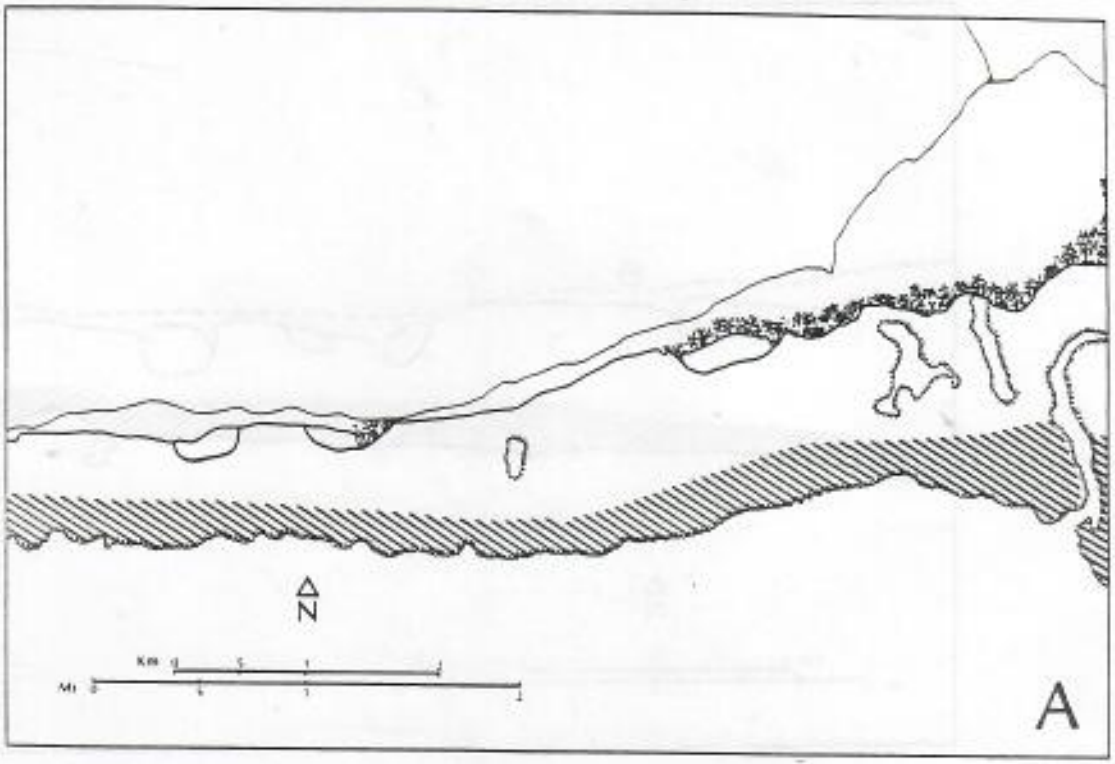
Bull penning activities are performed on the outer-portions of the fringing reef (Figures 8.1, 8.2, and 8.3). Bull penning is also a shallow-water activity and is normally carried out in waters five to ten feet deep. Bull penning involves using heavy woven nylon nets (unlike monofilament materials), small outboard motor-boats, and several snorkelers for setting and moving nets.

Like surround net gear, bull pen nets hang vertically in the water by means of floats and lead weights. Nets are laid in such a way as to surround coral boulders and reef outcrops. This strategy is employed to take advantage of the feeding pathways of the free-swimming fin-fish species as they move from the outer reef toward the reef flat to feed.

A great deal of skill and effort is required in laying the 10'x 200' nets which are strung together and arranged in a configuration resembling a gigantic question-mark with wings called "guides" (see Figure 8). Nets are arranged so that net wings lead fish to swim in a pattern that sequesters them within a "bag" or "corral." Fishermen close off the bag in order to harvest the fish from a boat anchored within the bag. By law, bull penners are required to lay their nets 1000 yards from the shore.[14] This regulation restricts the use of bull pen nets to the outer margins of the fringing reef.

Figure 8.1

Palaau Bull Penning Zone



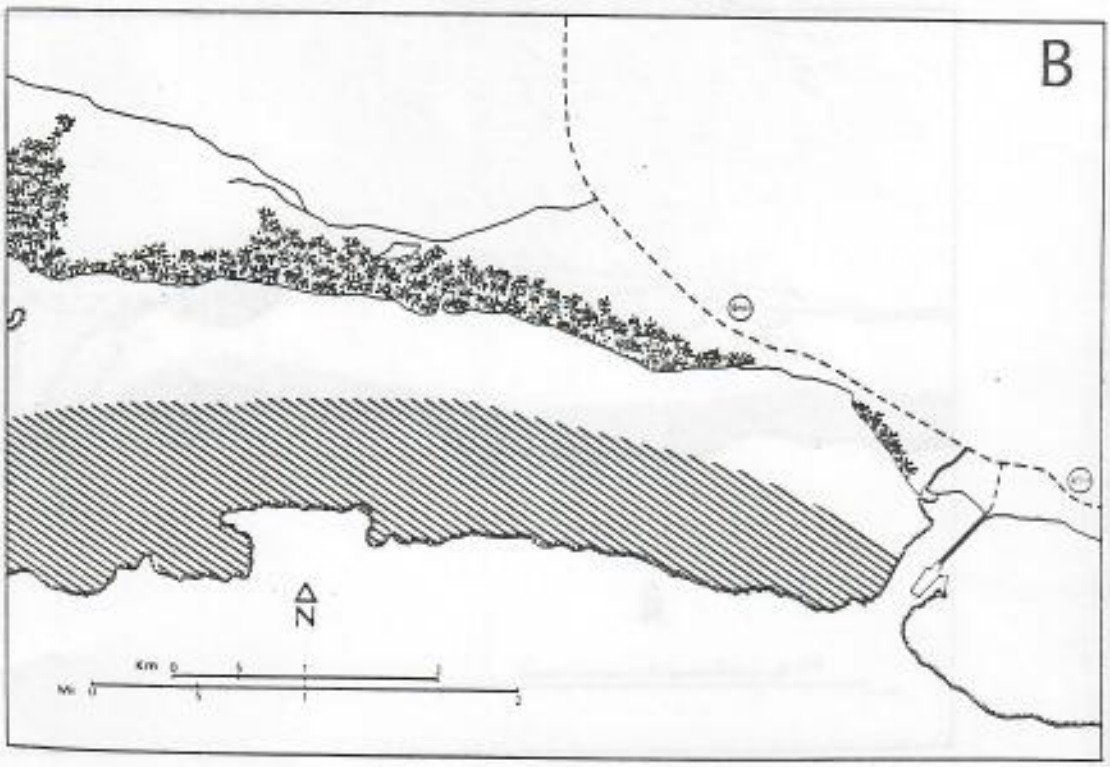
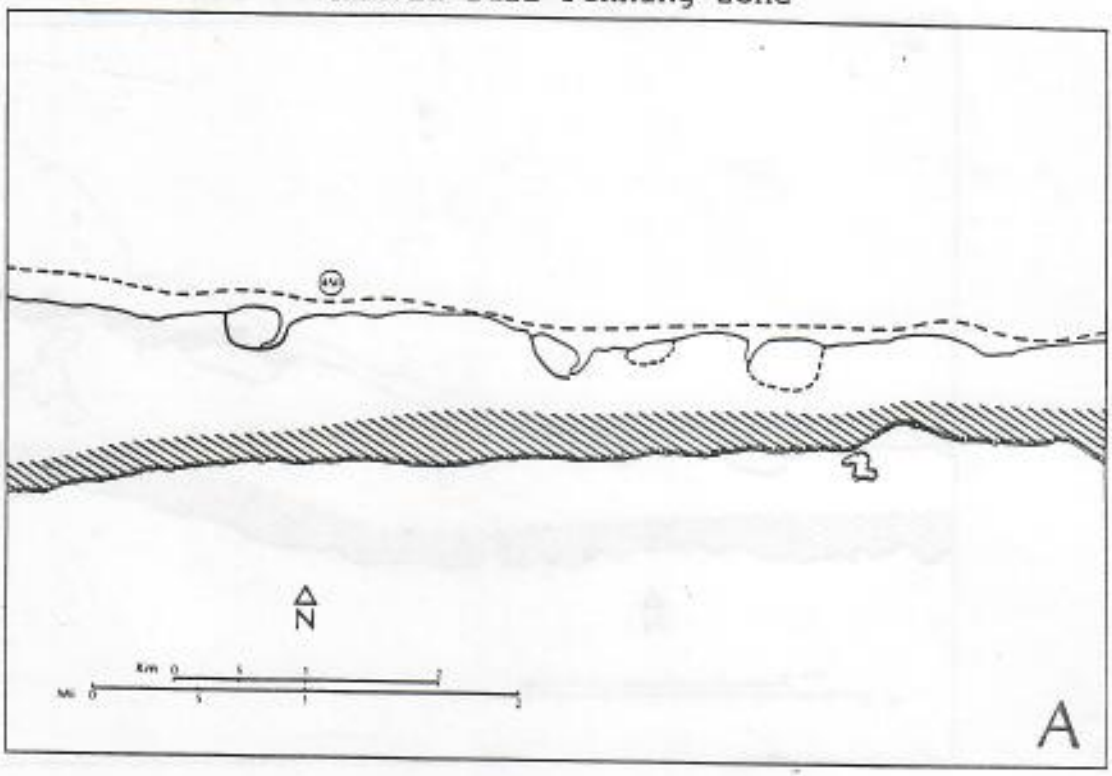


Figure 8.2

Kawela Bull Penning Zone



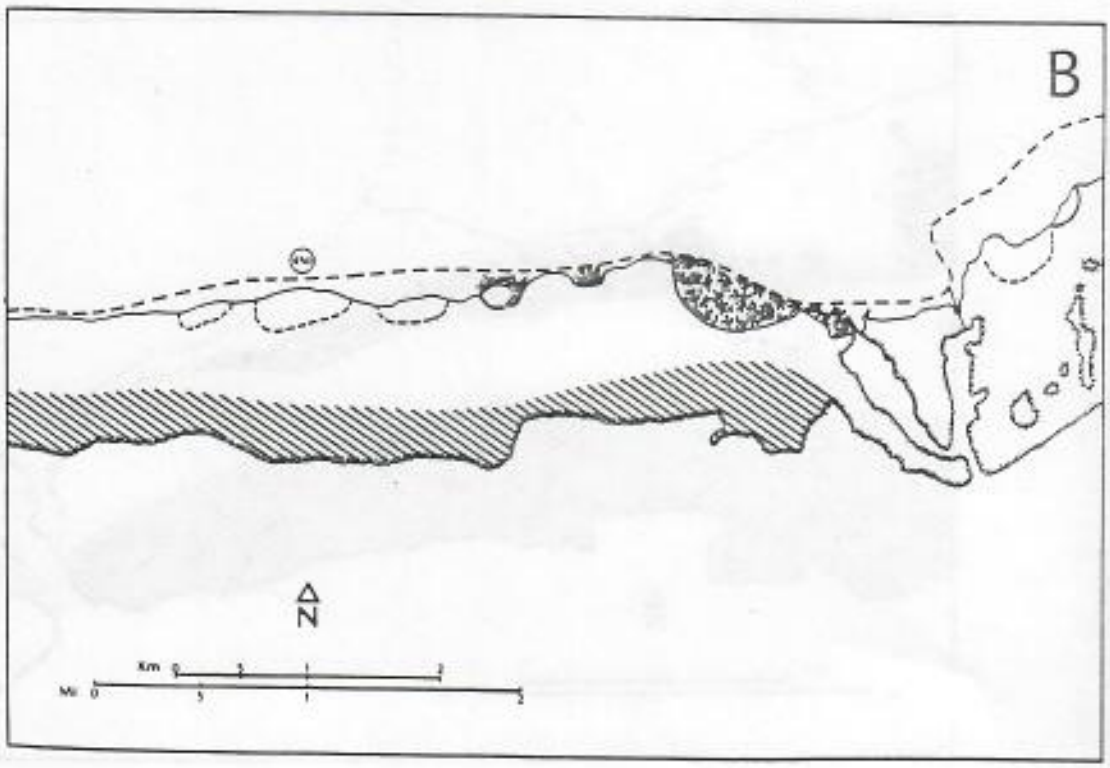
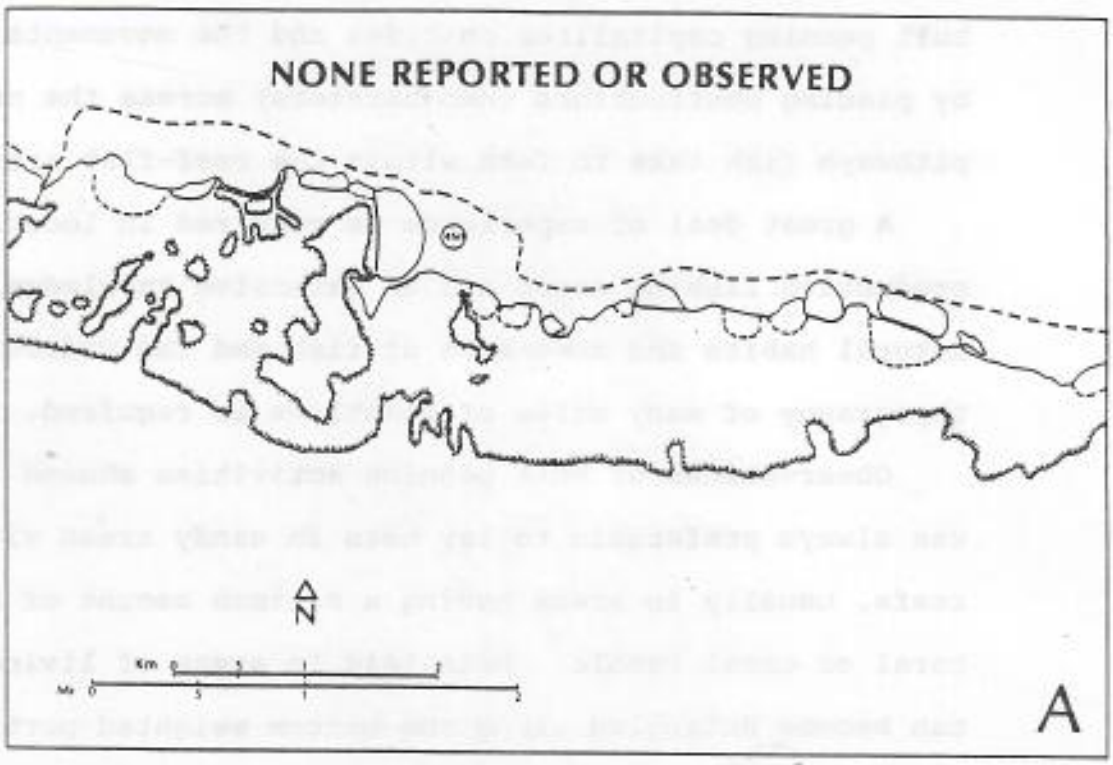
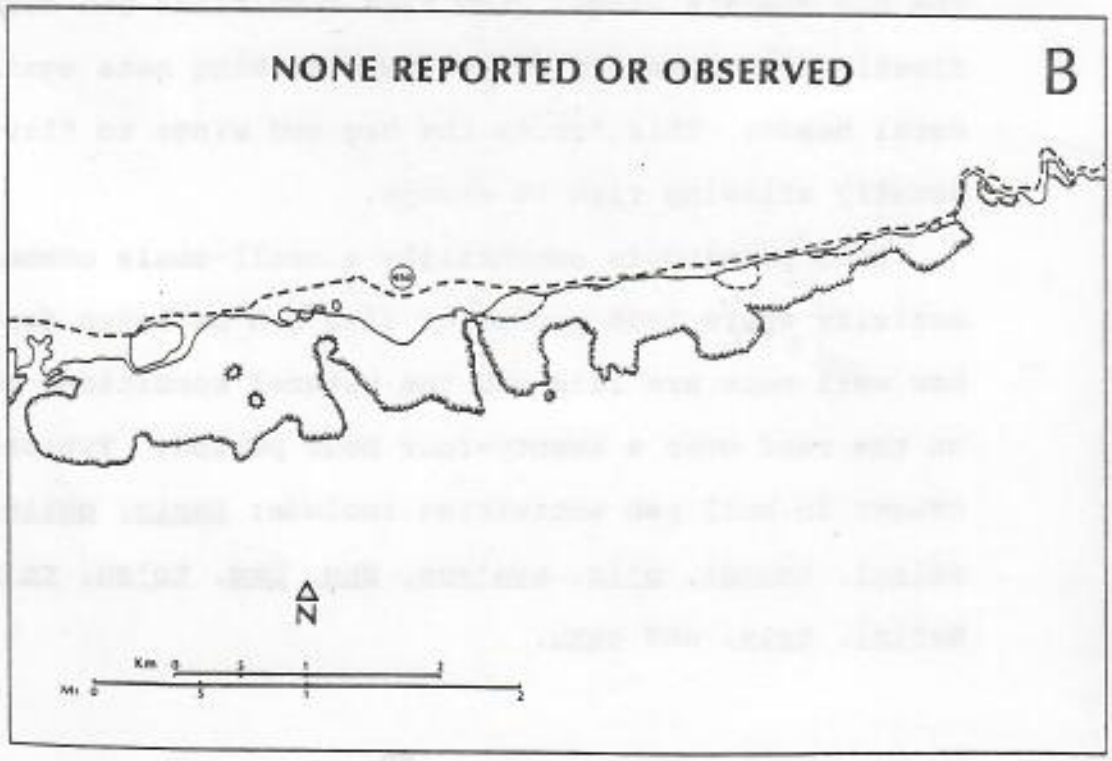


Figure 8.3

Manae Bull Penning Zone





Bull penning strategies take advantage of local reef terrain and the natural diurnal habits of fish. By design, bull penning capitalizes on tides and the movements of fish by placing obstructions (net barriers) across the natural pathways fish take to feed within the reef-flat area.

A great deal of experience is required in locating productive fishing areas and an extensive knowledge of the natural habits and movements of fish and the underwater topography of many miles of coastline is required.

Observations of bull penning activities showed that it was always preferable to lay nets in sandy areas within reefs, usually in areas having a minimum amount of live coral or coral rubble. Nets laid in areas of living coral can become entangled along the bottom weighted portion of the bag and its wings. Low tide conditions can compress the floating net assembly effectively hooking nets against live coral heads. This forces the bag and wings to "lay down" usually allowing fish to escape.

Bull penning is essentially a small-scale commercial activity where 1000 pounds of fish can be taken depending on how well nets are laid and the natural conditions existing on the reef over a twenty-four hour period. Typical species caught in bull pen activities include: Papio, omilu, weke, palani, kagami, o'io, awa'aua, uhu, uku, to'au, ta'ape, aha, manini, kala, and kaku.

Hawaiian green turtles, sharks, rays, and other non-commercial species are often found in bull pens. Releasing rays and turtles is difficult without allowing part of the target fisheries to escape.

Sharks present a particular danger when confined in nets and must be released or destroyed before fish can be harvested. Every effort is made to release these unsalable fish, but the risk of attack by hammerhead and tiger sharks is often too great. On rare occasions very young sharks suffocate after being held stationary in the soft net material by the roughness of their own hides. Small reef fish such as menpachi and aweoweo were the only other species of fish to be found dead in these nets.

Legally, bull penners are allowed to use two-thousand feet of netting or less for their activity. This represents an increase from a five-hundred yard net length restriction placed on bull pens for a short period prior to 1985.

Gill Netting

Gill netting (Figure 9) is classified as a passive indiscriminant activity and is by far the most wide spread method of fishing used on Moloka'i. Gill nets are by definition made of monofilament line or very thin gauge

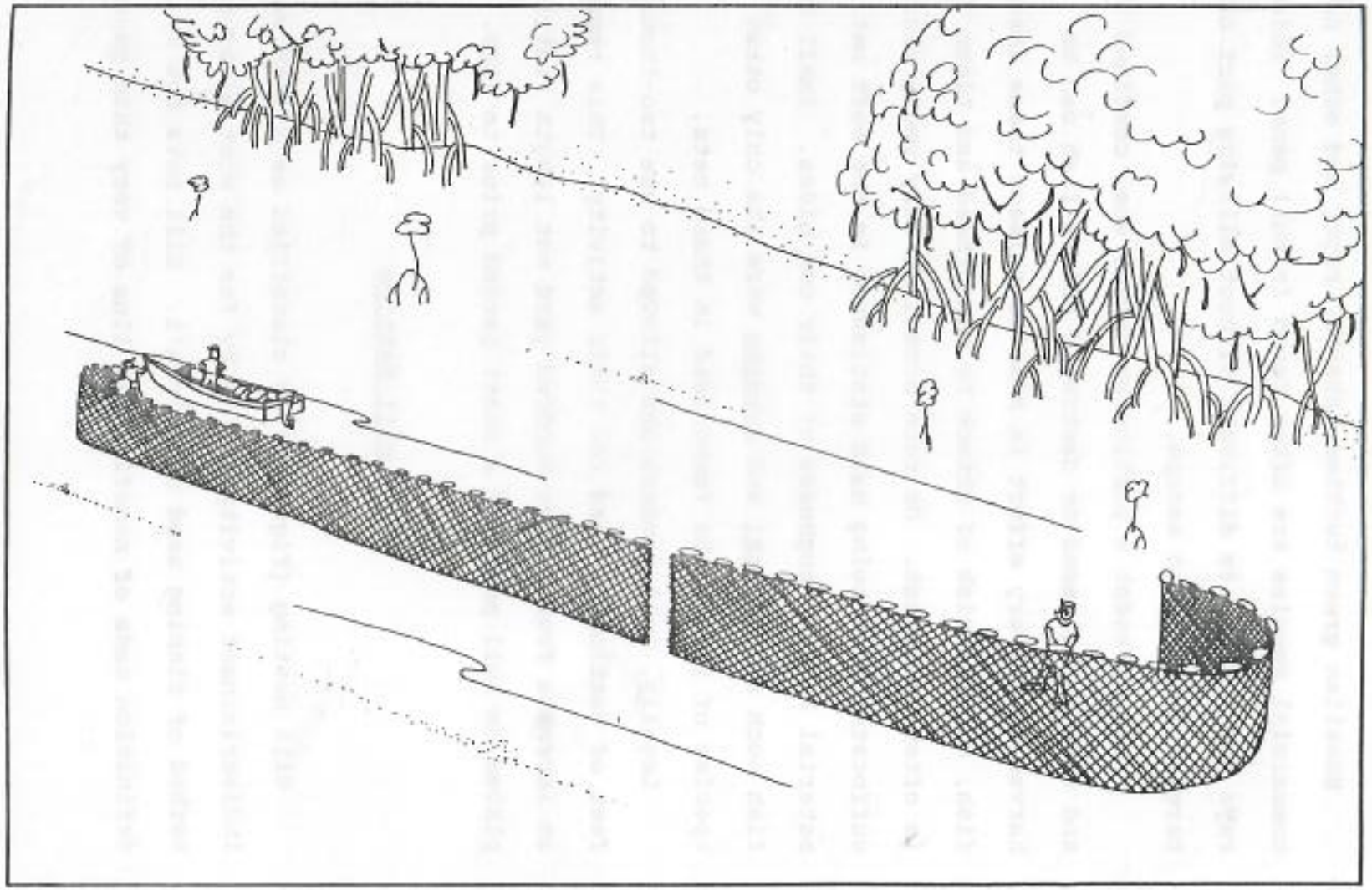


Figure 9 - Gill Netting

nylon cordage woven into the familiar square or diamond shapped pattern.

Although gill netting activities were observed in most parts of the reef-flat, most subsistence and small scale commercial use of gill nets was carried out in the inshore and middle portions of the South Coast fringing reef (Figures 9.1, 9.2, and 9.3).

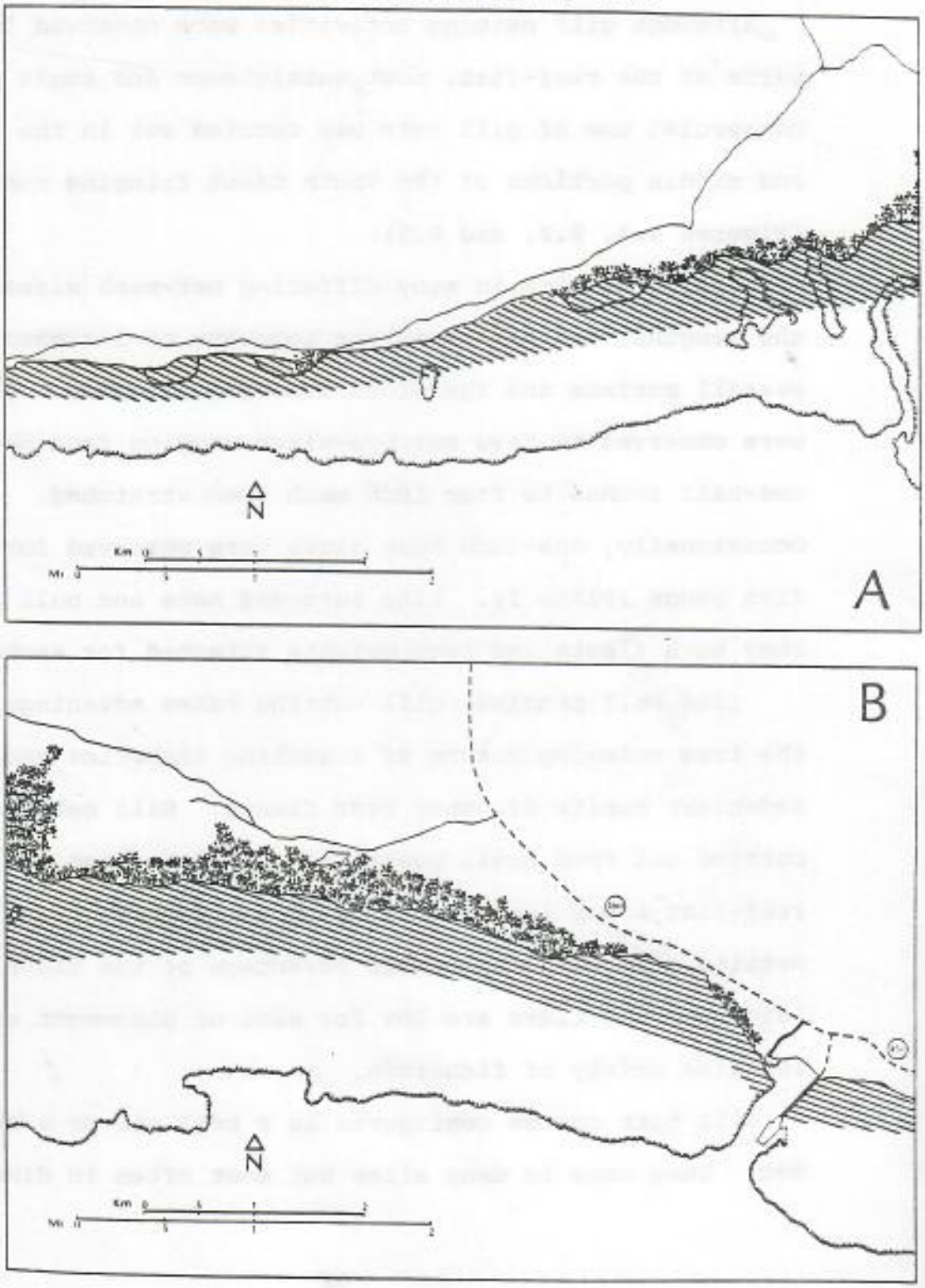
Gill nets come in many differing net-mesh sizes, widths and lengths, and can be strung together to increase the overall surface and therefore its effectiveness. Gill nets were observed to have net eye-sizes ranging from one and one-half inches to four inch mesh when stretched. Occasionally, one-inch mesh sizes were observed for use in fish ponds (Plate I). Like surround nets and bull pen nets, they have floats and lead weights attached for anchorage.

Like bull penning, gill netting takes advantage of both the free swimming nature of schooling fisheries and the more sedentary habits of other reef fishes. Gill netting is carried out from small boats, and is most often set up in reef-flat areas less than five to six feet deep. Gill netting strategies also take advantage of the tides and are laid when the tides are low for ease of placement and relative safety of fishermen.

Gill nets can be configured as a bull pen or a surround net. They come in many sizes but most often in dimensions

Figure 9.1

Palaau Gill Netting Zone



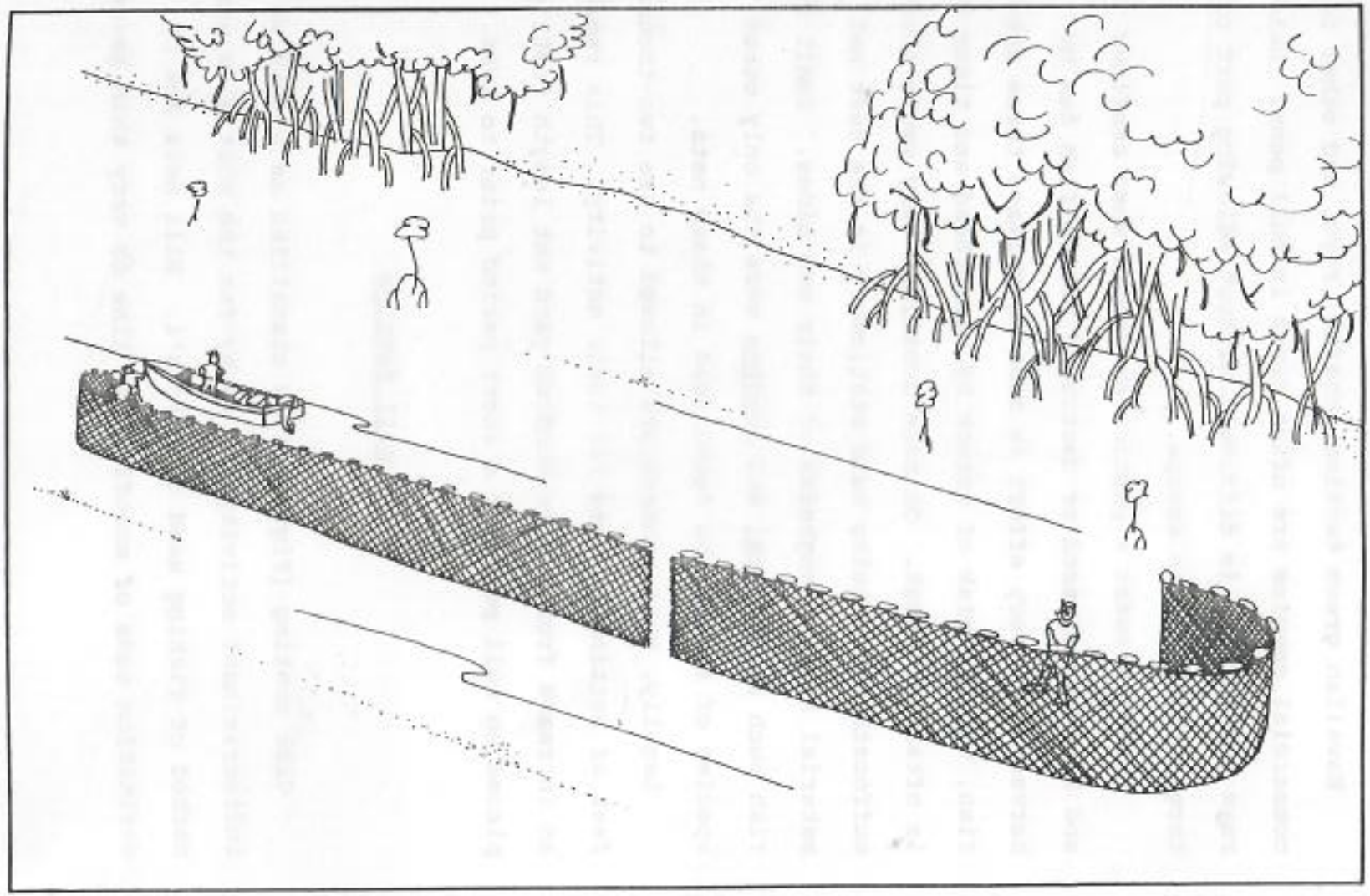
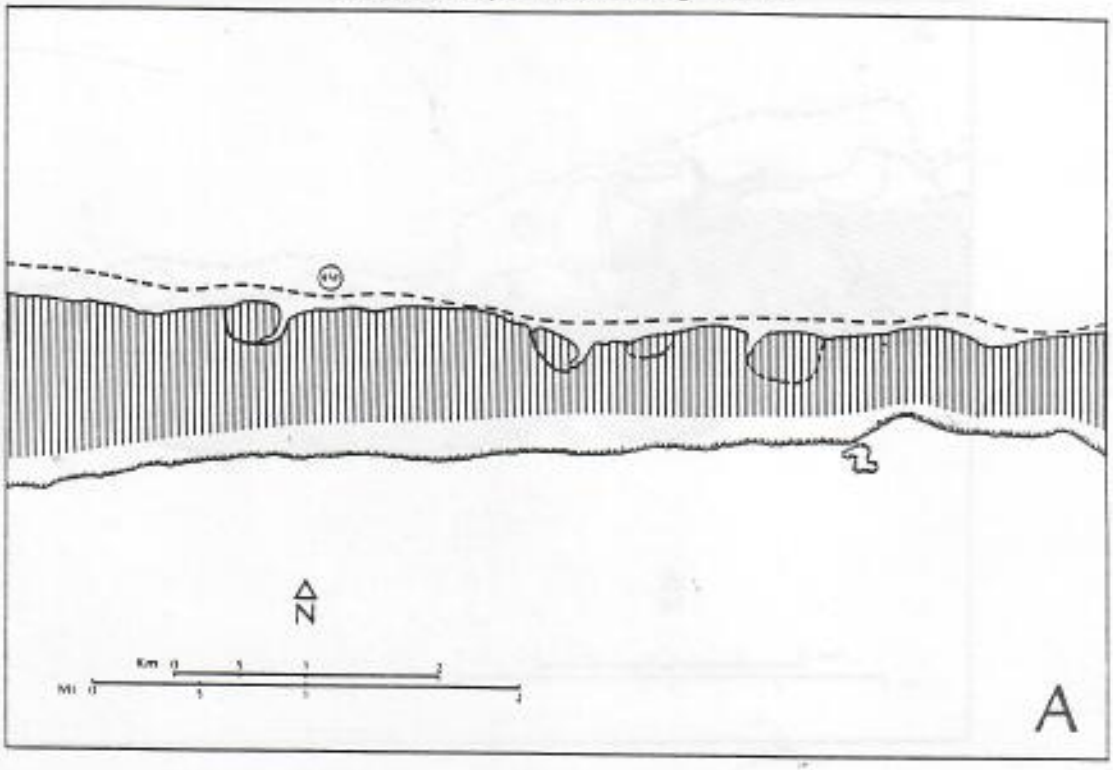


Figure 9 - Gill Netting

Figure 9.2

Kawela Gill Netting Zone



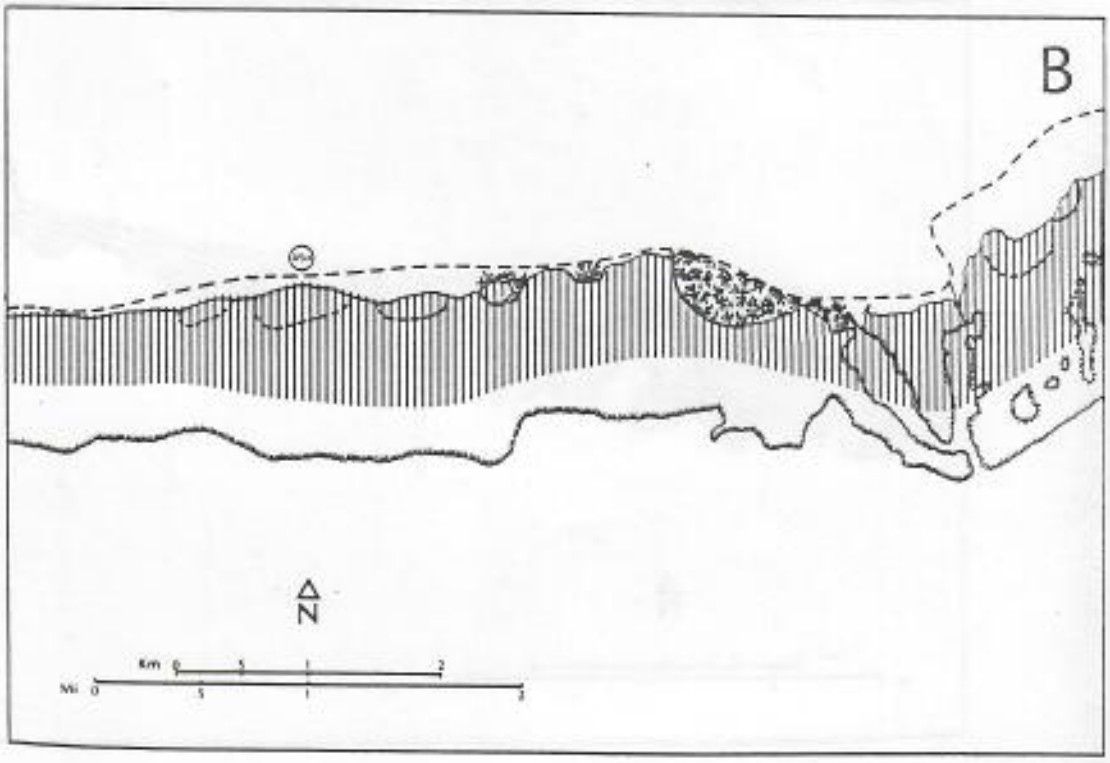
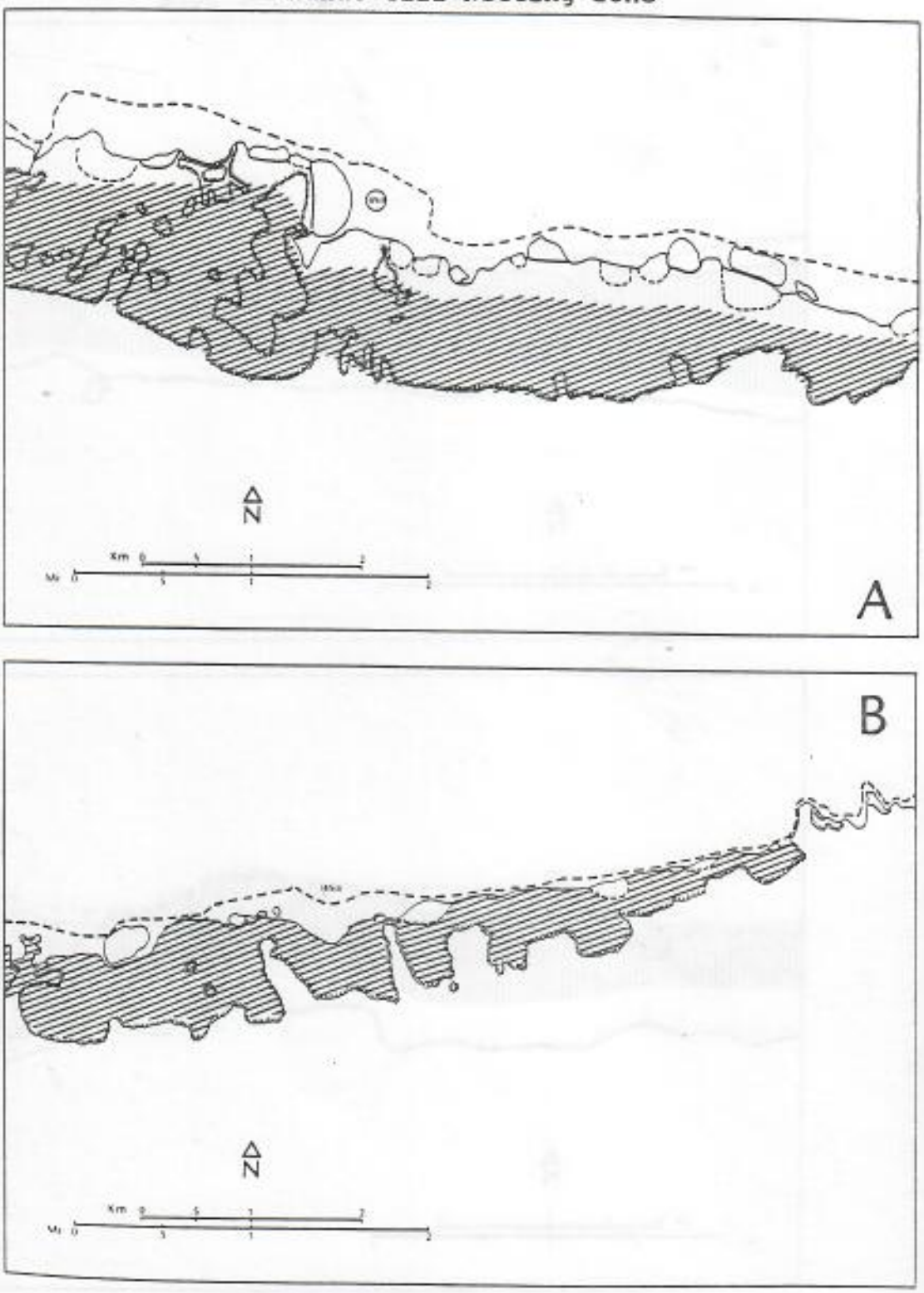


Figure 9.3

Manae Gill Netting Zone



of 5' or 6'x 200' for use by local fishermen. They are usually set out from a small boat by two or more individuals across reef channels or on reef-flats and are checked and harvested from time to time.

Fishermen say that fish "stick like magnets" to gill nets, and for good reason. Laid across natural migratory pathways, these nets take advantage of a school's instinct for avoiding obstructions, and feeding in nearshore waters during high tides. When fish are caught in gill nets, they struggle to work themselves free by trying to swim forwards. This only serves to entangle the fish more securely.[15]

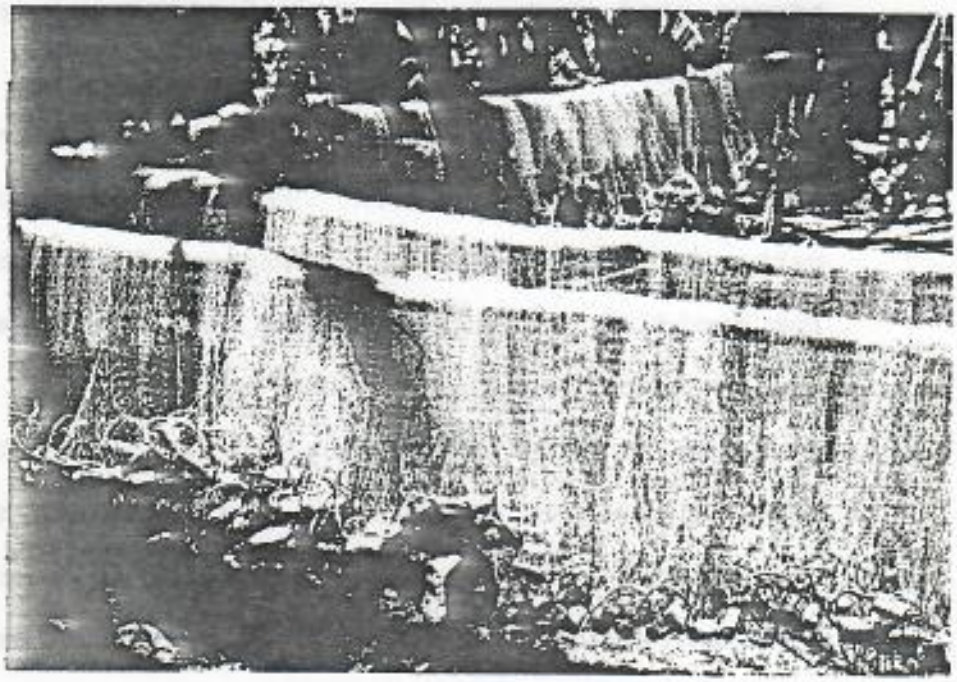
Typical harvests of fish in gill nets are nearly the same as for bull penning except that the larger species of fish (those heavier than ten to fifteen pounds) are not usually caught. During series of observed activities, papio, omilu, weke, palani and kaku were most frequently harvested. Restrictions on gill nets are identical to those previously mentioned for net technologies.[16]

Summary

Three main factors determine the spatial distribution of fishing activities on Moloka'i. These factors are interrelated and include: 1) the physical structure of the reef environment and the influence it has on the movements

Plate I

Small-Eyed Gill Nets Used in Fish Ponds



of target fisheries through it, 2) the chosen range within which each of the six fishing technologies can be carried out safely and effectively, and 3) the influence that fishing territoriality has on decisions to fish or not to fish in certain areas.

Fish move from the offshore to the inshore areas to feed through channels and reef flat depressions that occur along the South Coast fringing reef. All of the species listed in Appendix C were harvested in both the inshore and offshore portions of the fringing reef complex. Therefore, the physical structure of the reef appeared to offer little or no effective barriers to the movements of the popular fisheries except when negative tides are encountered.

The spatial range at which a particular fishing technique or gear is useful can be determined by reef topography. Throw nets and Drag nets are restricted to the shallower parts of the reef because their utility and effectiveness are greatest in those environments. Bull pen activities are usually restricted to areas uncluttered by coral heads and rubble. Surround nets and gill nets are generally limited to these areas as well. Spear fishing is limited by an individual's ability and choice rather than by gear. Yet, there is a vertical relationship between depth and the effectiveness of gear. In general, gear "power"

(range and accuracy) must increase with depth to correspond with the increase in size and speed of fish in deeper waters.

A respect for the territorial claims of the back yard fishermen in the Manae section seems to account for the sudden end of bull pen and drag net fishing at Kamalo marking the eastern section of the study area. The spatial distribution of bull pen and gill net activities are influenced by reef topography and the threat of community reprisal rather than by technological effectiveness. Bull pen fishermen appear to have been unjustly blamed for over-fishing the South Coast. Residents who had not witnessed how bull penning is done had overturned bull pen nets on several occasions in the east end of the area. In order to avoid conflict, bull pen fishermen restrict their activities to the Palaau and Kawela sections of the study area.

An absence of drag net activities within the Manae section may also result from community sanctions. Drag net fishermen harvest the small inshore fishes of the coast that are traditionally let alone by other fishermen. One fishermen suggested that because the drag net fishermen were Filipino and "liked smaller fish for food" their way of fishing was "taking all the babies." Local Hawaiian fishermen said they prefered to take the larger, mature fish as a matter of tradition.

Chapter 4

COMMUNITY FISHERY MANAGEMENT PRACTICES

The Fishing Problem: A Local Perspective

Local islanders say that community competition for nearshore marine products results from destructive fishing techniques used by some fishermen. They believe that without a formal system of traditional fishing rights, or restrictions enforcing laws and regulations for their coral reef fisheries, increased competition has resulted in severe resource depletion and community conflicts.

According to this view, coral reef fisheries are vulnerable to unrestricted use. They appear to have been over-fished or simply "scared away" by resident and non-resident fishermen alike. Older fishermen remember that great schools of moi, ʻamaʻama, and akule once darkened the shallow nearshore reef flats of Molokaʻi. Although many younger islanders doubt the accounts of their older counterparts, fishermen agree that there are more fishermen harvesting fish from Molokaʻi waters. In other parts of the Pacific, post-war intensification of nearshore fisheries use has resulted in the physical destruction of coral reefs,

depletion of fishery stocks in both number and variety, and fishing community competition for fisheries (Gomez, 1980; White, 1984; Spoehr, 1984). These same conditions contribute to declines in productivity within the fringing reef ecosystems on Moloka'i.

A majority of the Moloka'i fisherman interviewed said their fisheries were being more heavily fished by off-islanders than in the past. Several said they have come to view State fisheries regulations as favoring the commercial and sport fishermen over the protection of local fisheries and local fishermen. They said that noticeable depletions of several of their local fisheries were being caused by "outsiders" sending "coolers-full" of Moloka'i fish back to O'ahu or Maui on weekends. They also said they had witnessed unidentified fishermen "dumping hundreds of pounds of spoiled fish on the beach" because one fisherman had harvested more fish than was possible to keep on ice. It was often stated that local State-employed enforcement personnel are understaffed and ill-equipped to prevent those kind of episodes from happening.

Many local fishermen said they were inclined to shoulder the enforcement responsibility themselves. Some already have. One individual related how he had driven-off two "O'ahu fishermen" from an area on the East End by firing a shot-gun over their heads. Other fishermen choose to ignore

the State regulations. A local spearfisherman said this was especially true because, by not restricting outsiders from fishing in Moloka'i waters, the State was favoring non-local fishermen over locals.

Many of Moloka'i fishermen interviewed expressed the sentiment that "Moloka'i fish should be for Moloka'i fishermen." Said one man, "We are going to take what is ours until there is nothing left." Others felt that this attitude threatened the unique identity of local Moloka'i islanders, because locals "should be allowed to take fish anytime, but not hog the ocean for themselves...the ocean is for everybody."[17]

Local Fishery Management

Moloka'i fishermen concerned about the depletion of fisheries practice several conservation methods that may preserve or enhance the resource. These methods include: throwing back undersized fish, the rotational use of fishing grounds, the practice of secrecy regarding the location of productive fishing grounds, and the exercise of konohiki-style (exclusive user-enforced) territorial claims to certain fishery locations.

Local net fishermen conserved their resource by "letting the little ones go." Indeed, the "little ones" and larger

fish did often get away through holes created by normal wear and tear of woven nylon nets.

In general, fish were able to slip through, under, and over poorly laid nets. When monofilament gill nets with mesh sizes of two-inches or smaller are laid well, they allow for very little means of escape. One fisherman used two-hundred foot sections of gill nets tied together to produce lengths exceeding one mile. The total harvest exceeded six-hundred pounds of fish composed mostly of papio and weke.

During tidal changes fish had a tendency to bolt nervously upon encountering these artificial barriers and often managed to escape through even very small holes. This was less true for the tougher monofiliment and "shoji" net gear. It was said that once lost, the fish that got away one day would be caught by someone else the next. Few fishermen felt that the release of young or undersized fish would insure an abundance of fish for the future.[18]

Management Practices

Many small-scale commercial and subsistence fishermen interviewed said they tended to rotate the use of their fishing sites on a regular basis in order to conserve their resource. Decisions on where to fish changed in accordance

with the movements of fish, the tides, and whether other fishermen had extensively used an area. Fishermen chose a spot from an array of known aggregation sites and migratory pathways where experience indicated fish would most likely feed or spawn.

Notable exceptions to the informal rotation of sites sometimes occur during personal observations of the behavior of fishermen. One group chose not to remove their nets from a particularly productive site for several days. Gill nets were left in one place during the summer fish migrations of opelu, akule, and papio resulting in a massive harvest for a group of three individuals.

From a social standpoint, the rotation of fishing sites is necessary in order to avoid bad feelings between competing fishermen. On Moloka'i, the nearshore waters of the South Coast can be quickly surveyed in an automobile from the coastal highway. Fishermen often made quick visual checks of their competitors so that territorial overlaps could be avoided. In terms of resource management, this rotation may preclude over-fishing of the site's less migratory fisheries and help to sustain fishery yields at levels complimentary to both subsistence and commercial needs.

The avoidance of conflict and respect for established territorial use of fishing sites can lead to establishing

local konohiki-style or "fixed" (Cordell, 1978) territorial claims. Unchallenged use of certain fishing sites presented some fishermen with opportunities for establishing or reinforcing territorial rights, but most often resulted in resentment from other less opportunistic fishermen who had been excluded by these claims. These animosities never escalated into physical confrontations during the study period. However, fishermen often cited an incident involving the destruction of nets and the use of firearms (discussed above).

Secrecy can be considered an information-mangement device which has contributed to creating and maintaining rights to favored fishing areas. It may in effect conserve the resource by serving to disperse fishing pressure (Mckay, 1978:399). The use of secrecy by Moloka'i fishermen was a strategy for maintaining informal territorial rights to certain productive fisheries. If the amount of fish harvested lies somewhere below the reef environment's productive capacity, secrecy can be viewed as resource management "insofar as [it mitigates] the likelihood of over-fishing" the resource (Mckay, 1978:399).

One group of fishermen never discussed where they planned to fish, what they usually caught, or even what they hoped to catch with other fishermen. Since they had consistently harvested large amounts of fish (often more

than three-hundred pounds per trip), other fishermen often expressed a keen interest in the group's strategies and techniques.

The practice of secrecy was a social control mechanism by which fishing activities were dispersed over the South Coast reef environment. Off-island fishermen or new residents who were uninformed about where to fish in local community waters soon learned not to risk fishing in certain areas owing to information they received about threats from local fishermen. On Moloka'i, secrecy and efforts to preserve territorial control are tied to the informal establishment of fishing rights. The preservation of territorial control amounts to a spatial system of resource management by local fishermen.

Secrecy may also reflect a sophisticated understanding of local fishery production capacities. Research aimed at gathering numerical data on the weight, size and age characteristics of fishery harvests should be directed at monitoring the effects of community strategies (such as secrecy) for restricting access to local fisheries by non-residents and locals alike. The practice of secrecy may minimize the threat of over-fishing small-scale community fisheries by both locals and outsiders and, over time cause fishery populations to stablilze at production levels to fit local use patterns.

Management Strategies

As previously stated, a goal of this work was to interview Moloka'i fishermen for the purpose of gathering alternative fishery management ideas. The management ideas represent an aggregation of testimonies specifically related to questions on fishery management innovations and ideas.

Alter Net Mesh "Eye" Sizes

A management strategy that made the most sense to fishermen interviewed was the call for changing some state regulations on fishing gear. Adjustments would include altering certain technologies in two ways including: a) enlargement of net eye-sizes to be phased-in over a four to six-year period; it was suggested that net eye-sizes should be increased from 2 inches by an average of 1/4 inch per year up to an eye-size of three inches; and b) Limitation of gill net lengths to less than one mile. In conversations with local fishermen, they judged mile-long net lengths of monofilament gill nets to be excessive because of the "killing power" gill nets had on not only target species, but on non-target fisheries and the immature members of both groups. One fisherman said: "They kill everything."

Although fishermen tended to respect the rights and property of others, there were strong resentments of fishermen who spread their gear over large distances within shared fishing areas. Tensions also rose when fishermen left their nets in place for periods of several days.

Leaving nets in one place for periods longer than twenty-four hours is considered "unfair" or "greedy." Fishermen said that nets have been "turned over," torn, or stolen by locals who felt others were "hogging" the resource.

Redevelopment of Fish Ponds

Most of Moloka'i's fifty-three fish ponds and fishtraps have deteriorated over the years. Since the late 19th century, the maintenance and repair of fish ponds virtually ended after the redistribution of Royal Hawaiian land holdings (the "Great Mahele") during the mid-1800's. Since then, publicly and privately owned fish ponds have been damaged by waves from occasional Pacific hurricanes, filled in with silt from overgrazing of upland slopes, and covered by spreading forests of mangrove. However, despite the generally dilapidated condition of the majority of fish ponds, a few have been well maintained. These operational

ponds leave no doubt as to their function and value as holding pens and aggregation structures.

Thrownet fishermen often work both sides of fish pond walls which afford a useful throwing perch and vantage point. Dragnet fishermen take advantage of the the increased number of fish around the fish pond walls as well.

It was often suggested that the South Coast's remaining fish ponds be developed for the production of ama'ama, awa, and other brackish water fishes. Fish ponds worth developing for these purposes would most likely be Alii Fish Pond at Makakupaia (Figure 10), and Loipunawai Fish Pond at Ualapue (Figure 11). Both appear to have survived as productive ponds. They could be maintained and stocked by local volunteers or those performing community service on the island. Fishermen are willing to support projects that would make the ponds a model of Hawaiian fish pond productivity. Local ideas ranged from turning ponds into fishery reserves, shelters for fish fry, research facilities, a community source of food fish and commercial profit.

The redevelopment of several fish ponds and fishtraps for food production or for profit had the unanimous support of the Moloka'i fishermen interviewed. Practical ideas for the repair, maintenance, and restocking of fish ponds centered around the production of fish for sale to local

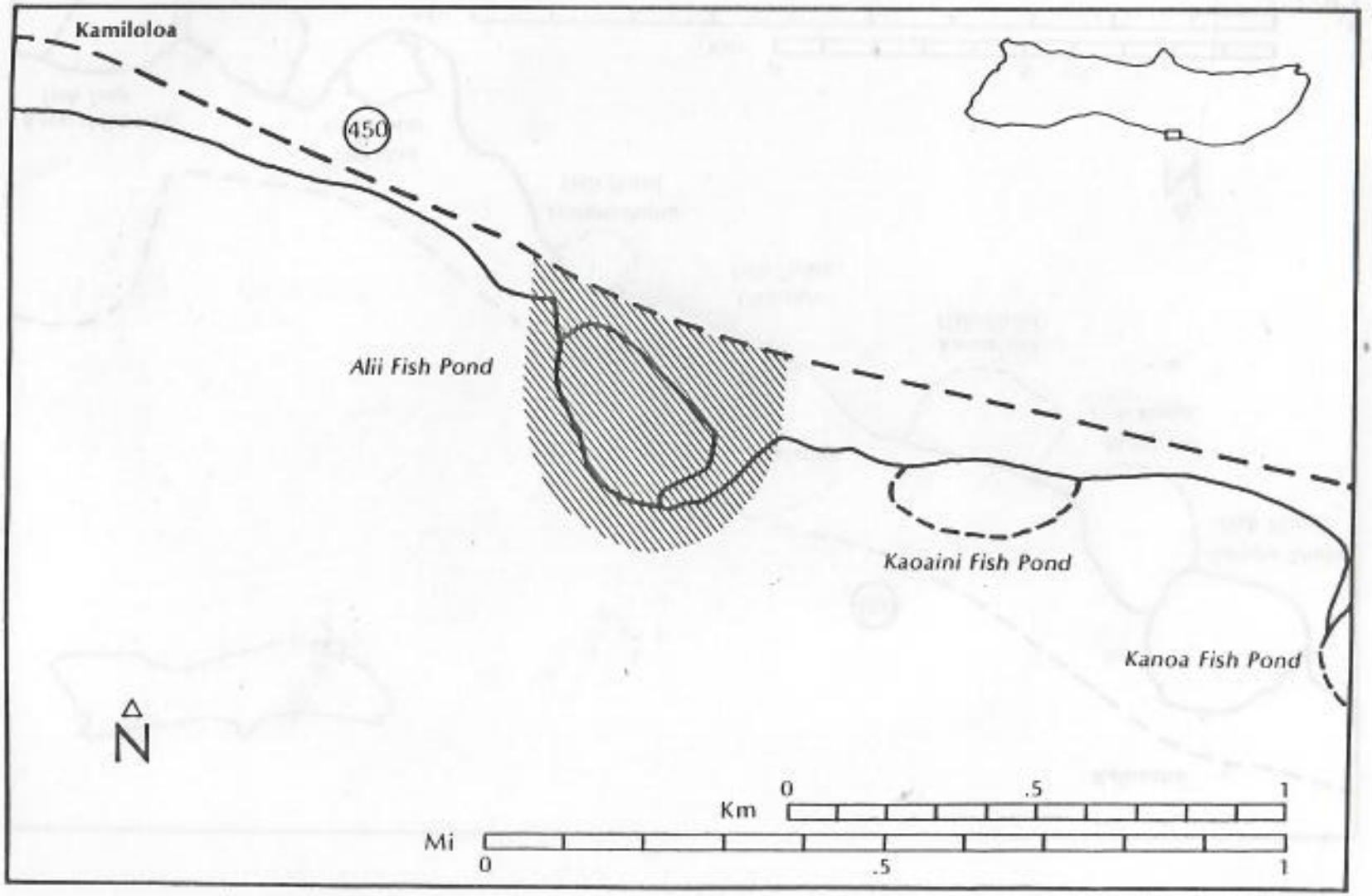


Figure 10 - Proposed Alii Fish Pond Sanctuary at Makakupaia

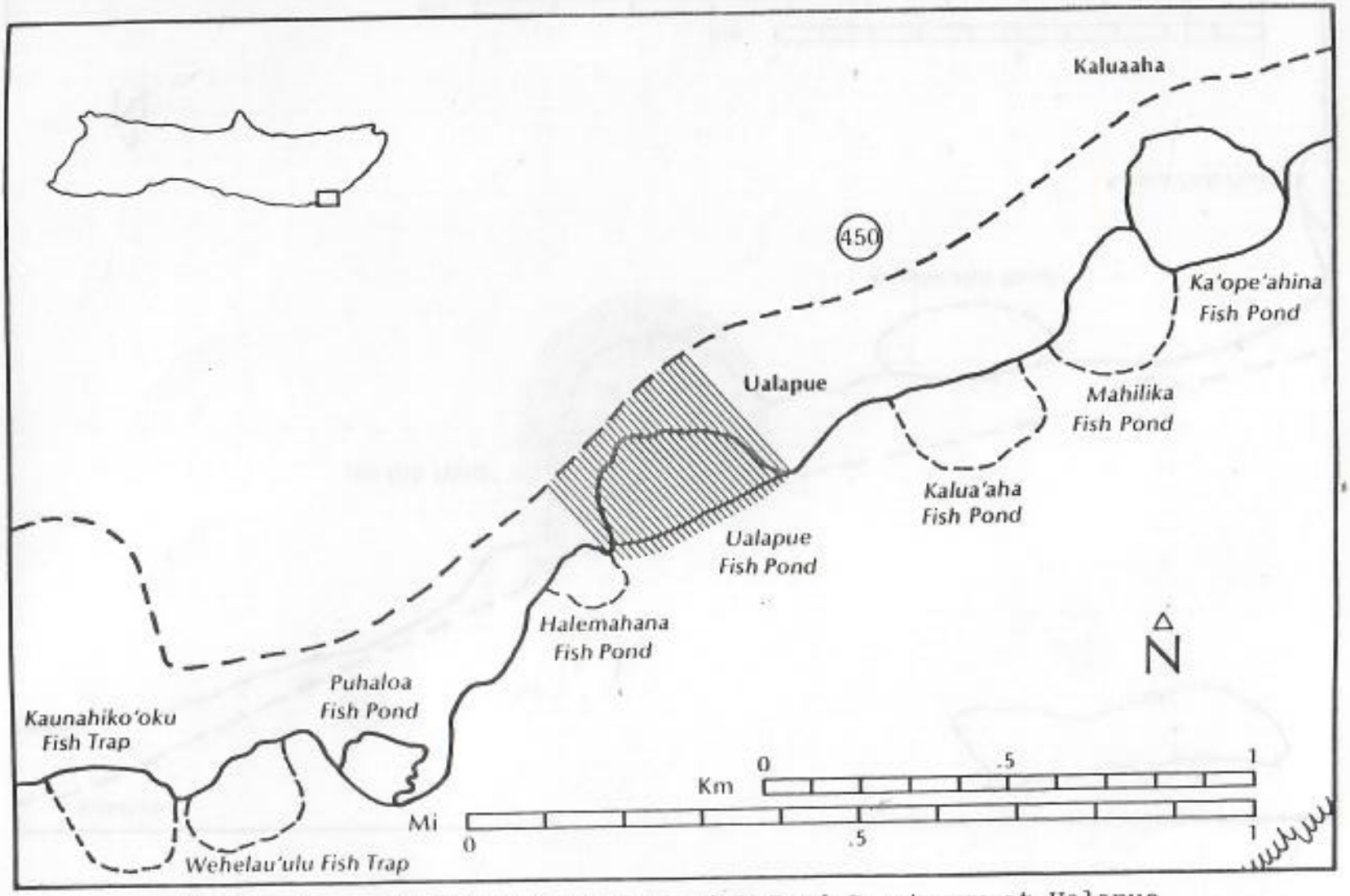


Figure 11 - Proposed Loipunawai Fish Pond Sanctuary at Ualapue

markets for direct consumption, and for the ponds value as cultural artifacts. The idea of using fish ponds as tourist attractions was favored by most as a way of generating badly needed local revenues, possible employment, and cultural education.

The primary problem in the repair and development of fish ponds lies in the low monetary returns experienced in the past for the amount of effort needed for fish pond upkeep. The logistical and engineering aspects of how to reconstruct the ponds present additional difficulties.[19] Reconstruction is considered by most to be too costly an endeavor and the investment returns too low. Few believed that even the most well kept fish ponds could develop into a profitable commercial enterprize since the market price of _'ama'ama_ could not generate profits. There was also a widespread belief that a large percentage of fish would be stolen from productive ponds.

A Fish Pond Plan

One individual suggested a plan framework for bringing some of the more decrepit (the majority) fish ponds into production. The plan includes setting a single state-owned fish pond aside for what amounts to a recreational park. Shoreline areas adjacent to the fish pond would require a

small entrance fee from off-islanders, mainland tourists, and other non-residents.

Fees would cover the costs of maintaining the pond and picnic areas, public bathrooms, and an information booth. Local residents would be exempt from entrance fees and enjoy fishing rights to the area, however locals and off-islanders would be required to possess a state fishing license. A $7.50 cost for the license was suggested with a bag (harvest) limit to be set by the state to reflect local fishery production levels. This fee could be used to defray costs incurred by the use of the Department of Land and Natural Resource enforcement programs. If successful, proceeds could go to establishing additional ponds as self-sustaining parks or managment areas.

As centers for the conservation of culture and fisheries resources (and perhaps for income), these operational fish ponds could prove to be economically and operationally feasible by attracting research, and enhancing local educational programs.[20] As recreational areas, fish ponds would provide unique environments for locals and visitors alike.

Existing Laws and Management Programs

The majority of fishermen who regularly sold their catch to the Honolulu auction houses said they favored enhancing

the existing management programs and fishing regulations as the first priority for improving local fisheries. They often referred to increasing the visibility of DLNR enforcement personnel, and to the need for tougher sanctions against violators, particularly against those taking fish during closed seasons. Tougher sanctions included the imposition of fines, the seizure of either boats or nets, or a combination of all three.[21]

Closed Seasons for Popular Fisheries

Several fishermen agreed with one fisherman's suggestion of extending the closed season (currently December to February) for the popular _'ama'ama_ fishery and establishing closed seasons for _awa_ (milkfish) and _oama_ (goatfish fry). For _'ama'ama_, a period of one month would be added at the beginning and at the end of the closed season expanding it to a five-month period. This was suggested to allow ama'ama a longer spawning period since fishermen reported they were taking ama'ama with eggs in November and March. The state of Hawaii currently allows licensed fish pond operators and owners to use nets with a "smaller mesh" (no eye-size or length limitations) to take young mullet or _pua_ (mullet fry) year-round for stocking privately owned fish ponds (DLNR,1985).

However, fishermen using nets with a one-half inch mesh size (Plate I) were observed to take mullet fry from ponds. The dead fry of kaku, ʻamaʻama, and papio (young crevally) intended for home consumption were quite easily obtained (Plate II) in plastic bags. When asked about the the taking of fry other than for stocking fish ponds, one individual suggested that the law be changed to allow for the limited use of small-meshed nets within fish ponds for short periods during certain times of the year after spawning season.[22]

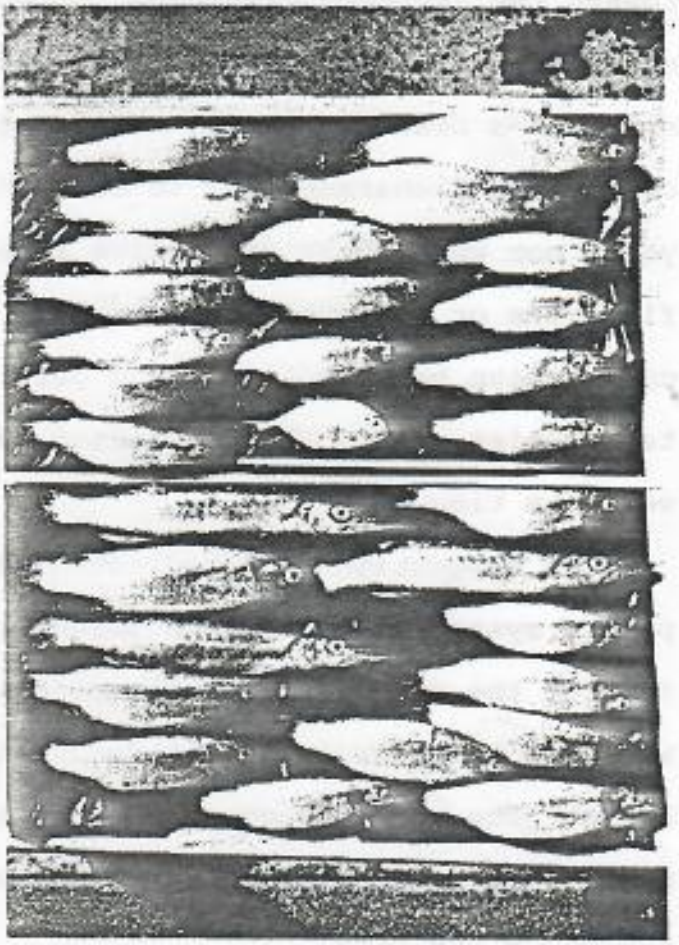
Red kumu was identified by many fishermen as having been "over-fished" because they were no longer seen in large numbers. It was suggested that an experimental closed season for red kumu be enacted on a trial basis to allow for the expansion of that particular population. Red kumu was consistently identified as one of the favorite fish of Molokaʻi as are most red fish.[23]

Fishing Permits

A permit system was offered in response to interview questions about how to pay for increases in fishery law enforcement measures, enforcement equipment, personnel, and research programs and establishing special management areas (see "Fish Pond Redevelopment" above). Fishermen

Plate II

Fry Taken in Fish Ponds



interviewed at the June 24th and the April 27th hearings in Kaunakakai felt that a permit system should be directed toward the "weekend warriors," or State resident and mainland sport fishermen trolling and spearfishing Moloka'i's coastal waters. It is not now known how many off-island fishermen come to fish in Moloka'i waters each year, nor what their collective impact is on the local fisheries or nearshore environment. The degree of competition between locals and outsiders is reflected in the testimonies of Moloka'i fishermen who say it is getting worse as time passes.

One suggestion included establishing an Island-by-Island permit system where by each island would impose a nominal fee for the use of local nearshore waters. Again, proceeds would go to enforcing state regulations already on the books. The person suggesting this idea admitted that it might seem unacceptable to the State's fishermen and therefore the DLNR.

DLNR officials reported that the National Marine Fisheries Service was (then) considering a saltwater fishing license for Hawaiian marine waters. DLNR representatives stated their opposition to this idea (Sakuda, 1986), and tended to side with commercial and sport fishermen. Local commercial fishermen stated then that they believed an

additional federal license was unfair because they already pay the state for their commercial licenses.

Moloka'i fishermen maintain that the sport fishermen (off-island fishermen and tourists) should be required to pay the additional costs of licensing. Arguments claiming that sport fishermen pay for their use of the reef in spending for lodgings and equipment while in Hawaii met widespread opposition from local fishermen. They could not accept statements made on behalf of DLNR that fishing supply sales and tourist spending revenues were used directly or in-part for enforcement of fishing laws and management programs. It seems that a licensing program is necessary to support any increase in funding to enforce fishing laws and develop conservation and management programs.

Kapu of Reef Areas

A rotational Kapu (management by area) of various reef areas was offered as a potential method of conservation of Moloka'i fisheries. Based on the Waikiki-Diamond Head Shoreline Fisheries Management Area model (DLNR,1985:40), instituted and enforced by the Aquatic Fisheries Division of the Department of Land and Natural Resources, areas considered to be intensively over-fished would be subject to alternating open and closed fishing periods. Closed periods

last for two years and encompass the area from the shoreline high water mark seaward to a distance of 500 yards or to the edge of the fringing reef whichever occurs first.

For the first two-year period, the management area is completely closed to all fishing activities. During the third year, the light impact of pole and line fishing is allowed. At the beginning of the fourth year, all types of legal fishing techniques and equipment are allowed. Fish population counts are taken along a common two-mile transect at the end of each yearly period.

Fish populations within the Kapu area at Diamond Head rose significantly from 150 pounds per acre in 1979 to a high of 450 pounds per acre before opening the area to pole and line fishing by 1981. Before opening the area to pole and line fishing during the second cycle, a total of and to 750 pounds per acre was recorded. The total pounds per acre fish left over after reestablishing fishing rights in the area increased from a the 150 pound per acre figure to a higher figure of nearly 250 pounds per acre. The total percentage of fish harvested was distributed over four groups of fishing activities.

A Kapu-type management framework has proven to be both cost-effective and successful in enhancing nearshore fisheries in Hawaii (Sakuda, 1986). However, there was some concern among small-scale fishermen during interviews and at

a June 24th public hearing called to discuss (among other management considerations outside the scope of this work) a Waikiki-style Kapu for Moloka'i. Fishermen said that this type of conservation strategy could seriously affect their efforts in fishing for akule, opelu, and other bait fish used in fishing for aku and ahi (tunas) if the deeper channels along the South Coast were to be included as closed areas during spawning periods.

Subsequent interviews with fishermen included questions related to the June 24th hearing. Their response to a Kapu-style closure of any reef areas revealed that they "didn"t want it in their backyard." For East-End fishermen, this was especially true. If placed in their fishing areas, they believed that "closing off a fishery was like putting a lock on a refrigerator or putting a fence around your own garden."

Some fishermen said during private interviews that it was more important to support the enforcement of existing fishing laws. They suggested that in order to enforce existing fishing laws, motorboats should be given to the enforcement personnel on Moloka'i "because there were none." They further suggested that net eye sizes be increased from the two-inch legal size to 2 and 1/2-inches during an initial three-year period, and then increase that size to 2 and 3/4 or 3 inches over an additional three-year period.

Marine Sanctuaries

Fishermen opposed the establishment of marine sanctuaries when: a) a complete kapu on all fishing rights was called for, and b), when sanctuary boundaries were placed near or within areas they customarily fished. The problem of sanctuary proximity to favored fishing grounds was based on the local belief that fishermen, when excluded from a favored area, would move in force to increase the fishing pressure in areas adjacent to their customary grounds. However, many fishermen who opposed the creation of marine sanctuaries favored fish ponds of the east end as likely sites if a complete Kapu were enforced.

Murphy's Beach Fisheries Management Area

The Fringing Reef between Moanui stream and Kumimi point at Murphy's Beach (Kumimi) was suggested as the first location for instituting the first marine sanctuary for Moloka'i (Figure 12). It was designated by fishermen because of its apparent similarity to the Waikiki area for two main reasons. First, the area is considered to be heavily over-fished. Second, its boundaries can be easily drawn and enforced. Third, it was identified as an historical spawning area for <u>'ama'ama</u>. It was also known by

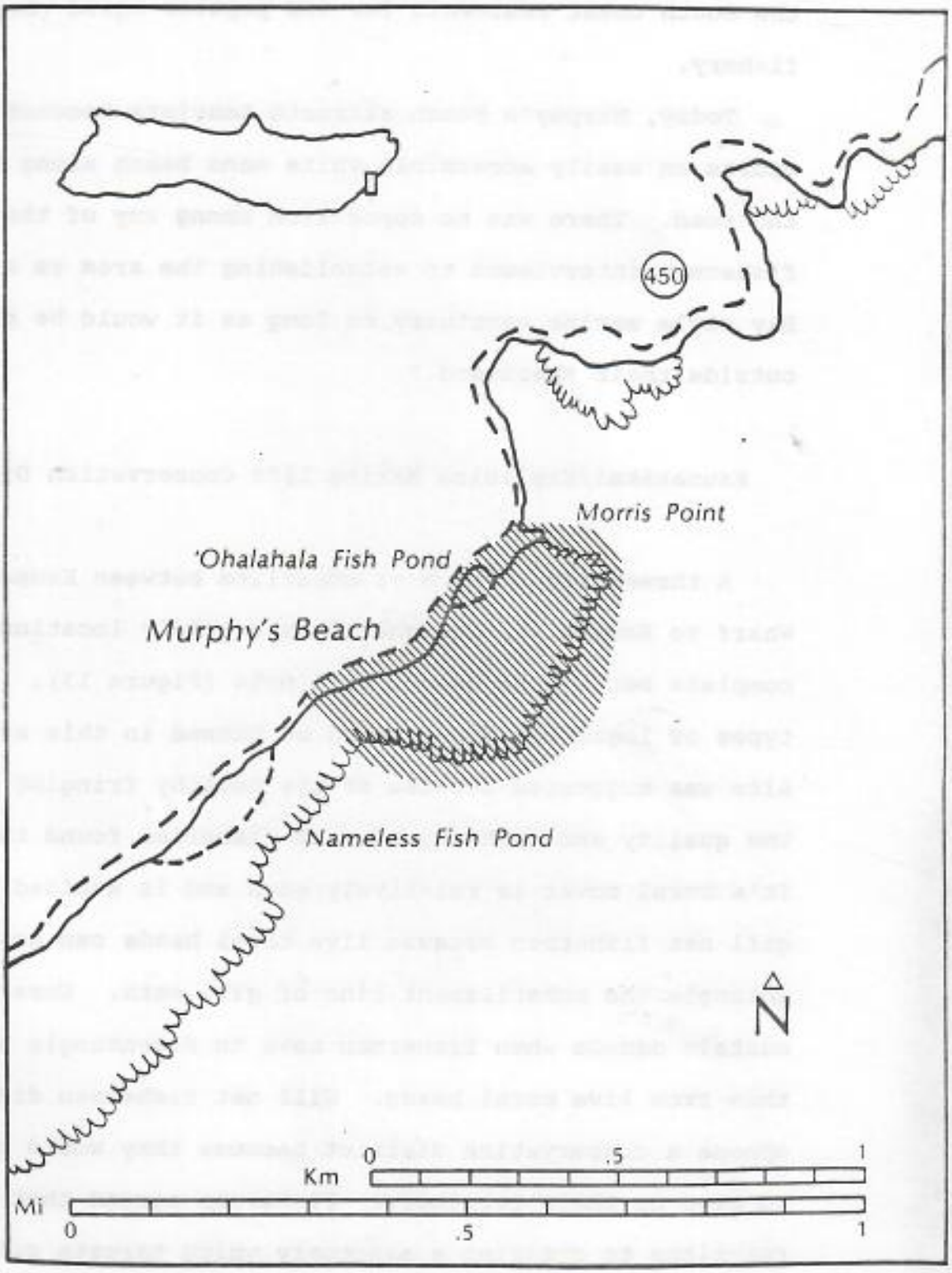


Figure 12

Proposed Kumimi/Murphy's Beach Fisheries Management Area

the South Coast residents for its popular squid (octopus) fishery.

Today, Murphy's Beach attracts tourists because it sports an easily accessible white sand beach along the East End road. There was no opposition among any of the fishermen interviewed to establishing the area as a Hanauma Bay style marine sanctuary so long as it would be placed outside their "backyard."

Kaunakakai/Kamiloloa Marine Life Conservation District

A three-mile stretch of coastline between Kaunakakai Wharf to Kawela was designated as a likely location for the complete ban on the use of gill nets (Figure 13). No other types of legal equipment would be banned in this area. This site was suggested because of its healthy fringing reef and the quality and quantity of reef fisheries found there. It's coral cover is relatively good and is avoided by most gill net fishermen because live coral heads can so easily entangle the monofilament line of gill nets. Corals also sustain damage when fishermen move to disentangle and tear them from live coral heads. Gill net fishermen did not oppose a conservation district because they would not have to give up their territory. Fishermen agreed that community reactions to creating a sanctuary which targets gill nets in

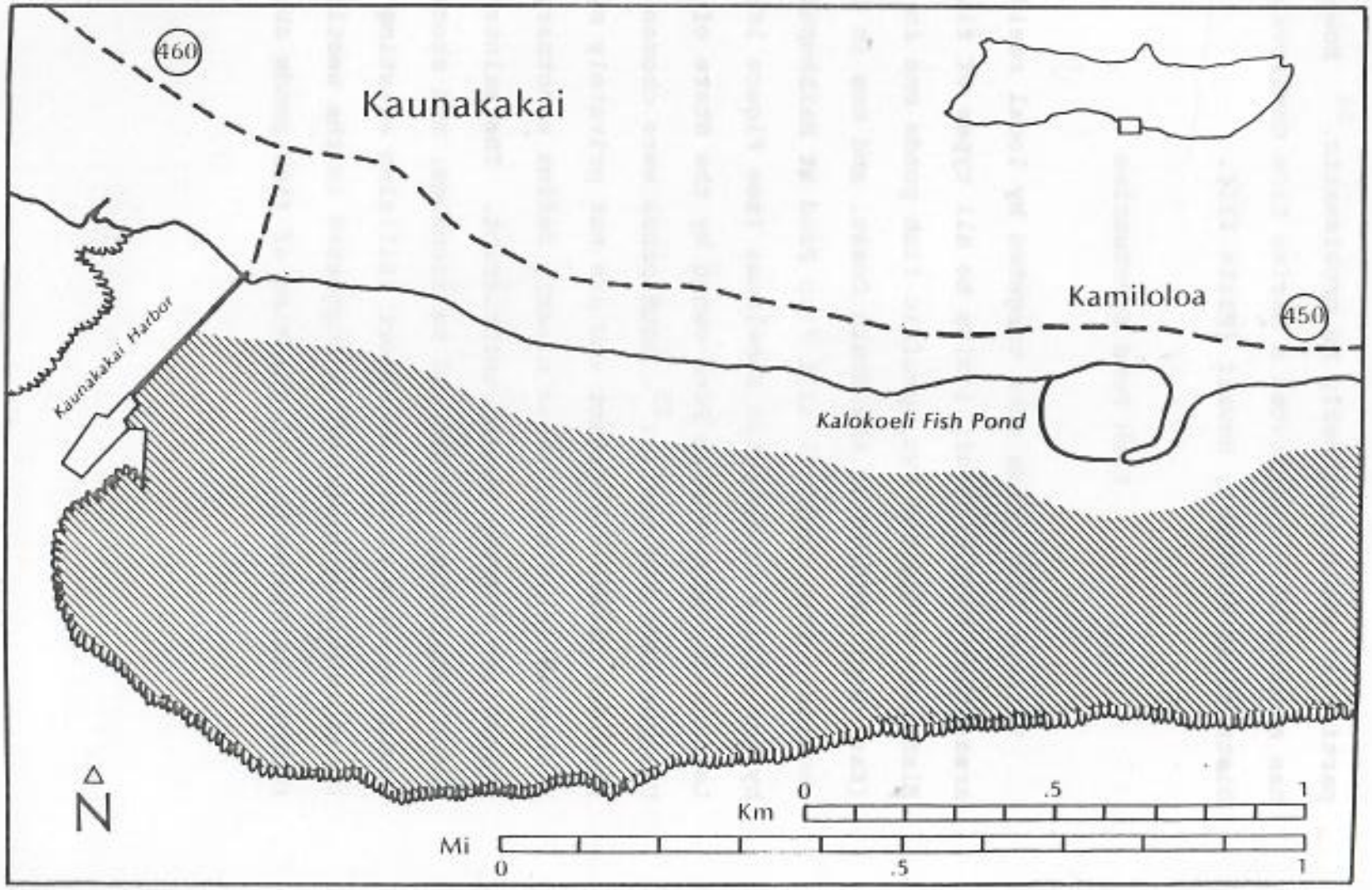


Figure 13 - Proposed Kaunakakai/Kamiloloa Marine Life Conservation District

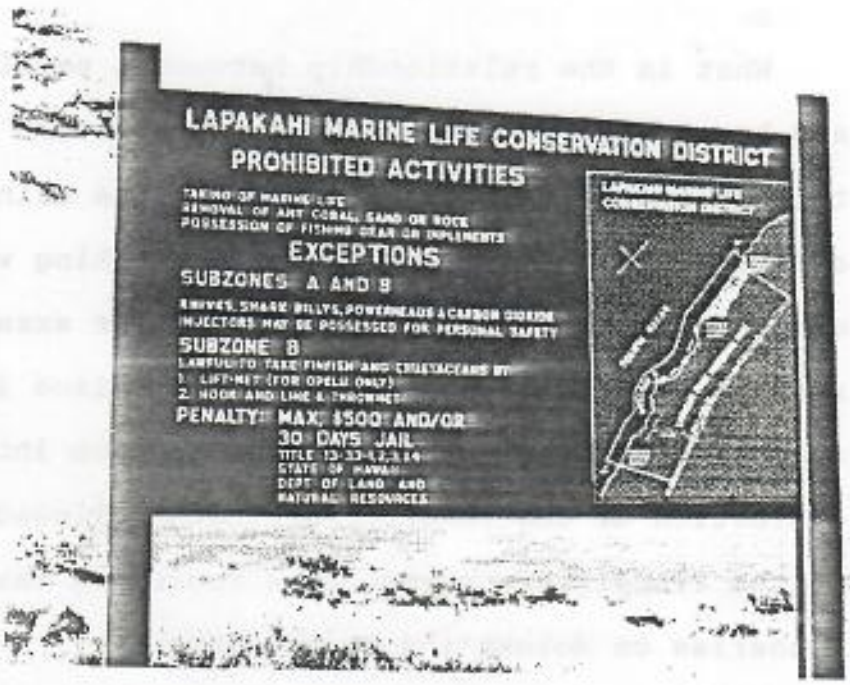
particular would admittedly be problematic.[24] However, DLNR has successfully instituted a Marine Life Conservation District at Lapakahi, Hawaii (Plate III).

Fish Pond Sanctuaries

Various fish ponds were targeted by local residents as areas that should be off limits to all types of fishing. Fishermen suggested two specific fish ponds one in the Manae (East-End) section of the South Coast, and one in the Kawela section. They include: Alii Fish Pond at Makakupaia owned by the Office of Hawaiian Homelands (see Figure 10), and Loipunawai/Ualapue Fish Pond owned by the State of Hawaii at Ualapue (see Figure 11).[25] Both ponds were chosen because they are relatively intact and are not privately owned. Fish pond walls themselves clearly define sanctuary boundaries thereby easing enforcement. The maintenance of ponds (desilting, structural maintenance, and stocking) would become a community effort utilizing existing DLNR and local community manpower as suggested in the section on the repair, maintenance, and stocking of fish ponds above.

Plate III

Lapakahi Marine Life Conservation District Sign



Chapter 5

CONCLUSIONS

What is the relationship between a people and a place, and how effective is this research approach for answering this question? A section following the main conclusions offers several recommendations for working with local communities as a bottom-up approach for examining the special relationships of a people to place in tropical nearshore environments. A final section includes a brief evaluation of the research approach followed by a discussion of the fishermen's perspective regarding the use of fisheries on Moloka'i's South Coast.

Fishing activities on Moloka'i are governed by local attitudes and perceptions shaped by the tools and strategies fishermen use to make a living. A collective community desire to maintain a lifestyle (and not necessarily economic gain) acts as the prime motivation for the exploitation of the island's South Coast fisheries. Three distinct social groups are principally responsible for the management of Moloka'i's coastal fisheries. They are: 1) local Moloka'i fishermen, whose lifestyle and livelihood depends on local fisheries; 2) non-residents using the reef for recreation

and economic gain, and 3) the local DLNR officers who monitor community fishing activities.

Moloka'i fishermen complain about a lack of governmental restrictions limiting off-island sport and commercial fishermen. At present, no plan exists for complementing the local style of fisheries management on Moloka'i although competition and conflict between users appears to be a state-wide problem. Future development plans for the south coast of Moloka'i will require that consessions be made between local fishermen and marine resource managers of the State of Hawaii.

Since Moloka'i fishermen are primarily responsible for managing their fisheries although the management burden legally belongs to the State. From the fishermen's viewpoint, the State appears to welcome maximum use by non-resident fishermen of a resource resident fishermen use to support their way of life. In turn, fishermen are skeptical of DLNR programs that do not preserve or enhance their fishing rights. Unrestricted public access to coastal fisheries has created a tendency in some local fishermen to "take what [fish] you can or someone else will take [them] from you."

Due largely to the open-access nature of Moloka'i's southern coastal zone, fishermen have developed strategies for self-regulating their fishery resources. One strategy

is to practice reef territoriality. Back yard fishermen who live along the South Coast may actually help to conserve the resource by controlling the number of fishermen entering areas of reef directly seaward of their coastal properties. Fishermen employ secrecy, misinformation and threats of violence to discourage access to their "back yard" fisheries.

State managers have begun to involve fishermen more directly in conservation planning for fisheries. Public meetings recently held on each major island of the State by DLNR have included requests for public testimony from Moloka'i residents on management plans now being presented by representatives of the Aquatic Fisheries Division.

The six Fishery Use Zones represent the socioenvironment of fishermen. They are areas where the most popular fishing methods are employed within the study site. They demonstrate where impacts to local fisheries occur and what those impacts are likely to be. They overlap to various degrees and correspond to natural pathways where fish feed and spawn across the fringing reef. For instance, gill netting can share some of the same areas with bull pen and surround net activities. Throw net and drag net activities overlap along the inner-most margins of the reef flat. Spearfishing activities can be carried out anywhere from the shore to the breaker zone and beyond, although they are

usually performed within the middle and outer margins of the fringing reef.

What does the research say about the relationship between a people and a place? Lifestyle is the key to understanding the beliefs and values behind resource use relationships. Fishermen have differing personal criteria by which they value their resource, yet they have a common desire to live a unique rural existence. Their personal beliefs, attitudes and knowledge govern their fishing activities, and in turn directly affect the health, productivity, and management of near shore zone fisheries. Yet, maintaining a rural lifestyle based on fishing is the driving force behind these activities.

A classification of Moloka'i fishermen as either "subsistence" or "commercial" depends on the degree to which fishermen are involved in harvesting for monetary gain or for personal consumption and would change daily. They do not see fishing as a "cash-earning activity" but rather a lifestyle; something to be and something to do in life. Fishing activities can result in part in commercial exchanges that supplement subsistence activities. Cash is a bonus for effort expended, allowing the fisherman to continue a part-commercial, part-subsistence lifestyle. The term semi-subsistence describes the local fishing way of life best.

The southern coastal fringing reefs of Moloka'i are a classroom, playground, supermarket, museum, and bank. Moloka'i fishermen measure success by how well they support their own rural way of life. But success depends on the island's capacity to provide the resources necessary to support that way of life. The South Coast environment is therefore a source of fish and a source of islander identity.

What interests fishermen are the ways in which fish are caught, the ways fish move across the reef, their spawning habits, and to those who more or less depend on fisheries for a living, what the market price of fish will be after they have shipped their fish to the auction block in Honolulu.

They are careful to preserve and reaffirm a social system that includes gift-giving and exchanges of money and labor as strategies for dealing with "hard times." This island-wide system of socioeconomic ties is based in part on the exchange of reef products. This traditional system of sharing has been successful primarily because Moloka'i islanders recognize (and take advantage of) the general unpredictability of a lifestyle so closely dependent on the coastal marine environment and its resources.

Moloka'i's resident fishermen worry about loosing their ability to monitor and control who uses local fisheries and

how they are used. Recreational, commercial, and semi-commercial fishermen (known as "weekend warriors") come from other islands of the State to compete with local fishermen for the same resources. More fishermen using the reef in ways that severely deplete local fishery stocks cause other fishermen to react by doing the same. If there is to be a "run on the bank" then no one wants to be at the end of the line.

Moloka'i fisheries are being harvested excessively through the use of fishing gear that does not discriminate based on size or species. Community tensions have developed over the misuse and mismanagement of fisheries by locals and non-residents alike. Competition between between residents and non-residents has helped foster Moloka'i's own "tragedy of the commons." Moloka'i fishermen have identified themselves, non-resident fishermen and the State fishery managers as being responsible for mismanaging their resource. Fishermen employ territorial restrictions on residents and non-residents alike to curb access to fishing areas adjacent to the "back yard" fisheries traditionally used for subsistence purposes.

Conflicts between fishermen over what they judge to be harmful fishing practices stems from differing personal attitudes toward use and conservation practices. Not all Moloka'i fishermen connect conservation practices to the

maintenance of their local lifestyle. However, the community management ideas discussed in Chapter Four represent a strong commitment by some local fishermen to conserve and enhance the productivity of Moloka'i's fisheries. They also represent a belief that conservation perpetuates the fishing way of life.

East-End fishermen have been able to maintain a limited degree of exclusive access to local fisheries for more than a generation. They continue to fish in the same manner, in the same places and still manage to support a semi-subsistence lifestyle. They use their knowledge about reef topography, the tides, and the behavior of fish in ways that guarantee a suitable supply of fish for themselves and their families.

It is ironic that a community's preferred reliance on fishery resources for both monetary and subsistence gain appears to foster practices that can lead to their destruction and depletion. In fact, some local fishermen believe that a serious depletion of nearshore fisheries has occurred yet chose to fish illegally or consistently used gear or methods that did not conserve fisheries.

Fishing practices that lead to overfishing were socially reinforced among Moloka'i fishermen. Peers often stated that State fisheries regulations were not worth obeying because they do not support the idea of Moloka'i fish for

Moloka'i people. However, many illegal fishing practices were justified on numerous occasions by others who said "there were enough fish to go around," or because "you cannot tell a Moloka'i fishermen that he cannot fish in his own back yard, or to throw back what comes into his net when it is already dead." These statements describe the prevailing use and management attitudes of many but not a majority of local fishermen.

The local economic and social linkages to Moloka'i's fishing way of life are weakened because of increased fishing pressures from growing numbers of non-resident commercial and semi-commercial fishermen from the more developed regions of the State. Fluctuations in the price and demand for coastal zone fisheries stimulate local fishermen to increase harvests for sale to markets on Moloka'i and in Honolulu. There may not be enough fish to go around for those who rely on fish for subsistence consumption and exchange as a way of life. The fishing community's rural lifestyle is perhaps more fragile in this sense than the fishery resource itself.

Barring a large influx of reef users to the island, the sharing system will continue as an important part of the Moloka'i's economy and local culture. Since Moloka'i is sparsely populated and commercially underdeveloped the present level of fisheries use does not yet appear to

present a commercial or subsistence crisis for Moloka'i residents.

Many fishermen believe that the enforcement arm of the DLNR is understaffed. When asked how to remedy this problem they most often responded by suggesting that DLNR provide the means to confiscate the nets of violators, e.g., large skiffs, field glasses or binoculars for hillside observation of fishing activities, and the employment of temporary support personnel from within the community. Costs for the program would be paid for by fines levied for infractions of state fishery laws, or from the sale of the impounded equipment of repeat offenders. At the time of this writing, no fisheries conservation district or marine life refuge had been established on Moloka'i.

Recommendations

Recent actions by the DLNR to solicit the testimony of local fishermen on management proposals at public meetings and hearings is improving the relationship between the State and resource user. However, the DLNR is not accountable to local fishermen for the laws, regulations and management programs they enact and enforce. The State legislature is accountable and should seek ways to make the DLNR's Division

of Aquatic Resources and its enforcement officers more able to respond to the needs of Moloka'i residents.

Present fishing laws and regulations should be changed to sanction the use of monofilament gill net eye-sizes larger than two inches. A study should be conducted to determine if restricting gill net lengths to one-thousand yards or less would significantly a) impact the fishermen's efforts to make a living and b) reduce the killing of non-target species. A more vigorous program of law enforcement that includes costlier penalties and fines for a) the misuse of fishing gear and b) the taking of reef fish and other aquatic life subject to closed season should be pursued.

The problem of what to do with Moloka'i's fishponds remains unsolved. As structures created to provide fish for a subsistence society prior to the introduction of cash-based economies, fishponds (with a few exceptions) continue to disappear beneath the silt and mangrove forests of the South Coast. Government assistance for fishpond development should be made available to determine how several of the most well-preserved ponds could be incorporated into the future commercial and cultural development of Moloka'i's South Coast.

If the DLNR plans to establish a management-by-area program styled after the Waikiki-Diamond Head Marine Life Conservation District, the State will need to carefully

consider the specific use within a chosen site. The district would have to be placed in an area that does not close popular fishing areas or undermine the territorial authority of back yard fishermen. The Kumimi-Murphy's Beach area may offer the best location for the first marine life conservation district on Moloka'i.

Reef territoriality may actually help conserve coastal zone fisheries. Fish population counts should be conducted in areas where territoriality is practiced and in areas where unrestricted access occurs. Such a study could yield some interesting results for comparison.

Efforts should be continually made to increase the exchange of information between Moloka'i community leaders, local fishermen, County and State legislators and planners, and the DLNR. A program should be started to monitor reef siltation, pesticide runoff, fishery depletion on the south coast. Community enforcement and education programs related to the enhancing fishery productivity should become part of an ongoing cultural and environmental conservation program for addressing the future of Moloka'i's fisheries. The Moloka'i Community Action Council (MCAC) and Moloka'i Economic Opportunity (MEO) offer two community-based organizations worthy of funding and logistical support to meet the requirements listed above.

A survey of the number of non-resident fishermen in Moloka'i waters should be made over several fishing seasons to determine how many and what kind of fish are being harvested by non-resident fishermen. This information should be compared to a similar survey of resident fishermen. The total numbers of fish "lost" to the local fishermen of Moloka'i could then be assessed for any socioeconomic impact non-resident fishing may have on the local community.

Research Method Evaluation

This project promoted researcher and resource user collaboration because its method of research emphasized the importance of fishermen in the management of marine fisheries in the coastal zone. It contributes to a growing body of marine geography and coastal zone management research that places equal importance on social and environmental problems related to resource use. It represents a cost effective research approach that is transferable to other geographical regions in Hawaii and the Pacific. Most importantly, this work presents a research perspective dictated in part by the immediate and long-range concerns of the Moloka'i fishing community.

A program using personal observations and experiences was effective because as time went on, a list of questions was continually refined to reflect the local fishery use situation from a local perspective. The field work process relied on the ability of the researcher to record information that represented what the fishing community on Moloka'i wanted to say.

The research process uncovered the core issues of concern to a community closely dependent on a prevailing resource use situation for their way of life. A first-hand accounting of the spatial distribution of major fishing activities and their effect on the coastal fisheries was usefully described in terms of "socioenvironment."

There are two main biases in the research approach. First, the approach was chosen because it opts for the bottom-up viewpoint described here as "the local perspective" that is grounded in the participant-observer method of social science research. Second, that controversial resource use issues provides the best starting point from which to observe and record the the relationships between a people and a place.

Time became a major constraint on the success of this tactic. It was relatively simple to locate and contact the referral group by telephone, but time-scheduling and

logistical problems occasionally prevented the extended or even initial contact with some fishermen.

Offering labor in exchange for information was a productive strategy because most of the time fishermen were willing to have the extra help on fishing trips even when it was not needed. Fishermen often enjoyed discussing their activities and what they thought best for Moloka'i fisheries. They especially enjoyed testing the researcher with different fishing tasks, yet never asking anything be done that they would not do themselves. Many fishermen just wanted to see that their ideas got into print and sent to "the legislature."

Most fishermen confided that they disliked "university types" asking questions and expressed concern over how their information would be used. Informal personal interviews were effective since most fishermen said that they distrusted those who administered questionaires. Participant observation as an approach was also worthwhile because fishermen appeared to be more at ease when fishing and spoke most freely about their lives and fishing during the most strenuous of tasks.

Fish provide a means of exchange between people that strengthens relationships among family members and establishes friendships. Fish can be sold for cash to pay for personal debts or used in lieu of cash to settle them.

Fish are used for subsistence and supplimental income. Fish offer welcome insurance against "lean" times, and are frequently included in the meals of all Moloka'i fishermen.

Fishing activities have been observed and their spatial distribution mapped for a portion of the South Coast of Moloka'i. Their distribution depends on the knowledge and daily habits of fishermen who lay claim to a patch-work of mud flats, shore lines, and coral reef. Their pattern of use varies according to the movements of fish they choose to catch and the tools they use to catch them. In general, fishing practices change across the study area from commercial activities in the west (Palaau) to subsistence dominated activities in the east (Manae). From the shoreline seaward, fishing activities become technologically more sophisticated and expensive in terms of time, labor and cash inputs towards the outer margin of the fringing reef. Conversely, most fishing activities are concentrated in the shallower central and inshore margins of the fringing reef.

Local perceptions vary among the fishermen of Moloka'i regarding the general depletion of the resource. Fish such as moi and the Hawaiian Mullet have been noticably depleted, as have kumu, akule, and opelu. Papio, weke, o'io, omilu, kala, kole and palani are now being heavily fished. Fishermen will continue to rely on alternate sources of income that have sustained them in the past when fishing was

poor. However, there seems to be a feeling that something must be done to stop the depletion, change the fishing laws and regulations, and keep the "weekend warriors" from Moloka'i waters.

A minimal amount of State involvement in Moloka'i's reef use management has left the responsibility of enhancing and conserving fisheries productivity directly to the shoulders of local fishermen. Because they view State laws and regulations as unenforceable and personally unacceptable, Moloka'i fishermen set up their own resource management strategies to protect themselves, and their fisheries. They use personal skill, knowledge of the reef environment, and gear to harvest fish that support their lifestyle. Fishermen also employ secrecy, territoriality, and knowledge of the reef environment to insure a suitable level of exclusive access through claims to South Coast fishing areas. These claims represent a community's approach to managing nearshore fisheries resources in Hawaii.

Appendix A

Molokai News Article

Needed: Ideas for Managing Molokai's Coastal Fisheries

Mike Baker, a student researcher from the University of Hawaii, is here to talk with local fishermen about fisheries resources on Molokai. During the next four weeks, he will gather fishermen's ideas about the use and conservation of marine resources on the sourth coast of Molokai. This information will be used to help him earn a Master's degree, but more importantly, for helping to create a beneficial management plan that includes the needs of the people of Molokai. A bound copy of his report will be donated to the Molokai library.

Your thoughts, ideas, problems and solutions will be very helpful in making important decisions affecting the future of this island's marine life.

Your kokua is requested in answering several questions including: How important is fishing and the lifestyle it provides to you? Would you use gill nets with a mesh size designed to catch only mature fish? Would you support a Kapu on certain fishing areas or fish? What should be done to change the present system of fishing laws? Do you think that repairing and using fishponds for local and commercial use can and should be done?

If you are interested in answering some of these questions, contact Mike anyday at 567-6424, 6:30-9 PM.

Source: The Molokai News, July 15, 1986.

Appendix B

Molokai Dispatch Article

Kokua, Please

Mike Baker, a student researcher from the University of Hawaii, is here to talk with local fishermen about the state of fisheries resources on Molokai. During the next four weeks, he will gather fishermen's ideas about the use and conservation of marine resources on the south coast of Molokai. This information will be used to help him earn a Master's degree, but more importantly, for helping to create a beneficial management plan that includes the needs of the people of Molokai. A bound copy of Mike's report will be donated to the public library in Kaunakakai.

Your thoughts, ideas, problems and solutions will be very helpful in making important decisions that affect the future of this island's marine resources. Your Kokua is requested in answering several questions: 1. How important is fishing and the lifestyle it provides to you? 2. Would you use gillnets with a mesh size designed to catch only mature fish? 3. Would you support a Kapu on certain fishing areas or fish? 4. What should be done to change the present system of fishing laws? 5. Do you think that repairing and using fishponds for local and commercial use can be and should be done?

If you are interested in answering some of these questions, you can contact Mike anyday at: 567-6424, 6:30 to 9 am.

Source: Molokai Dispatch, July 16, 1986.

Appendix C

List of Popular Fish Names*

Hawaiian	English	Genus/species
'A'awa	Hawaiian Hogfish[2]	Bodianus bilunulatus
Aha	Needle Fish	Strongylura gigantea
Aholehole	Banded Flag Tail	Kuhila sanvicensis
Akule	Bigeyed Scad	Trachurops crumenophthalmus
Ala'ihi	Squirrel Fish	Adioryx, Flammeo spp.
'Ama'ama	Striped Mullet	Mugil cephalus
Awa'aua	Milk Fish	Elops hawaiensis
Aweoweo	Bigeye	Priacanthus cruentatus
Kahala	Amberjack	Seriola dumerilii
Kaku	Barracuda	Sphyraena barracuda
Kala	Unicorn Surgeon[3]	Naso unicornus
Kole	Yellow-Eyed Surgeon	Ctenochaetus strigosus
Kumu	Purple Goatfish	Parupeneus porphyreus
Lai	Leather-Back Runner	Scombroides sancti-petri
Manini	Convict Tang	Acanthurus sandvicesis
Mano	Shark[4]	Galeocerdo, Carcharhinus spp.
Moano	Red/Black Goatfish[5]	Parupeneus multifasciatus
Mu	Hawaiian Porgy	Monotaxis grandoculis
Na'e na'e	Orange-Spot Surgeon	Acanthurus olivaceus
Nehu	Anchovy	Stolephorus purpureus
Nenue(Enenue)	Rudder Fish,Chub	Kyphosus cinerescens
'Oi'o	Bone Fish	Albula vulpes
Omilu	Forksal's Jack Fish	Carangoides ferdau
Opakapaka	Small-Scaled Snapper	Aphreus rutilans
Opelu	Mackerel Scad	Decapterus sanctae-helenae
Paki'i	Flounder	Bothus spp.
Paku'i ku'i	Achilles Tang	Acanthurus achilles
Palani	Dussimers Surgeon	Acanthurus dussumieri
Papio	Juvenile Crevally[6]	Carangoides, Caranx spp.
Po'o pa'a	Spotted Hawk Fish	Cirrhitus pinnulatus
Pualu	Ringtailed Surgeon	Acanthurus mata
Ta'ape	Blue-Lined Snapper	Lutjanus kasmira
To'au	Red and Green Snapper	Lutjanus fulvus
Uhu	Parrot Fish[7]	Scarus spp.
Uku	Gray Snapper	Aprion virencens
Ulua	Adult Crevally[8]	Carangoides, Caranx spp.
'U'u	Squirrel Fish[9]	Adioryx, Myripristis spp.
Weke	Goatfish	Mulloidichthys, Upeneus spp.

Other Important Fishery Names

Hawaiian	English	Genus/species
Limu	Non-Specific Seaweeds[10]	----------
Opihi	Hawaiian Saltwater Limpet	Cellana spp.
He'e	Octopus	Polypus spp.
Ula	Spiny Lobster	Panulirus pencillatus
Ula Papapa	Slipper Lobster	Scyllarides squamosus
'A'ama,Alaeke, Moala,Kualoa, Papai,Kuahonu	Crab[11]	Podophthalmus,Portunus, Ranina,Scylla spp.

*Adapted from : Titcomb, Margaret 1983. Native Use of Fish in Hawaii, University of Hawaii Press, Honolulu.; Tinker, Spencer Wilkie 1982. Fishes of Hawaii, Hawaiian Service Inc., Honolulu, Hawaii.; Randall, John E. 1981. Underwater Guide to Hawaiian Reef Fishes, Newton Square, Pennsylvania.

Appendix D

Interview Questions

The main body of primary research data was drawn from responses to questions posed in informal interviews. Initially, a collection of questions were designed to get at: a) the locally perceived condition of southcoast fisheries resources and fringing reef environments of Moloka'i and b) possible local sources of fisheries depletion and reef degradation. The following questions are organized under two main headings: Over-fishing and Local Management.

Over-fishing:

Is there an over-fishing problem on Moloka'i?

What are some of the causes of over-fishing?

What is the most important cause of over-fishing?

What should be done to stop over-fishing?

Habitat Degradation:

What kinds of fishing methods cause damage to reefs and reef fisheries on the south coast?

What do you think should be done to solve the problem?

What problems are created for you or your friends because of over-fishing and reef damage?

Have you noticed any particular place where the reef has been damaged by fishing activities? What kind of damage? Where?

After questioning the community on the issues discussed above, it was necessary to ask more penetrating and practical questions related to specific solutions to the issues and problems discovered during the first phase of questioning. The following list represents the second phase of questions which resulted in the management strategies discussed in Chapter 4.

Local Management:

What would you be willing to do personally to change the situation?

Interview Questions, Local Management (continued)

Have you heard about disputes related to fishing on Moloka'i reefs?

What do you think is the cause of these disputes? Are you satisfied with the present fishing laws? Why? Why not?

How can the present fishing laws be improved?

Should a Management-by-area system be used on Moloka'i? Why? Why not?

Do you think that the creation of marine sanctuaries and community enforcement will work for the Moloka'i community?

Where should Marine Sanctuaries be placed?

Under what circumstances would you be willing to turn in someone who violated marine fishing laws under a Management-by-area system?

Do you think that repairing and maintaining Moloka'i's fishponds for commercial use is a good idea?

How should fishponds be used for managing fisheries for Moloka'i?

If you had the power to change the present situation, what would you do?

Notes

1. This situation has been clearly described in Hardin's (1968) "tragedy of the commons" where individuals, without effective inducements or restrictions, excessively harvest marine fisheries for the sake of short term profit. This has resulted in the problem of "recruitment over-fishing," where "fishermen leave too few fish to sustain the fishery at its optimum level" (Johannes, 1978).

2. "Wrasse" is a generic name for a large number of colorful, medium-sized, territorial reef fish species in Hawaii. Most of the species encountered were of the genus: Bodianus, Labriodes, or Thalassoma. These fish were not often harvested or even preferred among the fishermen interviewed.

3. Surgeon fish species are also numerous and vary greatly in size and color. They are abundant within the study site and although less diverse than the wrasse species, they were observed and caught more often there. The most popular species are listed individually.

4. Species encountered during fishing activities were the Tiger Shark (Galeocerdo cuvieri), the Hammerhead Shark (Sphyrna lewini), the Black-Tipped Reef Shark (Carcharhinus melanopterus),and the Grey Reef Shark (Carcharhinus amblyrhynchos). These fish were most often observed dead in monofilament line nets, and were almost always two to three feet in length, with the exception of a five foot long Tiger captured and released live from a bullpen net.

5. Moano and kumu are listed separately from weke for two reasons: first, because there are several different local species, and second, because they are fished-for differently. Weke are usually harvested with nets because of their tendency to school in large numbers. Moano and kumu are more solitary in their habits and were found in groups of three or less.

6. Papio is a generic name for the juvenile form (less than twelve inches long) of both the Caranx and Carangoides species. There were three main types of Jackfish species most often observed including: white ulua, blue omilu, and the kagami or thread-fin ulua (Alectis ciliaris). These fish are valuable because they hold a fairly consistent dollar-value in Honolulu markets and are good eating.

7. There are many different types of Uhu on the reefs of Moloka'i and although difficult to catch, they are a favorite of most spearfishermen. These fish seem to act in very intellegent ways. When pursued, they show little fear and tend to stay just out of range of spears. In the nearshore waters surrounding the south Pacific island of Palau, Johannes has also observed this behavior in Parrotfish species and pronounced them "intelligent" (1982).

8. Several species of U'u were consistent casualities of monofiliment-type nets with an eye-size of less than two inches. These fish are considered good eating (as are most red-colored fish), but were rarely kept for anything but fertilizer by some fishermen.

9. Weke (Mullidae Family) observed on the south coast were the Band-Tailed Goat Fish or weke pueo (Upeneus arge) the so-called "Bad dream" fish. These fish are believed to cause nightmares or even slight hallucinations. Other weke encountered on Moloka'i included: the Gold-Banded Goat Fish or weke 'ula (Mulloidichthys auriflamma), the Samoan Goat Fish or weke 'a'a (Mulloidichthys samoensis), and Pfluger's Goat Fish (red weke) or weke 'ula (Mulloidichthys pflugeri). These fish were caught in conjunction with papio in nets. Weke are very good eating and command a small but very consistent price at Honolulu auctions. Some fishermen referred to weke as "trash fish" usually because the undersized fish of this type cannot be sold commercially but were killed in great numbers by monofiliment nets with eye sizes less than one and one-half inch.

10. Limu species are many and varied on Moloka'i. Limu was never collected by fishermen during our excursions on the south coast, and only once at a location at a sea cliff near Mo'omomi beach on the north shore. It was however noted that limu was used often in local dishes.

11. Crabs are especially popular fisheries. Species that were commonly caught or seen on Moloka'i included: Samoan Crab (Scylla serrata), Kuahonu Crab (Portunus sanguinolentus), and the Papai Crab (several families).

12. The Department of Land and Natural Resources defines "speargun" as: ..."any artificial device used to propel a spear or spears by means of compressed air or gas, elastic/spring, or any motive power. Although firearms are mentioned in the category title ("Firearms, Spears and Spear-guns") there are no written restrictions specific to their use as an underwater hunting device.

13. An important exception to the two inch mesh size rule allows fishermen using SCUBA a net mesh size of 1 and 1/2 inches to "bag and transport fish captured with legal gear to the shore or boat. Other exceptions to the two inch net mesh restriction exist for: licensed commercial tuna fishermen, licensed fishpond owners and operators, aquarium fish permittees, anyone fishing for fresh or salt water shrimp, opelu, or mikiawa (sardine).

14. Except on Moloka'i. According to the DLNR Digest (DLNR, 1985:4), bullpen traps "...may be set within 500 yards from shore west of Kaunakakai Wharf and 200 yards from shore east of Kaunakakai Wharf.

15. Most fish harvested in gill nets on Moloka'i were either dead or dying. Many nets were not checked within the prescribed period or were left at one location for several days. Often fish were partially eaten by what fishermen said were Moray eels (puhi), barracuda (kaku), or small sharks. Dead fish begin to decompose quickly in the warm waters of the reef flat and lose market value accordingly. Further, scarring of the flesh and skin discoloration occurs when the fish struggles in the net or when the fish is extracted roughly from the net by hand. The option of release of unmarketable or undesirable species is lost with gill netting activities.

16. Some fishermen manipulated the use of gill nets by tying nets together so that they overlapped. Nets laid in this configuration are called "shoji" nets after the familiar Japanese rice paper door. This use strategy effectively decreases net mesh sizes to less than the legal two-inch limit for gill netting reef fish species.

17. Relevant fishing activities associated with fringing reefs in the study area include: gathering by hand, spear, line, pole and lantern-fishing, trapping, trawling, throw netting, and gill netting.

18. This response was given when the question was raised about a witnessed taking of six lobsters during the closed season in July of 1985. This fisherman did not consider the south coast "over-fished."

19. Bull-penners were able to remove by hand fish that were less than legal size (and therefore unmarketable) alive and undamaged. This presents a unique opportunity for the tagging of large numbers of fish for purposes of fishery migration research. More importantly, this presents a strong case for the support of this type of fishing activity in Hawaiian waters.

20. The reconstruction of fishponds was considered a matter of having the right tool for the right job. One local resident suggested that the costs of running a crane and other heavy equipment needed for moving the large amounts of coral and stone materials could be lessened by using a technique for "rafting" stones into place. Dredging machines for silt removal could be replaced by work teams who could agitate the fishpond waters while taking advantage of tidal movements to sluice-out the pond during favorable tidal periods.

21. There are programs within the community that teach the native Hawaiian use of fishponds and the nearby coastal lands. These efforts represent small-scale research run by an alternative school on Moloka'i. It was suggested that this program be targeted for funding increases and expanded to include several of the best preserved fishponds publicly and privately available.

22. Some fishermen had personal experience with fishing laws and enforcement measures for the state of Alaska. They saw Alaskan regulations and stiffer enforcement laws as being superior to those of Hawaii by virtue of the fact that tougher sanctions were backed up with enforcement manpower and public mandate.

23. Banning the use of small-meshed gill nets or the taking of young fish fry was disagreed with by most fishermen. Moloka'i's Filipino fishermen net small fry as a mainstay of their traditional diet. Most fishermen felt that this group would be unfairly targeted should such a ban be enacted and enforced.

24. Opakapaka, ehu, onaga, weke ula, aweo weo, u'u and other redfish are particularly sought-after fish. Local fishermen consider their food value and their flavor to be superior to those of most other fish.

25. Perhaps allowing for the rotational or periodic use of the inshore zone (within 100 yards of the shore) area would stem the majority of objections.

26. Only two fishponds are mentioned here for use as sanctuaries because closing off any area to fishing is a sensitive topic for local fishermen. Ualapue fishpond appears to be the only state-owned fishpond that appeared usable as a sanctuary and as a productive fishpond complex. Other productive ponds were privately owned and were not considered in the analysis.

27. I discussed marine resource use problems with people representing professional resource conservation and development organizations on Oahu and Molola'i to wit, from the University of Hawaii, Hawaiian Homelands, the Hawaii Department of Land and Natural Resources, the U.S. Army Corps of Engineers, the National Marine Fisheries Service, the Office of Hawaiian Affairs, the Hawaii State legislature, and the Department of Planning and Economic Development.

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