



Socioeconomic Influences on Coastal Resource Use in Mahahual, Mexico.

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**SOCIOECONOMIC INFLUENCES ON COASTAL RESOURCE USE
IN MAHAHUAL, MEXICO**

**BY
JOSHUA CINNER**

**A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE
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ABSTRACT

Coastal resources provide important social, cultural, and economic benefits in many communities throughout the world. However, in many locations resource use practices are degrading the natural resources upon which coastal communities depend. Practices such as intensive and/or destructive fishing can threaten coral reefs and other coastal ecosystems.

Instituting changes in destructive resource use practices is often difficult because such practices may be related to social, economic, and cultural factors. Individuals and communities may participate in or tolerate resource-degrading practices because they may be the only option amidst difficult social and economic conditions. Initiatives that aim to deter resource abuse should identify and address the underlying factors that lead to such behaviors.

To determine how social and economic factors influence resource use, this thesis will examine relationships between socioeconomic variables (including wealth, education, migration, age, and coastal residency) and the ways in which people use and perceive coastal resources in the fishing village of Mahahual, Quintana Roo, Mexico. There are three main parts to the thesis: First, is a description of the ecological and social dynamics of the community, including the coastal ecosystems, infrastructure, socioeconomic characteristics, social structures, and resource use practices within and around the community. Second is an analysis of how socioeconomic variables influence resource use and perception within the community. A sample of local residents provide open-ended comments on a variety of projective stimuli, including photographs of local coastal resources and questions regarding coral reefs, fisheries, tourism, migration, and perceptions regarding the future. The socioeconomic characteristics of these respondents are examined to see if there are variations in uses and perceptions between socioeconomic groups. Analysis of these data indicates that wealth and education, respectively, are the most important socioeconomic variables influencing perceptions and uses of coastal resources. Finally, key issues regarding the integrated management of coastal resources in Mahahual are summarized. Potential interventions are also suggested that aim to address the needs and concerns of the socioeconomic sectors of the community presenting the greatest challenge to coastal management goals.

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CHAPTER 1 INTRODUCTION

This is a study of how social and economic factors influence perceptions and uses of coastal resources in the village of Mahahual, Quintana Roo, Mexico. Understanding relationships between socioeconomic factors and activities that negatively affect the environment is useful in managing natural resources because it can help identify root causes of environmental degradation, and allow these factors to be incorporated into an integrated management program. There is considerable literature supporting the theory that social and economic factors influence resource use on community, national, or regional levels (Stonich, 1992; Galvez et al., 1989; White, 1994; Pauly, 1990; McManus et al. 1992). However, the precise nature of these relationships, particularly within Mexico, is not well understood on a household level. Much of the socioeconomic data in Mexico are compiled by independent researchers and Non-Governmental Organizations (NGOs), and have yet to be applied to resource management (personal communication. Dr. C. Dyer, 3/00).

The supposition of this research is that the various ways in which people perceive and use coastal resources are dependent upon socioeconomic variables (including wealth, education, migration, age, and coastal residency). To determine which socioeconomic variables are most influential, this study examines relationships between household socioeconomic characteristics and the ways in which people perceive and use coastal resources. This information is then incorporated into a resource management context by recommending interventions that address the underlying factors behind resource degradation.

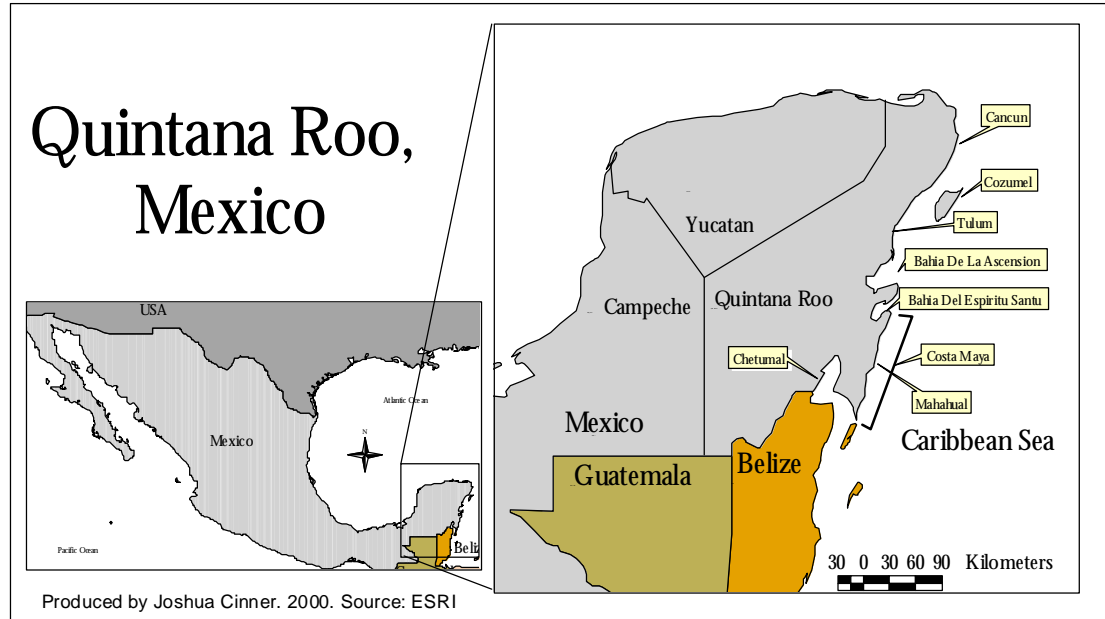
1.1 Communities Depend Upon Coastal Resources

The coastal environment of the Mexican State of Quintana Roo (figure 1.1) supports considerable tourism and fishery industries, upon which many residents depend for income and/or subsistence. Quintana Roo's diverse coastal environment is characterized by world famous tourist beaches such as Cancun and Cozumel, prolific mangroves in the Esprito Santo and Ascencion Bays, and part of the second largest coral reef system in the world, the Meso-American Barrier Reef. Though all of Quintana Roo's coastal ecosystems are of great economic and social importance, coral reefs, in particular, are crucial because they protect the coastline against hurricane damage and beach erosion, sustain subsistence and commercial fisheries, provide sand for beaches, and create recreational opportunities such as scuba diving. The social and economic base of many communities within Quintana Roo has evolved to depend, at least in part, upon the beauty and bounty of coral reef systems.

In southern Quintana Roo, communities utilize a variety of methods to exploit their surrounding resources (Basurto, 1996, 1997). However, some activities, including fishing, farming, and tourism, can alter the delicate balance of coral reefs (Jennings and Polunin, 1997; Pauly, 1990; Ruddle, 1996; Dalzel, 1996; Veitayaki et al., 1995). The nature and intensity of some activities can compromise the very habitat that both animals and humans depend upon for continuation of their livelihood. Unfortunately, instituting changes in resource use practices which are harmful to coral

reefs and other coastal resources is often difficult because the various ways in which people utilize their natural resources is invariably related to a multitude of social, cultural, and economic factors (Nazarea et al., 1998; Stonich, 1992; Galvez et al., 1989; White, 1994; Pauly, 1990).

Figure 1.1. Quintana Roo and the Yucatan Peninsula



1.2 Perceptions About Resources Can Influence the Ways in Which Resources Are Used and Managed

Recent literature about natural resource management (Pollnac et al., 1997; Pollnac, 2000; Nazarea et al., 1998) highlights the importance of understanding and incorporating local perceptions into resource management initiatives. In their study of perceptions about local resources in the Philippines, Nazarea et al. (1998) noted that individuals and communities utilize their surrounding resources based on a variety of social and cultural factors that shape their perceptions of the resource. Nazarea et al. (1998) claim “such factors can determine whether something is perceived as a resource and put to extractive or sustainable use or, alternatively, dismissed and neglected-or actively exterminated- as a non-resource.”

Perceptions about resources determine not only how a resource is utilized, but also its relative value to the community. In a similar study about perceptions of coastal resources in Indonesia, Pollnac (2000) discusses how the value that a community places on natural resources can have significant implications on how those resources are managed. According to Pollnac (2000), the value that something has to an individual or community reflects the satisfaction that can be gained from it. Satisfactions can be gained from something’s ability to satisfy basic needs such as food and shelter, or from its ability to fulfill loftier needs such as belonging and self-actualization (Pollnac, 2000). Nazarea et al. (1998) claim that exploring local perceptions about natural resources can provide:

an understanding of local populations' own internally defined standards, many of which are *qualitative, non-monetary, non-material, and long-term* and which often define what makes life, society, and the environment worthwhile. These culturally defined standards may include aesthetic, emotional, moral, religious, cosmological, and even inter-generational or "bequeath" considerations having a direct bearing on resource management.

For projects that aim to promote sustainable uses of coastal resources, it is important to understand which resources a community places values on and which they do not. In a baseline assessment of two coastal communities, Pollnac (1997) states "It is essential to understand individual perceptions of factors influencing the status of coastal resources prior to attempts to involve people in community-based management efforts." According to Pollnac (2000; p.1), resource management projects may need to "either direct outcomes at local values or somehow change these values." Gaining an understanding of how local communities perceive natural resources can allow developers of Integrated Coastal Management (ICM)¹ initiatives to adapt and refine management strategies to reflect the needs and desires of the stakeholders.

1.3 Social and Economic Factors Influence Coastal Resource Use

It is important to recognize that communities do not necessarily have a single perception regarding their natural environment. Social and economic factors can influence how people perceive their resources. Nazarea et al. (1998) state:

Different groups within local populations (e.g. rich versus poor, landed versus tenants, . . . old versus young) may have different perspectives and priorities in appraising their quality of life or their environment. In short, different categories of people view "reality" with different lenses based on their positions in the internal socioeconomic hierarchy. These different vantage points can help account for how each group or category of individuals manages the resources at its disposal to attain goals it considers important, as opposed to pursuing the goals of scientists or planners. Understanding these variations both within groups and among outsiders, can help facilitate the search for a common ground in the pursuit of broader goals such as environmental management...

Even when individuals or communities are interested in pursuing goals such as environmental management, social and economic cycles may influence their resource management decisions. In a study on how poverty can influence resource use in rural Honduras, Stonich (1992) claims that poverty often exacerbates resource abuse.

¹ Integrated coastal management is a set of activities that are designed to maintain and improve coastal resources and the human societies they support while minimizing social and environmental consequences (Olsen, Lowry, and Tobey, 1999; Underdal, 1980)

Stonich (1992, p. 386) states “because of economic and population pressures, governments and individuals are overexploiting the natural resources they control in order to generate income to satisfy immediate needs – whether those requirements are to generate foreign exchange at the national level or to increase current income at the level of the household.” For example, economic pressures may force poorer farmers to utilize land more intensively by cultivating higher proportions of their land and shortening fallow periods (Stonich 1992, p. 291).

As economic, social, and population pressures increase, resources may become over-utilized, stressed and less productive, which in turn forces people to further exploit their resources, creating a feedback cycle. Extreme resource degradation can disrupt local communities (White et al. 1994) and force people to migrate in search of better resources (Ruitenbeek, 1996). White (1994, p. 2) claims that as a result of coral reef degradation:

fishery catches decline, tourism suffers, coastal erosion becomes more severe, and local economies lose their resource base. Deterioration of customary resource use and tenure systems result from coral reef destruction and contributes to it. Social problems in coastal communities are made worse as people’s traditional modes of livelihood decline.

This cycle is further exacerbated by what Pauly (1990) claims is a traditional perception of the fishery being a “dump” for excess labor. Where economic opportunities are lacking, subsistence and commercial fishing can become saturated leading to over-fishing and resource degradation (Pauly, 1990; Laroche and Ramanarivo, 1995). Where unemployment prevails, it is likely that the sectors of the fishing industry that will become most exploited are those that are least capital intensive. McManus et al. (1992, p. 3) claim, “in the Caribbean, spear fishing is becoming an increasingly important economic activity as a result of socioeconomic factors related to underemployment and to the low outlay of capital equipment.” Unfortunately, spear fishing and other practices that require relatively small capital investments are often quite destructive to coral reefs (see section 7.5).

Though resource abuse can damage a community’s means of livelihood, tolerance of resource-degrading practices can be explained, in part, by Maslow’s theory of a hierarchy of needs (Maslow 1970). According to Maslow (1970), inability to meet basic needs such as food, shelter, and security can prevent people from pursuing loftier ambitions. For individuals or communities that are continually struggling to meet basic needs, many of the motives behind resource conservation (i.e. that there is an intrinsic value in nature) can seem too lofty to prioritize over their basic requirements; particularly when they require sacrifices. Despite legal sanctions, potential health threats, and the damage inflicted on coastal resources, communities may tolerate resource-degrading practices because they may be the only available livelihood option amidst chronic poverty (Galvez et al., 1989).

Within Mahahual there are a number of social and economic factors at play that could influence how people perceive and use their surrounding resources. Poverty, migration, and a lack of formal education define realities for some members of the community. This thesis will identify whether these factors influence the ways

in which people in the community perceive and use their coastal environment. However, choosing appropriate indicators to measure socioeconomic variables, particularly wealth, can be difficult.

1.4 Measuring Wealth

Cowell (1977) defines wealth as the sum of one's assets at a particular point in time. Wealth can include land ownerships, possessions (household and work related-fishing/farming gear), vehicles (boats, cars), money in the bank, the value of stocks and bonds, etc. According to Cowell (1977), wealth is an important and accurate indicator of economic and social well being because it "represents a person's total and immediate command over resources." Wealth can be measured on individual/household, community, national, and regional levels using a variety of indicators. However, concepts of wealth can vary considerably between cultures and communities.

Despite its cultural variations, wealth is used as an indicator of economic and social well being in a wide array of applied anthropology and development work (Kjell, 1997; Pollnac et al., 1997; Jones, 1996; Adams et al., 1997; Scoones, 1995). Examining wealth as an indicator of an individual, household, or community's well being has been an integral participatory research technique employed by many researchers involved in rural development (Pollnac, 1989; Jones, 1996; Adams et al., 1997; Scoones, 1995; Kjell, 1997). Adams et al. (1997), citing Chambers, 1994, claims "wealth ranking has become an increasingly accepted means of assessing relative socioeconomic status in the context of applied research projects and development programs." Measuring wealth is developing into a standard practice in rapid assessments of communities [often called Rapid Rural Assessments (RRAs) or Participatory Rural Assessments (PRAs)] which are useful because data can then be compared between communities and cultures (Adams et al. 1995; Pollnac, 1998; Jones, 1996). However, both Pollnac and Jones emphasize the importance of not transforming wealth ranking into a checklist type research that excludes local perceptions of wealth. Wealth ranking has become a popular component of community assessments because it can allow for a high degree of cultural flexibility.

Using wealth as an indicator of economic well being is an especially pertinent technique in the context of developing nations. According to Townsend (1970), in the cash economy context of many developed countries, measures such as income are relatively accurate measures of well being. Townsend claims that developed societies exhibit high monetary incomes, but low in kind incomes. In this situation, income may be an effective measure of well being as income information may be widely available and easily interpreted (Cowell, 1977). Cowell (1977) defines income as a change in a person's command over resources over a given time period. Because income reflects only the change occurring during the arbitrary time period (day, month, year) it has the disadvantage of excluding past accumulations of wealth, except when they are income-yielding investments (such as stocks and bonds). Cash income also excludes in kind income, which may be difficult to place a dollar value on.

Conversely, in many developing countries, people exist on a more subsistence level, so income is not necessarily representative of their well being. According to

Townsend (1970), rural societies tend to exhibit low monetary incomes, but high in-kind incomes. For example, a household which practices farming as its main productive activity may raise and eat goats, chickens, pig, cows, and a variety of vegetables, but not have a cash income representative of the quality of their diet. Thus, while examining well being in developing nations, income is simply not an accurate measure of social status, and a more broad-based, culturally appropriate definition of wealth must be developed.

Indicators of wealth can include concepts such as material style of life (MSL) and income, which are easier to examine on a smaller scale. MSL analyzes the household possessions within a survey population and constructs a scale based on the interrelationship between these items (Pollnac et al., 1997). Households are scaled based on the presence or absence of these possessions. MSL is easily examined on an individual/household level and does not require as large a sample size as indicators such as child mortality require for accuracy. This study utilizes MSL as a wealth indicator.

Some wealth indicators such as MSL can present problems if it is necessary to convert the wealth into money terms, as market prices may not reflect the relative utility that the items offer (Cowell, 1977). However, this study does not attempt to convert MSL into money. Cowell, 1977 also claims that wealth can present problems by not accounting for non-tangible investments such as education. While some researchers (Scoones, 1995; Adams, et al., 1997) have incorporated formal education into their wealth ranking, this study will explore education as an independent indicator of well being.

Development agencies such as the UN may incorporate health, presence or absence of resources (resources can include cash, capital assets, value of employee benefits, value of public services, and in-kind income), dietary information (caloric intake and nutrients), child mortality, educational attainment, and literacy in their measures of wealth (Townsend, 1970; Adams et al. 1997). However, the accuracy of many of these figures is dependent upon a relatively large sample size. For example, in the use of child mortality as an indicator, the death of one baby can give a household a 100% child mortality rate, which may not be representative of the social conditions the family lives in. Large sample sizes could present problems for one researcher with limited resources. Some of these indicators, such as dietary information may also vary dramatically with the season (Chambers, 1983). Wet/dry seasonal variation in food production and consumption may leave a researcher conducting a rapid assessment with very skewed data (i.e. people could either be very hungry or have an abundance of food, neither of which would necessarily be representative of yearlong average conditions).

Townsend (1970) points out that the selection of the variables used to measure well being may be a biased toward western-style consumption societies. Participation in cultural events such as recreation, funerals, religious ceremonies, and indigenous medicine are usually not accounted for in any of the well-being indicators, but may represent a significant proportion of resource consumption (Townsend, 1970; Nazarea et al., 1998). Poggie (1978) claims "Etic measures of success, based on Western socioeconomic motives, might be poor measures of adaptation in some societies... it

might lead to misleading interpretations.” Thus, it is critical that emic (community specific) measures of well-being are based on criteria offered by local people incorporating views and perceptions of their environment (Scoones, 1995; Nazarea et al., 1998; Adams, 1997; Jones, 1996).

Individual or household wealth can be influenced by many factors including income, education, occupation, tradition, political/social connections, ethnicity/race, remittance from abroad, and others (Townsend, 1970; Scoones, 1995; Adams et al., 1997). Adams et al. (1997) claim that in general, wealthier households demonstrate statistically significant better health, larger physical space, land ownership, have higher proportions of educational attainment, fewer dependents, among other expected findings related to wealth than poorer households. Due to the complex nature of social, cultural and economic factors that influence social stratification, there is not one effective measure of well being. Material style of life was chosen for this research because can be an emically-derived indicator of well-being that is easily measured and accurate for relatively small sample sizes and it does not exhibit proportionally large seasonal fluctuations.

1.5 Operations to Determine Socioeconomic Influences on Perceptions and Uses of Coastal Resource Uses

To find out how socioeconomic factors influence perceptions and uses of coastal resources, this thesis explores whether relationships exist between household socioeconomic variables (including education, age, migration, wealth, and coastal residency) and various perceptions and uses of coastal resources. A formal survey was used to elicit data about resource use, perceptions about resources, and household socioeconomic characteristics from the heads of households in the village of Mahahual, Quintana Roo, Mexico.

This thesis begins by using data from observations, key informant interviews, and questionnaire responses to define and describe environmental, social, and economic conditions in Mahahual relevant to ICM. Socioeconomic characteristics of respondents participating in farming, fishing, and tourism activities are then systematically examined to determine whether these variables are significantly related to the ways in which people utilize coastal resources. Since perceptions about resources can influence how they are used and managed, perceptions about coastal resources are explored based on open-ended responses to projective stimuli involving local coastal resources (including photographs of coastal resources and questions regarding fisheries, coral reefs, tourism, migration, and the future). Responses are categorized based on their content. To determine whether socioeconomic variables are significantly related to perceptions of coastal resources, the socioeconomic characteristics of respondents are examined based on groups formed by response categories. Relationships are summarized to determine which socioeconomic variable exerts the most influence on perceptions and uses of resources. This study concludes by examining key issues in coastal resource management in Mahahual and recommending potential ICM interventions that aim to address the root causes of coastal resource degradation.

CHAPTER 2 METHODS

2.1 Data Collection

Research for this thesis was conducted in Mahahual, Quintana Roo, Mexico from May to July, 1999. The boundaries in this study range approximately 12 kilometers north and 11 kilometers south of the village. The Northern boundary of the study was Rio Indio, a small community of several houses, a couple of bungalows, and a tiny store on the side of a house (figure 3.1.1). The southern boundary of the study was the hotel El Castillo.

Methods used to collect the data for this thesis included participant observation, key informant interviews (such as governmental officials, participants in various coastal activities, and village officials), 37 surveys of the heads of households (see appendix I for the survey instrument), and collection of secondary data (such as village statistics). Before the survey instrument was developed, one month was spent in the community observing, listening, asking questions, and engaging in a variety of coastal activities (commonly called participant observation). Throughout the research, 18 days were spent at sea with local fishermen partaking in a variety of fishing and tourism practices.

Thirty-seven of sixty-five households in the community were surveyed to elicit information on socioeconomic well-being, use of coastal resources, and perceptions of coastal resources (fisheries, coral reefs, forests, tourism) and other issues relating to coastal management (migration and hopes/worries about the future). Wherever possible, survey responses were confirmed by observations. For example, several people claimed that mangroves were not utilized in the area. However, observations indicated that mangroves were in fact used for construction and other purposes.

The survey examined socioeconomic information such as the age, years of formal education, length of time in Mahahual (referred to as “migration”), amount of time per month (referred to as “residency”), and wealth of respondents. Wealth was measured using a Material Style of Life (MSL) scale. From the survey information, each household has an individual value for each socioeconomic variable. These data are the basis for the overall analysis.

The survey also examined how respondents use and perceive coastal resources. To determine what activities households engage in, respondents were asked to list and rank the productive activities in which their household engages. Information regarding perceptions about coastal resources was elicited by two methods: (1) direct open-ended questions; and (2) Thematic Apperception Testing. Respondents were asked open-ended questions regarding fisheries, coral reefs, tourism, migration, and concerns about the future. Responses to the questions were grouped based on their content. Respondents were also asked to respond to 5 photographs of local coastal

resources, similar to the Thematic Apperception Tests (TATs)² employed by Nazarea et. al (1998) and Pollnac (2000).

A local resident who spoke proficient English was hired to assist in transcribing and translating the surveys, which were conducted in Spanish. Surveys were reviewed and translated within 24 hours, so that details could be added which may not have been initially recorded. Tape recorders were not used because residents of Mahahual generally view them as intrusive.

While a random survey method was initially attempted, an opportunistic survey method was eventually adopted. Opportunistic samples can be bias. An opportunistic method was adopted because heads of households were commonly gone (fishing, farming, or at their other home) for unpredictable and often long periods of time. In the context of household survey methodology, households are typically selected at random; however, if one or more is not willing or able to participate, a default location can be selected. Given the small size of the community, the opportunistic survey method used by this research should not introduce a great deal of bias because every household was initially a primary or default survey option. In order to complete a sufficient number of surveys given the time constraints of this project, I had to survey

² Thematic Apperception Testing (TAT), though some 65 years old, has recently been adopted as a tool in defining culturally relevant natural resource indicators (Nazera et al. 1998; Pollnac 2000). The TAT is a psychological assessment technique that has been widely incorporated in fields such as psychology and anthropology (Pollnac, 2000). Respondents are asked to provide open-ended feedback to visual stimulation such as a photograph. Psychological characteristics of the subjects can be diagnosed from interpretations of the content of their responses. Nazera et al. (1998) claim “the premise is that respondents tend to identify with some of the figures, thus revealing some of their own self-concepts and deep wishes in the process of story telling without much conscious effort.”

every household that was available and willing to participate. Every household in Mahahual was contacted and every household in the community that was willing or able to participate in the survey did.

Interviewing the heads of households is potentially gender-biased, because in this culture males are typically viewed as the heads of household. Thus, few females were interviewed. This may introduce bias in the descriptive statistics of the community (i.e. formal educational attainment may be different for males and females) and in areas of the research where males and females perceive things differently. In their Thematic Apperception Test, Nazarea et al. (1998) found several differences in the ways males versus females perceive the natural environment. Despite its gender-biased shortcomings, this methodology was adopted because it is culturally inappropriate in that region for two males (the research assistant and myself) to interview someone's wife in private. Female focus groups would have also been inappropriate and were, thus, not adopted. For the purposes of this thesis, persons that participated in the surveys are referred to as "respondents." Persons that participated in formal interviews (i.e. set meetings with government, university, or agency officials) or informal interviews (i.e. talks to fishermen on the beach) but may not have partaken in the survey are referred to as "key informants".

2.2 Analysis

Because data about coastal resources were gathered by two different methods (direct questions and TAT), two types of analyses were required to determine whether significant relationships exist between the independent and dependent variables. For analysis of the direct questions, households that have similar responses to questions regarding resource use³ or perceptions were grouped together. Mean values of socioeconomic variables were then obtained for the group. The t-test was used to test statistical significance of observed differences between mean socioeconomic characteristics across groupings formed by response categories.

Responses to the five photographic stimuli (TAT) were also grouped based on their content. Respondents were given a point for each category included in their response. Only reoccurring response categories were included in the final analysis. Respondents' socioeconomic variables were then correlated to their respective response category points using the pairwise Pearson's correlation model. Statistically significant relationships between socioeconomic variables and the uses and perceptions of coastal resources (both open-ended and TAT responses) were then examined to determine whether general trends exist between socioeconomic characteristics and the various ways that people use and perceive coastal resources.

³ Since some households participate in activities such as fishing infrequently, their direct impact on the coastal environment is different than that of a household that fishes frequently. To account for this discrepancy, respondents were asked to rank their productive activities based on importance to their household. Only productive activities ranked as primary or secondary importance are included in the final analysis. For example, this analysis will only consider the household to engage in fishing if fishing is ranked as the first or second most productive activity for the household. Households can be included in more than one category.

PART I. OVERVIEW

CHAPTER 3 MAHAHUAL AND SURROUNDING COASTAL ECOSYSTEMS

3.1 Mahahual: A Community at the Cross Roads

Several hours by car south of the hustle and bustle of famous Mexican tourism destinations such as Cancun, Cozumel, and Tulum, lies a vast, yet virtually untouched stretch of coastline referred to as the Costa Maya (figure 3.1). Characterized by prolific coral reefs, long beaches, and a practically impenetrable semi-arid lowland forest, local residents consider the Costa Maya one of Mexico's last frontiers. Along the coast, palm trees tower over beaches that are littered with seagrass, soda bottles and other plastic waste. Occasionally, a group of several parked fishing boats will indicate that a particular section of beach is used for fishing activities. About half way down the Costa Maya, the seemingly endless forest, palm trees, and mangroves that line the coast is briefly interrupted by a sleepy little fishing town called Mahahual.

Mahahual is a small Caribbean coastal community of about 300 people located 56 km to the north of Xcalak and 140 km from the city of Chetumal, in southern Quintana Roo, Mexico. Surrounded by the crystal-clear Caribbean Sea on one side and mangroves beginning no farther than 250 meters inland on the other, Mahahual seems hardly more than a strip of sand. The community is located just inland of the main fishing beach that is the social, political, and economic center of the town (figure 3.2). Almost all of the community's social activities, including sports tournaments, evening volleyball games, boat and equipment repair, festivals, town meetings, and even political elections are conducted at the main beach. The beach is broken up by several privately owned and fenced off parcels of beach-front property.

Figure 3.1 Mahahual and the Costa Maya.



Figure 3.2. Main fishing beach in Mahahual.



The multiple colors of the water on a calm day reflect the diversity of marine ecosystems, including seagrass beds, coral reefs, and pelagic waters. The bountiful fishery resources within these ecosystems attracted the most recent group of settlers to the coast. The majority of residents live behind a hotel, store, and three restaurants that lie across the street from the beach. The poorer households in the community have walls of vertical wooden posts (*cedro, caoboa, jabin, zapote, chitramon, tzalam,* and mangrove) and are roofed with a tarpaper-like substance referred to as *lamina de carton*. In stark contrast to these shanties, some of the wealthier residents live in two-story concrete houses. In the main area of town, the majority of buildings are on the inland side of the road. A dilapidated house on the seaward side of the road was damaged by Hurricane Mitch and attests to the necessity of building away from sea in this low-lying area.

Most residents in Mahahual make their living from the coastal environment, which provides them with a social, economic, and often spiritual connection with the coast. Productive activities include fishing, farming, hunting, black coral collection, tourism development, residential construction, wood collection, and a dive tourism industry. Some resource-use practices, particularly net and spear fishing, can cause considerable damage to coastal resources.

Fishing has long been the economic backbone of Mahahual. Currently, 65% of the 65 households in Mahahual engage in some sort of fishing activity. Fishing practices around Mahahual include gill and cast netting, spear fishing, hand and long line fishing, gleaning, and sport fishing. Fortunately, there are few reports of extremely destructive fishing techniques such as blast fishing or cyanide fishing which can devastate coral reef systems.

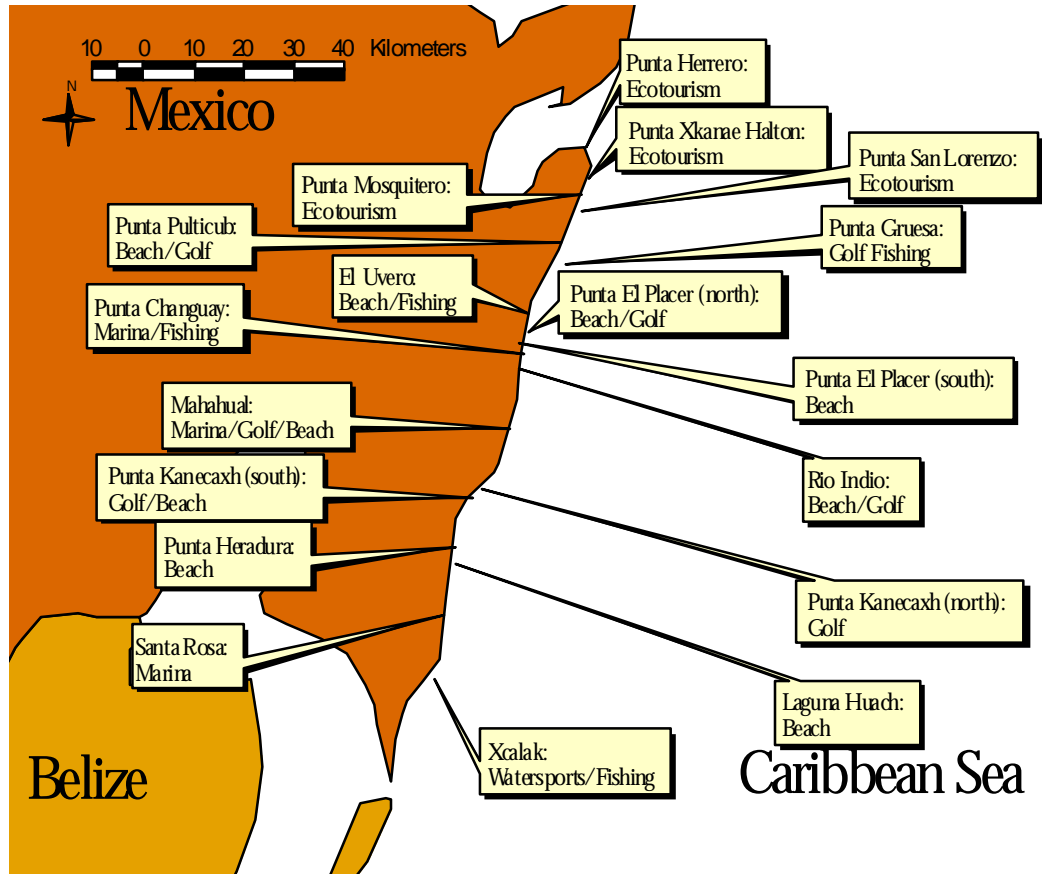
Despite the high number of productive activities that households engage in (37 households reported 40 distinct activities, though several are tourism related), economic opportunities in Mahahual are limited. Markets for fish, agricultural, and other products are several hours away. Infrastructure is limited in Mahahual. Production costs are high because there is no electricity to produce ice and

transportation is poor, resulting in spoilage of products and other difficulties. Recently, limited tourism has begun to provide some residents with an alternative income source.

Residents of Mahahual are caught at the crossroads of wanting to improve economic conditions by promoting tourism development, and wanting to preserve the rustic lifestyle, tranquillity, and natural beauty that the community now offers. The government and local residents are considering a fundamental shift to a tourism-based economy. Fide Caribe, a branch of government responsible for tourism development, has plans to develop the Costa Maya from Xcalak to Punta Herrero (figure 3.3). Mahahual is targeted to be the epicenter of this massive development project. Fide Caribe aims to build a cruise ship pier, airport, hotels, and increase Mahahual's population from under 300 to over 100,000 in the next 15 to 20 years (Personal communication, Dr. F. May). New roads, a cruise ship terminal, and an airport have already been constructed. Kottak (1999) presents an in-depth and long-term (almost 40 years) ethnographic study of the socioeconomic impacts of tourism and economic development on a small coastal community in Brazil.

Though residents are interested in the opportunity for tourism-based improvements in infrastructure and material wealth, some residents are apprehensive about the environmental and social changes associated with such large-scale development. A shift to a tourism-based economy may be detrimental to members of the community who are unprepared or unwilling to accept employment in the tourism sector because traditional productive activities such as fishing will be displaced. Residents claim that tourism developments in the north such as Tulum have left a legacy of geographic relocation, economic isolation, and the privatization of once public beaches.

Figure 3.3. Planned development along the Costa Maya.



3.2 Mangroves

Mangroves can be seen as far back as 20 km inland, though the majority of mangroves begin 50 m inland and range back approximately several hundred meters. There are four distinct species of mangroves: *rojo/red* (*Rhizophora mangle*), *blanco/white* (*Laguncularia racemosa*), *botoncillo/little button* (*Conocarpus erectus*), and *negro/black* (*Avicennia germinans*). An interesting observation was that the mangroves rarely extend to the waterline. When questioned about this, several key informants that have been there for up to 25 years mentioned that there have never been mangroves that extend to the waterline. Informants suggested that mangroves were cleared for the coconut plantations that dominated the coast before Hurricane Janet damaged the coconut industry in 1955.

Currently, local residents use mangrove wood for firewood, dye, construction of houses (roofs, posts, and walls), construction of fences, and mangrove swamps for land reclamation, sewage disposal, and as a dumping ground for garbage. The wood from mangroves is considered soft and many residents do not like to use it for construction. Activities that affect the mangroves include; dumping of trash, burning (typically for agriculture or development), development (including residential, tourism, and road construction), utilization for wood, disposal of sewage, and hurricanes.

Mangrove areas are commonly regarded as places of mosquitoes and horseflies and because of the wood's soft characteristics considered of little use. There is some

understanding among community members that mangroves are legally protected, though observation and confirmation by several respondents indicate that harvesting, though minimal, continues despite legal protection. The only historical use of the mangroves that is not currently being practiced is hunting, the reasons for which will be discussed in section 3.4. Respondents claim that barriers to utilization of the mangrove resources stem mainly from their protected status, and the potential expense of violation. However, residents do not perceive access restrictions to the resource as a pressing issue because the use of mangroves is minimal and enforcement of environmental regulations is poor.

Perceptions about the mangroves are such that some residents do not believe there have been, will, or even can be profound changes in the mangroves. These beliefs will be important if trying to implement a more comprehensive protection strategy, because they indicate that some residents may not see the need or importance of protecting the mangroves, and sensitization about the importance of mangrove ecosystems may be a necessary step during implementation of an ICM program.

3.3 Seagrass and Coral Reefs

Seagrass beds are prolific in the coastal lagoons. Except in the few locations where there are breaks in the reef, seagrass is often too abundant to allow for swimming. Thick piles of seagrass frequently wash up on beaches. Activities occurring in the seagrass ecosystem include gleaning (mainly for conch and a small clam called “*almeja*”), and digging channels (sometimes with a pickax) for boats to exit the reef lagoon during high tide.

Reef types are highly varied. Directly in front of Mahahual there is a fringing reef with a reef lagoon, that continue uninterrupted for many kilometers to the south (figures 3.4 and 3.5). The shallow reef lagoon provides safe harbor for boats. There are breaks in the reef directly north and south of town that allow fishermen to access the open ocean. The reef crest is very shallow and people were observed standing on it at low tide, fishing with rods. Dive operators agree that the reef is in good condition, but based on observations and reports of fishermen and dive owner/operators key informants, fish populations are low.

Figure 3.4. View of the reef along the coast. Source: Vasquez, 1998

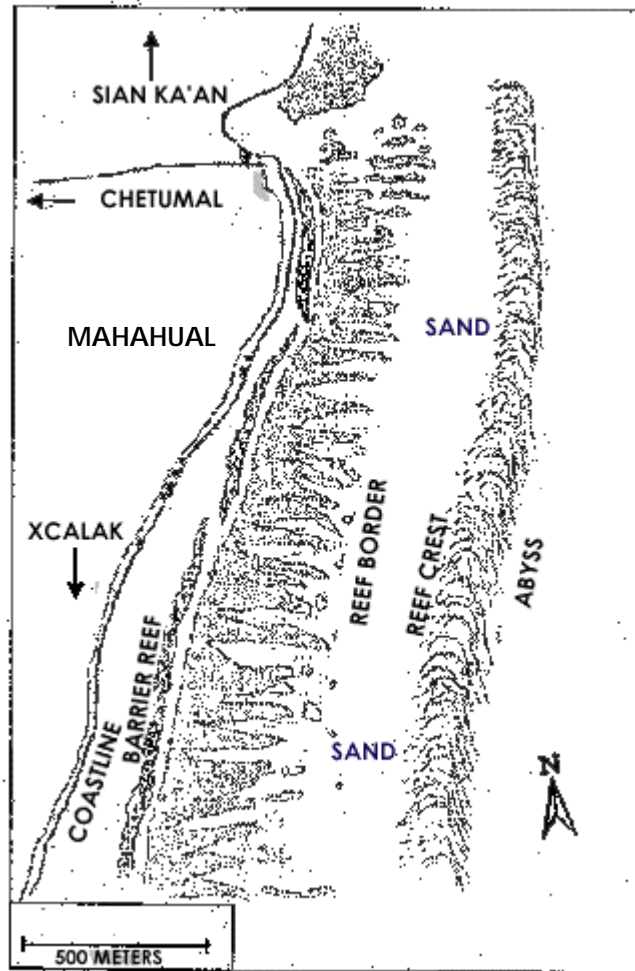
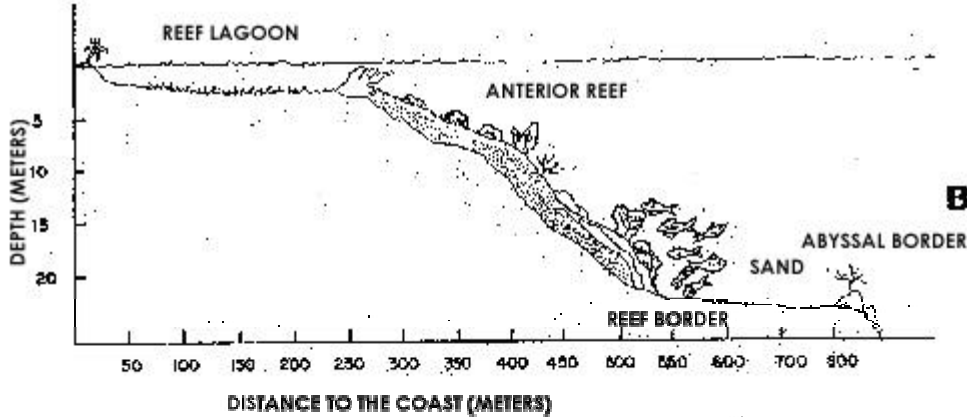
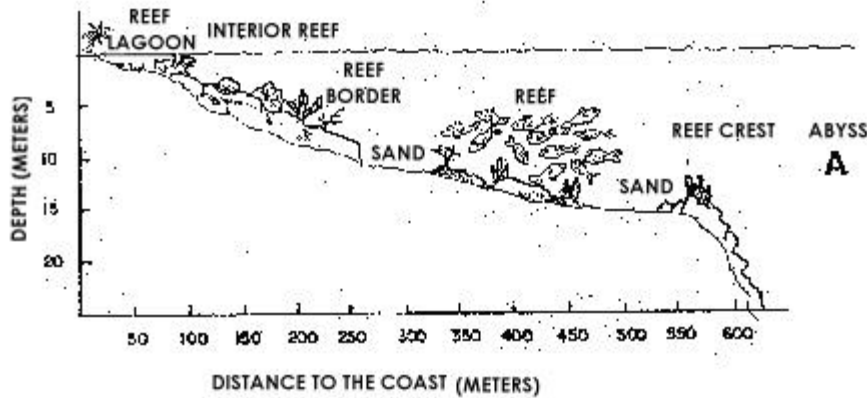


Figure 3.5. Reef Profile

- a) Reef profile in front of Mahahual.
 - b) Reef profile two km south of Mahahual.
- Source: Perera et. al, 1994



Approximately two kilometers north of Mahahual, at a planned site for a cruise ship pier, reef formations change dramatically. The fringing reef of the south gives way to a zone where the reef and land coincide to form cliffs. This formation results in higher wave action, deeper water, and fewer corals. The direct deep-water access may be responsible for the selection of this particular location as a cruise ship terminal.

Further north around Rio Indio, the benthic topography flattens out and currents seem considerably stronger. There are coral formations on the bottom, but they are few and far between, usually appearing as a single head of lettuce or brain coral. Rio Indio is a favored site among fishermen, who claim that it is less fished and there are more desirable fish there than around Mahahual. Rio Indio may also be favored because the nets often used in fishing there may sustain less damage in this area from the lack of reef, thus cutting down repair costs and time.

Banco Chinchorro consists of four islands grouped (from north to south) into Cayo Norte (2 islands), Cayo Centro, and Cayo Lobo (figure 3.1). Banco Chinchorro

lies some 45 kilometers off the coast of Mahahual. In a government effort to promote the sustainable use of the islands, Banco Chinchorro received protected area status in 1998. However, the enforcement of protected area status is negligible.. In the local fishing boats, the ride is 2-2 ½ hours and is extremely rough, even on a seemingly calm day. Based on observations and the reports of key informants, the reefs and fish populations around Chinchorro are in much better condition than nearer the mainland. The seaward sides of the atolls have a connected fringing reef that spans the entire length north to south. There are numerous shipwrecks around the atolls, which have immense tourism/diving potential, but if practices such as pillaging the wrecks for pottery and other material continue the potential will quickly diminish.

3.4 Inland Environment

The inland environment is also an important source of resources for the community of Mahahual. Informants identified a variety of resource uses in the forest, including: timber collection (*caoba*, *cedro*, *geanadillo*, *zapote*, *chacte viga*, and other hardwoods), *guano* collection (material used to make thatched roof constructions called *palapas*), hunting animals (wild turkey, peccary, white tailed deer, peacock, jaguar, ocelot, crocodiles, turtles), cattle ranching, agriculture (maize, cucumber, bananas, watermelon, and other fruit), collection of construction materials (residential and tourist), collection of vines for art and *palapa* construction, clearing for residential expansion, and creation of fire lines to prevent and control wildfires. Resources from the inland environment have traditionally been the basis of productive activities for many of the residents that live inland.⁴

While no permits are required for subsistence hunting (personal communication, Head Biologist, Uyumil Ceh Biological Reserve), permits are required to carry guns. Hunting is somewhat limited by the presence of soldiers and marines in the area that routinely patrol for drug trafficking and guns. It was mentioned that since many residents do not have official permits for their arms, they were less likely to go hunting because the soldiers and marines would confiscate their arms and fine them for lacking gun permits.

According to respondents, there are a number of issues that affect their ability to utilize inland resources. Problems include: resource degradation, restrictions on logging and burning, permit requirements, land ownership/tenure, lack of organizations and institutional support, and outdated laws that are not considered locally applicable. However, it was also mentioned that there are typically no problems accessing forest resources for subsistence uses.

⁴ According to key informants and respondents, coconut farms called “*copra*,” exploitation of *chicle* from *zapote* trees, and harvesting hardwoods used to be the predominant economic activities in the region before the 1950s. Over-exploitation of hardwoods led to the early demise of that industry. Blights and Hurricane Janet created difficulties with the coconut farming industry, minimizing its economic importance in the region.

CHAPTER 4

POPULATION AND SETTLEMENT PATTERNS

The local health clinic reported a full-time population of 261, consisting of 121 females and 140 males living in 33 households. The local (now former) Delgado (the locally elected municipal representative), reported a population of roughly 200 within the town, and 347 including K55 (see below for description of K55) and extending south a couple of kilometers. Observations indicate that there are 50 houses that are occupied by full-time residents. Contradictions in these numbers are due to a number of causes, including poorly defined geographical boundaries and a highly transient population. The average number of occupants per household can range from four to eight, depending on which population and household estimates are used. Household occupancy is highly varied because some households are occupied full-time by families and other are occupied by fishermen whose family lives somewhere else.

The central community itself is rather small, stretching back from the beach only 7 houses at its widest point. The majority of housing is clustered around the central area of Mahahual, but households are dispersed along the southern coast for 15-20 km. There are less than 80 houses within a 2-km stretch south of the central community, of which approximately 50 are occupied full-time. There is also a dispersed settlement several kilometers inland from the main village, referred to as K55 because this marks the 55th kilometer of road from the main highway (indicated by a highway marker). There are 13 additional houses with full time residents in K55, and three or four more that may be occupied part time or under construction.

K55 was originally settled as an agricultural area, but is becoming the focal point for controversy because it is the planned location for the displacement of coastal residents. When tourism development begins, relocation will present many problems for coastal residents that continue to engage in marine activities. For example, fishermen will be further away from their equipment and will be unable to monitor it during storm events or to prevent theft. Other residents simply do not want to live at K55. Key informants and observations indicate that K55 is also not nearly as pleasant a place to live as on the coast. K55 is hotter and bug-infested because the ever-present sea breeze that cools residents and blows the mosquitoes away does not adequately reach K55.

CHAPTER 5 INFRASTRUCTURE

Mahahual lacks municipal services such as electricity and water. There are three stores and five restaurants, though only three of the restaurants serve food regularly. There is a three floor concrete hotel, Hotel Mahahual in the center of town, and several bungalows that tourists can rent to the south of town. Hotel Mahahual supplies generator and solar produced electricity and pumped water to several community residents, who have connections to the hotel (through employment, family, etc.). A sandy road passes along the shore through the front of the town, which was the main road to Xcalak before a newer road was completed several kilometers inland in 1998.

Since there are no rivers or streams, fresh water for bathing and household use is obtained by numerous wells that are about 6 feet deep. However, 70% of households surveyed in the community drink bottled water. The only people that reported drinking water directly from their wells were several of the farmers that live inland at K55. Some 34% of surveyed households have a pit latrine and 49% have a concrete-lined septic tank. Twelve percent of the households reported neither and claimed to use the bushes and mangroves for toilets. In all cases, sewage is not properly treated for nutrients and the system may not even remove pathogens, which could leave the high water table especially susceptible to groundwater contamination.

Mahahual has a municipal dump; however, it is about eight kilometers, away and local residents without personal transportation have no means to bring their refuse to the dump. The dump was mentioned as a solid waste disposal method in 32% of the households surveyed. Some 51% of the households burned at least a portion of their solid waste, and 24% either buried their waste or illegally dumped it in the mangroves or bushes. A further 10% composted at least a portion of their waste. Shifts in the packaging of certain products have also led to increased volumes of solid waste. For example, disposable glass soda bottles have replaced most of the traditional returnable glass soda bottles, so the community has the burden of disposing of bottles that were formerly returned.

There is a truck that delivers food and other supplies twice a week to Mahahual. Two daily buses and a mini-van transport people between Mahahual and the state capital, Chetumal some 140 kilometers away. The transportation, especially the mini-van, can be used for pick-up and delivery of items between Mahahual and Chetumal, as can the food supply truck. There are two cellular telephones, one at the mini-super and one at the hotel, which are available for (paid) public use. Mahahual has a medical clinic with a doctor and a nurse, though there are complaints that it is often closed when people need it. The closest hospital is in Chetumal, as are the closest supermarkets, gas stations, and banking services. Pharmacies and dental services are available in Limones (about 1/3 of the way to Chetumal).

CHAPTER 6 SOCIOECONOMIC CHARACTERISTICS

6.1 Occupations

Households in Mahahual display occupational multiplicity. The sample of 37 households reported 40 distinct productive activities. Fishing is a productive activity in 65% of the households⁵, making fishing is the most popular activity in Mahahual (table 6.1). Other popular activities include farming and operating boat tours along the coast or to Banco Chinchorro. Diversification of productive activities allows residents to receive income when fluctuations such as seasonal variations and weather-related phenomena affect their primary productive activities. The proposed shift to a tourism economy will displace many currently practiced productive activities such as fishing and could be difficult for residents during the tourist off-season times or if tourism does not meet expected levels.

Table 6.1 Distribution of Professions

<u>Productive Activity</u>	<u>Ranked #1</u>	<u>Ranked #2</u>	<u>Total*</u>
Fishing	15	6	65%
Tourism	5	0	41%
Selling Fish	4	0	11%
Agricultural (ranching and farming)	4	6	32%
Commercial (not including restaurants)	3	2	22%
Pension/Unemployed	3	0	8%
Skilled/Trained Employment	3	3	19%
Restaurant	2	2	13%
Building (construction, carpentry, & thatched roof-making)	2	3	19%
Artisan Craft-Making	1	1	8%
Hunting/Gathering	0	2	16%
Children's Activities	0	1	15%
Domestic Work (laundry, house cleaning)	0	0	19%
Transportation	0	0	5%

* See footnote 5

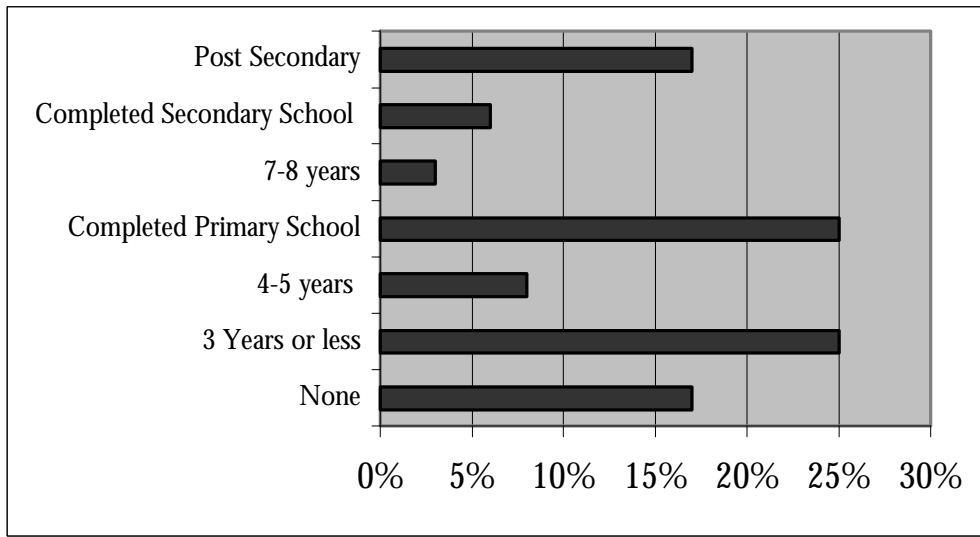
6.2 Education

Education is widely used as an indicator of wealth and social status (Pollnac et al., 1997). Respondents were questioned about their years of formal education (figure 6.2). Respondents have an average of six years of formal education. However, it should be noted that only the heads of households are interviewed, thus this average may not be representative of the educational attainment of the entire population.

Mahahual has a primary school and a very recent (August of 1999) secondary school. In the primary school there are 40 students; seven students in first year, seven in second year, five in third year, nine in fourth year, five in fifth year, seven in sixth year. There are only two children of primary school age that do not attend. At the time of the research, the secondary school was not yet open hence there is no data for student attendance at that school.

⁵ This figure accounts for all households that included fishing as a productive activity, no matter how it was ranked in importance.

Figure 6.1. Educational Attainment in Mahahual



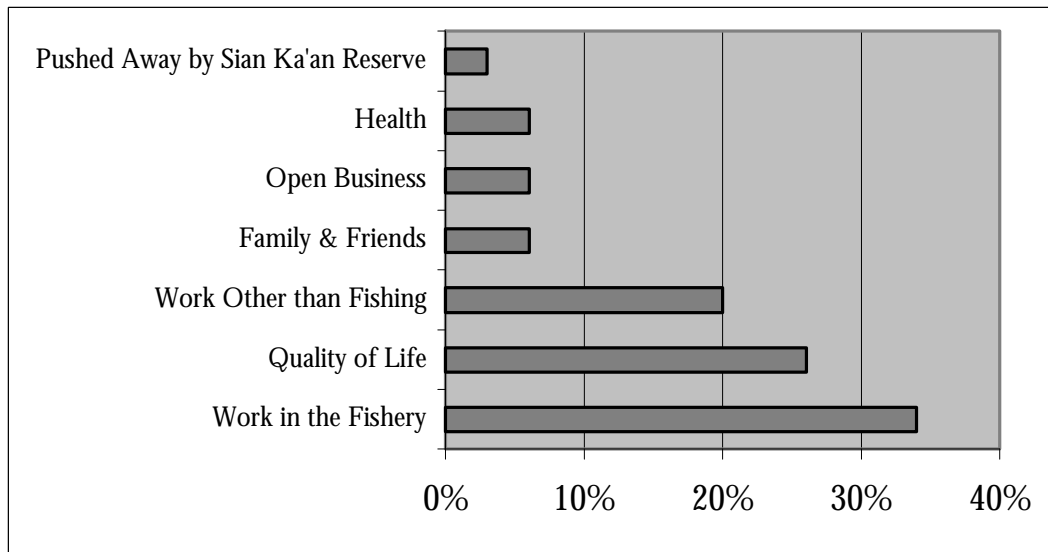
6.3 Migration

Of the 37 household heads interviewed, only one was born in the Mahahual area (Rio Indio). Due to the relative homogeneous migration status of respondents, analyses in chapters nine and ten regarding migration will be based on how long residents have been living in Mahahual rather than if they have migrated. The length of residency variable (referred to as simply “migration” in the analysis) is included primarily to discern whether long time residents have special concerns that could be addressed by an ICM program.

The median time that the respondents have lived in Mahahual is eight years (the mean time in Mahahual is 10 years, but this figure may be less representative than the median because it is distorted by extremes such as residents that have been there for 70 years). Many respondents also mentioned that they had only lived in Mahahual for a few years but had been coming to the area (typically for fishing) for a number of years. Many residents are originally from the State of Quintana Roo. Other common origins include the states of Vera Cruz and Yucatan.

Figure 6.2 illustrates the frequency of reasons that people moved to Mahahual. The primary reason for migration is employment opportunities in the fishery and other fields. This indicates that people moved to Mahahual primarily because of economic need, but also means that they had confidence in the natural resources of the area. Ruitenbeek (1996) states “population movement can be a useful indicator of environmental security.” Perceptions regarding the state of coastal resources will be discussed further in chapter ten. Other reasons include: quality of life, presence of family and friends, health concerns, and being displaced from fishing by the Sian Ka’an reserve to the north.

Figure 6.2. Reasons for migration to Mahahual



Mahahual is somewhat transient. Some people come to fish for a week or a weekend a month, others move to Mahahual for the lobster and conch seasons. The amount of time per month that respondents spend in Mahahual (referred to as residency in the analysis) is included to determine whether there are variations in the

perceptions of full-time versus part-time residents. Information was gathered regarding the number of days per month that respondents reside in Mahahual. The average number of days per month that respondents live in Mahahual is 27. However, this average is high because many cooperative members (typically part-time residents) were either not present or busy with preparations and unavailable to interview.

6.4 Material Style of Life

According to Pollnac et al. (1997), Material Style of Life (MSL) can be an indicator of relative wealth or social status in a community. MSL is a method of measuring wealth based on the presence or absence of household possessions. To determine culturally appropriate indicators of wealth, key informants were asked to describe the house of a rich person and the house of a poor person. A list of 24 items was developed including items such as a television, VCR, satellite antenna, gas stove, wood stove, electrical generator, vehicle, type of bathroom (septic system or pit latrine) and the type of walls, roof, and floor. Table 6.2 shows a distribution of these items within the community.

Table 6.2. Distribution of Material Wealth

<u>Material Possessions</u>	<u>Distribution</u>	<u>Material Possessions</u>	<u>Distribution</u>
Walls		Sanitary Facilities	
Cement	13%	Septic System	48%
Wood	51%	Pit Latrine	34%
Wood/Cement	11%	No Sewage	17%
Carton	19%	Miscellaneous	
Other	6%	Generator	14%
Floors		Antenna	8%
Cement	54%	TV	19%
Sand	35%	Stereo	8%
Cement/Sand	8%	VCR	8%
Roofs		Gas Stove	73%
Cement	3%	Wood Stove (inside)	8%
Zinc	5%	Wood Stove (outside)	21%
Thatch	16%	Second House	43%
Carton	76%		

To provide a clear picture of the distribution of material wealth within the community, a scale can be constructed based on the interrelationship between these items (Pollnac et al., 1997). These items were factor analyzed using the principal component method and varimax rotation, resulting in two material style of wealth factors that explained 45% of the variance (table 6.3). Factor 1 explained 24% of the variance and factor 2 explained 21%. Nine items did not have significant loading on either factor and were discarded from the analysis.

Table 6.3. Principal component analysis of material style of life

<u>Item</u>	<u>Factor 1</u>	<u>Factor 2</u>	<u>Item</u>	<u>Factor 1</u>	<u>Factor 2</u>
TV	.823	.097	Septic System	.355	.702

VCR	.764	.215	Gas Stove	.223	.688
Antenna	.743	-.023	Second House	.188	.639
Cement Floor	.677	.411	Latrine	-.079	-.611
Sand Floor	-.617	-.225	Wood Stove	-.102	-.572
Generator	.521	.395	Vehicle	-.202	.494
Cement Walls	.467	.350	Carton Walls	-.328	-.442
No Sewage	-.371	-.162			

bold denotes high factor loading

As indicated by table 6.3, the items that have the highest positive loading on the first component are TVs, VCRs, satellite antennas, cement floors, generators, and cement walls. Items with high negative loading on the first factor include sand floors, and the lack of sewage facilities. Thus, factor one (subsequently called “wealth factor one”) is comprised of accessories and floor structure.

Items with high positive loading on the second factor include septic systems, gas stoves, possession of a second house, and a vehicle. Items with high negative loading on the second factor include latrines, wood stoves, and carton walls. The second factor (subsequently called “wealth factor two”) is comprised of household structure, amenities, and luxury items.

The items on wealth factor one suggests that households with high loading on this factor are more settled in Mahahual. Items such as TVs, generators, VCRs, and satellite antennas could be stolen if a watchful eye were not kept on the items. Wealth factor two indicates a different type of wealth than wealth factor one. Due to the high positive loading of both a second house and vehicle, the second wealth factor represents a high degree of mobility. One would expect that a members of households with a high wealth factor two loading come to the coast to engage in productive activities and have families in another location. However, since structural and accessory items are present on both factors, distinctions between these two items are not clear cut. Thus, these wealth factors should be viewed in tandem rather than as independent wealth indicators.

A score on the component scale is calculated for each household based on the presence or absence of items in their household. Pollnac (1997) states “the factor (or component) scores are the sum of the component coefficient times the sample standardized value.” Thus, each item has a contribution to the factor score based on its loading in table 6.3. Items with high positive loading have a stronger contribution than those with low or negative values. Factor one scores in the community range from -1.049 to 3.053. Factor two scores range from -1.848 to 1.638. Scores are standardized, and have a mean of zero and a standard deviation of one.

6.5 Ethnicity and Religion

Mahahual is religiously homogenous : Eighty-one percent of respondents say their household is Catholic. Other religions include Agnostic, Atheist, Protestant, Evangelic, Christian Evangelic, and Pentecostal. There are no regular religious services in Mahahual, however, there are two churches (one in the center of town and one near K55) that are used for holidays and special events such as baptisms. Since the vast majority of respondents are Catholic and the other religious groups have so

few constituents, ethnicity or religion is not introduced as a variable in the analyses (chapters nine and ten).

Though Spanish is the predominant language one hears in Mahahual, language abilities in the area are diverse. Thirty-eight of forty people claim to speak fluent Spanish (the other two speak a little Spanish). However, eleven also speak a Mayan language, and several speak a variety of European languages, including Catalan, English, French, and Italian.

6.6 Gender

According to the local health clinic, Mahahual consists of 54% males and 46% females. This figure may not account for the fishermen that reside in Mahahual part-time. Observations indicate a higher proportion of males in Mahahual than reported by the health clinic. Since the heads of households were males in all but a few of the households interviewed, gender is not incorporated in the analyses (chapters nine and ten).

6.7 Age

The average age of respondents was 45 years. Since only the heads of households were interviewed, this number is not representative of the population as a whole. This variable is included in later analyses.

6.8 Correlation Between Socioeconomic Variables

Socioeconomic variables do not demonstrate high levels of inter-correlation. Table 6.4 indicates that length of time a resident has lived in Mahahual (referred to as migration in table 6.4) is correlated with age ($p=0.018$). This suggests that Mahahual does not generally attract older migrants. People typically move to Mahahual when they are young. As discussed in section 6.3, fishing is the number one reason that people moved to Mahahual. The methods of fishing employed in Mahahual (discussed in chapter eight) are difficult and may not be actively pursued by older people in search of a new home. Other variables are not correlated and represent independent socioeconomic indicators.

Table 6.4 Correlation Matrix of Socioeconomic Variables

	Education	Age	Wealth Factor 1	Wealth Factor 2	Migration	Residence
Education	1	-	-	-	-	-
Age	-0.274	1	-	-	-	-
Wealth Factor 1	0.141	0.178	1	-	-	-
Wealth Factor 2	0.200	-0.149	0.000	1	-	-
Migration	-0.329	0.387*	-0.195	0.074	1	-
Residence	-0.108	0.175	0.048	0.016	0.058	1

* $p<0.05$

CHAPTER 7 SOCIAL STRUCTURE

7.1 Social Stratification and Land Tenure

Mahahual, like most other communities in the world, is economically stratified. Some people have boats, vehicles, and other material possessions that others do not. However, with an increase in tourism this disparity may become greater. For example, a fisherman with a boat is occasionally able to take tourists diving on the coast and to Banco Chinchorro, earning a profit up to 1000 pesos per day (approximately \$110 US dollars) compared to 200-500 pesos (\$22-56) per day fishing. Tourist day trips to Chinchorro often start after the nets have been retrieved and end before deployment of nets at night, so the boat owner can generate income from both fishing and tourism. If the tourist trip is more than one day, regular crewmembers who do not go out with the tourists would not have the opportunity to fish while the boat is away. Thus, crewmembers can remain economically stagnant while the boat owners are earning increasing amounts of money.

As the disparity in the material style of life among community members increases, social problems could result. Concentration of assets, especially land, can result in augmented social differentiation and impoverishment (Stonich 1992, p. 391). Several informants mentioned that beach access has already begun to manifest itself as a pressing social issue in Mahahual. Several parcels of beachfront land (the land typically owned by residents with higher incomes) have been fenced off and marked as private property, a trend that may continue as more of the coastal land is bought up.

Several residents have also expressed concern about the availability of affordable land in Mahahual. Currently, only 25% of residents have title to their land (personal communication, Dr. F. May. 07/99). Some respondents claim that since Mahahual is targeted for tourism development the government is unwilling to relinquish possession through traditional land tenure systems that turn over title to residents that have occupied land for over five to ten years. One respondent remarked "If they don't have the security of titles, what kind of life are they going to live? None. You aren't going to invest in something they are going to take away. The people live here with their houses, sure, but they don't have the security of the title."

A representative from the governmental agency in charge of tourism development, Fide Caribe, claims that as part of the Costa Maya project, titles to land will be given to residents that are relocated to K55 (personal communication, Costa Maya representative, 07/99). However, many residents are not interested in being relocated.

7.2 Formal and Informal Associations

Key informants mentioned nine community groups: the baseball team, the soccer team, the neighborhood committee, the local police force, the delegation (local political representation), the parents' association, the volunteer firefighters, and two fishing cooperatives. When asked what community groups respondents participated in, 35% respondents indicated that they participated in one or more of these groups, while several respondents were unaware of any community groups.

The most active and organized associations in Mahahual are the two fishing cooperatives: Banco Chinchorro Cooperative and Langosteros del Caribe, each of which has approximately 30 members. There is also another cooperative that fishes at Banco Chinchorro, the Cooperativa Andres Quintana Roo, but it is based in Xcalak. Many members of the Banco Chinchorro and Langosteros del Caribe cooperatives live in Chetumal and come to Mahahual only to fish.

Lobster and conch are high priced fisheries and are important sources of foreign exchange in the region (Basurto, 1996). Regulations require fishers to be members of cooperatives in order to legally capture and sell these species (Basurto, 1997). Cooperatives are given exclusive rights to fish conch and lobster, as well as exclusive rights to all fishing activities in Banco Chinchorro. Cooperatives are also one of the only avenues open for fishermen (both members and non-members) to obtain loans for the purchase of a boat and/or motor. In Chetumal, members of the Langosteros del Caribe cooperative have also formed an official tourism cooperative called the *Paradiso Caribe*. Though the tourism cooperative is not active at the moment, a key informant claims that members are looking into obtaining a large boat to transport tourists to Banco Chinchorro.

7.3 Sea Tenure

Cooperatives are awarded exclusive fishing rights for Banco Chinchorro and for the statewide extraction of lobster and conch. The exclusive rights that have been awarded to the cooperatives have been a point of controversy between free fishermen (fishermen not associated with cooperatives) and cooperative members, because free fishermen routinely make illegal fishing trips to Banco Chinchorro. Cooperatives extract all types of species from Banco Chinchorro, but during lobster and conch seasons, harvests are more focused on the species in season. While lobster and conch are harvested by the free fishermen that fish illegally in Chinchorro, the free fisherman's target species are more commonly fish and shark, thus serious controversy is avoided by minimizing competition for species with exclusive rights. Despite the difference in target species, some cooperative members referred to free fishermen fishing in Chinchorro without permission as "pirates."

During this research, there were no observations of direct conflicts regarding sea tenure, however, there are several scenarios in which conflicts could manifest. Although resources are currently abundant enough to attract people to the area, there is an overall perception that fishery resources are declining (section 10.2). Intensification of fishing and tourism pressures could lead to a scarcity of both coastal and Banco Chinchorro fishery resources. Leach, Mearns, and Scoones (1999) state "conflicts over access often intensify when the resource in question becomes scarce..." Conflicts may also be exacerbated if the *Fide Caribe* tourism development displaces free fishermen from their coastal fishing grounds. This may force free fishermen to frequent Banco Chinchorro more often, resulting in more opportunities for conflict.

Despite potential conflicts, the relationship between free fishermen and cooperatives should not be viewed as completely antagonistic. Cooperatives do hire a significant number of free fishermen from along the coast and Chetumal to assist in

the harvesting of lobster and conch. A cooperative member claimed that there were as many as 300 fishermen working (legally) in Banco Chinchorro during lobster season, of which only 90 were cooperative members.

7.4 Enforcement of Environmental Regulations

The Secretaria De Medio Ambiente, Recursos Naturales y Pesca (SEMARNAP) is the federal agency responsible for developing and implementing environmental regulations. A branch of SEMARNAP, Procuraduria Federal de Proteccion al Ambiente (PROFEPA), is responsible for the enforcement of environmental regulations. However, PROFEPA has resource limitations and inadequate enforcement personnel [10 rangers in the entire state of Quintana Roo, most of which are located in the northern end of the state (personal communication, SEMARNAP official, 6/99)]; thus, environmental laws are generally not well enforced around Mahahual. However, PROFEPA does have enough of a presence that residents are not blatant about breaking environmental regulations.

The continual presence of army soldiers and marines is a deterrent to some crimes such as illegal hunting and turtle collection, but other regulations go virtually unheeded. For example: some fishermen continued to capture lobster throughout the closed season (March through June). During the closed season lobster production occurs for local consumption, sale to local restaurants, and even sale to market in Chetumal. However, during closed season, capture of lobster is low key, and full-scale production is not instituted by the cooperatives. When questioned about illegal practices, informants often claimed that subsistence capture of lobsters during the closed season is tolerated. Key informants also claim that commercial lobster activities are also tolerated as long as they are not blatantly disregarding the law.

Recently a harbormaster has been placed in Mahahual. His duties include enforcing safety regulations (i.e. making sure that vessels are equipped with the required safety gear and closing the port in bad weather events), making sure that vessel operators have the required licenses, training, and registration, and keeping track of the vessels that are in port. The presence of the harbor master been perceived as a hardship among some fishermen who view him as a limitation to days at sea (by closing the port) and believe the fees, licenses, and safety regulations that he enforces are too expensive and time consuming. However, the harbormaster does provide services such as critical weather information (i.e. sea conditions and port closures) to the fishermen with radios. Unfortunately, the vast majority of fishermen do not have radios (the only radio that was observed was in a fishing camp at Cayo Centro in Banco Chinchorro).

Since Quintana Roo is the newest state in Mexico, and the Costa Maya is the last frontier of the last state, coastal residents typically view themselves as pioneers. Many residents enjoy the freedom of being on the frontier. On several occasions it was mentioned to me that residents wouldn't live in Mahahual if they were the type of people who liked rules. The Harbor Master and SEMARNAP are viewed as entities that make their lives more complicated by adding more and more rules to choke them, and are thus generally disliked by residents. In general, ICM strategies that attempt to impose regulations upon the community will not be well received.

CHAPTER 8 ACTIVITIES IN THE COASTAL ZONE

8.1 Introduction

Most residents in Mahahual depend on coastal resources for their livelihoods. Unfortunately, some means of exploiting coastal resources are not sustainable. A wide array of activities occur around Mahahual that have the potential to alter or affect coastal ecosystems. Activities include: farming, clam (*almeja*) gathering, black coral harvesting, fishing, tourism and tourism-associated development.

8.2 Farming

8.2.1 Significance of Farming

Farming around Mahahual consists mainly of small-scale, family-run farms and ranches set several kilometers back from the coastline. Farms are typically about 50 hectares, and several houses are on a single plot. Harvests include *guano* (palm thatch used to make *palapa* roofs), bananas, watermelon, limes, mangos, peppers, chile peppers, cucumbers, tomatoes, and lemon grass. Most farmers reside in K55, though work may be further inland.

Key informants said that despite the relative abundance of fresh water, the topsoil is relatively thin which creates unfavorable farming conditions. Farming activities are also constrained by the presence of annoying insects. Key informants explained that during June, July, and August the mosquitoes are so bad that they cannot even farm. This was confirmed by observation.

8.2.2 Environmental Impacts of Farming

Farming practices around Mahahual have the potential to adversely impact the environment. Deforestation of forest and possibly mangroves, can increase erosion. Siltation from runoff can be detrimental to coral reefs. Animal feces, agricultural chemicals, and the environmentally insensitive use of pesticides can contaminate groundwater. Fertilizers and animal feces can add excessive nutrients to the ecosystem. Nutrient loading stimulates algal growth which can smother coral reefs.

8.3 Gleaning

8.3.1 Significance of Gleaning

According to Ruddle (1996), gleaning (gathering) is the most widely practiced method of reef species exploitation worldwide. Gleaning occurs mainly on reef flats, seagrass beds, and shores and is simply the manual collection of organisms, usually invertebrates. In southern Quintana Roo, commercial gleaners target *almeja*, a small white clam. However, subsistence gleaners also target blue and stone crabs, urchins, lobster, and octopus, among others (Basurto, 1997) using hands, machetes, rakes, nets or screens, hooks, and extraction sticks.

Almeja is routinely harvested from Mahahual's shoreline. Harvesters wade in shallow reef lagoons no deeper than one meter and use a bush hook (a hooked machete) to rake through the seagrass and mud, twisting the machete at the end of the

stroke (figure 8.1). When the *almejas* are encountered, a distinctive scraping sound can be heard and the harvester digs with the machete and his hands to extract the clam. *Almejas* are found about 10 cm below the surface in seagrass beds and occur in all types of seagrass. One harvester can gather 3-5 kilos per day of *Almejas*, which sell for approximately 40 pesos/kilogram (\$4.40 US, or about double the price of most fish). The meat of *almejas* is used for consumption and the shells are sold for jewelry and other types of artisanal crafts.



Figure 8.1. Man gleaning for *almejas*. Photo: Joshua Cinner

Almeja gathering is regulated by the award of a single permit to a cooperative that, in effect, has a monopoly in the southern part of Quintana Roo to collect and sell *almejas*. Twelve men work in the cooperative, in groups of four, typically in two week shifts. Harvesting areas are changed monthly to disperse the impact of the harvest along the coast.

8.3.2 Environmental Impacts of Gleaning

Gleaning can have negative impacts on the coastal environment. Walking on reefs, poking with sticks, raking, and scraping from the extraction device could cause substantial damage to corals. The environmental impacts of *almeja* gathering are mainly the damage sustained to the seagrass where the bush rake digs and turns. *Almeja* gathering could have significant impacts on seagrass ecosystems if it were more common. Possibly because the work is difficult and backbreaking, *almeja*

gathering does not attract more participants. Outside of the 12 *almeja* cooperative members, there were no other observations of *almeja* gathering.

8.4 Black Coral Harvesting

8.4.1 Significance of Black Coral Harvesting

Black coral is harvested along the Costa Maya from Rio Huach to Punticub. Only three people that are given permission from SEMARNAP to harvest the coral. The three work as a team and typically work one week on and one week off, depending upon the weather. Corals are harvested from a depth of 240 feet. Divers claim to dive for 20 minutes at 240 feet with a 40 minute decompression. Respondents did not indicate if black coral harvesters used NITROX, a combination of nitrogen and oxygen used for prolonging dive times. Coral is sold in Cozumel for 250 pesos/kilogram to be made into jewelry.

8.4.2 Environmental Impacts of Black Coral Harvesting

Black coral is an endangered species, and is internationally protected by the Convention on the International Trade of Endangered Species (CITES). Despite the international protection, domestic harvest continues. The harvesters are allowed to extract 150 kilograms per month of cleaned black coral. I witnessed an overflowing truckload of approximately ten bundles that the harvester claimed would account for only 25 kilos when cleaned. The valuable part of the black coral is the thicker part toward the stem. Thus the entire piece of coral is extracted from the base, leaving nothing to re-grow. Due to the extreme depths where black coral occurs and the expense of the equipment needed to reach it, extraction seems limited to those with the permits.

8.5 Capture Fishery

8.5.1 Significance

The Costa Maya is bordered by a fringing reef that is part of the Meso-American Barrier Reef, the second longest coral reef system in the world. There is a reef lagoon bordering the coast that varies in width from 200 m to 1 km (Basurto, 1997, p. 39). Fishing generally occurs adjacent to the reef crest in water depths ranging from several meters to 300 m. During bad weather, fishing activities become focused on the reef lagoon. Approximately 45 km. off the coast is Banco Chinchorro, which is a major fishing ground for finfish, lobster, and conch.

The capture fishery around Mahahual and Banco Chinchorro consists mostly of fishermen from Mahahual, Xcalax, and Chetumal. Popular fishing gears include: gill nets, spearguns, handlines, *palangre* (a long line system of hooks, floats, and lines), cast nets, rod and reel, gaffs, and fish weirs (table 8.1). Fishing activity in Mahahual usually occurs first thing in the morning when fishermen collect their nets that have been deployed the previous evening. During the day, most of these fishermen are usually engaged in net and other equipment repair. However, many spear fishermen fish throughout the day. Some spear fishermen take busses to and from more remote fishing areas along the coast. Fishers claimed to fish from Pulticub in the north, Punta Gavilan in the south, and Banco Chinchorro in the east (figure

3.1). During the study, observations indicate that normal fishing activities occurs between Rio Indio to the north and Maya Ha in the south. Trips to Banco Chinchorro are also common.

Table 8.1. Frequency of Fishing Gear Ranks

<u>Fishing Equipment</u>	<u>Ranked #1</u>	<u>Ranked #2</u>	<u>Ranked #3</u>	<u>Total Households Reporting Use</u>
Net	11	9	0	20
Spear	6	7	4	18
Palangre	3	8	2	13
Hook	1	7	5	21
N= 37				

Fisheries are limited in the south coast of Quintana Roo by a lack of supporting infrastructure (Basurto, 1997, p. 42). There is not continuous electrical power; thus, ice is not produced locally and must be trucked in from Chetumal. Fishermen typically store their catch in old freezers packed with ice before they take their catch some 2 ½ hours to market in the capital city of Chetumal. Basurto (1997, p. 42) confirms my observations that a lack of ice can result in spoilage and frequent discard of at least part of a catch. Fishermen must also travel to Chetumal for fuel, food supplies, equipment, and repairs, leading to an exorbitant production costs and limiting the quality and quantity of the fishery.

Problems with the harvesting and handling of fish are a cause for concern. Observations indicate that spoilage can account for up to 50% of catch on the trips to Banco Chinchorro. Spoilage occurs both in the water, when fish spend too long in the net, and from a lack of ice to store the fish for the return trip. Nets are deployed about 5:00 p.m. and are retrieved around 7:00 am. Fish that are trapped in the net too long die and decompose (indicated by whitening of the gills), and are then discarded. Decomposed fish can account for approximately 1/3 of the catch in a net. Fishing trips to Chinchorro can last several weeks or months, but re-supplies of ice are necessary every three to four days. In the event of bad weather, return trips can be delayed a day or two, resulting in more spoilage.

Such a high amount of spoilage may be of particular concern to biologists and policy makers that are developing models and policies about the fishery, because two fish may be killed for every fish that reaches shore. Spoilage during transit to market and in the market may mean that more than two fish may be killed for each fish reaching the table. Official SEMARNAP records of fish catches (table 8.2) account for what fishermen report and include a “fudge factor” for what they do not report and what is taken without permission. However, their “fudge factor” is considerably less than my observations of spoilage alone.

Figure 8.2. Marine species captured in Quintana Roo (in tons)

SPECIES	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Shrimp (1)	2,102	711	1,411	837	888	1,056	1,465	1,278	1,214	810	318	304
Conch (2)	986	900	877	360	191	210	315	315	315	328	414	308
Lobster (1)	659	785	449	422	360	339	281	398	505	450	392	342
Shark (3)	258	268	294	250	107	115	190	154	134	156	136	242

Fish (4)	2,092	2,080	2,977	2,925	2,664	2,599	2,899	3,084	3,038	3,026	3,270	2,485
Industrial Use (5)	40	77	105	25	9	29	51	10	15	28	27	52
“Fudge Factor” (6)	1,074	1,009	789	996	836	689	845	654	712	638	787	570
TOTAL	7,211	5,830	6,902	5,815	5,005	5,037	6,046	5,893	5,993	5,436	5,344	4,303

(1) Export to Europe, Japan, USA
(2) Export to States of Vera Cruz and Mexico City
(3) Local Consumption
(4) Regional Distribution (Yucatan Peninsula)
(5) Industrial Use- includes *almeja*, calamari, octopus, and fish
(6) Estimation of what people do not report or take without permission based upon what fishermen report and what inspectors find
Information based on official SEMARNAP statistics and interview 7/99

8.5.2 Fishing Vessels

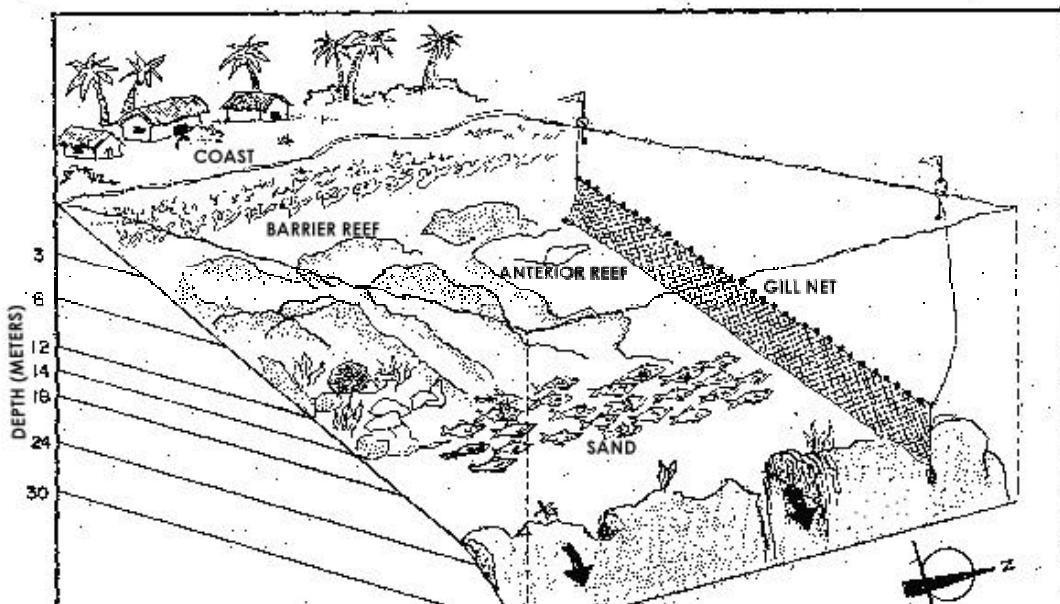
The typical fishing boat is the *launcha*, a 25 foot-fiberglass boat equipped with a 45- to 60-horsepower outboard engine. There are about 30 *launchas* around Mahahual. There are also several dugout canoes, several small fiberglass dinghies, a sailboat, a small aluminum boat, a small wooden boat, three v-hull boats used for sportfishing and diving, and two larger boats owned by the cooperatives to transport people, product, and equipment to and from Banco Chinchorro.

8.5.3 Fishing Practice Descriptions and Environmental Impacts

8.5.3.1 Gill Nets

Perhaps the most frequently utilized gear around Mahahual is the cotton gill net (figure 8.2). Though table 8.1 indicates that more households utilize hook and line than nets, the hook and line tends to be used as supplementary gear. Gill nets are designed to allow fish to swim partially through them, so that protruding dorsal and other fins get caught in the net, preventing them from going forward while their gills prevent them from going backwards. Gill nets are mainly size selective, though the smooth profile of some species (lacking protuberances) allows them to pass through gill nets (Dalzell, 1996, p. 166).

Figure 8.2. Diagram of gill net usage around Mahahual. Source: Perera, et. al, 1994.



The gill nets used in Mahahual have a gauge of about three inches, and target mostly barracuda and *cason* (small sharks). Nets are approximately 6 m high and range from 75 to 250 m in length (sometimes several nets are sewn together to make a longer net). Floats are attached to the top and sinkers to the bottom. Nets are deployed from a boat at depths of 3-30 m. Though most fishermen use cotton, there are monofilament nets as well. Gill net operations typically consist of three crewmembers, two to pull in the net and a snorkeler. Snorkelers free dive to depths of 30 m to untangle the net from the reef and retrieve any fish that may fall out during the net retrieval.

Gill nets can be set near reefs in channels or lagoons and can be utilized with the tide to capture fish that follow the tidal cycle. Nets are routinely tangled on coral heads (especially lettuce, knobby brain, fire, and elkhorn corals), and can cause significant damage to the corals by breaking off branches and/or entire coral heads. On every trip I observed between 5 and 25 places where each net became entangled around coral, depending upon benthic topography and currents of the deployment site. Typically 3-5 broken off pieces of hard coral and several gorgonian species would come up in the net, some as big as a human head. One net fisherman remarked “the nest destroy life all along the length. It kills turtles, breaks corals, and kills a lot of fish that can not be eaten. When a fish is in the net at eight at night until six or seven in the morning, it is no good. The net will be the first equipment to be prohibited.”

Smaller monofilament gill nets, called *lancear*, are also used to collect smaller fish from the reef lagoon (figure 8.3). These nets are typically deployed in a circle from a non-motorized boat. Fish are scared into the net by splashing, hitting the water, and throwing pieces of coral. These nets can snag small pieces of soft corals (figure 8.4).

Figure 8.3. Fishermen using *lancear*, a small gauge monofilament gill net, in the reef lagoon.



Figure 8.4. Pieces of coral frequently get caught in gill nets



8.5.3.2 Spear Fishing

Spear fishing is also a popular fishing practice (figure 8.5). Some fishermen only practice spear fishing, while others use it to fill in time between deployment and retrieval of nets or *palangre*. Spear fishermen target an array of species including barracuda, hogfish, grouper, snapper, lobster, and conch (though spear fishermen do not use the spear on the conch, they may collect conch and extract the meat during spear fishing trips, leaving the shell behind because it weighs too much).

Most spear guns utilized around Mahahual are store bought. Spears are generally constructed from metal rods and do not have barbs. Hacksaws and files are used to sharpen the point of the rod and carve specialized grooves for the tension and restraining devices.

Figure 8.5. A 102 kilogram jewfish caught with a spear. Photo: Orlando Iglesias



Spear fishermen can cause significant damage to the reef by bumping, holding, and even moving corals to access fish in caves. I witnessed one fisherman free dive ten to fifteen meters down and remove eight pieces of coral, some as large as his torso, to get a grouper that had ducked into a hole after he had shot it. Inaccurately fired spears can hit and even penetrate the reef causing damage and leaving it susceptible to infection. Spear fishermen may also stand on corals to locate other fishermen (figure 8.6).

Figure 8.6. Spear fisherman standing on coral while attempting to locate other spear fishermen.



8.5.3.3 *Hook and Line*

Hand lines are used from shore or a boat, and typically consist of a single hook, a sinker, and monofilament line. Sardines or undesirable pieces of larger fish are used for bait. *Palangre* is a longline system of hooks deployed at depths of 50-200 m. Hooks are about two arm lengths apart and are baited with sardines. Floats with flags are used on either end to relocate the lines.

Palangre hooks and lines can snag on benthic topography. There were several observations of *palangre* snagged on the bottom, though it was too deep to note the benthic composition. On these occasions, the line was tied to the boat and the motor was used to pull the line free. Whatever is on the bottom must surely sustain some damage when snagged by the *palangre*. Fortunately, *palangre* is typically used at depths that are much deeper than hermatypic (reef-building) corals can survive. Observations indicate that utilization of *palangre* causes less direct damage to coral reefs than other gear types used around Mahahual.

8.5.3.4 *Other Practices*

Other fishing practices such as cast netting, called *ataraya*, the use of gaffs (mainly to hook octopus while snorkeling), and the use of rods and reels are infrequently practiced but present. There are also several defunct fish weirs along the coast. These were used for the annual run of grouper. Government regulations to conserve the grouper stocks have made harvest during this time illegal, so the weirs are no longer used.

8.6 Tourism

Tourism around Mahahual typically focuses on two main activities: SCUBA diving and sport fishing. Some tourists come to Mahahual for the rustic ambiance. However, since the beaches are often covered in seagrass and there is no electricity or activities to occupy time during foul weather, Mahahual has few “passive” tourists (i.e. tourists that come for sunbathing or to lie on the beach).

8.6.1 Dive Tourism Significance

Currently most tourists depend on local fishermen to shuttle them to dive sites off of the mainland and at Banco Chinchorro because there are few other reasonably priced options. There are several SCUBA operators around Mahahual, including one dive resort with a high-speed yacht that can reach Banco Chinchorro in 30-45 minutes. At least one dive shop rents equipment and will arrange for fishermen to transport divers along the coast or to Banco Chinchorro.

Most residents expressed a positive opinion toward tourism and a desire to shift the economy away from fishing toward tourism. Many residents envisioned their role in the tourism industry as guides and boat operators carrying tourists to Chinchorro. However, discussions with several local tourism operators and the harbormaster, highlighted the complexity and expense of the training, regulations, and equipment that are legally required to carry tourists in boats. Increased tourism growth will likely attract professional multilingual guides that have the proper training and safety equipment. Local residents will not be able to compete with professional guides unless there are capacity building and investment project geared toward the current residents.

8.6.2 Environmental Impacts of SCUBA Diving

Corals are extremely sensitive and even the slightest touch can damage them. Divers inadvertently bump into corals while diving, sometimes breaking the corals. Some divers were observed holding onto corals for as much as 10 seconds to stabilize themselves while taking photographs.

Though Banco Chinchorro is officially a protected area, there is little or no action being taken to protect and preserve the natural and historical (i.e. shipwrecks) resources of Chinchorro. Divers are not given ecological talks preceding a dive, some spear fish with tanks (which is illegal), and some plunder pottery from several hundred-year-old wrecks. There are also no mooring buoys in Banco Chinchorro, forcing fishermen and dive operators to drop anchor. However, one dive operator who has worked for years around the Caribbean claimed that the sand conditions are so perfect for anchoring that careful vessel operators need not moor. Unfortunately, I witnessed anchor lines snagged around coral on several occasions. Continuation or expansion of such poor tourism practices could quickly degrade the delicate resources of Chinchorro.

8.6.3 Sport Fishing Significance

Sport fishing is also a popular pastime in Mahahual, more for local tourists from Chetumal than for foreign tourists. There is an annual sportfishing tournament, *la Copa Gobernador*, sponsored by the Chetumal Nautical Club. In 1999, there were

26 boats with approximately 100 fishermen participating. An additional couple of hundred people that came to observe. Species captured during the tournament included wahoo, barracuda, dolphin fish, cero, jack, snapper, shark, and white marlin. Weekend sportfishing trips around Mahahual are also common for some Chetumal residents. Foreign tourists seemed more likely to engage in sport fishing as part of a dive trip out to Banco Chinchorro, rather than a fishing trip in its entirety.

8.6.4 Environmental Impacts of Sport Fishing

Sport fishing tournaments in Mahahual are not catch and release. Sport fishing often targets species such as marlin, but much of the catch in the tournament I observed consisted of top-level predators and keystone species such as sharks and barracuda. According to Jennings and Polunin (1997), research regarding the effects of removing predators on reef fish community structure is contradictory. However, top-level predators help keep prey populations in check and healthy. Through removal of top-level predators, sport fishing may have indirect effects on ecosystem health.

8.6.5 Tourism Development Significance

Tourism in Mahahual is currently limited, with only one small hotel (20 rooms), several bungalows, and two large hotels under construction (Figure 8.6). However, there are plans to develop Mahahual as an international tourist destination. There is an airport that is almost complete and plans for a cruise ship pier. Residential housing will be situated in K55 and the population is targeted to increase to 110,000 people in the next 10-20 years (personal communication, Dr. Francisco May, 07/99). Development currently employs a fair amount of residents. Some 16% of households interviewed are involved in some type of development activity (construction, carpentry, etc.) though it was not specified if it was tourism or residential development. However, if plans to develop Mahahual as a tourism destination are realized there will be profound ecological impacts.

Figure 8.6. Part of a larger tourism development in Mahahual.



8.6.6 Environmental Impacts of Tourism Development

Tourism development may cause significant environmental damage both from nutrient overloading and habitat destruction. While SEMARNAP regulates the septic systems in tourism developments, the minimum standard septic system, called “ecological toilets” do not remove nutrients. Currently, development is so sparse that nutrient overloading is not likely a serious threat to coral reefs. However, with large developments such as the 80 room Fiesta Americana being built at Punta Herradura, nutrient overloading could become a serious cause for concern. Even if the larger developments utilize a sewage treatment system, it is unlikely that such a system will provide tertiary treatment, the level required for removal of nutrients.

Habitat alteration is also occurring as a result of tourism development. Even the smaller “bungalow” style resorts cause some habitat alteration. It is currently prohibited to cut or destroy mangroves. However, it is not uncommon to see areas where the mangroves have been cleared to extend the area of a plot. In addition the coastal road was routed through the mangroves to make room for the larger developments. At least one resort area had clearly altered mangrove habitat as part of its construction.

PART II.
ANALYSIS AND DISCUSSION

CHAPTER 9 SOCIOECONOMIC INFLUENCES ON RESOURCE USE

9.1 Introduction

This chapter will examine whether significant relationships exist between the types of resource uses that people engage in and their socioeconomic characteristics. Mean values of respondent's socioeconomic variables (including EDUCATION⁶, AGE, WEALTH, time as a resident in Mahahual [MIGRATION], and days per months that the respondent lives in Mahahual [RESIDENCY]) were examined for each resource use category. Descriptions of socioeconomic variables may be found in chapter six. The t-test was used to test statistical significance of observed differences between mean values of the socioeconomic characteristics and groupings formed by resource use categories. For example, the mean age of respondents that engage in spear fishing is compared with the mean age of respondents that do not spear fish. Table 9.1 presents probabilities associated with these tests for all of the variables.

Table 9.1 Socioeconomic characteristics of resource users

Resource Use	EDUCATION	AGE	WEALTH		MIGRATION	RESIDENCY
			Factor 1	Factor 2		
Tourism	0.579	0.83	0.673	0.793	0.469	0.480
Agriculture	0.553	0.332	0.789	0.448	0.905	0.273
Fishing	0.579	0.83	0.673	0.793	0.469	0.480
<i>Spear</i>	0.174	0.023	0.720	0.439	0.965	0.284
<i>Hook</i>	0.164	0.527	0.093	0.190	0.422	-
<i>Palangre</i>	0.775	0.780	0.720	0.022	0.998	0.273
<i>Net</i>	0.673	0.200	0.882	0.680	0.319	0.028
T-Test used to determine probability						
Probabilities in bold denote a statistically significant relationship						

⁶ Throughout this thesis, when age, education, wealth, migration, and residency appear in all capitals (EDUCATION, AGE, WEALTH, MIGRATION, and RESIDENCY) this will refer to their respective measured variables. For example, EDUCATION will refer to the variable measuring respondents' years of formal educational attainment. Likewise, WEALTH will refer to scores on the material style of life scale constructed in chapter 6. All socioeconomic variables are described in chapter 6

9.2 Analysis of Socioeconomic Influences on Coastal Resource Use

As indicated by table 9.1, there were no significant relationships between general categories of resource use (farming, tourism, and fishing) and the socioeconomic characteristics of respondents. However, when frequent fishing practices were broken down into the main gear types (spear, hook and line, *palangre*, and nets), two significant relationships became apparent. Respondents were considered frequent users of a specific gear type if they ranked it as the primary or secondary gear type.

Table 9.1 indicates that AGE was significantly related to respondents' engagement in spear fishing. Spear fishermen were an average of 11 years younger than other respondents. WEALTH factor 2 was significantly related to engagement in using *palangre*. Respondents that utilize *palangre* have a mean WEALTH score

(WEALTH factor 2) of .909 more than respondents that do not⁷. The amount of time that respondents reside in Mahahual was significantly related to the use of nets. Respondents that utilize nets live in Mahahual an average of 4 days per month more than respondents that do not.

9.3 Discussion of Socioeconomic Influences on Coastal Resource Use

The finding that spear fishermen were typically younger was not surprising, and there may be several reasons for this. The implications of this relationship are that a management intervention targeting spear fishermen will be dealing with younger people. In general, younger people are willing to engage in tourism, and seem less set in their ways (section 10.3).

Spear fishing, though potentially lucrative, is difficult and dangerous. Younger fishermen could simply be more productive at spear fishing. Older fishermen may be less physically fit, which could limit the depth, range, and ability of the fisher. Age can also produce other physical barriers, as well. For example, eyesight deteriorates with age and may result in decreased accuracy. Several respondents claimed that when they were younger they spear fished, but the extreme depths that the fishermen dive to became too difficult as they got older. There may also be a function of seniority. For example, net fishing in Mahahual consists of a crew of three. Two men to pull the net in, and one man to untangle the net from the reef. My observations are that the diver was always the youngest crew member. Older fishermen may simply get crew positions in other fisheries based on seniority.

The relationship between respondents' WEALTH and the likelihood that they use of *palangre* (long line) was perhaps the most important statistical relationship found by this study. Though the gear required for *palangre* is not more expensive than typical gill nets, one needs a dependable (thus more expensive) engine. Because

⁷ Although these differences seem small, it should be realized that the factor scores are standardized, with a mean of zero and a standard deviation of one. Approximately 68% of these scores fall within one standard deviation of the mean and 95% fall within two standard deviations of the mean. Hence, a difference of over ½ standard deviation is large and a difference of one standard deviation is extremely large.

palangre is the fishing practice that has the least (direct) impact on the coral reefs (section 8.5.3), this relationship may indicate that wealthier people have different impacts on coastal resources. If the wealthier people in my sample tend to have less of an impact on coral reefs, than perhaps an effective strategy to protect and preserve local reefs would be to increase the economic well-being of certain stakeholders. Practical strategies to increase the well-being of stakeholders will be discussed further in chapter 12.

The size, cost, and repair time required for nets could explain why full-time residents care more likely to use nets than part-time residents. Nets are large and heavy and could not be transported on busses. There is a heavy capital investment in the equipment; part-time residents would not want to leave expensive equipment unattended, exposing it to potential theft or vandalism.

CHAPTER 10
SOCIOECONOMIC INFLUENCES ON PERCEPTIONS
OF COASTAL RESOURCES

10.1 Introduction

Perceptions of the natural environment not only determine how resources are used (Nazarea et al., 1998), but can also influence what people believe should be done to conserve resources. Understanding how coastal people perceive the natural environment can help resource managers decide whether programs should be designed to compliment or change local beliefs, values, and behaviors. This chapter will explore whether specific socioeconomic sectors⁸ of the community are significantly more likely to have perceptions about coral reefs, fisheries, and tourism that are complimentary or contradictory to ICM goals of sustainable resource use. This chapter will also explore how socioeconomic factors influence people’s reasons for migration and worries/hopes concerning the future to determine why people moved to the area and what they are hoping for. Determining how socioeconomic factors relate to perceptions about the natural environment can help ascertain and address root causes of resource degradation.

10.2 Coral Reefs

10.2.1 Perceptions about Coral Reefs

Respondents were asked three open-ended questions about coral reefs: (1) “how does one find the state of the coral reefs?” (2) “How will the reef be in five years?” and (3) “What activities affect the reef?” Responses were then grouped into relevant categories. A response could have been included in more than one category, thus the number of responses varied with each question. Responses are presented in table 10.1.

Table 10.1. Relationships Between Perceptions Regarding Coral Reefs and Socioeconomic Variables

Response	EDUC.	AGE	WEALTH Factor 1	WEALTH Factor 2	MIGR.	RESI.	% of Total Responses
State of the Reef							
Poor	0.15	0.566	0.522	0.050	0.838	0.36	54%
Good	0.312	0.760	0.271	0.617	0.112	0.295	25%
Average	0.015	0.411	0.398	0.274	0.194	0.409	14%
Depends on Conservation	-	-	-	-	-	-	7%
Future of the Reef							
Depends on Intervention	0.386	0.215	0.587	0.027	0.419	0.551	48%
Worse	0.385	0.757	0.686	0.010	0.755	0.622	35%
Depends on Natural Events	-	-	-	-	-	-	9%
Same	-	-	-	-	-	-	9%
Reef is Affected by							

⁸ A socioeconomic sector is a group of people characterized by a common socioeconomic variable.

Natural Events	0.735	0.514	0.636	0.670	0.893	0.385	34%
Fishing	0.735	0.514	0.636	0.670	0.839	0.385	19%
Other Activities	0.549	0.821	0.700	0.675	0.518	0.169	15%
Ships	0.967	0.152	0.687	0.002	0.037	0.267	13%
Nothing	0.571	0.675	0.446	0.342	0.419	0.670	7%
Tourism	0.005	0.617	0.010	0.726	0.386	0.293	6%

Tabular entries are probabilities

T-Test used to determine probability

Probabilities in bold denote a statistically significant relationship

EDUC. = EDUCATION MIGR= MIGRATION RESI.= RESIDENCY

The majority (54%) of the interviewees' responses to the first question (about the state of the reef) indicated that they believe the reef to be in poor condition. Twenty-four percent of the responses indicated that they believe that the reef is in good condition, and 14% of responses suggested that the reef is in average condition. Thirty-four percent of the answers to the second question (about the future of the reef) reflected a belief that the condition of the reef will be worse in 5 years. However, of particular interest from an ICM perspective is that 48% of the responses suggested that the future condition of the reef will be determined by anthropogenic interventions such as development and conservation initiatives. Recognition that these factors can influence the condition of natural resources indicates that many community members would be amenable to ICM initiatives.

Respondents provided a plethora of answers to the third question (what activities affect coral reefs). There were 53 different responses for this question versus a combined total of 51 for the two previous questions. The high response rate to this particular question indicated that respondents have both an awareness of, and interest in what affects coral reefs. The high number of responses to this question also indicated that there is a great deal of variability in the respondents' understanding of what affects reefs. The majority (53%) of the interviewees' responses to this question suggested that factors such as fishing, ships, tourism, and other human activities have an effect on coral reefs. It was commonly mentioned that spear fishing affects the reef when spears hit the reef, and that gill nets damage coral when they are tangled in the reef and pulled free. Anchoring, grounding and oil spills were recognized as ways that boats can cause damage to the reef. Other activities mentioned that affect coral reefs include building piers, improper solid waste disposal, and deforesting mangroves. Thirty-four percent of responses indicated that natural events such as storms and hurricanes affect coral reefs. Only 7% of the answers suggested that interviewees believe that nothing can affect coral reefs.

In order to see if the responses were related to various socioeconomic characteristics of the respondents, mean values of respondent's socioeconomic variables (including EDUCATION, AGE, WEALTH, MIGRATION, and RESIDENCY) were examined for each response category. Descriptions of these variables can be found in chapter six. The t-test was used to test statistical significance of observed differences between mean values of the socioeconomic characteristics across groupings formed by perception of reef categories. For example, the mean years of formal education (EDUCATION) of respondents that claimed

tourism can affect coral reefs was compared to the mean education of those that did not. Table 10.1 presents probabilities associated with these tests for all of the variables.

Table 10.1 indicates that respondents' EDUCATION was significantly related to the likelihood that they will claim that tourism is likely to damage the reef, and that the state of the reef is average. Mean years of education for those who mentioned that tourism affects coral reefs was 8.2 years more than those that did not. Respondents who indicated that the state of the reef is average had an average of 6.4 years less education than those that did not.

Table 10.1 indicates that WEALTH was clearly an important factor influencing perceptions about coral reefs. Mean WEALTH scores for respondents that mention the effects of tourism (WEALTH factor 1) and ships (WEALTH factor 2) on coral reefs were 1.308 and 1.456, respectively, higher than those who did not. Respondents that claimed the future of the reef depends upon human intervention had a mean WEALTH score (factor 2) of .987 higher than those that did not. Respondents who remarked that the future of the reef will be worse in 5 years had a mean WEALTH score (factor 2) of 1.16 lower than respondents that did not. Respondents who claimed that the reef is in poor condition had a mean WEALTH score (factor 2) of .781 less than respondents that did not.

MIGRATION demonstrated a significant relationship with identification of ships as something that could affect coral reefs. The average length of residence in Mahahual for respondents that mentioned that ships affect coral reefs was almost 13 years more than those that did not. No statistically significant relationships exist between AGE or RESIDENCY and perceptions regarding coral reefs

10.2.2 Discussion of Perceptions about Coral Reefs.

Several trends were evident in the responses that should be addressed during the development of an ICM strategy for Mahahual. In particular, a high number of respondents indicate that they believe anthropogenic activities affect the reef. Conversely, a low number of respondents suggested that nothing can affect the reef. Together, these responses indicated that interviewees generally understand that there is a connection between human activities and the condition of natural resources. This conceptualization could facilitate people's understanding of the need for, and adoption of sustainable resource uses. For example, many respondents recognized that certain fishing activities affect the coral reefs upon which their livelihood depends: thus, they may support initiatives that promote sustainable practices.

Respondents who mentioned that tourism affects coral reefs had more education than those that did not. Less educated people could have a difficult time understanding the relatively indirect and abstract effects that tourism has on coral reefs. For example, nutrient pollution from untreated sewage and siltation resulting from clearing vegetation for hotels are common ways that tourism affects coral reefs. The damage that nutrients and siltation can cause to reefs is more indirect and abstract than damage from, say, poor fishing practices or an anchor; thus, may be more clearly understood by people with more formal education.

WEALTH proved to be a statistically significant factor in 36% of the responses about coral reefs. Higher scores on WEALTH scales was significantly related to the identification of factors affecting coral reefs. Wealthier respondents also claimed that the future of the reef is dependent upon interventions such as conservation initiatives or development. Wealthier respondents may be more likely to identify the factors that affect reefs because they are more mobile, have access to a variety of ideas through a variety of mass media such as television, and have more interactions with outsiders who may discuss these ideas (section 10.3).

Respondents that ranked low on WEALTH scales were more likely to claim that the current and future state of the reef is in jeopardy. Poorer respondents could be more observant of the reef conditions and view the reef conditions as more critical because their livelihoods are more dependent on them, and they do not have as many options available to diversify this dependence. For example, the poor are less mobile and can not travel to less used and/or higher quality reefs such as Banco Chinchorro because they lack a vehicle, likely have poorer quality engines, and may not be able to afford the gas. Poorer people also may not be able to purchase equipment such as *palangre* to target pelagic species, and may not be able to migrate easily if reef resources become too degraded.

Longtime residents could have many reasons for having identified ships as being harmful to coral reefs, including more local experience on the sea, witnessing or hearing about one of the many ships grounding on Banco Chinchorro, or participating in/observing changes from fishing practices that utilized anchors more frequently. One respondent mentioned that in the past, fishermen used hook and handlines more; a technique that sometimes requires anchoring over prime fishing areas. Long-term residents could have had more opportunities to observe the cumulative impacts of these effects.

10.3 Fisheries

10.3.1 Perceptions about Fishery Resources

Respondents were asked five open-ended questions about fisheries. Questions include: (1) “Are there any problems with the fishery?” (2) “What is the state of the fishery?” (3) “How was it when you arrived?” (this question was only asked of respondents who have resided in Mahahual for 5 years or more); (4) “How will it be in five years?” and (5) “what activities affect the fishery?” Responses were grouped into relevant categories. Responses can be included in more than one category. Responses are presented in table 10.2

Table 10.2. Relationship Between Perceptions of Fisheries and Socioeconomic Variables

Response	EDUC.	AGE	WEALTH WEALTH		MIGR.	RESI.	% of Total Responses
			Factor 1	Factor 2			
Problems Fishing							
Human Related*	0.274	0.266	0.690	0.041	0.545	0.476	60%
<i>Legislation</i>	0.043	0.225	0.343	0.124	0.965	0.280	42%
<i>Other (habitat Destruction, theft)</i>	0.012	0.532	0.757	0.387	0.201	0.490	18%

Natural	0.095	0.561	0.610	0.693	0.970	0.502	12%
None	0.109	0.412	0.146	0.159	0.689	0.124	27%
State of Fisheries							
Negative**	0.563	0.276	0.650	0.631	0.271	0.648	73%
<i>Bad</i>	0.829	0.225	0.009	0.788	0.072	0.243	56%
<i>Declining</i>	0.929	0.075	0.038	0.126	0.271	0.520	24%
Good	0.371	0.986	0.554	0.480	0.440	0.276	13%
Average	-	-	-	-	-	-	7%
State Upon Arrival							
More Fish	0.172	0.451	0.813	0.844	0.207	0.424	76%
More Due to Population	0.300	0.485	0.026	0.47	0.399	0.552	20%
Same	-	-	-	-	-	-	34%
Future of Fisheries							
Less Fish	0.440	0.943	0.674	0.300	0.428	0.591	68%
Depends on Economics & Regulations.	0.396	0.720	0.611	0.819	0.277	0.038	12%
Depends on Fishers Equal	0.134	0.119	0.791	0.001	0.706	0.272	14%
	-	-	-	-	-	-	5%
Fisheries Affected by							
Fishing	0.112	0.580	0.969	0.202	0.346	0.457	45%
Natural Events	0.386	0.862	0.608	0.556	0.507	0.286	20%
Legal Issues	0.266	0.761	0.565	0.226	0.754	0.477	20%
Other (noise, oil pollution, etc.)	0.859	0.066	0.289	0.388	0.450	0.382	8%
Land-Based Practices	0.391	0.313	0.478	0.013	0.317	0.344	8%

* "Human related" problems consists of "legislation" and "other" categories

** "Negative" category consists of "bad" and "declining" categories. Responses that are in both "bad" and "declining" categories are only counted in "negative" once.

T-Test used to determine probability

Items in bold denote statistically significant relationships

EDUC. = EDUCATION MIGR= MIGRATION RESI.= RESIDENCY

Forty-two percent of the responses to the first question referred to legal problems accessing the fishery. Most of these responses directly related to the new safety regulations imposed by the harbormaster that are expensive to comply with (section 7.4). Sixty percent of the respondents' answers attributed fishery problems to human factors, 12% blamed natural factors such as bad weather for causing access problems, and 27% claimed that there are no problems accessing the fishery.

Seventy-three percent of the responses to the second question categorized the state of the fishery as either poor or declining. Seven percent of the responses referred to the fishery as normal, and 13% reflected a positive outlook on the state of the fishery. Seventy-six percent of the responses indicated that the fishery was better when they arrived. Twenty percent of responses suggested that there were more fish when they arrived due to population issues such as fewer fishermen.

The general outlook concerning the future of the fishery is somewhat grim. Sixty-eight percent of the responses suggested that the fishery will be worse in 5 years. Fourteen percent of respondents' answers indicated that the future of the fishery is dependent on the actions of the fishermen, while 12% suggested that it is dependent on economic situations and regulations. Only 5% indicated that the fishery will be the same, and there were no responses indicating that it will be better.

There were also a variety of opinions about what type of activities affect the fishery. Forty-five percent of the responses suggested that poor fishing practices, certain gear types, increased fishing pressure, and other fishing activities affect the fishery. Twenty percent of the interviewees' responses indicated that legal issues such as increased regulations affect the fishery. Eight percent of responses reflected the idea that other activities such as oil spilling from sinking boats, noise and other activities affect the fishery, and 8% claim that land-based practices affect the fishery. Only 20% of the responses indicated that the fishery is affected by natural phenomena.

In order to determine if the responses were related to various socioeconomic characteristics of the respondents, mean values of respondent's socioeconomic variables (including EDUCATION, AGE, WEALTH, time as a resident in Mahahual [MIGRATION], and days per months that the respondent lives in Mahahual [residence]) were examined for each response category. Descriptions of these variables can be found in chapter 6. The t-test was used to test statistical significance of observed differences between mean values of the socioeconomic characteristics across groupings formed by perception of fishery response categories. Table 10.2 presents probabilities associated with these tests for all of the variables.

As indicated by table 10.2, the number of years of formal education that a respondent has achieved was significantly related to the likelihood that they will state that they have legal problems accessing the fishery. Respondents that proposed this statement had an average of 3.8 years less education than respondents that did not. EDUCATION was also significantly related to the statement that other factors, such as habitat destruction and theft of equipment create problems with the fishery. Respondents who mentioned that category had an average of 5.75 years more education than those that do not.

Table 10.2 indicates that WEALTH was significantly related to 6 responses about the fishery. WEALTH factors 1 and 2 each demonstrated three significant relationships with statements about fisheries perceptions. Respondents who claimed that the state of the fishery is bad had a mean WEALTH score (factor 1) of .913 less than respondents that did not. Respondents who proposed that the state of the fishery is in decline had a mean WEALTH score (factor 1) of .821 higher than respondents that did not. Respondents who mentioned that the state of the fishery was better when they arrived because there were fewer people/fishermen had a mean WEALTH score (factor 1) of 1.091 higher than those that did not.

Respondents who claimed that the future of the fishery depends on fishing issues such as poor fishing practices and over fishing had a mean WEALTH score (factor 2) of 1.407 less than respondents that did not. Respondents mentioning that the problems with the fishery are human-related, including legislation, theft, and destruction of habitat had an average WEALTH score (factor 2) of .908 less than those

that did not. Respondents who claimed that land-based practices affect the fishery had a mean WEALTH score of 1.65 more than respondents that did not.

The length of residence in Mahahual was significantly related to the statement that fishing is affected by increased fishing pressure. Respondents that mention this category have resided in Mahahual an average of 18.5 years longer than respondents that did not.

10.3.2 Discussion of Perceptions about Fisheries

The relatively high number and diversity of responses to the questions about fisheries was an indication that respondents view the fishery as an important resource. Unfortunately, many of the responses regarding the fishery indicated that the fishery is under stress from a variety of pressures including legal problems with access to the fishery, poor/declining resources, over fishing, destructive fishing practices, and other anthropogenic activities. A number of responses reflected the perceptions that there are problems with the fishery, and that there is a connection between anthropogenic activities such as fishing pressure, and stress to the natural ecosystem. Such perceptions can help coastal people understand the need for sustainable resource uses, and can allow ICM projects to build upon existing knowledge.

Though WEALTH was a statistically significant variable in 32% of the responses, there were not major conceptual differences between respondents that score high on WEALTH scales and those that scored low. Both wealthier and poorer respondents considered the fishery to be in a sub-average state, and claim that anthropogenic activities affect the fishery. The different responses between wealthy and poor respondents reflect mainly temporal perceptions about the fishery and ideas concerning the types of activities that can affect it.

Wealthier respondents tended to look to the past of the fishery, and attributed the declining condition of the fishery to population and land-based issues. Conversely, poorer respondents were more likely to have remarked that the current condition of the fishery is poor, and that factors such as fishing practices, habitat destruction, and legislation will determine the future of the fishery. Wealthier respondents may have discussed the past condition of the fishery because at the time the fishery was at its prime, they had the capital to invest in and exploit it⁹. Until about 15 years ago, Mahahual was difficult to reach because there were no roads or public transportation. Thus, wealthier respondents could have had better access to the boats and other resources that were necessary to exploit the fishery.

Wealthier respondents could have been more likely to claim that land-based practices and population pressures affect the fishery because they have better access to information. The wealthy could have better access mass media such as television and

⁹ As mentioned in section 6.3, many respondents claimed to have been fishing the area before they lived there. Those with access to the coast in the days before there were roads or public transportation may have been wealthier. Due to time constraints, information on pre-migration time in Mahahual was not collected.

newspapers and were more likely to claim they have learned different things (languages, recipes, etc. see section 10.4.1) from tourists. These information sources could provide the wealthy with exposure to different ideas regarding the environment. Wealthier respondents may also be more mobile and may have had more exposure to areas like Cancun where intensive population growth and tourism development have disrupted the fishery.

EDUCATION was related to the types of activities that respondents claim will create problems accessing the fishery. Less educated respondents were more likely to mention that legal problems pose problems accessing the fishery, while more educated respondents were likely to attribute problems to issues such as habitat destruction and theft. This may have been because less educated respondents have more trouble understanding the relatively complicated laws governing fisheries.

10.4 Tourism

10.4.1 Perceptions about Tourism

Respondents were asked three open-ended questions about perceptions of tourism: (1) “Why do you believe tourists come to Mahahual?” (2) “How has tourism influenced your life?” and (3) “Would you like to see tourism in Mahahual develop?” Responses were grouped into relevant categories. A response could have been included in more than one category. Responses are presented in table 10.3.

Table 10.3. Relationship Between Perceptions of Tourism and Socioeconomic Variables

Response	EDUC	AGE	WEALTH		MIGR	RESI	% of Total Responses
			Factor 1	Factor 2			
Reasons Tourists Come							
Natural Resources	0.890	0.669	0.913	0.436	0.139	0.693	37%
Aesthetics	0.709	0.466	0.013	0.338	0.825	0.759	14%
Traveling	0.322	0.831	0.415	0.055	0.469	0.864	11%
Tranquillity	0.841	0.623	0.721	0.384	0.234	-	11%
Cost	0.533	0.288	0.769	0.517	0.375	0.011	9%
Ambiance	0.375	0.813	0.613	0.807	0.853	0.839	7%
No Pollution	0.696	0.418	0.696	0.35	0.477	0.908	5%
Low Crime	-	-	-	-	-	-	4%
Advertisement	-	-	-	-	-	-	2%
Buy land	-	-	-	-	-	-	2%
Effects of Tourism on Life							
None	0.122	0.718	0.116	0.968	0.022	0.519	38%
Economical	0.339	0.976	0.352	0.329	0.160	0.786	35%
Personal	0.239	0.203	0.996	0.715	0.545	0.864	16%
Interactions (make friends)							
Learn Things (recipes, language skills)	0.051	0.125	0.588	0.018	0.576	0.839	11%

Tourism							
Development							
Yes-for Work	0.191	0.003	0.833	0.461	0.799	0.361	57%
Yes- for Social Development	0.441	0.3	0.344	0.245	0.131	0.111	23%
No	0.005	0.323	0.53	0.279	0.834	-	7%
Yes- if done well	-	-	-	-	-	-	4%
Yes-unspecified	-	-	-	-	-	-	4%

T-Test used to determine probability
Probabilities in bold denote a statistically significant relationship
EDUC. = EDUCATION MIGR= MIGRATION RESI.= RESIDENCY

There were numerous responses about what residents believe draws tourists to Mahahual, indicating a high degree of variability in people’s opinions on the issue. The most frequent single response was the aesthetic appeal of Mahahual (table 10.3). However, when responses relating to natural resources were aggregated (general nature 12%, beaches 9%, reefs 7%, ocean 5%, and forest 4%), a total of 37% of the responses suggested that tourists visit for the natural resources .

Thirty-eight percent of the responses suggested that that tourism has had no influence in the respondent’s life. Thirty-five percent of the answers indicated that tourism has had an economic impact on respondents’ lives. Personal interactions (such as making friends) and learning new things (including language skill, kitchen recipes, new ways of thinking, etc.) from tourists accounted for 27% of the responses.

When asked if they would like to see tourism develop in Mahahual, 93% of the responses were pro-development. Respondents were most interested in tourism as a means of economic and employment opportunity. Tourism was also suggested as a means of social development by 23% of the responses.

In order to determine if the responses were related to various socioeconomic characteristics of the respondents, mean values of respondent’s socioeconomic variables (including EDUCATION, AGE, WEALTH, time as a resident in Mahahual [MIGRATION], and days per months that the respondent lives in Mahahual [residence]) were examined for each response category. The t-test was used to test statistical significance of observed differences between mean values of the socioeconomic characteristics across groupings formed by perception of tourism response categories. Table 10.3 presents probabilities associated with these tests for all of the variables.

Table 10.3.1 indicates that EDUCATION was only significantly related to the response of not wanting tourism to develop in Mahahual. Respondents that mention this category had an average of 7.3 years more education than respondents that did not.

As indicated by table 10.3, AGE was significantly related to the response that they would like to see tourism develop in Mahahual because it would bring work. Respondents that cite this response were an average of 15.3 years younger than respondents that did not.

Table 10.3 indicates that WEALTH was significantly related to two statement regarding tourism. Respondents that claimed they have learned things from tourists had a WEALTH score of 1.229 higher (WEALTH factor 2) than respondents that did

not. Respondents who mentioned aesthetics as a reason that tourists come to Mahahual had a WEALTH score of .974 higher than the respondents that did not.

MIGRATION was significantly related to the statement that tourism has had no effect on the respondents' lives. Respondents who mentioned this category have been in Mahahual an average of 9.4 years longer than respondents that did not.

The number of days per month that respondents reside in Mahahual is significantly related to the statement that tourists come to Mahahual because of the relatively low cost. Respondents that mention this statement reside in Mahahual an average of 8 days per month less than residents that do not.

10.4.2 Discussion of Perceptions about Tourism

The majority of respondents claimed that tourists visit Mahahual primarily for the natural resources and beauty of the area. Natural resources were also the number one reason that respondents themselves moved to Mahahual (Sections 6.3, 10.6). This indicated that respondents have a degree of confidence in the natural resources of the area, and believe that these are valuable enough to attract people.

The perceptions regarding tourism varied considerably among respondents with different socioeconomic characteristics. Almost all of the respondents would like to see tourism in Mahahual develop. However, those that would not like to see tourism develop had significantly more education than those that would. The negative effects of tourism on Mahahual will include the displacement of local residents and their traditional resource use patterns (personal communication, Fide Caribe representative 7/99), habitat destruction, and changes in the social and cultural characteristics of the community. These repercussions may be more obvious or viewed as more serious to the more educated. Respondents with more education also mentioned the quality of life available in Mahahual as a reason for migration to the community (sections 6.3, 10.5). Clearly those that moved to Mahahual for the quality of life that the community offers were not interested in seeing it degraded for tourism.

Many respondents viewed tourism as a means of economic opportunity and social development. Younger respondents were more likely to be interested in tourism as a means of employment. Most respondents who mentioned that tourism would bring employment believe that their role would be to transport tourists to the various dive locations, including Banco Chinchorro. However, to effectively compete as professional guides, residents must adapt to the needs and demands of tourism. This will require capacity building in foreign languages, training in hospitality, and maritime safety, among others (see chapter 12).

While most residents are interested in the ability of tourism to provide jobs, there is a lack of experience dealing with tourism among some sectors of the community. Almost 40% of the responses implied that tourism has not had any impact on their lives. These respondents were significantly more likely to have resided in the area longer. Correlation of socioeconomic variables indicates that AGE and MIGRATION were positively correlated (section 6.7), thus it is younger people who are both interested in and being affected by tourism.

To effectively integrate long-term residents into an ICM program, follow-up research should be conducted to find out why they have not been affected by tourism.

Reasons may include long-term residents of the area being more set in their ways and are not as successful at adapting to the various demands that tourism careers would require. If this is the case, it is likely that when tourism develops in Mahahual the long-term residents will be less likely to integrate into the tourism-based economy and will attempt to maintain their current resource use patterns. Since certain fishing practices such as nets, longlines, and spear fishing are incompatible with tourism activities, such as scuba diving and snorkeling (i.e. there is a potential for a diver or snorkeler to become entangled, hooked, or shot), tourism development will displace fishing and other traditional resource use patterns. If long-term residents are unwilling or unable to adapt to the alternative livelihood options, attempts at capacity building or other integration strategies targeted toward them will be ineffective. Since the total number of long-term residents was relatively low, an ICM strategy utilizing grandfather clause type arrangements regarding current resource use patterns could be made for long-term residents.

Wealthier respondents were more likely to believe that tourists come to Mahahual for aesthetic reasons. Wealthier respondents also claimed that they have learned things (languages, recipes, new ways of thinking) from tourists. This may be because the richer respondents own the tourist facilities (i.e. restaurants, boats, hotels,) and have more exposure to tourists. Wealthier respondents being exposed to outside ideas from tourists supports the previously mentioned theory that wealthier people have access to different types of information than poorer people.

In general, the analysis of perceptions about tourism supports the need for capacity building in the tourism trade throughout the community. The majority of the community is interested in engaging in tourism, but there has been no formal training that would allow them to reap the benefits of the proposed development. Training and sensitization about tourism should reflect the needs and desires of the various socioeconomic sectors. For example, younger respondents are expecting employment from the proposed tourism, primarily in providing transportation to and from Banco Chinchorro; thus, maritime safety, foreign language skills, and micro loans to purchase necessary safety equipment would be valuable to that sector. More educated respondents do not want to see Mahahual destroyed by tourism, thus they may be interested in becoming involved in developing and implementing regulations that would help to protect and preserve Mahahual's cultural and environmental resources.

10.5 Thematic Apperception Tests

10.5.1 Description of Thematic Apperception Tests

Five photographs of local resources and resource use practices were presented to respondents (figures 10.1-10.5). Respondents were asked to discuss what they like or dislike about the photos. When the photo involved a person (such as figures 10.2 and 10.5), respondents were asked to tell a story about the subject and describe what the subject is thinking about. Responses to the photographs were categorized and analyzed based on their content. A response could have been included in more than one category. Tables 10.4-10.8 illustrate the frequencies of response categories for their respective photograph. Examples of some response categories include:

Aesthetic Value of Nature –encompasses statements of beauty

- “I like the part of the beach without construction”
- “I only like the sea...”

Intrinsic Value of Nature-encompasses statements of personal identification, self-actualization, and higher purpose.

- “We are few but lucky who can see this (reef). I am emotional when I see this. If this is destroyed, why go under water?”
- “I remember this view. It is my routine.”

Exclusion- encompasses statements regarding economic/racial segregation

- “It is a tourist zone and they do not permit fishing.”
- “...this beach is private..”
- “I believe the beach is private, only those with money can come here”
- “This is closed to people like us, there are many such places”

Pro-development- encompasses statements promoting development

- “things would be better here if there were other things here instead of the plants”
- “Magnificent...Mahahual in 15 years. I like development.”

Anti-development- encompasses statements against development

- “She is thinking that Mahahual can be like the first photo (photo 1 of Cancun). If Mahahual Changes it will not be free like this child.”
- I don’t want hotels, I don’t need them, they only bring trash”
- “This is what Mahahual is going to be like. I would not like there to be change.”
- I don’t like the hotels. I would not like to see Mahahual like this, we will lose the nature for hotels and bars. All that was made we will lose”

Utility- encompasses statements that describe the economic opportunity or usefulness

- “This boat can be used to fish...”
- “This is where the octopus that I capture live.”

Order- encompasses statements about order and cleanliness

- “I do not like the dirty beach, it is horrible.”
- “The beach is dirty.”
- “[The man] is thinking that the boat could be parked better.”

Conservation- encompasses statements about environmental conservation

- “We should care for this (reef). We are few but lucky who can see this. When I see this I am emotional. If this is destroyed, what will we go under water for?”
- We need to conserve this, to care for it. If an anchor or hook passes, they will break it.”
- If he does not care for the sea, he is not going to have anything. The hotels are going to finish the beach from pollution.”

State of the Resource- encompasses statements about the condition or appearance of natural resources

- “The colors are beautiful, but there are no fish!”

- “Is it all dead? I do not see any fish.”
- “Here there is change, this picture is full of life.”

Figure 10.1. Beach Scene in Cancun, Mexico



Table 10.4. Frequency of Response Categories for Figure 10.1

Photo 1 Response Categories	% of Total Responses
Aesthetic Value of Nature	22%
Exclusion	11%
Pro-Development	11%
Aesthetic Value of Development	11%
Anti-Development	8%
Order/Cleanliness	8%
Intrinsic Value	8%
Environmental Problems	7%
Economic Opportunity/ Production	7%
Social Problems	4%
Conservation	1%

Figure 10.2. A Man Fishing with Handline South of Mahahual



Table 10.5. Frequency of Response Categories for Figure 10.4.2

Photo 2 Response Categories	% of Total Responses
Production/Utility	11%
Order	7%
Fishing	11%
Intrinsic Value	22%
Aesthetic Value of Nature	4%
Social Problems	8%
Environmental Problems	8%
Development	8%
Like Natural Beaches	7%
Conservation	1%

Figure 10.3. Coral Reef in front of Mahahual



Table 10.6. Frequency of Response Categories for Figure 10.4.3

Photo 3 Response Categories	% of Total Responses
Aesthetic Value	29%
Natural Feature	20%
Conservation	14%
Intrinsic Value	12%
State of the Resource	9%
Utility/Production	9%
Habitat	6%

Figure 10.4 Coral Reef at Banco Chinchorro



Table 10.7. Frequency of Response Categories for Figure 10.4.4

Photo 4 Response Categories	% of Total Responses
Natural Features	23%
Aesthetic Value	17%
Personal Identification	12%
State of the Resource	8%
Conservation	8%
Transcendence	6%
Habitat	5%
Utility/Production	3%

Figure 10.5. A Girl Sitting on Bow of a Fishing Boat



Table 10.8. Frequency of Response Categories for Figure 10.4.5

Photo 5 Response Category	% of Total Responses
Purpose of trip	16%
Future of Girl	16%
Conservation	8%
Anti-Development	8%
Dangerous at Sea	6%
Freedom	6%
Boat on Beach	6%
Girl is Tourist	4%
She Wants to Become Fisher	4%
Fisherman's Daughter	4%
Social Problems	4%
Utility	4%
Other Responses (2% each)	14%

To determine trends in perceptions rather than discuss details, statistical relationships among individual TAT responses and socioeconomic characteristics will not be discussed. Instead, this chapter presents and discusses relationships between socioeconomic characteristics and response categories spanning multiple photographs. Respondents were given a point for each category included in each response. Reoccurring categories were included in the final analysis. The total number of points for each category was correlated to household socioeconomic variables (including EDUCATION, AGE, WEALTH, time as a resident in Mahahual [MIGRATION], and days per months that the respondent lives in Mahahual [residence]) using the pairwise Pearson's Correlation model. Table 10.9 presents correlation coefficients for all of socioeconomic variables and TAT responses, indicating that EDUCATION, AGE, and WEALTH were significantly correlated with TAT response categories.

Table 10.9. Correlation between TAT responses and Socioeconomic Variables

	EDUCATION	AGE	FACTOR1	FACTOR2	MIGRATION	RESIDENCE	%
Aesthetic	-0.084	-0.333	0.084	-0.019	-0.138	-0.052	17%
Intrinsic	0.258	-0.055	0.054	-0.069	-0.043	0.058	12%
Conservation	0.424**	-0.055	-0.015	0.235	0.087	-0.210	8%
Utility	0.017	0.402*	-0.115	0.197	0.144	-0.065	14%
Pro-development	-0.138	0.154	0.061	-0.092	0.173	-0.040	6%
Anti-development	0.423**	-0.028	-0.098	0.186	0.226	-0.264	6%
Exclusion	0.036	-0.239	-0.208	0.112	-0.032	-0.240	5%
Social Problems	-0.128	-0.149	-0.140	0.051	-0.110	-0.095	4%
Env. Problems	0.206	-0.083	-0.274	0.057	-0.040	-0.334	6%
Natural Features	-0.319	-0.204	0.117	-0.270	-0.001	-0.317	8%
Habitat	-0.230	-0.312	-0.132	0.065	0.025	-0.340	8%
Order	0.180	-0.110	0.347*	-0.201	-0.006	0.122	5%
Freedom	0.019	0.304	-0.052	-0.164	-0.054	0.149	1%
State of the Resource	0.299	-0.355*	-0.035	0.144	-0.081	-0.176	5%

N= 32 or 33
 *p<0.05 **p<0.02 based on uncorrected probabilities

10.5.2 Discussion of TAT Responses

The most frequent TAT response mentions the aesthetic value of nature. Second in frequency were statements about utility. Statements about the intrinsic value of nature were the third most frequent response. These responses indicated that while people hold a utilitarian view of tourism and the natural environment, the high appreciation of the aesthetic value of nature means that respondents also believe that these resources hold a higher value than what can be economically produced from them.

EDUCATION, AGE, and WEALTH were significantly related to TAT responses. EDUCATION was strongly correlated with conservation and anti-development statements (p<0.02). These relationships may exist because formal education can provide people with the exposure to various forms of media (i.e. the ability to read newspapers, books, etc.) and the ability to critically analyze this material. Thus, those with more years of formal education may be more exposed to ideas about conservation and the negative effects of tourism.

AGE was positively correlated with statements regarding utility and negatively correlated with statements regarding the state of the resource. Pollnac (2000) found a similar relationship with age in Indonesia. The positive correlation between AGE and utilitarian responses may reflect values and perceptions held by different generations regarding natural resources. Comments by older community members and pioneers of the area often expressed a mentality that associated nature with hardship, and that man is supposed to have control over nature. For example, a pioneer describes Mahahual when he first arrived as follows: “The forest was really ugly, the roads were only paths for cows, I had to cut it all.” Another man of 55 years old remarks “in 5 years, the forest will be better because it will be cut down.” Statements such as these indicate that nature is bad if it is not utilized for human purposes. AGE was also negatively correlated with responses to the state of the resource, indicating that younger people were more likely to describe the state of the resource.

An interesting relationship was that between WEALTH and statements regarding order. This relationship could indicate that wealthier people are accustomed to having more influence over their environment and generally believe that things can change. For example, saying that the beach is dirty implies that it could be clean. Wealthier people may be more likely to point out potential problems or solutions, rather than perceive themselves as victims of circumstance. This sense of empowerment is crucial in an ICM context because people who believe that change can occur could be more likely to take an active role in promoting change.

10.6 Migration

10.6.1 Perceptions about Migration

Socioeconomic characteristics of respondents were analyzed in this chapter to provide insights into which sectors of the community moved here for what reasons. This information is important in an ICM context because it may indicate the types of activities that people are willing to engage in and provide insights into where their interests and aspirations lie. Respondents were asked the open-ended question “Why did you move to Mahahual?” Responses were grouped into relevant categories. A responses could have been grouped into more than one category.

The majority of responses indicated that people moved to Mahahual for economic opportunity. Over one-third of the responses (34%) related to moving to Mahahual to become involved in the fisheries. Quality of life was also an important reason, comprising more than ¼ of the responses. Other responses included; moving to Mahahual to be close to family and friends, for health reasons (several respondents claimed that they followed doctor’s orders to move out of the city and to the coast to alleviate a variety of symptoms, including asthma), and because fishing further north was no longer possible because of fishing restrictions within the Sian Ka’an Biosphere Reserve.

Relationships between responses and socioeconomic characteristics of respondents were analyzed in order to determine the reasons that various socioeconomic groups moved to Mahahual. To accomplish this, mean values of respondent’s socioeconomic variables (including EDUCATION, AGE, WEALTH, time as a resident in Mahahual [MIGRATION], and days per months that the respondent lives in Mahahual [residence]) were examined for each response category. The t-test was used to test statistical significance of observed differences between mean values of the socioeconomic characteristics across groupings formed by reason for migration categories. Table 10.10 presents probabilities associated with these tests for all of the variables.

As indicated by table 10.10, EDUCATION was significantly related to the statement that respondents moved to Mahahual for the quality of life. Respondents that moved to Mahahual for reasons relating to the quality of life have an average of 4.6 years more education than respondents that did not.

Table 10.10 shows that WEALTH was significantly related to the statement that respondents moved to Mahahual for the fishery. Respondents that moved to Mahahual for the fishery had a mean WEALTH score (WEALTH factor 2) of .823 less than respondents that did not.

Table 10.10. Relationship Between Reasons for Migration and Socioeconomic Variables

Reasons for Migration	EDUC	AGE	WEALTH Factor 1	WEALTH Factor 2	MIGR	RESI	% of Total Responses
Fish	0.166	0.666	0.556	0.018	0.205	0.761	34%
Quality of Life	0.008	0.178	0.554	0.788	0.056	0.516	26%
Other Work	0.81	0.243	0.527	0.343	0.742	0.213	20%
Family & Friends	-	-	-	-	-	-	6%
Open Business	-	-	-	-	-	-	6%
Health	-	-	-	-	-	-	6%
Pushed Away by Sian Ka'an Reserve	-	-	-	-	-	-	3%

Bold denotes a statistically significant relationship

EDUC. = EDUCATION MIGR= MIGRATION RESI.= RESIDENCY

10.6.2 Description of Perceptions about Migration

People were attracted to Mahahual for a number of reasons including the quality of life and the availability of economic opportunities exploiting natural resources. Economic opportunity was the primary reason for migration to Mahahual. Fishing was cited most frequently as the main reason for moving to Mahahual, but this response was also related to a low WEALTH ranking. Poorer respondents were more likely to have moved to Mahahual for economic opportunities in the fisheries sector. More educated respondents cited the quality of life as a reason for moving to Mahahual. These relationships may indicate that poorer respondents maintain a more utilitarian view of the community, and educated respondents hold a more intrinsic perspective. Respondents with a higher amount of education were more likely to cite aesthetic reasons for moving to Mahahual.

10.7 Aspirations and Apprehensions about the future

10.7.1 Perceptions about the Future

Perceptions about the future are important to understand because they can provide natural resource managers with insights into the types of ICM activities that the community may be interested in pursuing, and allow an opportunity to address the community's aspirations and apprehensions. This information can also help identify priorities and concerns of the community that need to be addressed before people will be ready to engage in ICM programs. Two open-ended questions were asked regarding the respondent's perceptions about the future: (1) "What are the worries that you have about the future of yourself and your family?" and (2) "What do you hope for in the future?" Responses are grouped into relevant categories. Responses can be included in more than one category.

There were a variety of responses for both questions, indicating that respondents had a high degree of variability in both their hopes and worries. Issues

relating to employment and production were the number one preoccupation of respondents and the number two aspiration for their future. Lack of educational opportunities and worries that children will not be able to achieve (i.e. education, job opportunities) in Mahahual ranked as the number two and three worries, respectively. The number one hope for the future was prosperity and a better life. The third most common hope for the future was social development, including electricity, water, and improved capacity for local governance.

Worries and hopes about the future were analyzed with the socioeconomic characteristics of the respondents to determine if there are socioeconomic sectors of society that have unique concerns and/or aspirations regarding the future that could be addressed by an ICM project. This analysis was performed primarily to reinforce findings in other aspects of this thesis. For example, section 10.3 determined that respondents that have resided in Mahahual longer were less likely to have been affected by tourism. There was also a significant relationship between the length of time people have lived in Mahahual and preoccupation about social development. Thus, it is important for an ICM project to recognize that long time residents are apprehensive about the changes associated with the proposed tourism development and may have difficulty integrating into the tourism-based economy.

To determine how various socioeconomic sectors feel about the future, mean values of respondent's socioeconomic variables (including EDUCATION, AGE, WEALTH, time as a resident in Mahahual [MIGRATION], and days per months that the respondent lives in Mahahual [residence]) were examined for each response category. The t-test was used to test statistical significance of observed differences between mean values of the socioeconomic characteristics. Table 10.11 presents probabilities associated with these tests for all of the variables.

Table 10.11 indicates that WEALTH was significantly related to concerns about health. Respondents that indicate health as a concern had an average WEALTH score (WEALTH factor 1) of 1.35 higher than respondents that do not mention this category. As indicated by table 10.6.1, time of residence was Mahahual was significantly related to worries about social development. Respondents that mentioned this category as a concern have lived in Mahahual for an average of 19.25 years more than the respondents that did not. Concerns about social development included a lack of police, adequate medical services, and other infrastructure, and fear of displacement.

Table 10.11. Relationship Between Perceptions about the Future and Socioeconomic Variables

Worries about Future	EDUC	AGE	WEALTH		MIGR	RESI	% of Total Responses
			Factor 1	Factor 2			
Production/Employment	0.169	0.32	0.129	0.292	0.752	0.293	20%
Education	0.255	0.265	0.822	0.39	0.862	0.55	11%
Future of Children	0.391	0.282	0.601	0.997	0.24	0.365	9%
Health	0.073	0.464	0.01	0.102	0.879	0.522	9%
\$ and Food	0.137	0.154	0.256	0.403	0.411	0.399	9%
Social Development	0.356	0.301	0.595	0.783	0.006	-	7%
Hurricanes	0.365	0.344	0.565	0.689	0.433	-	7%
Quality of Life	0.696	0.965	0.682	0.085	0.794	0.933	7%
Personal/Spiritual Relationships	0.79	0.731	0.231	0.78	0.368	-	7%

None	-	-	-	-	-	-	4%
Retirement	-	-	-	-	-	-	4%
Natural Resources	-	-	-	-	-	-	2%
Hopes for Future							
Prosperity	0.565	0.171	0.784	0.617	0.287	0.248	25%
Production/Employment	0.355	0.623	0.432	0.178	0.618	0.147	17%
Social Development	0.391	0.573	0.456	0.317	0.702	0.257	15%
Family & Friends	0.547	0.222	0.271	0.411	0.765	0.745	10%
Tranquillity	0.851	0.899	0.618	0.25	0.439	0.399	8%
Post Death	0.512	0.128	0.462	0.052	0.766	0.4	6%
Natural Resources	-	-	-	-	-	-	4%
None	-	-	-	-	-	-	4%
Not to be Displaced	-	-	-	-	-	-	4%
Health	-	-	-	-	-	-	2%
No Tourism	-	-	-	-	-	-	2%
Learn English	-	-	-	-	-	-	2%
Bold denotes a statistically significant relationship							
EDUC. = EDUCATION MIGR= MIGRATION RESI.= RESIDENCY							

10.7.2 Discussion of Perceptions about the Future

As indicated by table 10.11, respondents were clearly more concerned with employment and social development than with issues concerning coastal resources. Neither of the response categories pertaining to natural resources even had enough responses to perform statistical analyses with socioeconomic data. Issues such as employment, social development, and education rank much higher than issues relating to natural resources.

Long-term residents were more likely to express concerns regarding social development. This could simply be because their expectations of social development for Mahahual have not been met in the almost 20 years longer that they have lived there. For example, one long time respondent remarked that he moved to the area because he “thought there would be progress in Mahahual.”

There were very few significant relationships between socioeconomic variables and perceptions about the future. The lack of abundant relationships was an indication that concerns and hopes regarding the future were diverse and span socioeconomic boundaries. Based on the great variety of responses regarding the future and the lack of statistically significant relationships, it would be impractical to design an ICM strategy that targets the concerns and especially the aspirations of a particular socioeconomic sector.

CHAPTER 11
DISCUSSION OF SOCIOECONOMIC INFLUENCES ON
RESOURCE USE AND PERCEPTION

11.1 Introduction

Chapters nine and ten demonstrated how household socioeconomic characteristics, primarily WEALTH, were significantly related to perceptions and uses of coastal resources. This chapter will examine patterns in the significant relationships that were presented in the preceding chapters. WEALTH and EDUCATION appear to be the most important socioeconomic characteristics influencing perceptions and uses of coastal resources. These two variables account for almost 74% of the statistically significant relationships from chapters nine and ten. Since it is difficult to discern a trend with few relationships, socioeconomic characteristics such as MIGRATION, AGE, and RESIDENCY that demonstrate a cumulative total of less than 27% of the significant relationships will not be discussed. Tables 11.1 and 11.2 summarize and group significant relationships discussed in chapters nine and ten by EDUCATION and WEALTH.

11.2 Wealth

Within Mahahual, the juxtaposition of wealth and poverty is quite evident. Poor households can lack basic amenities such as sanitary facilities. The poorest families struggle to obtain adequate shelter, clothing, and nutrition. Nearby, wealthy families have affluent resources such as new vehicles and satellite dishes. However, the dichotomy between wealth and the poverty in Mahahual is not only reflected in people's houses, clothes, and diet, it is also evident in the way they perceive and use the coastal environment.

The two WEALTH factors demonstrate more significant relationships with perceptions and uses of the coastal environment than do all of the other socioeconomic characteristics combined. This chapter will examine whether there were patterns in the ways that wealthier versus poorer segments of the community perceive coastal resources, and determine how the identification of these patterns can be applicable to an ICM program. Table 11.1 presents significant relationships (from chapters nine and ten) associated with WEALTH factors 1 and 2.

Table 11.1. Relationships Between WEALTH and Perceptions and Uses of Coastal Resources

<u>WEALTH</u>	
<u>Less</u>	<u>More</u>
a) reef worse in 5 years	g) future of reef depends on human intervention
b) future of fishery depends on fishing	h) ships affect reefs
c) fishery is in bad condition	i) tourism affects reefs
d) reef is in poor condition	j) fishery in decline
e) problems accessing the fishery are human related (legislation, theft of equipment, habitat destruction)	k) fishery was better due to population l) concerned about health
f) moved to Mahahual for the fishery	m) land-based practices affect the fishery

-
- n) learned things from tourists
 - o) Tourists come to Mahahual for aesthetics
 - p) use *palangre*
 - q) describe sense of order

Please note that “less’ and “more” are relative terms derived from the analyses in previous chapters.

Several patterns were evident in the responses posed by wealthier and poorer respondents. In general, wealthier respondents exhibited a more sophisticated view of natural resources; they had a clearer understanding of some root causes of coastal resource degradation, associated degradation with specific terrestrial and marine practices, utilized resources in a less destructive manner, and perceived a higher degree of control of their surrounding environment. Poorer respondents were generally more concerned with the fishery, more descriptive of the condition of the resource, and attributed problems with the fishery to the fishery itself, which can include problems with legislation, theft of equipment, lazy fishermen, as well as habitat/stock depletion.

Based on table 11.1, it is evident that poorer people in the sample are more dependent upon natural resources, particularly the fishery. Poorer respondents were more likely to have moved to Mahahual for the fishery [table 11.1 (a)]. Responses that related to the fishery also accounted for 67% of the significant relationships among poorer respondents [table 11.1 (b, c, e, f)], compared to only 27% among wealthier respondents [table 11.1 (j, k, p)]. The different response rate between wealthy and poor respondents indicated that fishing was more of a concern among poorer respondents.

The poor also placed a lot of emphasis on the condition of the resources, which they generally considered to be in bad condition. Sixty percent responses from the poor referred to the state or condition of natural resources [table 11.1 (a, b, c, d)], compared to only 27% among wealthy [table 11.1 (g, j, k)]. The poor may be more concerned with the condition of coastal resources because the resources they have access to could be in worse condition than resources that are accessed by the rich. Though the poor moved to Mahahual for fishery resources, their poverty may prevent them from accessing the best resources. Key informants maintain that the fishery resources close to Mahahual are worse than fisheries further away, including Banco Chinchorro. Only boats with adequate engines can access the better resources. For example, the range of the boat that I usually fished with was limited to about two kilometers. Our several attempts to fish further north in Rio Indio resulted in mechanical failures. Other boats needed to pull in our nets and tow us home. The captain said his vessel was unable to make the profitable voyage out to Banco Chinchorro.

In general, wealthier respondents are more likely to understand and concur with ICM conservation goals. Wealthier respondents demonstrated a greater understanding of the diversity of activities that can cause coastal resources degradation, including tourism, ships, population, and land-based practices [table 11.1

(g, h, i, k, m)]. These responses indicate that they are more amenable to a holistic approach to resource management (i.e. a watershed conservation initiative, etc.).

Wealthier respondents also perceived that they have a higher degree of control over their environment than poorer respondents. This pattern was evident from a contrast among the responses regarding the state of the environment. Sixty-seven percent of such responses had the wealthy maintain that the condition of coastal resources is dependent upon humans [table 11.1 (g, h)], compared to only 25% among the poor [table 11.1 (b)].

Wealthier respondents are also more likely to discuss a sense of order in the TAT. This relationship indicates that wealthier people have a sense that things can be modified or improved, rather than simply accepting what is there. This sense of empowerment is a critical aspect of active stakeholder participation in resource management initiatives (personal experience, US Peace Corps, Jamaica, 1996-1998). If coastal people do not understand and believe in ICM outcomes, they will be unlikely to actively engage in the processes (Pollnac, 2000).

Wealthier respondents are also more likely to have had non-economic relationships with tourists [table 11.1 (n)], i.e., learning recipes and languages from tourists. This indicates that the wealthy have more engaging relationships with tourists. These types of relationships are desirable because they allow locals to better understand foreign tourists and their wants, needs, and preferences. This understanding can then be applied to improve tourist services. This type of relationship also desirable from the tourists' perspective because it indicates they may have had an enriching cultural experience in Mahahual, something may be difficult to attain in tourist destinations such as Cancun. This type of experience may result in excellent "word of mouth" promotion of Mahahual as a unique and friendly tourist destination.

Not only do wealthier respondents perceive coastal resources in a paradigm that is more consistent with overall ICM objectives, but the relationship between the use of *palangre* and WEALTH indicates that they are also more likely to utilize resources in a method that is less degrading to the resources [table 11.1 (p)]. Though it may seem an indirect method of improving the coastal environment, a crucial aspect of an ICM program in Mahahual could be to increase the wealth of the poorer residents.

The different patterns of perceptions and uses of coastal resources between the wealthy and poor essentially reinforces Maslow's theory of a hierarchy of needs (Maslow, 1970). Maslow postulated that there are five hierarchical levels of needs: at the bottom is Physiological, then Safety/Security, Belonging/Social Affiliation, Self-Esteem, and finally Self-Actualization (figure 11.1). Maslow maintained that abstract issues such as self-actualization could not be achieved unless basic needs such as hunger and safety have been addressed.

Figure 11.1. Maslow's Hierarchy of Needs



Source: Villa, Thousand, Stainback, and Stainback. (1992), reprinted from Maslow (1970)

Though Maslow did not include environmental conservation in his hierarchy, it would likely be in the third tier (because it can fulfill a sense of belonging or place in the natural world) or on top of the hierarchy (because it can fulfill a sense of purpose or self-actualization). However, for the purpose of this research, its exact place in the hierarchy is not as important as its relative position above physiological and security needs. Thus, a person who cannot meet basic demands of physiology (i.e., food, basic shelter, etc.) or safety, will not be able to pursue goals of environmental conservation. For example, a fisherman who is free diving at 100 feet deep to untangle a net from coral (as is common practice in Mahahual), cannot be too concerned with how much coral they are breaking to free the net. His mind is preoccupied with getting the job done rapidly so that a physiological need (i.e. breathing) can be met. During my research, one of the regular crew-members on a net fishing boat did not show up to work and I was asked to fill in. Though I have worked as an education coordinator in a coral reef marine park for years and hold a high value on coral conservation, while underwater I put my physiological needs above my conservation ideals. My dives to depths of less than 35 feet put me under physiological stress; in order to rapidly ascend, I broke off branches of coral that, with time, may have been possible to untangle from the net. Spear fishermen and net fishermen are continually in a position of threatened physiology and security, thus actively and continually pursuing a paradigm of environmental conservation can be physiologically or psychologically difficult. Besides the occupational barriers discussed above, other factors such as nutrition, poor shelter, and economic pressure may present psychological barriers that prevent poorer people from pursuing the loftier goals of environmental conservation.

Occupationally, wealthier people are significantly more likely to utilize *palangre*, a potentially safer technique. Though *palangre* is a deeper water technique and may expose the crew to some risks that net fishing does not, it could be argued that one using *palangre* is not under the same chronic physiological strain as a spear fisher or net fisher. Wealthier people may be able to meet their basic needs and have a heightened sense of economic security, allowing them to pursue ideas about environmental conservation. Thus, a successful ICM program will need to consider ways to promote the well-being of poorer residents until they are at a position where they can begin to think about broader coastal management issues.

11.3 Education

EDUCATION is significantly related to seven statements regarding coastal resources, comprising 21% of the significant relationships found by this study. This chapter will examine whether there are patterns in the ways that more educated versus less educated segments of the community perceive coastal resources, and discuss how the identification of these trends can be applicable to an ICM program? Table 11.2 presents significant relationships (from chapters nine and ten) associated with EDUCATION.

Table 11.2. EDUCATION and Perceptions Regarding Coastal Resources

EDUCATION

Less

- a) discuss state of the reef
- b) have legal problems accessing fishery

More

- c) tourism affects reefs
- d) habitat/theft/other factors affect fishery
- e) Moved to Mahahual for quality of life
- f) Conservation
- g) Anti-development

Please note that “less’ and “more” are relative terms derived from the analyses in previous chapters.

Table 11.2 shows that formal education influences perceptions of coastal resources. The type and higher number of responses given by more educated respondents indicates that they are more aware of the problems and potential solutions facing coastal resource management.

In light of the tourism development that threatens the environment in Mahahual, those with higher education level were more likely to discuss social empowerment themes such as conservation and anti-development [table 11.2 (f, g)]. For example, the better educated state that there are alternatives to proposals (such as development) that they do not agree with. Discussion of progressive ideas such as conservation [table 11.2 (f)], indicates that more educated respondents may support conservation-based ICM initiatives.

Based on the significant relationships presented in table 11.2, the educated are more informed about the various problems and potential solutions associated with coastal resource management, and are thus, more likely to actively participate in ICM initiatives that support such beliefs. Education is an important factor in the acceptance

level of community members toward ICM goals. Thus, an important long-term strategy of an ICM program should be to facilitate participation in formal education, so that more community members are amenable to ICM interventions.

PART III.
CONCLUSION AND RECOMMENDATIONS

CHAPTER 12

CONCLUSION AND RECOMMENDATIONS

12.1 Introduction

Chapter ten discussed how perceptions and uses of natural resources are highly differentiated among community members based on their socioeconomic status. The different perceptions between socioeconomic sectors will also result in variations in the levels of understanding and acceptance of ICM interventions. Thus, there cannot be simply one program to effectively institute sustainable resource use practices. A multiplicity of factors needs to be addressed to adapt project activities to local conditions. This chapter will highlight some of the key coastal resource management issues in Mahahual and recommend ICM strategies based primarily on the analyses of previous chapters and the incorporation of numerous suggestions made by key informants for ICM projects.

Observations, key informant interviews, and analysis of the surveys indicate that many residents of Mahahual are caught at the crossroads between seeking economic opportunity and looking to preserve the quality of life and integrity of resources that initially attracted them to Mahahual. Almost all of the respondents and key informants indicated that they would like to see tourism develop in Mahahual. However, concerns were expressed that excessive or ill-planned development could lead to pollution, beach access problems, reinforcement of economic and social stratification, and social problems such as crime and prostitution that would disrupt the tranquillity and natural beauty of Mahahual. Evidence of their concerns has already materialized as portions of the beach have been fenced off and privatized.

12.2 Perceived Needs and Key Management Issues

This section will identify critical management issues as determined through observation, key informant recommendations, and analysis of perceptions of coastal resources. Olsen, Lowry, and Tobey (1999) claim “nothing is more critical to the success of a given generation of [coastal management] than the selection of the issues - both the problems and the opportunities – that a coastal management initiative will address.” The main need of the community in Mahahual, as expressed by several key informants, is infrastructure development such as electricity, piped water, improved roads, and solid waste management. Other informants discussed the importance of education (a secondary school has since been established), cooperation among community members, organizational development, and shifting the economic base away from the declining fishery. The following section outlines issues that were identified by key informants, observation, and/or analysis of socioeconomic data.

12.2.1 Environmental issues

- a) Resource use contributing to environmental degradation, including fishing practices that cause significant damage to coral reefs
- b) Tourism practices that damage coral reefs
- c) Increased tourism development resulting in environmental degradation
- d) Lack of an effective solid waste management program

- e) Water quality issues such as groundwater contamination
- f) Perceptions of local residents suggested that they are generally amenable to ICM initiatives:
 - i) Many residents perceive that resources are becoming degraded
 - ii) There is a general understanding that there are connections between human activities and the condition of natural resources, particularly by the wealthy and educated

12.2.2 Social issues

- a) Beach access could be limited by tourism development
- b) Land tenure issues such as fear of geographical displacement by tourism
- c) Residents will need capacity building to accommodate the shift toward tourism as an economic base, since many have had no previous tourism experience (particularly the long-term residents)
- d) Fear that tourism development may increase social and economic stratification and increase social problems
- e) Wealthy and educated residents have perceptions about coastal resource that indicate they are more likely to understand and engage in ICM initiatives.
- f) In general, poorer respondents are more dependent upon coastal resources (particularly fisheries).
- g) Current lack of adequate employment opportunities
- h) Inadequate educational opportunities

12.2.3 Institutional issues

- a) An expressed lack of functioning community organizations.
- b) Potential and real sea tenure conflicts between free fishermen and cooperative members
- c) Insufficient compliance regarding environmental regulations resulting from laws that are difficult to comply with (e.g., expensive and difficult to understand) and ineffective vigilance by community residents and government agencies.

The following section briefly discusses the need and context of interventions which address the issues outlined above.

12.3 Suggested Interventions: An Opportunity for Integrated Coastal Management in Mahahual

Most residents in Mahahual believe that their natural resources are deteriorating, and that something should be done to prevent further degradation. Residents attribute natural resource degradation to an array of variables, but believe that most of them are anthropogenic. Since many people in Mahahual understand that human activities can degrade the coastal resources upon which their livelihoods depend, there would likely be support for initiatives that promote sustainable use of coastal ecosystems.

There are several reasons why the timing for the implementation of an integrated coastal management (ICM) program is ideal. The proposed tourism development will likely alter social, economic, and environmental dynamics of the community. Though many community members may not understand how the development will impact their lives (i.e. employment, relocation, etc.), they are expecting changes in their lifestyles. Thus, at this time, residents are relatively open to new ideas, and their social and economic malleability may provide a window of opportunity to introduce ICM goals including sustainable resource use. It is also important to set a precedence of sustainable resource use while the community is still relatively small. ICM programs will be easier to implement with a smaller target audience, and future residents (and businesses) may be more likely to comply with local initiatives that are actively in place upon their arrival.

This chapter provides recommendations for appropriate interventions that reflect the needs and desires of the community, with particular regard for the specific socioeconomic sectors whose uses and perceptions of coastal resources may conflict with overall ICM goals of sustainable resource use. The interventions presented in this chapter are aimed at what could be realistically achieved by a grass-roots NGO. While NGOs would have difficulty providing basic infrastructure services such as roads, electricity, and water, they could be highly effective in facilitating and promoting solid waste management, alternative income projects, formal education, and capacity building opportunities such as organizational strengthening, guide training, education, and environmental sensitization.

Potential interventions should follow some general guidelines, including:

- a) Start with a small project that will likely produce immediate and successful economic returns. It was suggested that only a few people would engage in a new venture, but other members of the community would closely watch them. However, the small project must not be seen as exclusive to a particular group or strata of the community. It must be very clear to the entire community that they are welcome to participate. It was suggested that after a successful first project, confidence and interest would increase.
- b) Training and organizational strengthening need to be provided so that a community group can be representative, professional, and effective.
- c) A successful project may be one that can be picked up during bad weather when fishing is not possible. During my research, the port was closed by the harbormaster for eight days and open with precautions (emergency use only) for five days, most of which was during one month. These closures left some fishermen without a main source of income for almost two

weeks. It was suggested that a project such as seamoss aquaculture in the reef lagoon would be desirable because the lagoon is accessible and safe during bad weather.

- d) A project should seek to reduce dependence on fishing for families willing to engage in alternative occupations.
- e) The project must have community approval. The respondents would be willing to listen to proposals of viable projects and decide which may be appropriate for Mahahual. The community should also be given the opportunity to suggest their own projects.
- f) Successful interventions will need to be sensitive to the community's desire to live a relatively unregulated lifestyle.

Recommendations for potential interventions focus on reducing stress on coastal ecosystems through two methods: direct (i.e., changing resource use practices) and indirect (i.e., changing underlying social paradigms responsible for uses and perceptions of coastal resources). The following section elaborates on interventions which address the issues outlined in the preceding two sections.

12.3.1 Promote Alternative Fishing Activities

Current net and spear fishing practices are destructive to coral reefs. Reductions in these practices are desirable from an ICM perspective. In general, there should be an emphasis on the creation of non-fishing activities, however, alternative fishery activities could be pursued by some fishermen.

One alternative is to promote offshore fishery activities such as *palangre* or sport fishing that do not directly damage coral reefs. Several key informants said that they would be willing to devote a higher proportion of their time to *palangre*, particularly since the fish captured by this method fetches a higher market value. These informants also claimed that the price for the higher quality fish will increase as tourism-related demand for the product increases. Since younger people are significantly more likely to engage in spear fishing, a relatively destructive practice, their participation in an alternative fishing strategies will be crucial. To encourage participation, the specific interests of young spear fishers should be determined and incorporated into any alternative fishing strategies.

However, deep-water fishery exploitation is may not be a viable alternative for all of the fishermen to transfer to, and should only be pursued by a limited amount of fishermen. Though key informants claim that the pelagic fishery is underexploited, there is no data to determine how many fishermen it could support. In the face of such uncertainty it is better to be conservative and limit the number of fishermen that are supported in this endeavor. Sport fishing and *palangre* also target predator species, the effects of which are somewhat controversial (Jennings and Polunin, 1997). Since many fishermen fish the reef lagoons in stormy weather, mobilization to a deep-water fishery may not entirely halt the exploitation of reef resources.

Another alternative fishing option would be to limit destructive fishing practices to locations where they do the least damage. For example, net fishing in Rio Indio would not be as detrimental to coral as in other locations because there is very little coral in the area. Benthic studies could determine where coral composition is

relatively low and net fishing could be limited to such areas if target species can be found there.

12.3.2 Promote income-generating activities including alternative livelihoods

Strategies that promote occupational changes are often difficult for development projects to implement, particularly among fishers. Fishing fulfills non-economic satisfactions that can cause fishers to remain in the fishery even when catches and income decline (Pollnac, Pomeroy, and Harkes, 1998). It is important for development policy-makers to understand and address the idea that some fishers may not want to change occupations.

However, there is a good indication that respondents in Mahahual are interested in supplementing at least a part of their fishing with other activities. Ninety-seven percent of respondents remarked that they would like to see tourism develop in Mahahual, most of which claimed that they would seek employment in tourism. One key informant remarked “the sea is my love, my passion, but only when she is calm. Today, when it took us five hours to remove the nets from the reef [usually a two hour job], and the waves were ten feet, I would have preferred to be working in a bar or with tourists, or something where my life is not in danger.”

Alternative income projects should seek to reduce dependence on resource practices that are most degrading to the environment. These programs should also be tailored for the specific interests of different socioeconomic groups. Stonich (1992, p. 395) claims that income generation programs “must be aimed at increasing the income-generating activities which comprise the economic strategies of different categories of rural households.”

In Mahahual, poorer respondents perceive themselves as dependent upon fishery resources. Thus, alternative income projects should promote alternatives for residents engaged in destructive fishing practices, particularly within the poorer segments of the community. By reducing dependence on the coastal resource use practices that have relatively severe negative effects on the environment, income generating strategies may help relieve pressure from coral reefs and other resources, and prevent or reduce sea tenure conflicts. However, alternative income strategies should not only seek to change, but also increase sources income for participants. Chapter eleven indicates that wealth, particularly among poorer segments of the community, must be increased for paradigms of conservation to be adopted. Some alternative income projects include:

- a) **Aquaculture-** There are several aquaculture alternatives that may be viable, including marine algae/seamoss farming. Please see appendix II for details concerning potential aquaculture ventures.
- b) **Artisan craft making-** marine themes were suggested, and creative ideas utilizing marine shells were demonstrated. This would be especially useful as supplementary income for fishermen. When the weather is bad they could engage in craft-making or gathering supplies instead of risking their lives at sea or fishing the reef lagoons.
- c) **Tourism guide/hospitality industry-** Since 97% of the community surveyed claim that they would be interested in tourism development, this

will likely be a well received alternative for much of the community. There will be many opportunities in the tourism industry, however, many respondents believed that their role would be in transporting tourists to dive sites. Transporting tourists to Banco Chinchorro and other dive locations could be a particularly effective alternative employment strategy for fishermen. This alternative will allow fishermen to utilize their skills at sea and may fulfill some of the non-economic aspects of job satisfaction that often make fishermen reluctant to leave the fishery and quick to return. Suggestions for facilitation of this strategy are presented in 12.3.3 (b).

12.3.3 Capacity Building

- a) **Institutional Strengthening-** facilitate community organizations so that they can be effective at expressing and achieving the goals of the community. Outside of the cooperatives, there are few viable community organizations. Organizational capacity building promoted by local NGOs could empower the community to actively plan their future (Stonich 1992). According to Galvez et al. (1989), community organizations can “become conduits for the educational (aimed toward the development of an ecological consciousness) and technoeconomic programs (aimed toward the improvement of their members’ economic conditions).” Such organizations could assist the community in a number of ways, including:
 - i) Explaining environmental and safety regulations to fishermen and tourism operators;
 - ii) Empowering residents to prioritize and make decisions regarding the community;
 - iii) Facilitating land tenure procedures;
 - iv) Ensuring that tourism planning incorporates beach access

- b) **Tourism capacity training, and formation of a tourism cooperative (that is open to free fishermen).** This could help to set standards and regulate poor tourism practices such as pillaging wrecks. However, local residents will remain noncompetitive in the tourism industry unless several criteria are met, including:
 - i) Language training, especially English, French, Italian, and German (Note: it was emphasized that there must be separate classes for adults and children. Adults would be insulted to be in a class with children, thus separate classes for primary school, secondary school, and adults may be necessary.)
 - ii) Residents must be in compliance with local, state, and national requirements for tourism operations. A mechanism should be created to inform residents of the current and changing requirements for tourism operations.
 - iii) Access to loans in order to pay fees and purchase necessary safety and comfort equipment

- iv) Training in biological identification and communication of local flora and fauna
- v) Training in tourism sensitivity and hospitality

The interests and aspirations of all members of the community regarding tourism should be identified and encouraged. Analysis of the survey data suggests that different age groups may have different strategies regarding tourism.¹⁰ Long-term residents have had significantly less experience with tourism and expressed concerns about the equity of social development. Thus, strategies that target the particular interests of younger and older residents would be more likely to be well supported and may help prevent increases of social stratification.

12.3.4 Increase Educational Opportunities

While a secondary school has been built since the research began, there are still inadequate educational opportunities. ICM in Mahahual could benefit from reinforcement of natural science and adult educational programs such as literacy. Increasing educational opportunities could be pursued by an NGO by placing volunteers (nationals and foreigners) in the school. A cooperative extension program could be set up with a university to provide teaching students with experience and provide residents of Mahahual with better education.

12.3.5 Solid Waste Management

A project focusing on the solid waste management problems of the community, including formal disposal and reductions of solid waste would be well received. Recycling efforts are also important because major soda distributors such as Coca-Cola have recently switched from reusable glass bottles to disposable plastic and glass bottles which the community is now responsible for disposing of. Proper battery and oil disposal or recycling should also be made available.

12.4 Summary

There are an array of factors which influence how people in Mahahual utilize and perceive coastal resources. MIGRATION, RESIDENCY, AGE, EDUCATION, and WEALTH were all significantly related to various uses or perceptions of the natural environment. Among these variables, WEALTH demonstrated the most influence on how people use and perceive coastal resources. Wealthier respondents demonstrated a better understanding of the activities that affect coastal resources and were more likely to participate in activities that are less destructive to coral reefs. This can be explained by applying Maslow's theory of a hierarchy of needs. Poorer people may be more concerned with meeting basic needs and, thus, may not be able to continually engage in conservation-based practices. Unfortunately, poorer people are also more dependent upon coastal resources, particularly fishing, so it is precisely

¹⁰ Though the data indicates that migration time, rather than age, is significantly related to the statements that tourism has had no influence on respondents' lives and that they have concerns about social development, age and migration variables are significantly correlated.

them who must be engaged in resource conservation. Thus, an effective ICM strategy for the community will be to increase the well-being of the poorer segments of the community so that they can begin to practice paradigms of conservation.

Currently, there is window of opportunity in Mahahual that may facilitate the introduction of an ICM project: Residents of Mahahual are at the nexus of a massive development project that could drastically alter their quality of life. A variety of issues are arising as pressure for development and a change in lifestyle increases. The proposed tourism development may bring an improved material style of life for some residents, but the costs may include geographical displacement to a less desirable location, displacement of traditional means of livelihoods, environmental degradation, and a loss of beach access. Such issues could be the focal point for a larger NGO or government ICM initiative. Interventions, such as capacity building, could put residents in a position to maximize the benefits of the social changes while promoting sustainable coastal resource use.

Appendix I. Survey

1. Edad _____ 2. Sexo _____ 3. Estado Civil _____
4. Cual es su origen?
5. Por cuanto tiempo Ud. Ha vivido en Mahahual? _____
6. Donde vivia antes de mudarse Mahahual? _____
7. Porque se mudo a Mahahual? _____
- 8a. Cuantos dias del mes vive en Mahahual y la Costa Maya?
- 8b. (Si no vive todo el tiempo) Tienes una casa fuera de Mahahual?
9. Que otras partes de Quintana Roo, el pais, u otros paises ha visitando durante este ano?
- II. INFORMACION SOCIOECONOMICA

10a. Cuales son las actividades productivas que realizan los miembros de su familia, las cuales contribuyen a obtener ingresos para su casa (comida, materiales, dinero)?

Actividad	Season/temporada	Persona

10b. Por favor ordene las actividades anteriores de acuerdo a su importancia

- 1.
- 2.
- 3.
- 4.
- 5.

11.a. A que te dedicas?

11b. Dias por semana o temporada?

11. Que otras actividades tienes?

11c. Si pesca, pertenece a la cooperativa o es libre?

11d. Si pesca, que equipo trabaja, cuando lo usa, y donde?

Equipos de pesca	Season/temporada	Target especies	Lugar

11e. Si hicieras una lista de mayor a menor importancia de los equipos de pesca que utilizas, en que orden los pondrias?

Equipos de pesca	Season/temporada

11f. Si hicieras una lista de mayor a menor importancia de las especies de peces que tu capturas, en que orden las pondrias?

especies	Temporada

12a. Que equipo (de cualquier clase) tiene?

12b. Que Equipo usa?

13. La casa tiene:

Planta electrica	Antennae parabolica	Vehiculo	Estufa
Fosa septica	TV	Launcha	Otro
Letrina	Video grabadora	Motor	Estufa de lena (fuera o dentro)

14. El techo es de:

Madera	Guano	Otro
Lamina de zinc lamina de carton	Material desechable	

15. El piso es de:

Cemento	Mosaico	Arena	Madera
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16. Las paredes son de:

Cemento	Madera	Madera/cemento	Material Desechable	Otro
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17. Cuantos cuartos hay en la casa?

Habitaciones	Bano	Cocina	Sala	Otros
--------------	------	--------	------	-------

18. Donde consigue su agua potable

Pozo publico	Compra	Deposito del agua
--------------	--------	-------------------

19. Que hace con su basura

La llevo al basurero	La quemo	Composta	Otro
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20. La otra casa

a. La casa tiene:

Planta electrica	Antennae parabolica	Vehiculo	Estufa
Fosa septica	TV	Launcha	Otro
Letrina	Video grabadora	Motor	

b. El techo es de:

Madera	Guano	Otro
Lamina de zinc lamina de carton	Material desechable	

c. El piso es de:

Cemento	Mosaico	Arena	Madera
---------	---------	-------	--------

d. Las paredes son de:

Cemento	Madera	Madera/cemento	Material Desechable	Otro
---------	--------	----------------	---------------------	------

e. Cuantos cuartos hay en la casa?

Habitaciones	Bano	Cocina	Sala	Otros
--------------	------	--------	------	-------

f. Donde consigue su agua potable

Pozo publico	Compra	Deposito del agua
--------------	--------	-------------------

21.Por que Ud. Cree que vienen los turistas a Mahahual?

22.Como el turismo ha influenciado en su vida?

23.Le gustaria ver el turismo en Mahahual desarrollarse?

24.Cuales son las otras actividades economicas que le gustaria ver se desarrollaran en Mahahual?

III. PERCEPTIONES SOBRE LOS RECURSOS COSTEROS

25a. Que uso se le da al mangle cerca de Mahahual?

25b. Que uso se le daba en el pasado al mangle?

25c. Tiene problemas utilizando el manglar (acceso, legislacion)?

25d. Como considera que se encuentra el manglar actualmente?

25e. Como estaba cuando llegaste?

25f. Como crees estara en 5 anos?

25g. Que actividades lo afectan?

26a. Que uso se le da al monte cereca de Mahahual?

26b. Que uso se le daba al monte en el pasado?

26c. Tiene problemas utilizando el monte (acceso, legislacion)?

26d. Como considera que se encuentra el monte actualmente?

26e. Como estaba cuando llegaste?

26f. Como crees estara en 5 anos?

26g. Que actividades lo afectan?

27a. Que aplicaciones tiene la Pesca cerca de Mahahual? (commercial, religiosa, ornamental, etc.)

27b. Tiene problemas para pescar (acceso, legislacion)?

27c. Como considera que se encuentra la pesca actualmente cerca de Mahahual?

27d. Como estaba cuando llegaste?

27e. Como crees estara en 5 anos?

27f. Que actividades lo afectan?

28a. Que uso se le da los corales cerca de Mahahual?

28b. Que uso se le daba los corales en el pasado?

28c. Tiene problemas utilizando los corales (acceso, legislacion)?

28d. Como considera que se encuentra los corales actualmente cerca de Mahahual?

- 28e. Como estaba cuando llegaste?
- 28f. Como crees estara en 5 anos?
- 28g. Que actividades lo afectan?

IV. PARTICIPACION COMUNITARIA

- 31. A su entender , cuales son las leyes para la pesca?
- 35. A cuales grupos comunitarios pertenece?
- 36. Como participa Ud. En la toma de decisiones de la comunidad?
- 37. Le gustaria participar mas en la toma de decisiones de la comunidad?
Como?
- 38. Cuales son las preocupaciones sobre el futuro de Ud. Y su familia?
- 39. Que espera del futuro?
- 40. Si en este momento tuvieras en este momento 2,000 pesos, que harias con ellos?
- 41. Si en este momento tuvieras 36,000 pesos, que harias con ellos?
- 42. Religion _____ 43. Cuales idiomas habla ud.? _____
- 44. Cual es su grado de estudios?

English Version of Survey

1. Age _____ 2. Sex _____ 3. Civil Status _____
4. Where are you originally from? _____
5. How long have you lived in Mahahual? _____
6. Where did you live before Mahahual? _____
7. Why did you move to Mahahual? _____
8a. How many days per month do you live in Mahahual? _____
8b. Do you have a house in another place besides Mahahual? _____
9. Have you visited other parts of Quintana Roo, Mexico or another country within the last year? _____

II SOCIO-ECONOMIC INFORMATION

10a. What activities do you or other members of your family do that financially contribute to the household's income?

activity	Season	Person/relationship

10b. Please list the activities according to their importance.

- 1.
- 2.
- 3.
- 4.
- 5.

11a. What do you do?

11b. How many days per week or seasonally do you work at this job?

11c. Do you participate in other activities?

11d. If you fish, what gear do you use, when and where?

Fishing gear	Season	Target species	Place

11e. Please list the importance of the fishing gear from most to least.

Type of gear	Season

11f. Please list the importance of the species you catch, from most to least.

Species	Season

12a. What equipment do you own?

12b. What equipment do you use?

13. Household items.

Generator	Satellite dish	Vehicle	Stove
Septic System	TV	Boat	Other
Latrine	VCR	Motor (for boat)	Wood stove

14. Roof material

Wood	Guano	Other
Corrugated zinc/cardboard	“Disposable” material (often found on street)	

15. Floor material

Cement	Mosaic (tile)	Arena	Wood	Other
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16. Wall material

Cement	Wood	Wood/Cement	“Disposable” Material	Other
--------	------	-------------	-----------------------	-------

17. Rooms

Bedroom(s)	Bathroom	Kitchen	Living room	Other
------------	----------	---------	-------------	-------

18. Where do you get your water?

Public well	Buy	Water station
-------------	-----	---------------

19. What do you do with your garbage?

Take it away	Burn it	Compost it	Other
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20. If you stated that you have another house...

20a. Household items.

Generator	Parabolic antenna	Vehicle	Stove
Septic System	TV	Boat	Other
Latrine	VCR	Motor (for boat)	Wood stove

20b. Roof material

Wood	Thatched	Other
Corrugated zinc/cardboard	“Disposable” material (often found on street)	

20c. Floor material

Cement	Mosaic (tile)	Arena	Wood	Other
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20d. Wall material

Cement	Wood	Wood/Cement	“Disposable Material	Other
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20e. Rooms

Bedroom(s)	Bathroom	Kitchen	Living room	Other
------------	----------	---------	-------------	-------

20f. Where do you get your water?

Public well	Buy	Water station
-------------	-----	---------------

21. Why do you think tourists come to Mahahual?

22. How has tourism influenced your life?

23. Would you like to see tourism develop further in Mahahual?

24. What are other economic activities you would like to see develop in Mahahual?

III PERCEPTIONS ABOUT THE COASTAL RESOURCES

25a. What are mangroves used for?

25b. What were some past uses of mangroves?

25c. Do you have any problems accessing or being prohibited from using the mangrove?

25d. What condition is the mangrove in now?

25e. What condition was it when you arrived

25f. How do you believe it will be in 5 years?

25g. What activities affect the mangrove?

26a. What is the woodland/forest used for?

26b. What was the woodland used for?

26c. Do you have any problems accessing or being prohibited from using the woodland?

26d. What condition is the woodland in now?

26e. What condition was it in when you arrived?

26f. How do you believe it will be in 5 years?

26g. What activities affect the woodland?

27a. How is fish used in the community (commercial, religion, for fish tanks)?

27b. Problems with fishing access or prohibition from fishing?

27c. What condition is the resource in now?

27d. What condition was it in when you arrived?

27e. How will it be in 5 years?

27f. What activities affect the fishery?

28a. What is coral used for?

28b. What was coral used for?

28c. Do you have any problems accessing or being prohibited from using the coral?

28d. What condition is the coral in now?

28e. What condition was it in when you arrived?

28f. How do you believe it will be in 5 years?

28g. What activities affect the coral?

29a. What are the turtles and manatees used for?

29b. What were the turtles and manatees used for?

29c. Do you have any problems accessing or being prohibited from using the turtles and manatees?

29d. What condition are the turtles and manatees in now?

29e. What condition was it in when you arrived?

29f. How do you believe it will be in 5 years?

29g. What activities affect the turtles and manatees?

I didn't have time to ask these-people were giving me bs answers b/c they are prohibited

30a. What are the beaches used for?

30b. What were the beaches used for?

30c. Are there problems in accessing or being prohibited from using the beaches?

IV COMMUNITY PARTICIPATION

31. According to your understanding, what are the laws relating to fishing?

32a. Do the people here comply with the laws?

32b. If you feel they do not, what is the frequency of the violations?

32c. Why do you believe people violate the laws?

33. According to your understanding, what are the rules relating to the use of the woodland?

- 34a. Do the people here comply with the laws?
- 34b. If you feel they do not, what is the frequency of the violations?
- 34c. Why do you believe people violate the laws?

- 34.1. According to your understanding, what are the rules relating to the use of the mangrove?

- 34.1a. Do the people here comply with the laws?
- 34.1b. If you feel they do not, what is the frequency of the violations?
- 34.1c. Why do you believe people violate the laws?

- 35. Who are the groups of people that make up this community?-What types of community groups are there (i.e. PTA, soccer team, etc)
- 36. How do you participate in the local decision making process?
- 37. Would you like to become more active in the decision making process?

- 38. What are your future concerns for you and your family?
- 39. What are your hopes for the future?

- 40. If at this moment you had 2000 pesos, what would you do with them?
- 41. If at this moment you had 36,000 pesos, what would you do with them?

- 42. Religion
- 43. Languages
- 44. What is the highest grade of education you have attained?

Appendix II. Aquaculture

Several key informants expressed interest in pursuing aquaculture as a supplementary form of income. However, it is with some reservations that I recommend the adoption of aquaculture ventures as an alternative income generation strategy. Aquaculture in the Caribbean enjoys limited success; about one-third of the aquaculture projects in this region have failed (Ryther, Creswell, and Alston. 1991). In addition to economic instability, aquaculture is associated with a number of social and environmental problems (Pollnac, 1991; National Research Council, 1999). Despite the associated risks, aquaculture does have the potential to off set some of the pressures on the coastal resources of Mahahual and the feasibility of such a project deserves exploration. This appendix will briefly discuss some of the risks and benefits of aquaculture. It should be noted that both economic or biological feasibility assessments should be performed prior to initiation of such a venture.

According to the National Research Council (1999):

adverse environmental impacts (of aquaculture) can include genetic and food web consequences of genetically modified or non-native organisms that escape; degradation or destruction of wetland and mangrove habitats to provide space for mariculture facilities; contamination of surface- and groundwater by fish wastes, pesticides, antibiotics, and other drugs; generation of redtides and related phenomena; and overfishing of wild populations to provide broodstocks for mariculture farms...

Aquaculture projects may also reinforce socioeconomic cycles that are contradictory to development goals (Pollnac, 1991). For example, aquaculture can increase wealth for those already well off, while occupying and/or degrading resources that are essential for the poor, (Pollnac, 1991).

Despite the potential social and environmental problems that can be associated with aquaculture, it can provide an important source of food and money (including foreign exchange) for communities and governments. Several community members suggested that they would be interested in pursuing aquaculture as initially a supplementary, but possibly over time an alternative activity to fishing. The advantages to the implementation of an aquaculture project in Mahahual include removing direct fishing pressure from coral reef ecosystems, “provide healthy food for [local] populations, reduce reliance on imported products to meet the demands of the tourism industry, increase export opportunities, and provide... employment and industrial opportunities” (Sandifer, 1991).

There are many important things to consider in evaluating the viability of aquaculture for a community, including market demand, technological availability, ecosystem potential and capacity for species cultivation (Sandifer, 1991), and sociocultural dynamics of the community (Pollnac, 1991). Sandifer (1991) claims that there is the potential for a number of species to be farmed in the Caribbean, including queen conch (*Strombus gigas*), freshwater prawns (*Macrobrachium rosenbergii*), marine shrimp (*penaeus* spp.), freshwater finfish (*Oreochromis* spp.), redfish (*sciaenops ocellatus*), spiny lobster (*panulirus argus*), brine shrimp (*Artemia*), oysters

(*Crassotrea* spp.), marine finfish, and seaweed (*Gracilaria*). For more detailed information on the aquaculture, one can consult Hargreaves and Alston (1991), Mathias, Charles, and Baotong (1998), and FAO (1994).

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