“LOBSTERS ARE LIKE GOLD”: PERCEPTIONS OF RESOURCE ACCESS AND MANAGEMENT IN A MEXICAN COMMON PROPERTY FISHERY

By

AVA LASSETER

A THESIS PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF ARTS

UNIVERSITY OF FLORIDA

2006

Copyright 2006

by

Ava Lasseter

This thesis is dedicated to the lobster divers of Los Flamencos.

ACKNOWLEDGMENTS

I thank Dr. Peter Collings, my chair, whose door was always open. I also thank my committee member, Dr. Anthony Oliver-Smith, for making me rethink some of my assumptions in new ways. I am grateful for their guidance and support.

I also want to thank Dr. Mark Brenner for suggesting the research site and assisting me with initial contacts and Dr. Allan Burns for encouraging me to work in the Yucatan. Edward W. Tennant helped me greatly with his talent for map making.

I cannot offer thanks enough to the whole community of Los Flamencos, who gave of their time and patience with my constant questioning. I thank the fishermen who taught me how to dive for lobsters and the cooperative staff that explained the history and inner workings of the cooperative and fishery. The regular treat of lobster ceviche to snack on during the long afternoons of weighing lobster tails made the research seem more like a fiesta than work. Most of all, I thank my host family for making me feel cared for and at home. Maybe I can eat just *one* more panucho.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Abstract of Thesis Presented to the Graduate School
of the University of Florida in Partial Fulfillment of the
Requirements for the Degree of Master of Arts

"LOBSTERS ARE LIKE GOLD": PERCEPTIONS OF RESOURCE ACCESS AND MANAGEMENT IN A MEXICAN COMMON PROPERTY FISHERY

By

Ava Lasseter

August 2006

Chair: Peter Collings
Major Department: Anthropology

This study examines how a common property resource, spiny lobsters (*Panulirus argus*), is perceived and exploited in an artisanal fishing community in the Yucatan, Mexico. Like many marine resources, spiny lobsters are principally open access.

The thesis addresses the intersection of resource management, common property theory, globalization, and luxury resources on the global market. The classic explanation for the overexploitation of common property resources, Hardin's *Tragedy of the Commons*, fails to explain the community under study. The tragedy is usually criticized for its assumptions about self-interested resource users in an open access environment. This thesis demonstrates that other factors, both internal and external to a community of resource users, must be considered in an analysis of a common property resource.

Internal factors include the short history of exploiting lobsters as a resource, local level conflicts, the ecology of the resource, and a high rate of immigration. Factors

external to the community include an obligatory and exploitative relationship with a single exporter and the demand on the global market by elite consumers.

The local fishermen's cooperative served as the host institution for the research. Participant observation was the principal methodological tool. A semi-formal interview was also conducted with 37 members of the cooperative, representing 30% of the cooperative's population. The fishermen were asked about their perceptions of the stability and abundance of the fishery in both the recent past and for the future, and also about their attitudes toward the cooperative. A freelisting exercise of fish names revealed aspects of the fishermen's knowledge of their resource.

Lobsters are also analyzed as a luxury export commodity, where their value has been socially constructed. This construction of a commodity has a direct relationship with how the community of producers exploits the resource.

The lobster fishery is subject to federal management, although enforcement is weak and compliance is inconsistent. Local management has been virtually absent owing to the recent history of exploiting the resource as well as conflicts within the community. Although the fishermen are caught in a cycle of indebtedness and the tragedy of resource collapse may seem inevitable, the cooperative is enacting measures within the community to escape the cycle. Thus, as the fishermen now perceive that the future of their resource is in question, they are beginning to take a more active role in regulating their resource.

CHAPTER 1
INTRODUCTION

"Lobsters are like gold," an older fisherman says to me as he explains the competition surrounding the harvest of lobsters. He recognizes that the number of fishermen is increasing as harvests for each fisherman decreases. Only members of the fishermen's cooperative should be able to harvest lobster, but the catch of fish species should be open to all, he says. Yet, he next expresses empathy that all fishermen are just trying to make a living.

Later, while out to sea with a crew of divers, I got to thinking about his comment. We are so far from shore I have lost sight of land. Just as I become aware of a sense of isolation, I realize how many other boats are actually around us: seven, maybe eight? They are spread far apart, most near the horizon, each crew careful to protect their exact location. When a boat finds a spot that yields many lobsters, the crew is especially careful to hide their success when another boat passes nearby, lest the newcomer record the coordinates on their own GPS device for later investigation. The broad expanse of coastline suddenly seems small and crowded with boats.

From our boat, I let my eyes follow the bright orange hose, the *manguera*, from the air compressor to the diver below. The turbid green water of the Gulf of Mexico off the Yucatan coast makes it difficult for me to find the diver otherwise. The *manguerero*, or boat helper, turns off the noisy air compressor and suddenly everything seems silent. I watch the diver search the spongy layer of algae that hugs the bottom, looking for cracks and rocky structures that break up the otherwise monotonously covered substrate. Finding

no lobsters here, the diver gives up searching the area and tugs on the hose feeding him air. The captain responds to the request by securing the diver's hose around his leg. Slowly, he motors the boat to a new spot, pulling the diver along the bottom. A few minutes later, the diver tugs his air line, signaling the boat to stop. He has found some rocky structure and he wants to search there for lobsters.

Finally, the first diver of the day surfaces after more than two hours underwater. Before taking the regulator out of his mouth, he passes up his catch, a dozen impaled lobsters, speared together on a metal rod like a *shish kebab*. "No hay mucho," he tells me as he pulls himself on board, expressing dissatisfaction that he was unable to harvest more. Two hours of diving had yielded only what fit on one 3-foot long metal rod. The crew's total harvest for the day would total 20 kilograms of lobster tail. The diver climbs on board dripping seawater and immediately lights a cigarette.

The regional buyer for this community of fishermen pays roughly $25[1] per kilogram of lobster tails to the fishing cooperative. The cooperative pays its members roughly $18 per kilogram at the time of harvest, with an additional $5 per kilogram reimbursed at the end of the year as a kind of savings bonus. The difference goes toward administrative and production expenses of the cooperative.

Harvests are largest at the beginning of the season when one crew may bring in more than 30 kilograms of lobster tails in one day. A handful of highly successful fishermen harvested over 60 kilograms a day during the first week of the season, 2005, while most other crews harvested less than 20 kilograms per day. After the first month of

[1] Values are given in US dollars, based on an approximate exchange rate of 10 pesos to the dollar. Therefore, the buyer paid 250 pesos per kilogram of lobster tails.

the season, daily harvests per boat average 10 kilograms per day. A bad day could bring less.

The crew I joined above will be paid roughly $360 by the cooperative for the day's 20 kilograms of lobster tails. This amount is then split into 3.5 parts, with each of the two divers receiving one equal share. The owner of the boat, usually a diver as well, receives one part for expenses related to the boat. The remaining half a part goes to a non-diving crew member (the manguerero) who is often a young son or nephew of the captain.

The lobster diver, then, who does not own his own boat, earned over $100 for the day's work. The captain, who both owns the boat and works as a diver, earned over $200. This represents a large sum of money in a region where staples like a kilogram of beans costs little more than $1US, and a stack of tortillas a mere 30 cents. After a four month long closed season on the harvest of lobster, the money is much needed among the families of lobstermen.

The high value of lobster and the virtual open access status of the fishery have led to rapid population growth as newcomers move to the community. Diving for lobster is not a traditional livelihood in the area. While the species of lobster is native to the area, the practice of harvesting lobster for export, by compressed air diving, was introduced through state-sponsored programs of rural development in 1970. Fishing for grouper and octopus, the next most important commercial species of this area, have a long history of harvest for local and regional markets. Now, lobster, grouper and octopus are all harvested for national and international consumption.

Although federal laws now exist to regulate lobster harvests, a lack of enforcement results in little respect for the rules at the local level. The cooperative official responsible

for regulation enforcement complained to me constantly that he was unable to do his job. Most fishermen had no conscience, he said. He also bemoaned local restaurants and black-market buyers for contributing to the problem. Undersized lobsters are, in fact, served in the local restaurants both during and prior to the lobster season. These illegal, small lobsters have no exchange value on the export market, but local restaurants will pay fishermen a good price for them.

A situation has thus developed where competition is more evident than cooperation. Fishermen complain of decreasing catch sizes and worry that there is no future for the fishery. Fishermen also complain when others violate the federal regulations, and then concede that they, too, must engage in such behaviors out of material necessity. The fishermen's cooperative is obligated to sell their entire harvest to a single exporter who controls the price paid for lobster. Many of the cooperative's members are deep in debt to the exporter. A lack of security to the future of the fishery drives many fishermen to harvest as much as they can today.

Statement of the Problem

Marine resources are declining globally due to over fishing and destruction of habitat (Watling and Norse 1998; Acheson and Wilson 1996; McGoodwin 1990). This decline in resources is occurring despite attempts at state-level management, which for the most part, fail. Although fishing communities depend on these resources for their livelihoods, fisheries are often overexploited to the point of collapse.

Why would a community of users overexploit the resources on which their future depends? The decline of fisheries is usually explained by the *Tragedy of the Commons* (Hardin 1968), which sees a fishery's collapse as a problem of competition for open

access resources. This explanation, however, places blame solely on local level producers and assumes that each acts as a rational economizing individual.

Resource managers of the formal economics tradition assume that the set of conditions exemplified in the Tragedy of the Commons model are applicable in all common property resource scenarios. The Tragedy of the Commons model, however, is not universally valid for all instances of common property resources. No community in the world exists in isolation from all others, and small-scale harvesting for local consumption does not necessarily lead to a fishery's collapse. Resource demand and value are created and defined by the global market, well outside the local context of extraction. Thus, the local exploitation of a luxury export commodity involves actors at numerous scales: local, regional, and global. This construction of a resource as a commodity influences how the resource is perceived and exploited by local users.

Research Objectives

At the broadest level, this thesis investigates the intersection of a population, a resource, and a market. More specifically, it addresses how global demand impacts finite resources in a predominantly open access environment. Anthropologically, I focus on how local perceptions of a high value global commodity have created a local situation of competition and fuel a cycle of debt and dependence.

Consequently, this thesis has the following objectives: (1) to analyze how a community of fishermen perceives their common property resource base, and (2) to understand how the local use and perceptions of a common property natural resource are incorporated into and defined by the broader regional and global system.

The perceptions and exploitation of a luxury export commodity (spiny lobster) at the local level are connected to issues at both the regional and global level. By addressing

how local extraction is connected to the ecology of the resource, it then becomes clear how users fit into and are impacted by the total biophysical environment in which they reside. Ecological, economic, political, socio-cultural and historical factors are integrated in the analysis. The fishermen do not form a homogenous group. Different interests exist among members of the cooperative concerning the resource. Additionally, the local knowledge of the resource within its environment as well as the local perceptions of resource availability are analyzed within a multi-scalar political ecology framework.

Across these variables, this thesis examines a local context of resource use and places it within the broader global system. The Tragedy of the Commons fails to entirely explain the local situation and I suggest an alternate scenario: that local cooperation has failed due to both external and internal factors. Very often, only internal factors are considered thereby placing blame for resource overexploitation entirely on local, already marginalized resource users. Ultimately, the community of users will either be unable to prevent the tragedy of resource depletion from playing out, or they will recognize their common interest in the future of the resource and implement successful communal management strategies.

Methodology

This thesis is based on fieldwork conducted over three months during the summer of 2005. A small fishing community on the northern coast of the state of Yucatan, Mexico, served as the primary research site. Data was collected among members of the original fishing cooperative in the community, which served as the host institution for this research. There are 123 members (*socios*) of the cooperative. There is now a new cooperative in the community, consisting of roughly 100 former members of the original cooperative who broke away and started their own cooperative in 2003. More detailed

information on the situation of the cooperative will be addressed in chapter 3 on local community background. In addition to the two cooperatives, there are numerous “free” fishermen (*libres*), who sell their catches on the local black market or to one of the cooperatives.

A sampling frame of the cooperative’s 123 members was constructed to produce a sample of 37 fishermen, representing 30% of the population. A semi-formal interview was conducted with 33 individuals in this sample, representing participation from 89% of the total sample. No fisherman declined to be interviewed; the remaining four individuals from the sample were unavailable to be interviewed, as they were not residing in Los Flamencos during the month preceding the opening of the lobster season. Four additional cooperative members were recruited using the same interview schedule as with the random sample participants. These four individuals were active fishermen with strong ties to the community.

The inability to locate all of the fishermen in the random sample raises an important point: an increasing number of Los Flamencos’ fishermen reside within the community only during the lobster season. Those who are not permanent residents reside in nearby non-coastal communities or cities, or migrate to Cancun area resorts or to North America for work during the closed lobster season. This migratory pattern is related to the open nature of the resource and the ease with which people may move into the area, even on a temporary basis, to exploit the fishery. Thus, for many fishermen, the fishery is opportunistic in nature as opposed to being a fundamental part of membership in the community.

The 37 interviews were conducted during the month of June, while the fishermen were preparing for the opening of lobster season, which begins on the first of July. Only a handful of all members of the cooperative were fishing for other species during this month. Others were engaged in local employment such as construction work or on nearby ranches. The majority, however, had no form of employment at this time, and some took out bank loans to support their families until the beginning of the lobster season.

The principal methodological tool for this study was participant observation. I was able to join the fishermen on both fishing and lobstering trips where I learned to both dive and clean lobsters. I talked with the lobstermen daily as they departed in the mornings and returned with their harvests in the afternoons. I also waited in line with them for hours in the cooperative office as they received their day's pay, one by one.

Research Site

The village of Los Flamencos[2], the subject of this investigation, is a rural fishing community on the north coast of the state of Yucatan, Mexico. Along with the states of Campeche and Quintana Roo, these three Mexican states make up the Yucatan peninsula (Figure 1-1). While the fishing communities of Campeche focus on the export production of shrimp and octopus, those of Quintana Roo focus on lobster and sport fishing for tourists. The coastline of the state of Yucatan, lying between Campeche and Quintana Roo, faces north into the Gulf of Mexico. Here, the target species of the neighboring states overlap: lobster (*Panulirus argus*) and octopus (*Octopus maya*), as well as red

[2] I have changed the name of the community to preserve anonymity and to protect the fishermen and cooperative from punitive actions that may result from any admitted violations of federal harvesting regulations.

grouper (*Epinephelus murio*) are present in quantities sufficient to support artisanal fisheries.

The state of Yucatan's coastline is subdivided into two regions of fishing cooperatives: east (*oriente*) and west (*occidente*), with roughly a handful of fishing villages in each. Since 1990, each region has formed an umbrella federation that incorporates all of the fishing cooperatives of that region. Most fishermen on the Yucatan coast are members (*socios*) of cooperatives within their communities.

Figure 1-1. Map of Mexico showing the three states of the Yucatan Peninsula: Campeche, Yucatan, and Quintana Roo. Map by Edward W. Tennant.

The fishermen of Los Flamencos are members of the Federation of Eastern Cooperatives (*Federación de Cooperativas de Oriente*), and the community is typical of other member fishing communities in the federation. The first of the area's fishing

cooperatives was initiated by the state in 1970. The fishing cooperatives serve as the intermediary between the fishermen and the regional buyer. The cooperative also provides ice for members' fishing trips as well as the storage and transport of harvests to the buyer in Merida. Recently, the cooperative has split into two as a result of local conflicts. This conflict will be addressed further in chapter 3.

The community has a permanent population of roughly 2,000 people. Fishing is the primary occupation of over three quarters of the male, economically-active population. The remaining adult men are engaged principally in labor at nearby ranches or construction. Because the fishing season for lobsters is closed for four months of the year and the majority of lobsters are caught in the first month of the season, most men look for additional work. Local labor options are limited, but include carpentry, construction, and ranching.

When the lobster season is closed or yields are low, many of the younger men leave the community to work in the Cancun area resorts. Compared to the options to work locally, these young men are able to make a good income, and thus invest in fishing capital independently. This means that young men who leave the community seasonally for work are more likely to become boat captains at a young age and with less experience. Because of this trend, the fishermen do not represent a homogenous group and a distinction seems to exist between those fishermen who live in Los Flamencos year round, and those that leave the community seasonally for other opportunities.

The non-fishing population of Los Flamencos also changes with the seasons. From July to September, the population is at its peak. During July, all fishermen are out to sea daily harvesting lobsters. Most will even work on Sundays during the first weeks of the

season. August is the month of vacation for the many Mexican tourists who come to Los Flamencos. Many resident families even rent their houses to these tourists, and reside with other local family members during this time. The two restaurants are usually closed or empty outside of this busy season. By late September, some fishermen report that as average catches dwindle, they cease diving and leave the area for work elsewhere. Principally, this means work in the tourist industry of Quintana Roo. This group of fishermen, mentioned above, sees their investment to catch lobster as not worth the effort for the returns once daily catches average 10 kilograms per day. Most fishermen, however, elect to remain in the area with their families, although they may target other species such as line fishing for grouper or using the *jimba* to catch octopus.

Many women in the community run small shops or food stalls out of their homes. Locals will know which homes sell various things like sandwiches (*tortas*) or hot dogs (*salchichas*). Other women may do work such as tailoring for the required school uniforms to supplement their family's income. A few houses have small home gardens, although these must be above ground as the entire community is built on rocky landfill.

Spiny lobster (*Panulirus argus*) is the primary commercial species for the fishermen of Los Flamencos. Lobsters are harvested by diving with compressed air, which is supplied by hose from an onboard air compressor. Fish are harvested by spearfishing while diving for lobsters, but fish caught on lobster trips is often not sold because of its low exchange value. Much of this fish is instead reserved for domestic consumption. While a kilogram of red grouper is worth 16 pesos ($1.60) when sold to the cooperative, a kilogram of lobster tails brings 180 pesos ($18), with another 50 pesos per kilogram reimbursed to the fishermen by the cooperative at the end of the year.

Because of the difference in value, many divers also refrain from spearing fish until shortly before surfacing. Fish are physically more fragile than the hard exoskeleton of lobsters and are easily damaged if pulled around on a metal rod for the duration of a two-hour dive. There are some divers who, having little success with lobsters will focus on spearfishing.

Diving for lobsters is the main occupation of the fishermen of Los Flamencos, although octopus and grouper are also important commercial species in the area. Most fishermen in Los Flamencos acknowledge making a good living from the harvest of lobsters. However, the fishermen are feeling the limits of the resource's abundance and watching as more people enter the fishery. Coupled with this increasing competition for resources, the fishermen are also tied to a middleman who exercises control, both direct and indirect, over the fishery. Thus, the small-scale lobster fishermen are tied into, and dependent on, a global system in which they have little power.

It is also important to note that the north Yucatan coast is especially prone to seasonal hurricanes. The lobster season begins in July, coinciding with the beginning of hurricane activity in the Atlantic Ocean. This results in routine disruptions to fishing as a livelihood. In September 2002, the communities along the Yucatan state's coast suffered extensive flooding and structural damage from Hurricane Isidore, the results of which are still evident. In the first month of the lobster season, 2005, while this research was conducted, Hurricane Dennis prevented fishing for five days due to turbid water. Shortly thereafter, the entire community was evacuated for Hurricane Emily, which caused extensive damage throughout the eastern part of the peninsula. Altogether, hurricanes

resulted in 14 days of lost livelihood for the fishermen of Los Flamencos[3] during the first month of the lobster season, 2005. I will return to discuss the consequences of climatic changes in chapter 3.

Plan of Thesis

As noted above, this thesis addresses the principal concerns about the intersection of resource use, management regimes, and globalization. The remainder of this thesis looks at these topics from multiple perspectives.

Chapter 2 consists of a theoretical overview of issues in fisheries, common property resources, knowledge, export commodities and management. Chapter 3 presents an ethnographic description of the fishing community, the harvest strategies for lobster, the role of the fishing cooperative, and the relationship of the local fishermen to the regional fish buyer. Chapter 4 consists of a summary of the ecology of spiny lobsters and the biophysical setting of the community including climatic phenomenon.

Chapter 5 summarizes the data collected from the 37 interviews. The analysis focuses on the fishermen's perceptions of their resource base by looking at how fishermen interpret their rights of access to the resource and their beliefs about their future access to lobster harvesting. Following this emphasis on local perceptions, spiny lobster fishing is examined at the regional and global scales, where non-local actors have differing interests in the resource.

In Chapter 6, the findings of the research are applied to the accepted principles of resource management. Spiny lobsters are first compared to agricultural exports. I define

[3] Days were counted if less than 25% of cooperative members left the port. While the fishermen report that they do not usually lobster on Sundays, they will do so if other days have left them unable to fish. Therefore, assessment of these non-fishing days includes Sundays.

spiny lobsters as a luxury export commodity as understood by economic anthropologists. This concept is then applied to the issues of common property resource management. As community resource management, or CRM, becomes more popular as an approach to the management of resource use, many factors must be considered. The cohesion of a community (the assumption that a community is homogenous and shares a common interest) should not be assumed. The socio-cultural and historical variables at the local level are important to consider if local management is to be a viable option.

The discussions and conclusions of this thesis emphasize that attempts at local level resource management must include consideration of the total environment in which resource extraction occurs. Ecological, economic, political, socio-cultural and historical factors are crucial to consider for successful management of resource use. By using a political ecology theoretical framework, the analysis incorporates these factors in order to understand the local context of resource use.

If the goals of management are to be realized, however, the interests and responsibilities of actors at all scales must be acknowledged. Ultimately, successful management will necessitate the participation and cooperation of local users. Whether Los Flamencos will, in the end, exemplify the Tragedy of the Commons remains to be seen. In certainty, the tragedy is not an inevitable outcome.

If the goals of management are to be realized, however, the interests and responsibilities of actors at all scales must be acknowledged. Ultimately, successful management will necessitate the participation and cooperation of local users. Whether

Los Flamencos will, in the end, exemplify the Tragedy of the Commons remains to be seen. In certainty, the tragedy is not an inevitable outcome.

CHAPTER 2
LITERATURE REVIEW

This thesis draws on several theoretical issues, in an attempt to explain one local context of open access resource exploitation. In the end, the problem of common property resource overexploitation is best explained as an issue of relationships. These include relationships within the community among the resource users and those relationships between the resource users and agents within the broader system of which they are integrated.

Here, small-scale fisheries, and the features that typify them are first introduced. Next, issues of common property resources are discussed, with a particular focus on the different forms of access that govern such resources. Common property does not equate with a free-for-all, open access. The various forms of access that govern some common property regimes may be understood as management. The issue of management, then, is addressed, through fisheries management, as well as top-down and bottom-up institutions. Co-management is the meeting of top-down and bottom-up forms, and in an ever-widening global system, may prove to be a necessary combination of resource governance. The idea of knowledge as the basis for local management is important in understanding the local systems of resource use that may be in place. Finally, the construction of a resource into a commodity, and what this means for the small-scale producers who find themselves producing for a new market is discussed.

Artisanal Fisheries

Small-scale fisheries provide more food for more people, with a higher number employed and a significantly lower reliance on costly fossil fuels than large-scale fisheries (Poggie and Pollnac 1991). Fishermen are usually classified as artisanal (small-scale) or commercial (large-scale) based on the level of capital invested and the degree of involvement (or lack thereof) in market production. Also referred to as petty commodity producers reflecting the kin relations within crews (Poggie and Pollnac 1991), artisanal fisheries are defined as utilizing simple technology (both for fishing equipment and transportation) requiring low capital investment to catch species for local consumption. These fisheries have a greater reliance on human labor than mechanized power (Poggie and Pollnac 1991).

In artisanal fisheries, capital is owned by those engaged in the labor process. Artisanal fisheries may thus be described as independent, where the captains own the means of production (boat, motor, etc.). However, captains are often deeply in debt to moneylenders and middlemen.

In contrast to the artisanal fisheries, commercial fleets have far higher capital investments (Sabella 1980). In commercial fisheries, the owner of capital (means of production) is not likely engaged in the labor of fishing. Captains and crews are wage laborers, with wages usually determined by the size of the catch.

In fact, the distinction between artisanal and commercial fisheries is better described as a continuum than a line. Artisanal fisheries are increasingly integrated into producing for the global market. New technologies such as motorization and GPS are becoming more accessible to rural fishing communities. The primary distinction then, lies

with whether the owners of capital are engaged in the production process (artisanal) or not (commercial).

Common Property Theory

A resource is anything that has value to humans (Blaikie and Brookfield 1987). This value may be based on utility (crude oil) or aesthetics (beauty of nature). Human communities depend on resources in their environment to provide for their needs. Resources have a *use* and/or *exchange value* for the producer.

The term *common property resource* is defined as "a class of resources for which exclusion is difficult and joint use involves subtractability" (Feeny et al. 1990, Berkes et el. 1991). Fisheries present a good example of such resources, as it is difficult to exclude potential users from harvesting a mobile resource living in a medium that may be difficult to fence and patrol. Fisheries collapse is blamed on intense extraction pressure. Thus, joint use at a high level ultimately results in *subtractability* in harvest size for each user.

Access to common property resources varies among human communities. Feeny et al. (1990) identify four types of common property rights: open access, private property, communal property, and state property. These four categories are not necessarily distinct; combinations may be present (Feeny et al. 1990). The distinction between open access and communal property warrant mention here, as this oversight was at the root of much of the debate surrounding Hardin's "Tragedy of the Commons" (1968).

In open access resource situations, access to the resource is unrestricted. All members of a community have rights to extraction, but so do non-community members. Communal property resources are defined as resources that are shared by an identifiable group. The resource is the property of a group or community that controls, in some way, access to the resource. That is, some form of restriction exists that regulates access.

Restrictions of access may take two forms. Exclusion of non-members from access to the resource is one such mechanism. Regulating and controlling the use of the resource by members is another (Ostrom and Schlager 1996).

Hardin's theory of the *Tragedy of the Commons* (1968) is widely regarded as a seminal work in common property theory. The Tragedy is presented as a narrative of individual herders that continue to add sheep to their own herd. Ultimately, the herders are able to benefit more from their individual effort than they lose due to the overall degradation, the impacts of which are bore by all. The simplicity of the story appeared to have an innate logic.

Critiques of the Tragedy quickly followed. McCay and Acheson (1987) point out the Tragedy's assumption that self-interest supercedes cooperation to the point of resource degradation. In the Tragedy, there is no mention of the social structure of the users; they each act only as individuals with unrestricted access. Feeny et al. (1990) point out that the Tragedy assumes a situation of complete open access to the resource, and acknowledge that in such a case, the Tragedy may in fact become inevitable. The authors make the point, however, that this often comes about after communal access systems have been eroded due to external pressures.

Berkes (1992) interprets the Tragedy's assumptions as Eurocentric because self-interest is normalized. Berkes points out that human communities are able to use common property resources without overexploiting them, by regulating their use among the group. In the Tragedy, the common property resource is open access and cooperation to regulate access to the resource does not occur.

In cases of conflict, problems often arise due to a failure to recognize a shared interest among a community or group of resource users (Fox 1993). Berkes argues (1992) that cooperation does exist when a population realizes the advantages of cooperation. Such systems of cooperation are a characteristic of communal property resources.

Open Access Marine Resources

Marine resources are often open access. Coastal fishing communities are often restricted to subsistence production, due to their isolation from regional markets (Poggie and Pollnac 1991). In order to produce for a non-local market, capital investment is required to preserve highly perishable catches. When a resource is restricted to local consumption, limited extraction pressure may not necessitate the imposition of rules regarding use. Even early large-scale fishing industries saw the world's fish supply as inexhaustible and resisted regulatory controls (Gordon 1998). We can thus assume that in areas engaged in a communal property regime (local management, see below), such forms of regulation only originated when the limits of a resource's abundance was perceived.

The perception of resource instability among resource users may lead to efforts of regulation (McCay and Acheson 1987) or to maladaptive use practices. Such maladaptive practices are often depicted as a feature of the Tragedy of the Commons narrative, as evidenced in a rental property analogy. When the future use of a resource is not secure, such as when land is leased, there is little incentive to protect the resource's ability to reproduce itself (Gordon 1998). So it is assumed that with open access marine resources, users will exploit the resource to the point of collapse (Townsend and Wilson 1987).

Fisheries Management

Top-down Management

In the wake of a global realization that the world's resources are not infinite, attempts to address this "crisis" are being made. Management and the conservation of resources are usually proposed as the solution (Shotton 2000).

State level management systems work on the assumption of an open access marine environment, even when marine resources are managed locally as communal property (McCay and Acheson 1987). These top down, or state-regulated, management approaches usually take the form of closed fishing seasons and catch size quotas. Governmental management strategies are frequently enacted without involving local knowledge of target species' ecology, which is regarded as anecdotal, and are applied regardless of the existence of a local management system (Mackinson 2001, Berkes et al. 1991).

Management in fisheries attempts to identify the maximum level of sustainable harvests (Gordon 1998). The theories on which fisheries management is based come from a conventional economics framework. Fisheries managers use models, such as the Schaeffer curve, in order to determine maximum yields. The Schaeffer curve depicts the relationship between effort and yield (Townsend and Wilson 1987), and is a basic concept in fisheries management. Such models plot fishing effort (the costs of capital and labor that fishermen invest) against yields. As fishing effort increases, catch increases up to a certain point, after which further increases in effort results in decreasing catch size. In other words, after reaching the maximum sustainable yield, further effort always results in lower catches. This is another expression of diminishing returns. The goal of such models as the Schaeffer curve is to identify the point at which species may be

extracted without harming the reproductive abilities of the entire species. An individual fisher's cost per unit of effort (CPUE) is a standard measure to determine the efficiency (that is, economic maximization) of human labor. Management entails lowering effort to maintain catch size (Townsend and Wilson 1987, Acheson 1981).

Top-down management strategies aim to identify the point of maximum extraction. If too many fish are taken, the fishery will collapse. However, managers consider a failure also to result if harvests fall below maximum sustainable yields. Then, the fishery is regarded as being used *inefficiently*. In fishing, *inefficiency* refers to fish populations that are not exploited at their maximum potential. That is, more of the resource may have been extracted for the same level of investment. *Overexploitation* refers to fish that have been harvested at levels that negatively impact their ability to reproduce to previous numbers. Fisheries managers attempt to walk a fine line between inefficiency and overexploitation.

Several problems exist with top-down management (Gordon 1998). Such approaches assume constant rates of recruitment and overlook the chaotic nature of fisheries (Acheson and Wilson 1996). Fisheries are also an especially tricky resource to manage due to their aquatic habitat which complicates efforts at determining population size.

Furthermore, as Durrenberger (1997) has shown, fishermen do not follow the predictions of the Schaeffer curve and do not necessarily decrease effort as yield decreases. On the contrary, a strong sense of occupational identity among small-scale fishermen, and the inability to change their occupation easily, yield an increase in effort despite a decreasing catch size. At some point, of course, a further increase in effort with

a corresponding decrease in yield must lead to the adoption of an adaptive strategy, but this apparently happens long after it would be predicted by the Schaeffer model.

Bottom-up (Local Management)

Management is an attempt at control. A communal property resource refers to a community of users that share ownership and regulation of the resource. A resource that is communal property falls under a system of local management. Communal property resources then, are locally managed resources.

Local management systems differ from conventional fisheries management techniques. Local management strategies in small-scale fishing communities are concerned with managing the biology of the target species as well as restricting access to the resource in various ways (Acheson and Wilson 1996). However, local management systems may break down due to pressure on resources from outsiders who are not subject to local norms of regulating behavior, or be undermined when state regulations are imposed on communities (Berkes et al. 1991).

Local management systems may come under stress due to changes from within the community as well. When these systems break down, they are often irreparable. For example, in a fishing village in India, all fishermen have converted to motorized boats. The rapid change in technology has negatively impacted the local social system of fishing. The new technology also led the fishermen to become indebted to moneylenders. The fishermen are now driven to destructive trawling in order to harvest sufficient catch sizes to repay loans. The fishermen are thus financially restricted from reverting to non-motorized boats (Chacko 1998). In such cases, state-level regulations may be the only hope to both protect local communities and manage their resources sustainably (Acheson 1998).

Among many fishing communities, local management systems exist independent of government regulations. Anthropologists have recognized numerous strategies in small-scale fishing communities that may be termed local management. These include social pressure to limit technology of grouper fishing in Belize (Crawford 1995), control of information on prized fishing locations in Brazil (Forman 1967), cooperative agreement to regulate net mesh size in Brazil (Robben 1989), limitations on entering the fishery in Brazil (Cordell 1978), hereditary rights to fishing zones of lobster in Belize and Mexico (Sutherland 1986, King 1997, Cochran 1997), and communal organization to lobby for state legislation in Peru (McDaniel 1997) and Maine (Acheson 1997, Acheson 1998).

Communal property marine resource systems may take the form of marine tenure and are known to exist in some fishing communities (Cochran 1997), although other local controls are more often in place that serve to limit access to the fishery. Fishing spots are not often owned, but “information management” is in operation to restrict access to good fishing locations (Forman 1967; Stuster 1978; Acheson 1981). Secrecy is more often used for fixed locations of demersal (bottom-dwelling) species, as opposed to more mobile pelagic (open-water) species, where passing on information about a school of fish implies an expectation of reciprocity (Acheson 1981). Examples of fishing location ownership occur with the inheritance of lobster fishing zones in Belize (Sutherland 1986) and the exclusivity of the lobster gangs in Maine (Acheson 1987). The current increase in use of GPS units to identify successful harvesting locations occurs with the safe-guarding of the notebooks in which coordinates are listed.

Local management strategies are usually patterns of behavior and not conscious attempts to fish below a recognized carrying capacity (McGoodwin 1990). Conformity of

behavior is enforced at the local level through social pressure (Acheson 1987, Berkes et al. 1991, Acheson 1998). In these examples of local management strategies, what is shared in common is cooperation among the group that participates in the making and enforcement of the rules. This cooperation is crucial to the success of local management initiatives. Identifying shared interests among resource users (Fox 1993) is necessary for management to work without strict external enforcement.

Co-management

Local management arises from within communities as an adaptation to the local environment (McGoodwin 1990) and is reproduced daily in the actions of fisherfolk (Robben 1989). These behaviors, while not static, are enforced locally when breached. Penalties range from social pressure and stigmatization (Warner 1997, Acheson 1998) to gear sabotage (Acheson 1987). Enforcement of State regulations, on the other hand, is external to the system and may lack a consistent local presence (Berkes et al. 1991) or be limited to fines (Warner 1997).

Sometimes, local management of resources may co-exist with State management. Locally enforced hereditary fishing zones are in place to limit entry to the lobster fishery in Belize (Sutherland 1986) and Mexico (Cochran 1997), while the state also regulates this fishery by imposing a closed season and exacting punitive fines against violators.

The local, contextual knowledge of resource users is crucial within the system of local resource management (Pomeroy and Berkes 1997). However, in order to protect the system from disruption, there is room for state level regulation and enforcement as well. Co-management linking the state and local levels offers a balance to this dilemma. Co-management connects local resource users and state-level governing institutions in a relationship of mutual responsibility for a resource (Sen and Nielsen 1996, Pomeroy and

Berkes 1997, Mackinson 2001). A system of checks and balances is provided to the local users. Support of formal regulations in the event of local system stress is provided by fisheries managers, while resource users are able to offer locally produced knowledge about the condition of the resource which is necessary for on the ground monitoring of the resource (Warner 1997). This negotiation of mutual responsibility and contribution of both top down and bottom up is necessary for successful fisheries management.

Knowledge

Local knowledge represents what resource users have learned about their environment and serves as the basis for how resources are used. Thus, local knowledge is directly related to local management (Berkes et al. 2000).

In a comparative study carried out in Brazil and Australia, indigenous respondents reported differences in observed fish behavior of a primary target species in each country (Silvano and Begossi 2005). The same species may have a different habitat depending on the local marine environment. A top down management scheme developed without consideration of this local variation would thus not work.

Detailed taxonomies exist as part of the local knowledge of a people's resources (Pollnac 1981, Morrill 1967). Those who have the most attuned knowledge of the marine environment will best be able to extract resources from it. Knowledge among fishermen may pertain to the habits of fish, such as diet and life cycle, the marine environment itself, such as topography, composition of the substrate, tides, etc., skill with equipment, both for fishing and boats.

Fishermen are known for secrecy of their skills (Andersen 1980, Acheson 1981, see above). Secrecy is also used as a "spacing mechanism" which works to give a kind of "temporary property rights" to fishermen (Forman 1967). Such information may be

shared through a code (Stuster 1978) so that reciprocal exchanges are more formalized. Secrecy, or control of information, then, comes from personal experimentation and understanding of the marine environment. It serves a managerial function of exclusion directed towards some who *are* allowed access to the resource.

The difference in information management for demersal and mobile species mentioned above has been criticized by Durrenberger and Palsson (1987). In their examples where this pattern does not hold true, however, other cultural factors exist such as social relations that instead dictate resource management. Their examples also concern fishermen working in fully capitalist systems on a much larger scale as, as opposed to the small-scale operation that is the focus of this thesis.

While marine species move, movement patterns are not random (Jennings et al. 2001). With time and experience, fishermen learn the movements and habits of different species. Some learn this more than others, and this will correlate with greater fishing success. It is this understanding of not only the targeted species, but of the marine system as a whole, that will lead to fishery management and property systems. Such an understanding represents a *mental map* of fish movements, substrate topography, geography and seasonal and tidal patterns. This temporal and spatial map is often the basis for resource territorial rights (Cordell 1978). Further studies of the knowledge of fishermen would be valuable in understanding how resource management systems evolve in particular fishing communities.

Local knowledge of the marine environment takes on certain characteristics that differ from terrestrial ecological knowledge. For example, the understanding of lunar tides is crucial to fishing, not only because of fish activity, but also for safety

considerations of both equipment and crew. According to Cordell (1974), fishing spots of canoe fishermen in southern Bahia, Brazil, are not understood spatially, so much as temporally. Tides affect water levels, and thus the location of fish populations. Each day in the lunar calendar is named and remembered according to its corresponding water level. Other types of fishermen do not share this attuned understanding of the subtle alterations in the marine environment. Bottom-trawlers and nylon net fishermen who are equipped with effort-reducing (and substrate-damaging) technology have spatially and economically marginalized the canoe fishermen.

Another example that shows just how attuned local knowledge is to the marine environment concerns the origin of ciguatera, which is a type of food poisoning that occurs when certain tropical fish with high levels of ciguatoxin are consumed. These toxins are heat-resistant, so cooking the fish does not remove them. The toxins concentrate in fish at greater levels as they move up the food chain. The poisoning occurs when humans consume an affected fish (usually a large, adult specimen) at the top of the food chain. Fish such as barracuda, amberjacks and some snappers and groupers, when greater than five pounds, are the leading culprits.

The origins of ciguatera were long a mystery to western scientists. The toxin is named for a marine snail that was believed to cause the first recorded poisoning in Cuba. According to a 1929 account in Samoa, the origin of the toxin was believed to be a strychnine-like alkaloid found in the flesh of certain snappers, groupers and surgeonfish (Jordan 1929). In the late 1960’s, the origins of ciguatoxins was still being debated by scientists. Research at this time was zeroing in on the cause (Scheuer et al. 1967). It is now well known that ciguatera poisoning is caused by benthic dinoflagellate algae found

on some corals (Burkholder 1998). A concurrent 1967 paper by Morrill, however, mentions a Cha-Cha fisherman of St. Thomas, who was regarded as being the most knowledgeable in the area. The fisherman was certain from his life-long fishing experience that ciguatera poisoning originated from algae that passed up through the food chain. The fisherman's knowledge was due to his personal observations and experience (skill acquisition) with the marine environment as a system (Morrill 1967). This example speaks to the value of locally developed knowledge. Having a greater understanding of the marine environment as a whole leads not only to better success as a fisherman, but may also lead to more conservation-like behaviors that encourage sustainable use of the resource.

Luxury Export Commodities and Small-Scale Producers

The literature on fisheries and agricultural producers is usually separate from one another. Firth (1966) points out that full-time fishers must be involved in trade since they would be unable to subsist on fish alone, as opposed to agricultural producers who may rely completely on their own production. He also points out the more seasonal nature of agricultural production, compared to the ability to produce fish daily. While the Malays were able to harvest fish year-round, in the community on which this thesis focuses, fishing does not provide a stable year-round income. Due to federal regulations on closed seasons and the required investments in order to access fish stocks far out to sea, fishing is more similar to the seasonal nature of agricultural producers elsewhere. Nevertheless, there is much to compare between small-scale producers of the two groups.

Both small-scale farmers and fishers are often rural peoples, subject to structures of power from above. Such power structures may be felt in unequal economic relationships such as debt (Dore 2003). Landowners control peons and migratory laborers in Latin

America and the U.S. through cycles of debt. Similarly, wealthy fish buyers who act as middlemen control fisherfolk through the control of fish prices and loans for the capital that small-scale fishing requires for boats and motors (Chacko 1998, Djohani 1997). Among both small-scale farmers and fishers, cycles of debt can lead to environmentally damaging practices (Chacko 1998, Djohani 1997, Stonich 1995).

Previously producing for local or regional markets only, both rural fishers and farmers are increasingly producing for the global market. Both groups often enter such market relations in a marginalized position. Two types of production will be addressed here: farming and resource extraction.

In response to rural poverty, governments and development institutions such as the World Bank have attempted to institute production reforms at the local level. These plans are usually designed and approved with little input or involvement by actors at the local level. One such reform is the promotion of commodities referred to as “nontraditional agricultural exports” (Conroy 1996) These are commodities produced for export to wealthy nations where such commodities are in demand. The trend toward non-traditional agricultural exports has led many rural people to cease producing subsistence crops in order to grow luxury-export cash crops on which they could not subsist. Such non-traditional exports, what I term “luxury export commodities” are luxury products such as vegetables and cut flowers. Production of such goods responds to a demand by wealthy market consumers who want particular goods year-round, as opposed to when they would be seasonally available in their own climate (Thrupp 1995).

The problem with this shift toward producing luxury goods for the export market is that once people give up subsistence farming, it is difficult to go back. “Once key skills

disappear by not being transmitted to a younger generation, they are effectively lost forever" (Heyman 2005). This skill loss may be applied not only to technology eroding knowledge, but also to a new household reliance on consumer goods.

A risky scenario results where rural communities produce commodities that do not serve subsistence needs should the world market price collapse. Rural communities face the very real danger of being left to survive on a crop with no exchange value and little use value as well. This exemplifies one of the fundamental features of underdevelopment (Frank 2000, Escobar 1995).

Local resource commodities on the global market place demands on locally abundant resources, altering social relations at the local level based on global demand. Frank's theory of the Development of Underdevelopment (1969 in 2000) and Wallerstein's World Systems Theory (1979 in 2000) depict a pattern to the flow of commodities. Natural resources move from satellite/peripheral countries to metropolis/core countries. Technology and manufactured goods with value-added prices flow in the other direction. The price balance between the two inevitably favors the production of core countries. The unequal balance in trade between natural resources and technologically produced goods is mirrored in the unequal balance in labor, where labor is worth far more in core countries than in peripheral ones.

Political Ecology

A political ecology analysis addresses a problem by incorporating the political economy with a local ecological setting (Blaikie and Brookfield 1987). That is, a local problem is understood as a socio-political and historical construction within a particular ecological setting. A problem such as competition and overexploitation of resources is thus addressed by examining the historical context of the community and resource use,

the political context of power relations, and the social and cultural factors that characterize the local context (Stonich 1993). All these factors are situated in a particular ecological system where the resource in question is produced.

Another facet of political ecology is its attention to the interests of actors at multiple scales. Resource problems are not created in isolation at the local level. Rather, the interests of actors at regional and global scales must be considered and their relations with those at the local level included in the analysis. Actors at regional or global scales may not seem to play a direct role in local processes, but the interests of such agents create pressures that local level agents respond to. Small-scale producer communities do not exist in a closed system. All communities are integrated in some way with actors outside of the community. Therefore, when a community shifts production from subsistence to export, the community becomes inextricably connected to a foreign market. The new relations of power that arise must therefore be integrated into the analysis of resource use. Very often, such market integration leads to the dependence of small-scale producers on the volatile prices and preferences of a foreign market (Thrupp 1995).

A political ecology analysis of resource exploitation may thus provide a new critique of Hardin's Tragedy of the Commons. Although a resource is predominantly open access, thereby conforming to the assumptions of Hardin's Tragedy, users who exploit a common property resource for the global market, are inseparably entwined with that system. Therefore, the exploitation of the resource must be considered in its relation to a broader system. Also, the analysis includes internal factors at the local level that go beyond the simplicity of viewing resource users as self-interested individuals. Rather, the

history of the community's members, their local conflicts and social structure are incorporated to reveal a more holistic view of the use of the resource.

Conclusion

The following chapters will introduce the practice of diving for lobsters in Los Flamencos and the ecology of spiny lobsters. The analysis of how the fishermen perceive their resource, including the knowledge they have of their environment, is then compared against the system of access governing the common property resource. The construction of lobsters as a luxury export commodity on the global market, however, impacts issues of management. Currently, the fishermen of Los Flamencos harvest their resource in an open access situation. Whether or not the Tragedy of the Commons plays out, however, has to do with more than just the form of access that the resource users have.

By examining the various issues surrounding common property resource management, the explanation of resource use must consider the internal and external factors guiding the community of users. The relationships of community members with each other should be considered as well as with agents outside of the community. A political ecology approach is, thus, most suitable.

This thesis ends on an optimistic note. At the time of research, the fishermen were planning to institute a communal property management strategy that they themselves will attempt to enforce. The new initiative was set to be implemented after my departure from the community. Perhaps, the dismal perceptions of the future abundance and access to the resource that the fishermen displayed in interviews will incite successful cooperative action.

CHAPTER 3
RESEARCH SETTING AND ETHNOGRAPHY

The Community

Los Flamencos, a small fishing community on the Gulf coast of the state of Yucatan, Mexico, is typical of the several fishing communities of the eastern half of the Yucatan state's Gulf coast. Around 2,000 people now call Los Flamencos home, and this number has steadily increased since the harvest of lobsters began roughly 35 years ago, roughly coinciding with the replacement of the community's Maya name for a mestizo one.

Because it is a fishing community, Los Flamencos orients its town center around the waterfront breakwater (*malecon*) rather than the square central park that is typical of most Latin American towns. The waterfront area is still referred to as the *parque*, and men gather here to talk under the shade of potted palm trees when not fishing. The main street into town ends at the malecon. It is at this intersection that the town's church sits, facing due west, directly across from the local government offices (*palacio*) facing due east, where the offices of the mayor and the small police department are located.

Interestingly, the community's six policemen are employed only part-time, principally working on the weekends and during festivals. Enforcing the prohibition of the sale of alcohol on Sundays and maintaining order among the cantinas' clientele are their main responsibilities. Nevertheless, the policemen still regard fishing as their primary occupation.

Located in mangrove swampland, Los Flamencos has been built on top of reclaimed, filled land. Flooding is a constant concern, but especially so during hurricane season. The latest to severely impact the community, Hurricane Isidore, struck the area in September, 2002 causing significant damage to village infrastructure. Many of Los Flamencos' brightly painted wooden houses were damaged or destroyed by Isidore, but the community has since recovered. Newly constructed, and in some cases still unfinished, one-room concrete buildings are now common, as are large rooftop water tanks which provide a reserve supply of water during the frequent interruptions in service.

The community has experienced a population boom in the last few years, owing largely to the draw of the open lobster industry, which began in 1970. Many of the fishermen are first generation members of the community, having arrived when they were children or adolescents. Because of rapid demographic growth, there is an increasing demand for housing. On the outskirts of town, bulldozers are constantly at work, clearing and filling mangrove swamp for new homes.

Archaeological evidence reveals Maya settlements in the area, but the contemporary population does not identify itself as Maya. Only a few elderly residents, who claim to have learned the language as children on nearby ranches, speak Maya. The population is now entirely mestizo.

Few of the fishermen have finished the equivalent of ninth grade, and some are illiterate. Families move to Los Flamencos and other fishing communities along the coast because of the availability of work in the lobster industry, which provides a lucrative income. The ease of entry into the local fishing industry is another factor that may not

occur elsewhere. In Punta Allen, a lobstering community in the south of the state of Quintana Roo (Cochran 1997), families with multi-generational histories in the community control entry to the fishery. Additionally, jobs are scarce in the interior of the Yucatan peninsula, which is dominated by ranches that rarely pay more than the Mexican national minimum wage of roughly $4US per day. The wages offered in nearby Cancun, only four hours by bus, draw migrants to the Yucatan from all over Mexico. Several fishermen find work in the Cancun area resorts during the closed lobster season, leaving their families behind in Los Flamencos. Because of this ease of access to the fishery, and the lack of a long-standing history of resource users, the lobster fishery is largely treated as opportunistic by those who arrive, looking for work. This will ultimately impact how the resource is perceived and exploited.

While the year-round population of Los Flamencos is now roughly 2,000 individuals, the population swells in August with Mexican tourists on summer vacation. Tourists come to visit the beach, see the wild flamingos, and to eat fresh seafood. Many nonresident fishermen also arrive at this time for the opening of the lobster season. There is no bank or post office in Los Flamencos. The fishing cooperative must handle all finances in Tizimin, Yucatan state's third largest city and around an hour away by car. Buses and minibuses depart and arrive from Tizimin several times a day. Most of the roads within Los Flamencos are wide and paved. The two main roads, the one entering the community and the intersecting one along the waterfront, have concrete planters built into them containing palm trees.

Schools exist in Los Flamencos for children through the ninth grade. Children choosing to go on to high school (*prepa*) must commute to a larger community at least 30

minutes away. Many of these boarding school students live with relatives during the school week, returning to their parents' homes in Los Flamencos on the weekends.

A young doctor fulfilling her mandatory community service runs a small state clinic where services and medicine are free. A second physician's office handles patients that have state social security-sponsored health care coverage, or can afford to pay to visit a doctor. The free medicine given by the state-run clinic is regarded as weak and inferior to that provided by the other doctor. Most of the clinics' staff as well as the teachers are not locals and nearly all leave the community on the weekends.

All homes have electricity, although most of the new concrete-block rooms, which were built with relief funds following Hurricane Isidore, have yet to be wired. Water service is intermittent for everyone, and seems to shut off unexpectedly once or twice a week for a few hours. This does not seem to result in much disruption, as most homes now have large water tanks on their roofs, also obtained from relief funds following Hurricane Isidore in 2002. These tanks are filled by the municipal water supply and provide water via gravity when the water system is not functioning.

There is little obvious socio-economic stratification in Los Flamencos. While the houses are, overall, simpler and smaller than in Tizimin, all have refrigerators and televisions, and most even have basic cable which offers five channels. Microwaves and DVD players were the popular new purchases at the time of research, with the majority of homes I visited having both. Young people are increasingly obtaining cellular phones, which they primarily use for inexpensive text messaging. Cell phone calls are prohibitively expensive.

Due to the town's small size, it is possible to walk cross-town in any direction within 15 minutes. The streets are largely devoid of cars as few people have them. Bicycles are common, and regularly fill up the four car parking lot in front of the fishing cooperative office, a sure sign that a meeting is in progress. Motorbikes, a sign of wealth, are becoming more common, although few families own one.

The standard of living appears to be fair and comfortable among community members. Most of the indicators of wealth seem to be acquired in the short time after the lobster season opens when money seems abundant. At this time, major purchases are made, such as microwaves and cell phones. Finances seem much tighter during the closed season, when occupational options are severely curtailed.

One family that I knew was unable to obtain a bank loan prior to the beginning of lobster season. They had run out of money, and the father was unable to buy food to feed his wife and two children. The man's sister-in-law whispered their predicament to me, and I noticed that the family was invited to have dinner at relatives' homes. I sponsored a *torta* (sandwich) party one night, and invited the family. The ulterior motive of assisting the family was never openly addressed, but kin relations in the community exist and form a sort of moral economy, which prevented families from going hungry or falling into poverty (Scott 1976). The lack of an obvious stratification of wealth among community members, however, did not seem to restrict upward mobility or the display of signs of wealth, such as among the few people who own a car.

When the lobster season opened, the first thing this previously broke father, mentioned above, did, was to buy a cellular phone for his son. While I hope that the man is able to save money this year to last his family through the cash-poor closed season, I

recognized how important it was to him to provide his family with the material goods that other families have. In a sense, the gift replaced the shame the man surely felt at not being able to feed his family on his own.

An Outline of Fishing Economies in the Yucatan

The northern coast of the Yucatan peninsula, Mexico, is dotted with fishing communities that harvest the abundant resources of the Gulf of Mexico. Until the recent emergence of lobstering, however, most of the fishing villages were largely domestic producers, with a small part of their catch being sold in regional markets. Before the emergence of lobstering, fishermen focused on line-fishing for grouper and shark, bamboo pole *jimbas* for catching octopus, and using nets for other species such as *pico rojo* (ballyhoo), the bait used for line fishing. Except for sharks, these target species are still harvested for sale to the regional market. In fact, some older fishermen continue to make nets by hand, for sale to other fishermen.

In the past, sea cucumbers, conch, and other mollusks were also economically important to the fishery. Overfishing and ecological damage from hurricanes, however, have decimated the populations of these species. While local home consumption of various mollusk species remains common, all species of conch and sea cucumber are now protected from commercial exploitation by federal regulations.

Currently, the Caribbean spiny lobster (*Panulirus argus*) has the highest value, by weight, of all extracted marine resources in the area. Lobster is followed by octopus (*Octopus maya*) and red grouper (*Epinephelus morio*) in both value and importance to the fishery.

Only men fish for the primary species in Los Flamencos, though women are beginning to become involved in the production facet of the marine economy. A

woman's fishing cooperative has recently formed with 13 members, however, these women fish exclusively for the bait used to capture octopus. During fieldwork, only one woman was encountered harvesting lobster. Twice widowed with four children to feed, she sells whatever she can catch to local restaurants or the black market. As she fishes alone, she is restricted to free-diving (without compressed air) in nearby waters, so her harvests remain small.

Capital and Technology

The fishing boats (*lanchas*) in Los Flamencos are 25 feet long, made of fiberglass, and have an outboard motor (Figure 3-1). Of the roughly 120 cooperative members, 60 boats are owned. Many captains have constructed homemade tops for sun protection. These are made from locally obtained materials. One boat captain recycled a tarp-like banner from the last political election, proudly supporting the PAN party. Each boat also has a large cooler for ice, which occupies the center of the boat. Regardless of target species, this is the basic set-up for open-water fishing. Other equipment is specific to particular target species, requiring a full-time and diversified fisherman to invest in significant capital to remain productive year-round.

The strategies for harvesting each of the three primary target species (spiny lobster, octopus, and red grouper) differ in technological inputs. While most fishermen focus on only one species, some target all three, depending on the season. The majority of fishermen focus on diving for lobster, which usually includes spearfishing (grouper and hogfish) at the end of each dive. Harvesting lobster has the most recent history of all harvested species. A small minority of lobster fishermen also fish for grouper with long-lines during the closed lobster season. Another group of fishermen engages principally in the capture of octopus. Some fishermen are now leaving their chosen fishery during the

Figure 3-1. Fishermen prepare their fiberglass fishing boat (*lancha*) for the opening of the lobster season. Each lancha is equipped with a center ice box for the preservation of a day's harvest. The air hose (*manguera*) is coiled in the bow of the boat. A fisherman is attaching the regulator, used for breathing, to the air hose. Photo by A. Lasseter (July 2005).

summer tourist season to work as *lancheros*, shuttling Mexican tourists to the nearby beach, or on flamingo tours.

Fishing for octopus is the least technologically intensive of the principal harvested species. Octopus, worth roughly $1.60 per kilogram, whole, is captured with a *jimba*. A jimba consists of two bamboo poles, each extended from the bow and stern of the boat from which lines rigged with bait are attached. The bait, primarily horseshoe crab, and some true crab species, is often caught by women in the community, as mentioned above. Of all the targeted species in Los Flamencos, the capture of octopus has the longest

history. The fishermen rely on the movement of the waves to rock the boat and move the bait, fooling the octopus into accepting it. This technique of fishing is dependent on the water movement that comes with the rougher seas of the fall months. Calm seas generally mean poor octopus harvests.

Grouper, principally red grouper, is caught on long-lines (*palangre*). Other species, including small sharks (*cazón*) and yellow-tailed snapper (*canane*) are also captured on the palangre. While the technique of fishing with a long-line is not nearly as technologically intensive as lobstering, the fishing grounds are the farthest from shore of all the targeted species, necessitating long fishing days and a greater dependence on fossil fuels. All fishing boats are motorized; I observed no sailboats in all of Los Flamencos.

Compared to octopus and grouper fishing, the technological investments for the capture of lobster remain the highest of these targeted species. These investments are relative, however, and lobstering is still comparatively small in scale and heavily dependent on human labor.

Unlike grouper and octopus fishing, lobster diving requires an air compressor, hose, regulator, mask and fins. This system, known as “hookah” in the U.S., is less expensive but more dangerous than SCUBA. SCUBA would require the additional investment in tanks, and more expensive air compressors than the ones currently used in Los Flamencos. The onboard use of inexpensive air compressors, however, place divers at risk of carbon monoxide poisoning from the boat motor’s exhaust fumes. Many captains neglect to buy the $40US filter for the air compressor, or fail to regularly change the cotton and carbon filling.

The use of compressed air allows the divers to reach greater depths and to dive for longer than free diving alone. Lobsters are not found in abundance suitable to commercial harvesting in shallower waters. At the beginning of the lobster season, divers' depths average 10 meters. The divers move into deeper waters as the season wears on and lobsters become more scarce in the shallower waters. Some divers reported that they dive to over 20 meters, searching for lobsters, although they acknowledged this as dangerous behavior. Because lobsters are more abundant at greater depths in this region, prior to the introduction of air compressors for diving in the 1970's, lobsters were not exploited in the area as a commercial resource.

Although boat owners once relied on intuition and landmarks from shore to find productive fishing sites, nearly all captains now use a GPS device to relocate successful spots. Diving also requires a glove and *gancho*, a hook attached to a metal rod with which the divers pull out the lobsters from their hiding places.

Divers also spearfish while lobstering. While this practice violates Mexican federal regulations (spearfishing is not permitted when the hunter is relying on compressed air), the cooperative accepts, and the regional distributor purchases, speared fish. The practice is, therefore, ubiquitous. Many fishermen do not sell their speared catch at all, reserving it for home consumption. When speared fish is sold, it is worth roughly $1.60 per kilogram per whole fish. A crew may spear five to ten kilograms of fish a day, which does not add much to the day's overall wage. Other crews focus on spearing fish rather than lobstering, and may harvest 40-60 kilograms per day. Thus, a crew's wage, which must be divided, may total roughly $70-90.

Use of GPS

Nearly all crews now use GPS devices to find lobsters. Lobsters aggregate in cracks and caves in the ocean substrate. These cracks and caves are random, and interspersed with wide spaces of sandy bottom covered in a thick layer of algae (Figure 3-2). Such rocky structures may cover a small area or extend along as a long crack in the substrate. The fishermen spread out along the coast where it is only possible to see the haze of shore. Using only natural navigational clues such as triangulation makes finding the cracks and caves very difficult. The advantages of allowing crews to mark and return to caves where lobsters were found are obvious.

While these repeated returns to cracks and caves that have previously yielded lobsters have increased fishermen's harvests, many fishermen have voiced concerns about their use. Only one fisherman interviewed in the study sample claimed he does not use, and is against the use of GPS devices. He felt that reliance on the devices was undermining fishermen's awareness of environmental information. Several fishermen reported that the previous season was their first time using a GPS device. These fishermen acknowledged that utilizing GPS was beneficial to them personally, but would lead to over harvesting.

The coordinates of successful spots are written in small notebooks and are closely guarded. The captain and boat owner owns the GPS device and always keeps the coordinate notebook. While fishermen may change boats, they may not take the coordinates they may have found with them. The notebook and coordinates remain with the boat.


A


B

Figure 3-2. Underwater photos of spiny lobster habitat. (A) Divers seek out cracks in the substrate as seen here, which are ideal hiding places for spiny lobsters. The presence of reef fish signals such structures. (B) Lobsters usually aggregate in groups within the caves and cracks. Photos by A. Lasseter (July 2005).

A Detailed Look at Lobstering in Los Flamencos

For roughly four months before the beginning of lobster season there is little activity on the docks. Only 12-15 fishermen harvest grouper by long-lines during this time. Fishermen reported that because the price of grouper has dropped and fuel costs have increased, it is difficult to make grouper fishing worthwhile.

Boat owners and crewmembers have different responsibilities in preparing for the opening of the season. Boat owners are responsible for the boat and diving equipment. Wetsuits, fins, and masks are the responsibility of the individual diver. Air compressors are painted and parts replaced before the season starts. During the last few weeks of the closed season, many fishermen take out loans to cover their expenses before the opening of lobster season.

The dock and malecon are crowded with fishermen on the day before the season opens. The freshly painted compressors are loaded on the boats, secured and tested (Figure 3-3). Carpentry skills are shared as each boat constructs a stable place to secure the heavy air compressor. A few crews are still scrubbing their boat's bottoms with muriatic acid, a task most others completed the week before. Tools, equipment and advice are shared readily, and everyone seems anxious and excited.

The typical lobstering crew is made up of three individuals: two divers and a helper (*manguerero*). Typically, one of the divers is also the owner of the boat. The helper is often a son or nephew of one of the divers, or a newcomer to the community who is learning to lobster. He is in charge of turning on and off the air compressor, and for feeding the air hose (*manguera*) to the diver. Profits from a day's trip are divided evenly into 3 ½ parts: one part goes to the boat, one part to each of the two divers, and the remaining half part goes to the helper. The boat owner must purchase oil and fuel and maintain the boat with the designated share. Numerous variations exist on this model, such as two brothers co-owning their boat, or two divers who do not use a helper.

Figure 3-3. Each crew's compressor is uniquely painted. Stripes, streaks, or polka dots of any color combination of available paint are more common than those compressors painted a solid color. The loading of the compressor onto the lancha is a communal activity. Compressors are loaded the day before the season opens. Photo by A. Lasseter (June 2005).

Most fishermen leave from port around 7 a.m., and return between 3 and 6 p.m., the exception being opening day, when everyone departs at 6 am. Because the lobsters are caught by sight, daylight is necessary and restricts an earlier departure.

With the beginning of lobster season, several food stalls open in the early morning, selling tortas to those fishermen whose wives did not prepare their lunch. The most popular of these stalls is run by a fisherman who claims there will be no future in lobsters, so he is investing his money now in a restaurant. His morning torta shop becomes a *taqueria* (taco shop) in the evenings. He still fishes occasionally, and I saw

him one day, when the crew I was fishing with visited his crew's boat. He was proudly showing off an enormous *cherna* grouper he had just speared.

The lobster grounds are roughly 45 minutes to an hour from the port. When the crew reaches the selected dive site, one diver prepares to descend. The two divers will dive in turns of between 1 ½ to 3 hours each. Three turns occur each day, with the divers alternating on diving first. On the first day, then, one diver will dive twice and the next day, when he occupies the middle slot, only once.

Some divers use wetsuits. While the surface water of the Gulf is warm, a thermocline exists, and the water on the bottom is much colder (24ºC). The hose (manguera) from the compressor has a regulator attached, which reduces the compressed air to human breathing pressure. The hose is tied to a weight belt. The diver puts on the weight belt and rests the hose over his shoulder so the regulator is waiting in front of his mouth. A mask and fins comprise the rest of the dive gear. Additionally, the diver carries a gancho, a spear, a metal rod with a bluntly pointed tip, and a spear gun. The diver wears a special glove (*guante*) for picking up the spiny lobsters.

The diver, seated on the side of the boat, waits for the captain to tell him when to jump in. The captain steers the boat according to the coordinates he has programmed into the GPS, signaling to the diver when they are directly over the recorded spot. Once the diver is in the water, it is the manguerero's job to feed out the hose. The manguerero must also remember to start the air compressor when the tank gets low, and to shut it off again when full.

After the diver descends to the marked cave, he will either ascend with a lobster harvest if the spot was fruitful, or request that the captain move the boat. The diver does

this by tugging on the hose he is breathing from. The captain then secures the hose (around his leg or by sitting on it) and begins moving the boat, towing the diver along the bottom. The diver tugs on the hose again when he has found a cave to investigate.

Most of the time, the first diver of the day will begin by hunting for an octopus. The first month of the lobster season occurs during the last month of the closed season for octopus, so this octopus will not be sold. It will usually be consumed at home or used for hunting the following day. Once an octopus is found and caught, it is impaled on a spear. If a lobster moves deep inside a cave where a fisherman is unable to reach it, he will thrust the spear with the octopus inside the cave and shake it around. This will scare the lobster out of its hiding place. All fishermen recognized that lobsters are scared of octopus, and reported using an octopus in this way.

Once a cave or crevice is found containing lobsters, the diver will catch them one by one by sliding the gancho, with the hook facing upward toward the lobster's body, under the animal, hooking it on the carapace and slowly pulling the animal out.After pulling a lobster out of its cave, the diver grasps the anterior side of the animal and kills it by impaling it on a spear. Owing to the sharp spines that cover the body of the lobster, he always does this with the hand protected by the guante. Up to 20 lobsters may be stacked in this way on the rod. The advantage of the rod is that the diver is able to remain on the bottom, signaling to the captain to move the boat in search of new caves, and to carry his catch with him, without having to surface.

If the diver finds a large number of lobsters aggregating in a single cave, as may occur early in the season, he may choose to gather them together by their antennas after

killing them, and ascend. After delivering the lobsters to the boat, he will continue his dive.

The divers usually reserve spearfishing for the end of their dive, so as not to damage the fish by being dragged through the water. Hogfish and different species of grouper are the most commonly speared fish species. Other octopus will also be caught as encountered.

The manguerero is also responsible for “opening” the lobsters. Opening the lobsters refers to separating the tail from the carapace. In Los Flamencos, as is true among all the artisanal lobstering communities along the Yucatan coast, only lobster tails are sold. Some communities in Quintana Roo harvest live lobsters. Live lobsters generate a higher price by weight than tails alone, but require more preservation in the form of filtered seawater and tanks. When the manguerero has some time between compressor duties and feeding the line to the diver, he will open the lobsters. The carapaces will be stacked in a corner of the bottom of the boat, and the tails will be placed on ice in the cooler (Figure 3-4).

The carapaces are never dumped overboard where lobsters are caught. When the boat approaches the mainland on the return trip, the carapaces are dumped overboard. All but one fisherman, when asked for an explanation for this practice, reported that the lobsters get scared away and don’t return to areas where there are carapaces. I was told that the presence of lobster carapaces is a sign of mortal danger to a lobster. One fisherman offered a different answer and reported that the carapaces would attract groupers and octopus, the top two predators of lobster in this area.

Figure 3-4. Carapaces separated from the lobsters' tails remain in the bottom of the boat until the crew approaches shore, when they are thrown overboard. On the left are the empty carapaces. On the right are the lobsters waiting to be "opened." Photo by A. Lasseter (July 2005).

After returning to the docks, the lobster tails are unloaded for delivery to the cooperative. Only now are lobsters measured to ascertain legal size status. Undersized lobsters, octopus (during the month of July) and any fish designated for home consumption remain on the boat and are retrieved later. The rest of the catch is carried to the waterfront reception area to be weighed, recorded and frozen. General boat cleaning duties are also carried out, usually by the manguerero.

The cooperative reception area contains a large garage opening for the delivery truck, which regularly brings shaved ice from the ice factory for the fishermen. The fishermen pay for ice through the sale of their catch: each kilogram of catch is nominally

reduced in price to cover the cost of ice. This price is part of the difference between what the cooperative pays the members, and what it sells their harvests for to the regional distributor. The normal price of one-half of a peso (5 cents) per kilogram of a fishermen's catch goes to the price of ice. Because a crew pays for the ice out of what they produce, they do not pay for the ice used on a bad day where little was caught. Behind the ice truck is the reception area, with a desk for the recording of lobster weights, a large and small scale, and two tables for cleaning and measuring the lobster tails.

One fisherman brings in the total product from his crew. Once the tails and fish are weighed, the fisherman is given a receipt for the total catch. The crew may then collect the money from the nearby cooperative office later that evening and the captain will divide the parts for each crewmember according to the agreed on arrangement.

The lobster tails are stored in a walk-in cooler, on ice water mixed with salt, until the next trip to the regional fish buyer in Merida, approximately four hours away. During the first month of the season, the cooperative will send the truck to Merida roughly every other day.

Diving Safety

Diving on compressed air presents specific hazards. Many of the boat owners do not buy filters for their compressors. This poses the potential problem of carbon monoxide from the outboard motor entering the air tank and poisoning the diver. As the boat motors are usually running while the compressor is filling the tank, the risk of carbon monoxide contamination is high. Because the partial pressure of a compressed gas such as carbon monoxide increases at depth, the divers' risk of injury increases. Extended bottom times and failure to ascend slowly, thereby allowing for decompression, increases

the risk of decompression sickness. Other risk factors for decompression sickness include dehydration, alcohol consumption, fatigue, and smoking (Germonpre et al. 1998).

All divers interviewed possessed knowledge of safe diving practices to avoid decompression sickness and were aware of the behaviors they needed to take to avoid it. Nevertheless, only seven divers in the sample reported always doing decompression stops before surfacing and only 12 expressed taking some care in ascending. Fourteen divers (38%) interviewed reported taking no care when ascending and simply rise to the surface when they are ready. An additional four fishermen in the sample do not currently dive; they are either in training or have ceased diving. Given that all fishermen interviewed reported diving between 3 and 6 hours a day (and were observed diving between 1 ½ and 5 hours a day) to depths of up to 15 meters, the incidence of decompression sickness may be predicted as high. Research has shown that long bottom times at depth without taking the time for slow ascents are the three primary risk factors for decompression sickness (Germonpré et al. 1998).

Many divers laughed at how many times they have been rushed to the decompression chamber after returning to port. The nearest hyperbaric chamber is roughly an hour's drive away. In the 2004-2005 dive season alone, one in four members of the fishermen's cooperative were sent to the decompression chamber with symptoms of the "bends" (decompression sickness). Several of these were sent to the decompression chamber more than once. Luckily, none suffered permanent physical damage, likely owing to the relative proximity of a hyperbaric chamber. Among fishermen who spend many months out to sea, such immediate care is unavailable, resulting in a higher incidence of death or permanent paralysis (Bernard 1967). Membership in the

cooperative requires that members pay for subsidized health insurance that covers trips to the hyperbaric chamber. The cooperative also pays part of the cost that is uncovered by the insurance, with the government covering the rest.

Management Issues

Cooperative Formation and Government Involvement

Prior to the 1970s, the limited marine resource economy of Mexico targeted domestic, local, and, occasionally, regional production. This state of affairs was due largely to a lack of infrastructure. Refrigeration to preserve catches, and dependable transportation to urban markets simply did not exist. During the 1970s and 1980s, the Mexican government began a series of agricultural distributive reforms aimed at aiding the rural poor (Fox 1993). As part of this process, the government encouraged the formation of community fishing cooperatives (Poggie 1980). The government was involved in both the formation of cooperatives as well as aiding in the construction of facilities for the preservation and processing of marine resource production (U.S. Library of Congress 1997).

In some areas, fishing communities had already taken steps to organize themselves and manage their resources. One example of such “bottom-up” organization (discussed in chapter 6) is found among the lobster fishermen of Punta Allen, in the state of Quintana Roo. There, the fishermen have instituted a system of local management consisting of private marine fishing zones within which individual fishermen are allowed to catch lobsters. In time, no further fishermen were allowed to enter the fishery, and the private fishing zones are now transferred via inheritance (Cochran 1997).

This example of local organization and management, however, seems to be the exception rather than the norm in Mexico, and most communities are effectively open

access. The prevalence of open access regimes could be due to any of a number of factors. It has been suggested that the need for local management and organization may not exist when pressure on a resource is low, as has been the case in much of Mexico, at least until recently. The fishermen of Punta Allen were already harvesting lobsters for commercial export prior to the initiation of cooperatives in the rest of the country. This could be due in part to their proximity to the lobster fisheries of Belize, where private lobster zones and fishing cooperatives preceded those of Punta Allen (King 1997, Sutherland 1986). In other areas, where the infrastructure and organization for commercial export did not exist, production would have been lower as it was limited to local or regional distribution. Marine resources are very fragile, rendering preservation necessary for commercial exports.

When the government initiated cooperative formation in Mexico, such programs were not matched by species regulations. In fact, no fisheries were regulated before 1994, although local management existed in various forms, as mentioned above. This lack of regulation was based primarily on the government's emphasis on increasing yields, not limiting harvests (Hernandez and Kempton 2003). Cooperatives, not individual fishermen, were granted a number of government permits and capture of the various species was limited to the permit holders within the cooperative. In other words, to capture particular species, a fisherman was supposed to have a permit *and* be a member of the respective cooperative. The permits were not valid outside of the institution of the cooperative.

While the cooperatives were created as independent institutions, they are obligated to report catch totals to the federal state. Additionally, they are aided financially by the

state. The political ties of various cooperatives to particular political entities also confer financial advantages. These associations will become important in the case of the Los Flamencos cooperative.

In the case of the Caribbean spiny lobster, the cooperatives along the northern Yucatan coast originated around 1970, when the fishermen of Los Flamencos organized with 27 starting members (*socios*). In 1974, the first government spiny lobster concession was granted for a term of 20 years. Additional permits could not be granted within this time, and all permits were restricted to fishermen within the cooperative.

The termination of the first concession in 1994 coincided with the first governmental regulations concerning catch controls, as well as the beginning of the new concession. These new catch controls were instituted for several fisheries throughout Mexico in the form of NOM-006-PESC-1993 (Norma Oficial Mexicana), the first such legal specification of marine species extraction. The catch controls varied according to the species.

In the spiny lobster fishery, these new controls consisted of a minimum size limit and season closure for the entire fishery. Gear specifications exist but pertain to trap use, which is not utilized among the artisanal lobstermen of the north Yucatan coast, so is not addressed here. (Commercial lobster fleets based out of Progreso target spiny lobsters in the deeper waters of the gulf, and do use traps. One fisherman in Los Flamencos complained to me that the Progreso lobstermen are partly to blame for locally decreasing lobster harvests.) The new regulation continues to grant extraction rights only to cooperatives and their members. The regulations further specify that recreational lobster

harvesting is not permissible in Mexico, as is popular in Florida. Recreational fishing in Mexico is limited to line fishing for sport fish.

A Brief Comparison of Federal Lobster Regulations: Mexico and Florida

There are two primary restrictions governing the harvest of spiny lobster in Mexico: a closed season and a minimum catch size. A closed season (*veda*) prohibits the harvest of spiny lobsters in Mexican waters from March 1 until June 30 each year. This season coincides with the main spawning season of the species. There is also a minimum catch size set at a length of 13.5 cm for the tail of an individual. While these regulations were enacted in 1994, enforcement remains virtually nonexistent.

The closed season and minimum size restrictions closely approximate similar regulations in Florida, which has the most profitable spiny lobster fishery in the U.S. Florida regulations specify that imported lobsters must also conform to domestic size restrictions. This is the strongest factor in the designation of Mexico's minimum size for spiny lobsters, as much of Mexico's harvest is exported to the U.S. market. The state of Florida, however, has numerous regulations on the spiny lobster fishery that do not exist in Mexico (Table 3-1).

In neither location does a maximum size limit exist. Because lobster fecundity increases as size increases, prohibiting the harvest of large individuals could be a valuable management tool. Fishermen would surely resist such a regulation, as lobster value is determined by weight. Large individuals bring a very high price.

In Mexico, only members of a cooperative have the right to harvest lobster. Florida, however, grants recreational access to the lobster fishery. While recreational fishing regulations in Mexico are aimed specifically at a foreign tourist industry, in Florida, the

Table 3-1. Comparison of the regulations governing the harvest of *Panulirus argus* in Mexico and Florida. (Regulations are presented for Florida and not the U.S., thus comparing regulations for the same species.) Included here are those regulations that are relevant for comparison to Mexican lobster divers.

MEXICO	**FLORIDA**
Closed Season: March 1 – June 31*	April 1 – August 5 (excluding recreational mini-season)
No recreational extraction of lobsters	Recreational permits, including "mini-season"
Minimum Size: 13.5cm (5.3 inches)	Minimum Size: carapace 3" or tail of 5 1/2" (14cm)
No maximum size limit	No maximum size limit
Artificial habitat may be constructed to attract lobsters	Prohibited to take lobsters from ANY artificial habitat
Lobsters may be killed underwater	Lobsters may NOT be killed underwater
Lobsters "opened" while at sea	Lobsters may NOT be "opened" at sea; whole lobster must return to shore with carapace and tail intact.
No effort limit for divers	Effort limit of 250 lobsters per day per vessel, regardless of number of licensed divers aboard
No more permits granted since 1994 (20 year concession) Concessions granted to coop with permits for 20 years	No more commercial permits granted from Jan.1 2005 – July 1 2010
No legal support for regulations; guidelines only. No enforcement.	Strict enforcement including aerial support

recreational regulations impact use by local residents. Recreational access in Florida includes a "mini-season" before the official commercial season opens. For two days at the end of July, recreational divers who have purchased a license from the state may catch up to six spiny lobsters of legal size, per day.

In Mexico, there are no maximum catch limits on spiny lobsters. Among the rural lobster communities on the northern Yucatan coast, it is a virtual open access resource. In Florida, however, commercial divers may take no more than 250 individual spiny lobsters per boat, per day, regardless of how many licensed divers are working on a single boat.

Another difference between the Florida and Mexican regulations lies in the use of artificial habitat. In Florida, it is forbidden to harvest any lobster found within or nearby any form of artificially created habitat. In Mexico, some fishing communities harvest lobsters entirely from constructed lobster habitat (*casitas cubanas*), such as in Punta Allen (Cochran 1997). Various lobstering communities along the northern Yucatan coast have experimented with the use of artificial habitats for attracting lobsters. The topic of artificial habitats will be addressed in the following chapter on species ecology. Nevertheless, the important distinction is in the complete prohibition of using artificial habitats in Florida, while in Mexico, such use remains under experimentation.

The government of Mexico restricts and regulates the capture of many marine resources, including lobster, octopus and grouper, the three main target species of the fishermen of Los Flamencos and the entire Yucatan state coast. Closed seasons now exist for each of the three species, with 2005 being the first year for the implementation of a one-month closed season for grouper fishing. Additionally, both grouper and lobster share a minimum catch size. While the administration of federal regulations is a step in the right direction for the management of such resources, they remain top-down only directives. Without proper enforcement and support at the local level, such regulations are virtually ineffective. Additionally, such top-down regulations often fail to consider variations and change within local ecosystems.

Everyone in Los Flamencos is aware of the closed season and minimum size regulations, whether or not they harvest lobsters. Despite this awareness, poaching during the closed season, and the taking of undersized lobsters is common. Even within the cooperative, standard practice contradicts federal regulations. For example, throughout

Mexico, spear fishing is prohibited while relying on an artificial air source. Nevertheless, carrying a spear gun is routine for all lobster fishermen, and the cooperative buys all speared fish of commercial species.

“Undersized” Lobsters

In Florida, lobsters must be measured where they are found in the ocean and their bodies kept intact until brought to shore. In Mexico, there is no formal restriction on the killing of lobsters while underwater or out at sea. It is standard practice among the fishermen of Los Flamencos to kill the lobsters underwater and then “open” (*abrir*) them on the boat. To “open” a lobster refers to cutting the carapace away from the abdomen, thereby separating the head and tail (Figure 3-5).

Divers in Florida are required to carry a measurement tool with them at all times when in the water. Mexican divers are unencumbered with such a regulation. While fishermen in Mexico should determine the legal size status of a lobster where it is found, the reality is that the lobsters are killed underwater without adequate measurement. Some fishermen claim that they are able to select only lobsters of legal size, and feel certain that they can make this determination underwater. Other fishermen concede that they take undersize lobsters because if they do not, the next diver surely will.

It is noteworthy that, due to an optical phenomenon with the use of a mask underwater, everything is magnified by 25%. This may result in the harvest of undersize lobsters that appeared to be of legal size while underwater.

Only after the lobsters are killed and the carapaces removed do the divers of Los Flamencos measure the lobster tails to determine those of legal size status, and thus those that may be sold to the cooperative. This practice obviously precludes the safe release of undersized lobsters. Small lobsters are not purchased by the cooperative, as the

Figure 3-5. “Opening” a lobster is the process of separating the carapace (the head) from the meat-filled abdomen. Usually, this duty belongs to the manguerero, who wears a glove for protection from the lobster’s spin covered body. Fishermen complain that an irritating acid is released from the animal’s body fluids, which also necessitates the use of a glove when opening the lobsters. Photos by A. Lasseter (July 2005).

distributor is unable to purchase them for export. Nevertheless, the cooperative does not penalize fishermen for submitting undersized lobsters. The undersize lobsters are returned to the fisherman, who is left to sell the undersized individuals to local restaurants or to consume them at home. Sometimes, the worker in the production facility who is in charge of measuring the lobsters will keep the undersize ones for his own consumption. Workers in the production facility are fishermen serving two year elected terms for the cooperative. They are unable to fish regularly while serving as a cooperative official, and for this reason, are often given fish or lobster by other fishermen.

The harvest and sale of undersized lobsters is illegal in Mexico. Nevertheless, restrictions are often more lax in Mexico than in the U.S. It is fairly common and simple to order fresh lobster in restaurants out of season. Undersized tails are usually served. Regional resorts will even advertise the opportunity to feast on “mini” lobster tails in tourist publications (Figure 3-6).

Impacts of Harvesting Undersize Lobsters

While it is certain that Mexican lobster divers, at least occasionally, harvest undersized lobsters, the impact of this practice remains unknown. There is no evidence as yet that the reproductive capabilities for the population are impacted. As will be discussed further in the next chapter concerning lobster ecology, large individuals are responsible for a disproportionate amount of the fertilized eggs that make it to the planktonic mass. Intense fishing pressure that eliminates all large individuals may, theoretically, have a greater negative impact than the harvest of undersized lobsters.

It is possible that the capture of small lobsters may negatively impact the following season’s harvest, although this also has not been proven. Marine biologists know that spiny lobsters undertake long benthic marches across the bottom of the Gulf (Herrnkind

SPECIALITIES STRAIGHT FROM THE SEA

La Cueva del Pescador Restaurant

Looking for the freshest seafood around? La Cueva del Pescador is the place for you. Featuring all the favorite catches direct from the sea, "the Cueva" can satisfy the cravings of any seafood lover!

FISHING TRIPS

HOOK IT & COOK IT!!

Owned and operated by fishermen, the staff at the Cueva has extensive knowledge of the sea as well as each of her tantalizing treasures. A few of the house specialties include jumbo shrimp, boiled Caribbean King crab, mini-lobster tails, and the fish filet. Each is available fried, grilled, sautéed in garlic and butter, and some are also available with curry or with a mushroom sauce. A tasty option for the fish filet is the Veracruz style – wrapped in foil and baked with tomato, onion, and pepper. Have a land-lover in the group? Have no fear. The Cueva also offers some outstanding options "not from the sea."

A favorite happy-hour hangout for locals, the Cueva offers a fun, up-beat atmosphere that only gets better as you slip off your sandals and put your feet in the sand. The cocktails are potent, the liquors are choice, and the service is prompt so you will not go dry! Be sure to try a pitcher of Gonzalo's famous margaritas to ensure your party feels no pain.

For those who love to fish or maybe wishing to reel in their own dinners, try a fishing trip. 'Hook It and Cook It' is the motto of La Cueva del Pescador, and there is no better ending to a day spent fishing than having your catch transformed into a delicious meal with no work involved on your part.

For a festive night and succulent seafood, stop by La Cueva del Pescador, located across from Akumal Bay in Plaza Ukana I.

PLAZA UKANA I - AKUMAL

Figure 3-6. Advertisement from a Cancun tourist publication. The resort offers "mini-lobster tails" (circled) as one of its house specialties. Undersized lobster tails may not be sold for export, as it is illegal to import them to countries such as the U.S. Rather, the "mini" tails find a ready market in the tourist resorts of the Cancun area.

1985). Whether small lobsters that avoided harvest remain in the local area to be captured later as larger individuals is, as yet, undetermined.

The federal regulations in place governing the size and season for lobster harvesting are efforts at controlling extraction pressure. The regulations themselves may be ineffective due to lack of enforcement at the government level, and lack of compliance at the local level. Additionally, whether or not the controls are an effective means of achieving the goal of sustainable future harvests may also be in question.

The Local Fishing Cooperative

The fishermen's cooperative serves as the intermediary between the fishermen and the regional exporter in Merida, the state capital, roughly four hours away by ground transport. The cooperative's socios deliver their harvest to the cooperative production facility, where it is weighed and a receipt given in return. The cooperative pays the fishermen less per kilogram for each species than it receives from the regional fish buyer in Merida. These expenses go toward the cooperative's expenses, and a new budget is presented by the cooperative each year.

The officers of the cooperative are elected every other November to serve a two-year term. During this time, they are paid a year-round salary, as they are unable to fish regularly. Positions include president, treasurer, secretary, head of enforcement, and health director, in charge of the social security program (*IMSS*). Numerous stories abound about corrupt officials, although the cooperative has taken steps to minimize this problem. During my time in the community, the current cabinet of officials was collecting evidence to charge a former treasurer with stealing. That particular individual is one of the more successful fishermen. I observed that his always hefty daily lobster catch was docked a large percentage every day as restitution to the cooperative. The

cooperative refrained from expelling the fisherman despite his egregious behavior, deciding that it was better to recover some of the financial loss by allowing him to continue harvesting lobsters.

It is the duty of the head of enforcement (*Presidente de Vigilancia*) to ensure that members only sell their catch to the cooperative, and also to make sure that the federal regulations are observed. The serving officer during my stay in the community found his efforts thwarted at every turn. He received reports in the weeks leading up to the opening of the season that fishermen were seen diving for lobsters. He would notify the CONAPESCA authorities, but they would never arrive until the following day. The authorities, with no resources for patrolling the waters, would walk to the end of the docks, look around, and report that they had observed nothing. In their defense, there is little to be done without the resources to conduct proper patrols.

The local official also complained to me that he knew the illegally harvested lobsters ended up in both the local restaurants. Yet, he felt he could do nothing, especially after acknowledging that the restaurant owners are kin to some of the socios. The owner of the larger, waterfront restaurant, directly next door to the cooperative's production facility, is the brother of two members of the cooperative, one of which is the current officer in charge of social security. As the production facility workers clean and weigh the lobster tails that are brought in, much lobster meat accumulates on the cleaning tables. Someone will inevitably collect the good pieces of meat and send it next door in a large bowl. The bowl returns in about half an hour, with a large bag of fresh *totopos* (tortilla chips) and the lobster meat made into *ceviche*, a coastal specialty of seafood pickled in

lime juice and cilantro. In reciprocity, the owner of the restaurant frequently visits the production facility where he picks out the fish he wishes to buy.

Los Flamencos had only one cooperative until 2003, at which time it split into two. Fishermen reported that prior to the split, the cooperative had developed two internal factions. Tensions ran high, leading to violence. As a result, even separate bars (*cantinas*) now operate in the community, catering to the members of each cooperative and their supporters.

I was alternately told that the conflict centered on the rivalry between the supporters of the PAN or PRI political parties of Mexico, or that it revolved around two rival families in the community. These two explanations are likely related and inseparable. From what I could piece together, one large, extended family had a sufficient number of kin members and supporters to maintain possession of the elected positions of the cooperative. This resulted in a conflict for control of the cooperative, and for access to resources and power that control of the cooperative offered. Thus, the relationship between the family rivalry and the political rivalry are connected when a political party promises financial resources in exchange for allegiance.

All interviewed fishermen felt that the split was a positive solution to the conflict, and nearly all felt that the causes of dispute were irreparable. Nevertheless, it was difficult to get people to talk about the conflict that resulted in the division of the cooperative. Perhaps, there is discomfort in discussing such a deep schism in the community given that kin relations sometimes cross the dividing line of the cooperatives. It is also possible that many in the community are not even sure of what actually transpired. While people were extremely open and willing to talk about all other aspects

of the community and fishing, it became clear that I would need to spend more time in the community to understand this conflict.

Despite the existence of separate cantinas, the division was most apparent among the officers of the cooperatives, as opposed to the general fishermen. One time, at the regional distributor's office in Merida, a representative from each cooperative was in the waiting room of the wholesaler, waiting to be paid. They never acknowledged the other's presence, although each chatted with the other representatives from neighboring communities, who were also in the room.

At the time of the cooperative's division, an agreement was made that membership would be capped at 225 members collectively between the two cooperatives. The original cooperative still holds all of the government concessions as well as the majority of the members: 127 to 98. This alternate cooperative must still file paperwork with the original cooperative due to the government regulations concerning the permits in order to sell lobsters for export. It is also the responsibility of the fishing cooperatives to report their members' production yields of each species to the appropriate government agency, CONAPESCA (Comisionado Nacional de Acuacultura y Pesca).

The original cooperative served as the host institution for this research, although informal interviews and one lobster fishing trip were conducted with members of the new cooperative. All data presented from interviews refers to respondents who are members of the original, host cooperative.

Lobstering outside the Cooperative

Although legally it is necessary to belong to a cooperative in order to capture lobsters, numerous "free" fishermen (*libres*) are active, both on their own boats and working on the boats of cooperative members. In this way, there are many more than 225

fishermen of both cooperatives, working in Los Flamencos. The cooperatives will buy lobsters from any fisherman, although non-members receive a lower price per kilogram. Additionally, there are three local individuals who buy fish and lobster, including undersized tails, from any fisherman. These individuals have their own trucks and sell regionally, principally to restaurants. All fishermen in the community are aware of their activities. The cooperative's stance toward these buyers varies: sometimes, cooperative members blame these buyers for what they see as resource overexploitation by free fishermen; at other times, cooperative members themselves will sell their catches if a higher price is offered than at the cooperative. This, the opportunistic nature of the fishery is reinforced.

The cooperative officially prohibits its members from selling their harvests elsewhere. If a member is caught selling their harvest outside of the cooperative, they are first given a warning. If caught a second time, they are fined by the cooperative. A third offense brings termination of membership. There is a wait list for entrance to the cooperative, and membership entails benefits such as access to the social security system.

Nevertheless, while the cooperative formally prohibits the outside sale of members' harvests, the rules are sometimes changed. Occasionally, the regional buyer will lower the purchase price, and the cooperative will allow members to sell their harvest elsewhere. Prior to the beginning of the lobster season, the price for grouper was lowered, and the cooperative stopped buying it completely. It was not economical for the cooperative to make trips to the distributor for the price he was offering. The few fishermen that continued to work sold all of their harvest to the local black market

buyers. Therefore, while some fishermen begrudge the black market buyers, the buyers offer a consistent venue for fishermen to sell their harvests to the regional market.

Regional Level: Fish Exporter

With the introduction of lobster diving and the increase in capital investments that it entails, a system much like debt peonage has formed between the fishermen and the regional fish buyer (Dore 2003, Knight 1986). Once thought of as a coercive arrangement, debt peonage was later understood as a basically voluntary, although exploitive, system that came about as rural communities began to produce for a capitalist market (Knight 1986). A system of debt peonage is thus evidenced in the relationship between the peon, who is dependent on the landlord for access to consumer goods and production capital, and the landlord, who controls the price paid for what the peon produces.

In Los Flamencos, the regional buyer (the landlord) owns both of the buildings where the cooperative's office and production facility are located, as well as the ice factory. The cooperative is contractually obligated to sell all lobster produced to this one buyer, representing a form of monopsony. Additionally, it is the cooperative's financial responsibility to deliver the product to the buyer's facility in Merida, a four-hour drive away.

The buyer, in turn, loans the capital needed for new boats and repairs to the fishermen (the peons). Given the technological intensity of lobster diving, these expenses can be considerable and numerous fishermen owe huge sums, effectively ending any hope for dissolving the relationship. This same buyer has similar arrangements with the other cooperatives of the eastern federation, and thus has virtual economic control over most of the northern Yucatan coast's lobster industry.

The buyer also dictates the price paid to the cooperative for lobster, and it is on this point that the fishermen feel most exploited, and the comparison to debt peonage is most evident. Cooperative meetings often focus on members' frustrations at being committed to a single exporter. They are well aware that their lobsters would bring a higher price if sold to another buyer in Cancun.

Through this relationship of obligation, the fish buyer is able to control the community of fishermen. The cooperative and its fishermen have little recourse when the price of lobster and fish drops. The buyer is the link between the local fishermen and the global market and he has managed to secure his position as the sole buyer for several communities. He is a very successful businessman, adept at making a profit.

One of the cooperative officers told me (with dripping sarcasm), that the Merida buyer is a really smart man. The buyer knows how to lower the price at just the right time, and charge the fishermen more for boats and motors, he told me. The buyer also sends end-of-the-year turkeys to the cooperative, to distribute to all members as a kind of bonus. This officer told me that he knew who really paid for the turkeys. The fishermen did. Those were very expensive turkeys, he said.

The fishermen, aware of their exploited position with the regional buyer, are collectively attempting to change the situation. They are now requiring that fishermen pay a set amount toward their debt, everyday, although this has not been enforced by the cooperative treasurer. The cooperative officials, along with the officials of the other neighboring cooperatives of the federation (but neglecting the inclusion of the secondary community cooperative of Los Flamencos) have negotiated a grant from the government, matched by a bank loan, to build their own production facility. The cooperative's

representative to the federation told me that the cooperative would still be obligated to sell 50% of their catch to the distributor in Merida for some time to come, but he hoped that within a year or two, the cooperative would be able to begin exporting their own lobsters. He also acknowledged a pessimistic future of lobstering, but had hopes that the community would be able to begin shrimp or tilapia farming. Such a change would be easier, he felt, if the cooperative owned their own production facility.

While the current situation of the Los Flamencos fishermen appears to be one of debt peonage, a successful end of their obligations to an exploitative landlord would represent the community's ability to cooperate. Such empowerment will hopefully see the community uniting around their resources, instead of viewing them as supplying individual opportunities.

Conclusion

The fishermen of Los Flamencos harvest spiny lobster principally for export to the global market. Lobster's high value and status as a luxury commodity mark its complete integration into the global capitalist system. Therefore, capitalist concepts such as supply and demand, economic rationality, maximization, and competition, will be applied to the local context of resource exploitation in the analysis to follow.

The links to agents at both the regional and global level are necessary to consider when developing an explanation of resource use and perceptions. The local fishermen interact with non-local actors through the cooperative, of which they are members. Their attitudes toward and interaction with this organization are important.

The cooperative did not originate from a community initiative. Actors outside of the community designed the organization to serve as the framework for the new production of an export commodity. Now fractioned in two, the community has a

difficult time identifying common interests. As Fox (1993) puts it, “collective action by social actors requires two minimal conditions: the *perception* of shared interests or identities and the *opportunity* to act as a group.” The cooperative provides the opportunity to act as a group. Unfortunately, the fishermen struggle to identify shared interests.

The local situation appears to be one of intense competition. The cooperative is viewed as a means of profit, rather than a way of uniting the community around a common shared resource. Additionally, the stability of access to the resource is not secure. There are far more fishermen than lobster permits, and the number of new fishermen, although not cooperative members, increases each year. The open access nature of the resource, where newcomers to the community are able to harvest from the fishery with relative ease, perpetuates the perception of instability concerning the future of the resource.

The next chapters focus on specific facets of the lobster economy, beginning with a discussion of lobster ecology. Then, the perceptions of the lobstermen concerning the stability and future access to their lobster resources are addressed. This analysis of the fishermen’s perceptions aims to relate the predominating open access situation to the perceptions of the resource users themselves. Finally, a two-part discussion where (1) spiny lobsters are analyzed as a constructed commodity of high value, and (2) the concept of management of this commodity is discussed as it applies to the perceptions of the local level users.

CHAPTER 4
ECOLOGY

The particulars of a local ecosystem necessitate different strategies of resource exploitation. The method of and technology for harvesting spiny lobsters among the artisanal fishing communities of the north Yucatan coast differ from techniques used to harvest the same species in other parts of its range. This chapter presents an overview of the local marine ecosystem of the research community, a summary of current knowledge of *Panulirus argus* ecology, the techniques that Los Flamencos fishermen use to catch spiny lobsters, and the management issues confronting Los Flamencos' fishermen. Just as strategies of exploitation are particular to the local environment, so must attempts at management consider the specifics of a local context. This necessarily involves local participation. In particular, the combination of the history of exploitation of spiny lobsters and the current ecological conditions have potential to result in a classic *Tragedy of the Commons* situation that complicates the ability of local users to manage their resource.

Local Ecosystem: The Gulf of Mexico

The Gulf of Mexico is a relatively warm body of water with little current, compared to the colder waters of the nearby Caribbean. A northward current moves up the coast of Quintana Roo, entering the Gulf of Mexico through the Yucatan channel, ultimately connecting with water moving out from the Gulf of Mexico through the Straits of Florida (Figure 4-1). This outward flow forms the beginning of the Gulf Stream, the current that flows northward up the eastern coast of the United States.

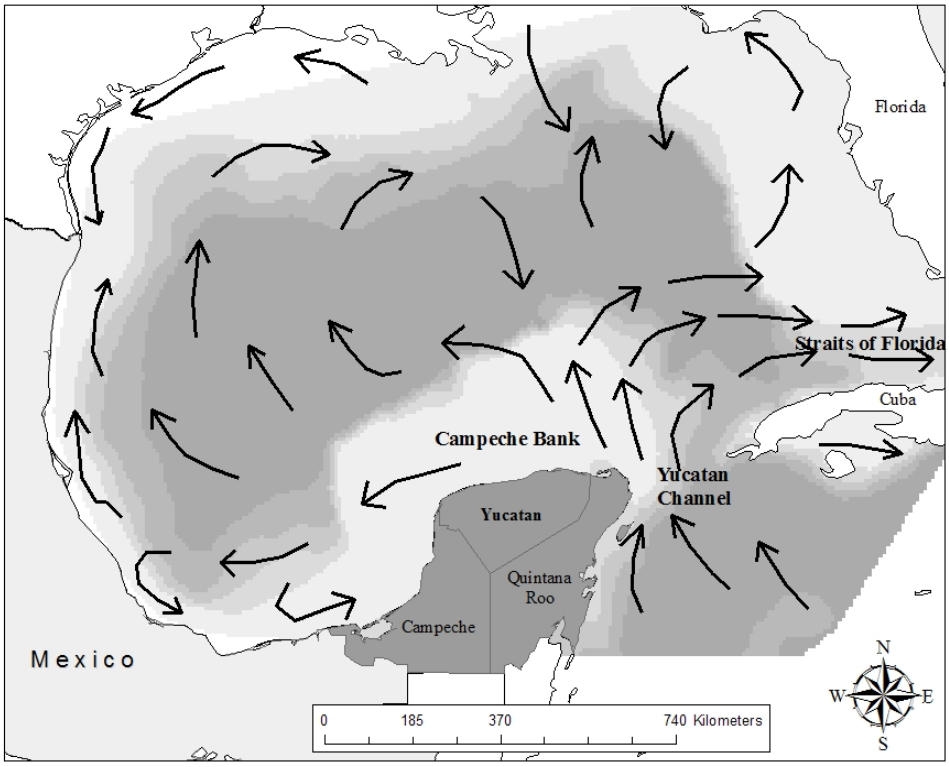

Figure 4-1. Map of the Gulf of Mexico displaying current movements as water enters the Gulf by the Yucatan Channel, where it moves in slow, circular patterns within the Gulf. The water exits the Gulf through the Straits of Florida. This water, now warmed, forms the beginning of the northward flowing Gulf Stream. Current movements adapted from Ehrhardt (2000). Map by Edward W. Tennant.

Because it is nearly land-locked, the water in the Gulf stews around slowly, much like a simmering pot.

An additional feature of the Gulf is evidenced in the broad continental shelf of the north coast of the state of Yucatan, which is far wider than that found off the coast of Quintana Roo. Known as the Campeche Bank, the depths of the shelf increase far more gradually on the north coast, providing a wider stretch of shallow water in which to harvest lobsters. Unlike the clear waters of the Caribbean, the waters of the Gulf tend toward turbidity. The relative lack of current allows for the accumulation of a benthic

layer of algae (*yerba*) that covers much of the shallow substrate where the lobsters are harvested (Figure 4-2). When present in large quantities, this bottom layer of algae accumulates in the caves and holes that spiny lobsters aggregate in. Storms routinely


A


B

Figure 4-2. Photos showing the typical algae covered substrate of the lobster harvesting zone. (A) depicts what most of the substrate looks like until a diver is able to find a break in the algae as seen in (B). Photos by A. Lasseter (June 2005).

"clean" the substrate of this alga, or alternately, distribute it. The presence of excessive yerba makes the caves in which the lobsters take refuge more difficult for the divers to

find. Even when the fishermen are able to locate caves, an overabundance of algae may prevent divers from successfully capturing the lobsters.

The warm waters of the Gulf contribute to another hazard for the fishermen: hurricanes. As occurred during the record hurricane season of 2005, storms tend to intensify rapidly when they reach the Gulf of Mexico. The warm waters stimulate the lower pressure that fuels storms (Bengtsson 2001). Hurricane Isidore in 2002, for example, devastated the northern Gulf coast of the Yucatan with both flooding and structural damage. The mangroves surrounding the town of Los Flamencos have yet to recover from Isidore and are littered with debris, including both dead mangroves and household trash. Furthermore, the fishermen report that the once abundant populations of conch and sea cucumbers have largely disappeared since the hurricane struck. There is currently no commercial fishery for sea cucumbers, which in the past, has brought a high price for export to Asia. Despite the fishermen's claims, the commercial fishery for both sea cucumbers and conch had ceased prior to Hurricane Isidore, which served to further decimate the already overexploited populations of these resources. Federal regulation now bans conch harvesting on the northern Yucatan coast, although conch ceviche is available at local restaurants.

Pollution

The Gulf of Mexico serves as the watershed drain for most of the central U.S. (Goolsby et al. 2001, Alexander et al. 2000). Due to the extensive area of drainage, pollution into the gulf from industry and agriculture is a significant problem (Hill 2004, Goolsby et al. 2001). Heavy metal pollution involving mercury, phosphorus, lead and cadmium in sediments, for example, are creating new environmental dilemmas in the Gulf (Garcia-Hernandez et al. 2005). Methyl-mercury bioaccummulates in many marine

species and poses an additional hazard for human consumption (Morel et al. 1998). Additional pollution in the Gulf occurs from oil spills (Patton et al. 1981), but the mere presence of oil platforms has also been shown to impact local populations of benthic organisms (Hernández Arana et al. 2005).

The bulk of the pollutants that reach the Gulf occur in the form of nitrate nutrients, principally from agricultural land (Goolsby et al. 2001). An estimated 16% of all nitrate fertilizer used on crops along the Mississippi River watershed, for example, eventually ends up polluting the waters of the Gulf of Mexico (Hill 2004).

One specific phenomenon associated with nitrate pollution is the Dead Zone that forms every spring in the Mississippi delta region of the Gulf of Mexico (Rabalais 2002b). A Dead Zone is an oxygen depleted area of water, and the one that forms in the Gulf can grow up to the size of some small American states (Hill 2004). Excessive nutrients (nitrates) cause a population bloom in phytoplankton, the decomposition of which leads to a depletion of oxygen in the water (Rabalais et al. 2002a). Due to the lack of oxygen, fish species are forced to move from the huge algal bloom. Benthic species, which are not nearly as mobile, often suffer high mortalities (Rabalais 2002b).

Existing in all natural bodies of water, populations of algae are particularly prone to booms and busts. When food is abundant, the population swells; when sustenance is unavailable, populations decrease. For aquatic algae, excessive nutrients in the water result in population explosions often referred to as “blooms” Today, terrestrial-based runoff from agricultural inputs such as fertilizer, but also including sewage, is the most common cause of excessive nutrients in the marine environment. These nutrient-caused blooms can have many harmful effects on aquatic ecosystems (Goolsby et al. 2001).

Algal blooms, also referred to as “red tides,” can be either toxic or non-toxic. The Dead Zone of the Gulf of Mexico, discussed above, is an example of a non-toxic algal bloom. While marine mortalities may result from the Dead Zone, it is due to the hypoxic water and not to a toxin produced by the algal organism. Other types of non-toxic algal blooms also have negative impacts, such as an algal mass that blocks out sunlight, killing benthic sea grasses that are dependent on the sun for photosynthesis.

Sometimes, the impacts of algal blooms are not readily apparent. A seemingly benign episode may have indirect repercussions on economically important species. As an example, an algal bloom in the south of Florida indirectly caused spiny lobster juvenile mortality by killing the sponge habitat in which the juvenile lobsters took refuge (Herrnkind et al. 1997). The affected sponge species represented the bulk of non-anthropogenic habitat available to spiny lobster juveniles at that particular life stage. This relationship was only recognized because the bloom occurred during an experiment by Herrnkind et al. (1997) on the effect of artificial habitat on the recruitment of juveniles. The research team’s control group of juvenile lobsters disappeared when their sponge habitat was destroyed, while the individuals taking shelter in the artificial blocks placed by the research team survived.

Herrnkind et al.’s study demonstrates the complexity in the set of relationships between a species of high commercial value and any of a number of other species on which it depends. Algal blooms may or may not affect the mortality of lobsters directly, but they may also impact other species on which lobsters depend, either for food or habitat. In terms of local human exploitation, the lobster fishermen of the northern

Yucatan coast do not know where the “nursery” is for their juvenile lobster population and would not know if an approaching algal bloom posed a threat.

Toxic algal blooms are most often caused by species from three classes of unicellular algae: dinoflagellates, diatoms, and cyanobacteria (Van Dolah 2000). Of the 85 toxic algal species that have been discovered, 37 of these are found in the waters of the Gulf of Mexico (EPA 2006). Some of these classes of organisms are in the same genera that lead to some common shellfish and fish poisonings. The dinoflagellate responsible for ciguatera, the most common marine toxin affecting human consumption of fish, is one such organism. Ciguatera does not occur as an algal bloom. Rather, it is an organism which bioaccumulates in fish that have fed on it, climbing the trophic levels of ever larger fish species and causing gastrointestinal and neurological problems in humans when contaminated fish are consumed.

The local fishermen of Los Flamencos are well aware of the possible impacts of these algal blooms, or red tides, on their catches and livelihoods. The mere rumor of the presence of a red tide makes the regional news (Briceno Perez 2005, Tzec Valle and Briceno Perez 2005, Ucan Salazar 2005) and generates much local gossip. This is due in part to a lack of knowledge and understanding, both at the local and scientific levels, of the causes and impacts of each new algal outbreak. Los Flamencos’ fishermen, for example, reported that sometimes, a *marea roja*, or red tide, left them unable to fish for weeks and caused respiratory problems among people in the community. Others reported that the fish killed as a result of the red tides polluted the beaches or decreased the populations of commercial species, such as grouper. No fisherman with whom I spoke

purported to know the cause of the red tides; fishermen reported only that the *aguas malas*, or bad waters, wash in from elsewhere.

While there is no evidence at present that the pollution cited above is currently impacting the harvest of spiny lobsters in Mexico, the slow circular movements of the Gulf waters, its relative isolation, and the known migration patterns of many commercially important fish species should lead us to suspect transnational connections in regards to Gulf activities and contamination. Further research on transnational issues of pollution is needed.

Lobster Ecology

Panulirus argus, or the Caribbean spiny lobster, is one of the 33 species of commercially important spiny lobsters of the genus Palinuridae (Lipcius and Eggleston 2000). *P. argus* is the only lobster species of commercial abundance along the north coast of the Yucatan peninsula and most of the Caribbean. This species is also the primary species caught in the waters off south Florida, the Bahamas, the Caribbean islands, and as far south as northeastern Brazil (FAO 2002). Half of all commercial spiny lobster harvests worldwide are of the species *Panulirus argus* (Lipcius and Eggleston 2000).

Spiny lobsters are members of a genus distinct from the clawed lobsters, such as *Homarus americanus*, which is found in the cold waters off the coast of New England. Spiny lobsters do not possess edible front claws; only the tail is eaten. Instead of claws, the exoskeleton of the Caribbean spiny lobster is covered with countless spiny defenses (Figure 4-3).

The spiny lobster has a complex life cycle, consisting of numerous stages of different habitat and dietary requirements (Kanciruk 1980). Research and debate about

Figure 4-3. Photo of *Panulirus argus*, or the Caribbean spiny lobster, showing the spines covering the animal's exoskeleton. Note the distinct horn-like spines over the eyes, and the antenna spines evident in the animal's shadow. The sides of the tail also have spines on each segment, which the animal may contract in defense with much force while still alive. Photo by A. Lasseter (July 2005).

the length and number of these stages is ongoing and much of the published data concerning the life cycle of the spiny lobster is contradictory, representing how much has yet to be learned about the species (Herrnkind 2005, Lipcius and Eggleston 2000, Arce and de Leon 2000).

Fertilized eggs are carried under the tail of the female until they are released into the open ocean. The early stages in the life cycle of the spiny lobster involve a series of up to 11 planktonic larval stages lasting from 6-24 months (Arce and de Leon 2000, Lipcius and Eggleston 2000). These planktonic stages serve to disperse the larval lobsters (Cobb 1997) and, as such, mobility is subject to water movements. The length of time in which the larvae spend in the water column allows for their distribution throughout the Atlantic Ocean (FAO 2001). This ultimately means that larvae produced in one area of

the species' range likely results in offspring reaching maturity far from the parent population.

Larval dispersal thus presents a complex scenario for regional attempts at "managing" the species: the efforts of control in one area may be limited by the activities of users in other countries. An underlying point in this thesis is thus reinforced: when addressing issues at the local level, we must consider that the local does not exist in isolation from the total system. The interconnection of disparate parts suggests causal relationships may involve distant actors.

At the end of the planktonic larval stages, spiny lobsters enter the *puerulus* stage, where they actively swim toward potentially suitable habitat on which to settle (Arce and de Leon 2001). The settlement times for the puerulus stage differ among the regions of commercial abundance. This settlement occurs from September to December in the Caribbean and Yucatan, but in February and March in the south of Florida (Arce and de Leon 2001).

At first, post-larval juveniles live solitarily, adopting algal or sponge habitats in shallow coastal waters (Phillips and Sastry 1980) before moving into crevice structures where they live socially (Childress and Herrnkind 1996). While juveniles usually prefer coral crevices, they have also been found in mangrove habitats in areas where coral options are limited (Acosta and Butler 1997). This would likely be the case on the Yucatan's Gulf coast, where mangroves predominate. As the juveniles grow into sub adults, they seek out crevice-type habitat in deeper waters, where the preferred habitat is easier to find.

Another feature of spiny lobster ecology, important to the commercial exploitation of the species, is the difference in reproductive success among individuals. Larger individuals produce exponentially more eggs and sperm than smaller, reproductively mature, individuals (Arce and de Leon 2000, Macdiarmid and Kittaka 2000). This means that smaller individuals are only marginally responsible for the reproduction of the species. This fact of lobster reproduction is important, yet it is almost entirely overlooked by spiny lobster resource managers. Both Florida and Mexico have government regulations specifying a minimum harvest size for lobsters. This protection allows smaller lobsters to remain in the population, preserving the following years' legal size harvest. These smaller lobsters could only minimally contribute to the overall recruitment of the species.

Neither Florida nor Mexico places a *maximum* size on individuals that may be caught. Lobster is valued according to its weight, putting high extractive pressure on the largest individuals. A conflict is thus created for resource managers: larger individuals are heavily targeted for their high value, but the extraction of these individuals may negatively affect recruitment of future generations.

On the other hand, new research proposes that the heavy exploitation of large individuals may ultimately favor the selection of reproductively viable smaller individuals (Wahle 1997). That is, natural selection will favor smaller individuals that are able to reproduce prior to mortality. This microevolutionary perspective is further supported in a study that compared a fishery and sanctuary population of *P. argus* in south Florida (Bertelsen and Matthews 2001). Bertelesen and Matthews demonstrated that small lobsters raised in a sanctuary were not observed carrying eggs, while in the

fishery zone, the same sized individuals were frequently observed carrying fertilized eggs.

Lobster Harvesting in the Gulf

Panulirus argus is recognized as a single species with an extensive range despite habitat variation ranging from coral reefs to mangroves. As a result of such differing habitats, harvesting strategies depend on the specific local environmental conditions. Commercially abundant populations of lobster on the east coast of Mexico are limited to the states of Quintana Roo and Yucatan. Given the differences mentioned above between the two bodies of water, communities that harvest from the Gulf adopt different strategies than those harvesting from the Caribbean.

Harvesting Strategies

Owing to the complexity of their life cycle and stage dependent dietary needs, lobsters remain beyond the reach of aquaculture (Kittaka and Booth 2000, Phillips and Evans 1997). The dietary necessities of larval lobsters change with enough frequency to thwart attempts to cultivate them. All lobsters on the market, therefore, are caught by either traps or diving.

Divers may harvest lobsters from either artificial habitat, specifically constructed for attracting lobsters, or from natural formations, such as cracks and caves in the ocean substrate. Divers may free-dive in shallow water, using only a mask and fins, or use compressed air, either by SCUBA (self-contained underwater breathing apparatus) or “hookah” (compressor and hose). Regardless of the method employed, lobstering is both labor and technology intensive.

An alternative to diving for lobsters is found in the use of lobster traps, or “pots,” as have been used in Caye Caulker, Belize since at least the 1930s (King 1997,

Sutherland 1986). The use of traps seems to be predicated on a local availability of lobsters in shallow waters. Elsewhere, fishermen report difficulty in finding an abundance of legal size lobsters in such shallow waters. This observation offers support for studies reporting the movement of sub-adult individuals into deeper waters to find appropriate habitat (Childress and Herrnkind 1996).

Where commercial quantities of lobsters do exist in shallow waters, diving is the preferred method of catching them. In some places, artificial habitat has been created to attract the lobsters. With the availability of appropriate habitat in shallow waters, the lobsters remain in the area rather than seeking out habitat in deeper waters. The idea of using artificial habitats, called *casitas cubanas*, (little Cuban houses) came to Mexico from Cuba (hence the name) where they had been in use since the 1940s (Baisre 2000). The casitas are extensively used in Punta Allen, a fishing community in the south of Quintana Roo.

In Punta Allen, the fishermen have partitioned the Bahía de Ascensión, a large, nearly enclosed bay, into private territories. Within the hereditarily owned territories, the owners have constructed hundreds of casitas made of wood and concrete that serve as artificial habitat for the lobsters. The abundance of available habitat may explain the resultant abundance of lobsters that remain in the bay (Childress and Herrnkind 1996). Without the artificial habitat, there are few natural formations in which the lobsters could take refuge. The shallow waters of the bay in which the lobsters are found (2-3 meters deep) allow the fishermen to freedive to the casitas with only mask and fins (Figure 4-4). This eliminates the need for expensive and dangerous compressed air equipment.

Figure 4-4. Freediving to artificial habitat, known as a *casita cubana*, in Punta Allen, Quintana Roo. Lobsters will aggregate beneath the concrete structure. The diver lifts the slab and scoops out any resident lobsters with his net. Photo by A. Lasseter (July 2005).

By utilizing hereditary territories, newcomers are excluded from the fishery. This provides security to the resource, and stability of harvests. Data does not exist to state with certainty that the control of access results in greater harvests for those fishermen engaged in a closed access situation. Other factors, such as currents and the recruitment of lobsters into the Bay must be considered.

Harvesting in Los Flamencos

The natural presence of a commercially abundant population of lobster, then, is likely determined by the availability of suitable habitat. The shallow waters near Los

Flamencos, and along the north coast of the state of Yucatan, do not generally have abundant crevice habitat, forcing lobsters to range to greater depths.

The fishermen of Los Flamencos claim that it is unfeasible for them to use traps for lobsters due to the abundance of algae on the substrate, which would clog the traps. Traps may only be used in deeper waters, one fisherman said, where the larger commercial fleets based out of Progreso go to harvest lobsters. These commercial fleets are setting traps in waters up to 80 meters deep, beyond the shallow shelf of the Campeche Bank (see Figure 4-1).

Fishermen report that the algae that makes trap usage unfeasible is also the reason they are reluctant to use artificial habitats. It should be noted, however, that the construction of casitas would require time and financial investments by fishermen who would not be guaranteed exclusive rights to harvest from them. Hence, the open access situation of the resource is likely a better explanation for not using artificial habitats at this time.

Roughly five years ago, a few of the casitas were placed in shallow waters near the port of Los Flamencos by a group of researchers from Mérida. When I observed the casitas while on a dive shortly before the opening of the lobster season, most of the casitas had lobsters within them. Algae did not appear to pose a problem to accessing lobsters within the casitas. When I returned to shore, numerous fishermen asked me if I saw lobsters in the casitas, and one crew whispered to me that they planned to stop there on the first morning of the open season.

One drawback to the use of the casitas results from hurricane damage. Hurricane Isidore damaged the handful of experimental casitas in Los Flamencos, which

discouraged the fishermen from building more. The concrete A-frame structures rise only inches above the sandy bottom, and differ only slightly from those of Punta Allen. During the hurricane, they either broke apart or were buried in the moving sand. The fishermen of Punta Allen, on the other hand, accept that repairing storm damage to their casitas is a routine part of their workload.

Population of the Resource

Species' population cycles fluctuate just as harvest yields fluctuate. Such changes in a species population are related to the system of interdependencies within the ecosystem as a whole (Arreguín-Sánchez 2000). Spiny lobsters are a part of their total ecosystem, and so are related to the population dynamics of other species. Octopus and red grouper populations off the Yucatan coast are known to fluctuate in multi-year cycles (Arreguín-Sánchez 2000). Both octopus and grouper are known predators of lobsters, so we can hypothesize relationships among the cyclical populations of each of these species. Berger and Butler (2001) found that spiny lobsters actively avoid areas, such as caves, where octopus are known to live. The hard exoskeleton of a lobster is no match for the sharp beak of an octopus. The fishermen of Los Flamencos were also aware of lobsters' fear of octopus. The frequent molting of a lobster's exoskeleton renders it soft and defenseless to carnivorous fish species such as grouper.

These complex relationships point to the difficulty in determining target harvest yields. The population of lobsters is difficult enough to determine. The relationship of lobsters with other species, each with their own population dynamics, further complicates managers' attempts to identify a quantifiable extraction quota. Harvesting at maximum yields represents unsustainable practice, not just for the resource, but also for the human populations that depend on them. When the target population decreases, whether due to

excessive fishing pressure or natural species population cycles, the human populations, which have come to depend on previous yields, tend to overexploit the resource to meet material needs. This pattern, based on open access resources, leads to maladaptive extraction practices when the future exploitation of a resource is unstable and unpredictable. All common property resources are not open access, a point that will be developed further in the following chapters.

CHAPTER 5
PERCEPTIONS OF AN OPEN ACCESS RESOURCE

Introduction

This chapter addresses how the fishermen in Los Flamencos perceive their common property resource in a predominantly open access environment. Based on 37 interviews conducted with members of the original and larger cooperative of Los Flamencos, the data presented here depicts a situation of competition for what are felt to be diminishing returns. Attitudes toward the cooperative appear to revolve around achieving personal gain, rather than the recognition of a common interest. The lack of knowledge that the fishermen seem to have about the marine environment where lobsters are found is further evidence of the recent history of harvesting spiny lobsters and the opportunistic nature of the fishery.

When I arrived in the community of Los Flamencos in May 2005, the fishermen acknowledged that lobstering was a much more lucrative pursuit than other livelihoods in the area. However, they complained that the limits of the resource's abundance had been reached. The fishermen observed that more people entered the fishery each year. Their cooperative had recently divided into two. They expressed feelings of frustration at being tied to a middleman who exercises control over their livelihood, both directly and indirectly.

The status of lobster as a luxury food item in the global market has led to the development of whole communities, like Los Flamencos, based on providing for this demand. Thus, the small-scale lobster fishermen are tied into, and dependent on, a global

system in which they have little power. Although a negative picture is thus painted, the fishermen, through the structure of the cooperative, are beginning to exert efforts at taking control of their resource.

Perceptions of Resource

In order to analyze the perceptions that Los Flamencos' fishermen have of their resource, I include factors such as what the fishermen think about the future, stability, and abundance of their primary resource. I also look at their attitudes about who in the community should have access to the resource, and how they feel about the violation of government regulations. Additionally, this chapter explores the cooperative members' attitudes toward the cooperative itself. Finally, attitudes toward new technologies such as the use of GPS devices, and the knowledge fishermen have of the marine environment are addressed. I then compare the perceptions of the fishermen in their own words, with data from the cooperative as well as with my own observations.

This analysis rests on the assumption that how fishermen perceive their resource will direct how it is exploited. Just as the lack of food security may lead to debt and social inequalities (Romanoff 1992), so may a lack of security, or perception of security, lead to social problems. Unsecured access to a common property resource may lead to cooperation or competition (Berkes 1992). The existence of a community cooperative and thus, recognition of a shared interest, does not equate with cooperation (Fox 1993). Sometimes, Hardin's *Tragedy* is realized as users' self-interest wins out (Hardin 1968).

The fishermen of Los Flamencos produce for the global market and do not exploit their resources in an isolated system. Nevertheless, Los Flamencos is a common property resource community. That is, the community depends on a common property resource for its members' livelihoods. The resource users' perceptions will be applied to the concept

of common property resource management in the next chapter, and then move on to address how such local perceptions fit into and are shaped by factors at the regional and global scale.

Research Methods

During fieldwork, data was collected on three fronts: 37 semi-structured interviews conducted with a sample of 30% of the cooperative members; harvest data from cooperative records; and participant observation among the fishermen and within the cooperative. This analysis is based on a comparison of the three data sets.

The interviews were conducted with the socios of the larger, original cooperative, which served as the host institution for this research. Due to strained relations between the leadership of the two cooperatives, working with both cooperatives was not feasible.

Some of the interviewed cooperative members are not active lobster divers and either work exclusively as non-diving crewmembers or are in training to become divers. One fisherman in the sample owns his own boat but does not dive. This individual is one of the community's most active grouper fishermen, and has been fishing in the community since long before lobstering was introduced.

The interviews were conducted during June 2005, the month preceding the opening of the lobster season on July 1. Interviews were conducted in Spanish and lasted between 30 minutes and two hours in duration.

Lobster harvests were monitored for the individuals in the sample and for the host cooperative as a whole during the entire month of July. The records for the opening month of the preceding year were also obtained, allowing for a comparison of harvests both by interviewed individual and the cooperative as a whole. Data was only available for these two years, owing to the split in the cooperative the year before. The analysis

presented here only represents harvests of the larger host cooperative, thus it does not represent the production of the community as a whole. Statistics for the small cooperative were not available to me, and do not exist for the free fishermen that sell lobsters to local restaurants or the black market buyers.

The third data set collected is based on participant observation. The cooperative has two main facilities: an office where records are managed and members are paid for their harvests, and a waterfront production facility that receives, weighs and stores the members' catches. With the beginning of the lobster season, I visited the docks in the early morning as the fishermen departed, then spent the afternoon on the docks and in the production facility as the fishermen brought in the day's catch. I spent the evenings in the cooperative's office, chatting to the fishermen as they waited in the long line to be paid for the day's harvest. I also joined five different crews on single day lobster trips during the first month of the season.

Data Analysis

Perceptions and Knowledge

The semi-structured interviews were designed to elicit local fishermen's perceptions of their access to the resource, the future abundance of the resource, and who had rights to access the resource. Questions also investigated the fishermen's knowledge of their primary resource, as well as their attitudes toward the cooperative in which they are members. Further questions concerned the attitudes that members had toward the cooperative institution. Although the interview did not focus on eliciting knowledge of the resource and environment, freelists were conducted to gauge a sense of which species were most salient among the fishermen. Together, this data was collected to assess how the fishermen understood their relationship to their primary resource.

Abundance, Stability and the Future

I operationalized "perceptions" to include how the 37 fishermen felt about the abundance, stability of access, and potential for future harvests. Interviewed fishermen were first asked if they thought there were enough lobsters for each fisherman. While 27% felt that there was enough lobster, 49% felt there were not enough lobsters for each fisherman. 5% feel that there are less now, but sometimes there are enough for all fishermen, and 19% said that there are only enough lobsters in the first month of the season (Figure 5-1).

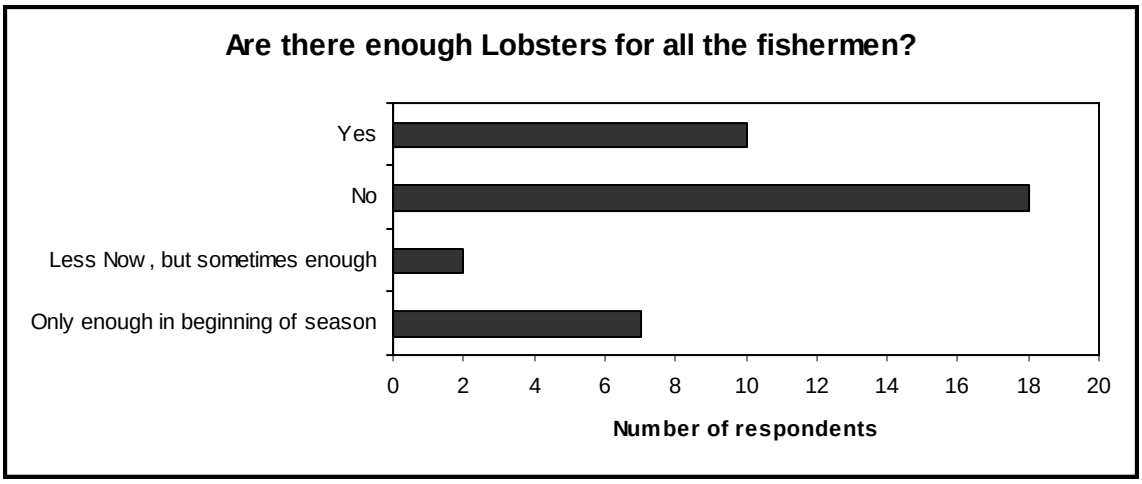

Figure 5-1. Graph depicts responses of cooperative members concerning whether they felt that there were enough lobsters for all fishermen. Most felt that there were not enough lobsters. Seven respondents felt that there were only enough lobsters during the first month of the season.

To address perceptions on the stability of the resource, I asked the fishermen how their catches have changed from five years ago until now. They were asked to report whether their catches have increased or decreased (a lot or a little), or stayed the same, according to a Likert-type scale. A total of 70% reported that their catches have decreased, with 17 fishermen reporting that they had decreased a little, and nine fishermen reporting that catches had decreased a lot. Eight fishermen, or 22%, reported

that their catches have stayed the same over the last five years. One fisherman was not catching lobsters five years ago. Another fisherman claimed his catch had increased a little because there are more lobsters and he is able to get a higher price for them. One other fisherman reported that his catch had increased a lot in the last five years, explaining that he now goes to deeper waters, farther from shore, where he is able to find more lobsters (Figure 5-2).

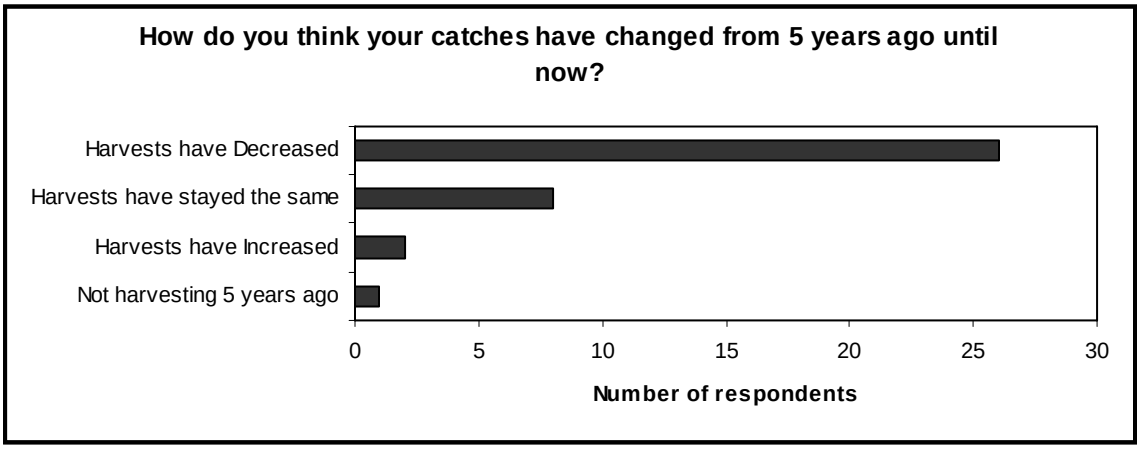

Figure 5-2. Graph depicts how cooperative members feel that their harvests have changed in the last five years. Most of the interviewed fishermen reported that their lobster harvests have decreased. 41% of those fishermen, who reported that their harvests have decreased, cited an increase in the number of boats or other fishermen as the cause.

Going out to deeper waters involves an increase in risk. Given the divers' behaviors, there is an increased risk of decompression sickness. Also, as the fishermen do not carry radios with which to call for help, and natural navigational clues seem to be used less as GPS is used more, the fishermen are in greater danger of losing their way back to shore in the event of a sudden storm or mechanical failure. In the week before I arrived to begin fieldwork, mechanical failure almost cost the lives of two fishermen. They were rescued after spending a night adrift at sea.

Of the fishermen who reported decreased catches over the last five years, the most commonly cited reason (41%) for the change was due to an increase in the number of fishermen or boats. Other reasons reported included that the lobsters were overexploited and that the lobsters were not allowed to grow (16%). These explanations may be interpreted as an effect caused by an increase in the population of fishermen. Finally, one fisherman blamed the large lobster fleets that are based out of Progreso, to the west. These lobster fleets use traps in the deep waters off the Yucatan coast, beyond the dive zone of Los Flamencos' fishermen.

I also asked the fishermen what they thought fishing for lobster would be like in five years. In response to the open-ended question, 86% replied that there would be less lobster available in five years, while two fishermen believed that there would not be a change in the amount of lobster. No fisherman reported believing that there would be more lobster in five years, although two fishermen responded that new technologies will bring unspecified changes in the next five years. One respondent could not predict what diving for lobster would be like in five years (Figure 5-3).

In summary, over half of those interviewed felt that there are not enough lobsters for all the fishermen. Enough, translated as *suficiente*, was left open to the fisherman's interpretation, thus reflecting his perception of the fishery. Almost three-quarters of those interviewed reported that their harvests have decreased in the last five years. Reasons for the decrease centered on an increase in the population of fishermen. Finally, when asked about the future of their resource, 86% felt that their harvests will be smaller than now.

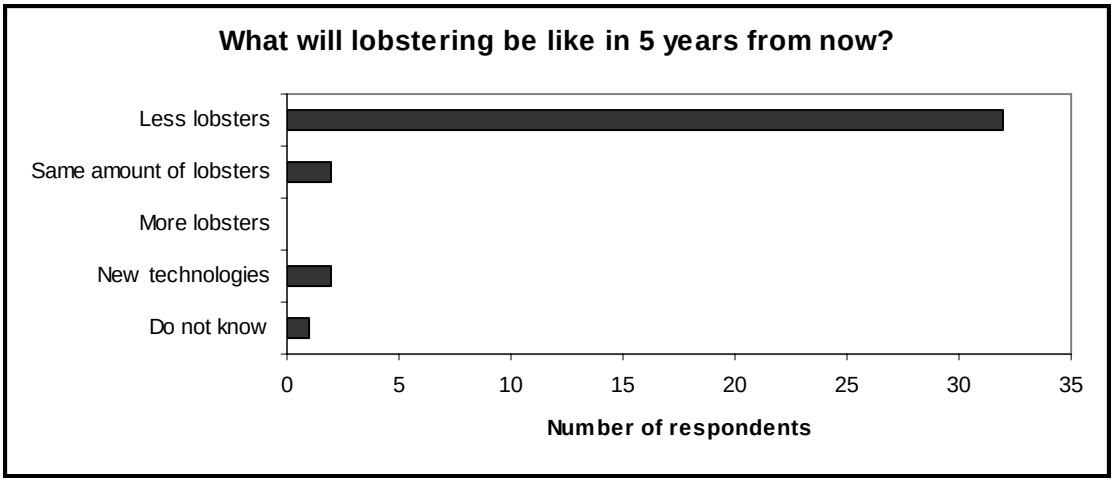

Figure 5-3. Graph shows what cooperative members think about the future abundance of lobsters in 5 years. Most reported that they thought there would be less lobsters available. No fisherman reported believing that there would be more lobsters in five years, although two fishermen thought that new technologies might become available that could change the fishery in unpredictable ways.

Rights to Access

Rights of access to common property resources may take different forms. Prior to the interviews, I was aware of the cooperative's legal possession of government permits, including the existence of far more members than permits. I was therefore interested in who the fishermen considered to have rights of access to harvest lobster.

Of the fishermen interviewed, 76% said that harvesting lobsters should be the sole right of cooperative members, which would limit lobster fishermen and crews to a maximum of 225 individuals in the community, between the two cooperatives. Many of those interviewed (24%) felt that non-members should be able to work as non-diving crew members, or that non-members should only be permitted to dive as long as one crew member was a cooperative member (Table 5-1). Some fishermen expressed sympathy that non-members need to earn a living, too, and the member would be hesitant to punish non-members for engaging in the industry. Fishermen noted that Los Flamencos is a small community where everyone knows each other.

Perhaps this tolerance of non-members, and difficulty in regulating access, stems from the fact that very few of the cooperative members themselves actually have permits for harvesting lobsters. The cooperative has allowed membership to increase far beyond the number of permits granted in the 20-year concession. Interviewed members professed reluctance to punish local black market buyers and restaurants, both because of community connections as well as admittance of involvement.

Table 5-1. Most interviewed fishermen felt that membership in the cooperative should designate who may harvest lobsters, even though the cooperative has far more members than permits for capturing lobsters. No respondents stated that harvesting lobster should be open to anyone, although many felt that non-members could harvest lobsters if they worked with a member.

Who has Rights to the Harvest of Lobsters?

Only members may harvest lobster	Non-members may harvest lobster when working with a member
76%	24%

The cooperative members feel that, as members, they have rights to harvest lobsters. I then asked the sampled fishermen in an open-ended question about whose responsibility they thought it was to enforce the rules. Many fishermen mentioned more than one agent as having responsibility. The cooperative and its officials were mentioned by 73% of the fishermen as having responsibility for enforcing the rules. Some 65% named some authority figure outside the community, including two state level organizations (CONAPESCA and SEGARPA) that are involved with the country's natural resources. The Port Captain, a position appointed at the state level, the governor, and unspecified "authorities" also received mentions. Of the fishermen, 32% mentioned their own responsibility for the rules, noting that the fishermen (*los pescadores*) or everyone (*de todos*) bore responsibility for enforcing the rules (Table 5-2).

Generally, management was considered the responsibility of those one-scale up. That is, the fishermen regard the enforcement of the rules and management of the resource on which they depend to be the responsibility of those at the state level. Responsibility for the resource is not regarded as belonging within, and *to*, the community.

Table 5-2. Respondents gave many different answers as to who they felt bore responsibility for enforcing the rules governing lobster harvests. Many respondents named numerous agents of responsibility.

Whose responsibility is it to enforce the lobster regulations?	**% of Respondents**
Cooperative; Cooperative officers	73%
Authorities outside of the community; Government agencies	65%
Port Captain; Local authorities	19%
Members and the Fishermen themselves; “Everyone”	32%

Finally, many fishermen distinguished between harvesting lobster and fish. These individuals emphasized that it was acceptable for anyone to fish; only lobsters should be restricted to members and recalls the title of this thesis. Again, the cooperative has permits for 40 fishermen but has many more members. Therefore, the cooperative is actually acting outside of the law. There is no enforcement, and the fishermen seem to feel that as long as long as they are members of the cooperative, they have the legal right to harvest lobsters. Under the specifications of the federal regulations, however, they do not.

Breaking the Rules: Why fishermen take undersize lobsters

In an open-ended question, the fishermen were also asked what they thought was the biggest problem in the fishery. Only five fishermen specifically mentioned that the harvesting of undersized (tails of less than 13.5 cm) lobsters was the biggest problem. One fisherman noted that the restaurants and resorts that are always willing to buy small lobsters cause the problem. Other major problems mentioned included decompression

sickness (six mentions), too many fishermen, and expensive fuel. Nine fishermen responded that there were no problems.

I then asked, also in the form of an open-ended question, what the fisherman would like to change about the fishery. Nine fishermen mentioned that the closed season (*veda*) should be longer, because only small lobsters were left at the end of the season. Two fishermen wanted more enforcement to protect undersize lobsters. Seven mentioned discontinuing the use of GPS devices. Six others said that they would like to use either traps or "lobster houses" on private marine territories.

The fishermen raised a variety of issues in the above questions. While many fishermen alluded to the issue of taking undersized lobsters, I was already aware of the perception of this problem prior to beginning the interviews. The cooperative's officials had each told me that the harvesting of undersized lobsters was a huge problem. The enforcement official (*presidente de vigilancia*) complained bitterly of his inability to do his job. Both the practice of taking undersized lobsters and harvesting out of season were widespread, he said.

Therefore, I asked the fishermen why people harvest undersized lobsters. The most frequent response (65%) was that fishermen harvested lobsters to be sold. Local restaurants and the local black market buyers will buy lobster year-round from anyone, but they pay less than half what the cooperative pays for lobster. Thus, the fishery is principally viewed opportunistically by fishermen who will take restricted lobsters, if they have the opportunity to profit from doing so.

Other reasons given for why fishermen harvest small lobsters include that the fishermen do not think about the future or that they have no conscience. I was also told

that undersized lobsters were harvested to eat at home, or were taken out of necessity in order to cover fuel expenses. This becomes increasingly common, many fishermen said, toward the end of the season when legal size lobsters become scarce. Only one fisherman told me that small lobsters were harvested because the diver was unable to determine if the individual was of legal size while underwater.

Two fishermen reported that if they did not take the small lobsters, the next fisherman would. This sentiment invokes Hardin's "Tragedy of the Commons" (1968) most clearly. The frank answers of those two fishermen exemplify the economic rationality that seems to guide the actions of many more fishermen. In a fishery that has been set up as a commercial venture where fishermen were indoctrinated into the export market with this resource (one not exploited before), such problems could have been anticipated.

Capital Investment for Diving

Diving for lobsters is capital intensive. Beyond the boat and motor that are used for all commercial fishing in Los Flamencos, lobstering requires an on-board air compressor, hose, regulator, mask and fins. Some divers also use wetsuits for thermal protection. Additional tools particular to harvesting lobster include a glove, metal rods with hooks (gancho), and a speargun.

The total investment in capital to begin lobstering is extremely high. This means that men will always enter the fishery as a manguerero, a position that does not require any equipment. A diver is responsible for his own mask, fins, and wetsuit, if he chooses to use one. If bought from the regional distributor in Mérida, a new mask and fins will cost roughly $57US, which is feasible after working as a manguerero. Wetsuits can cost

hundreds of dollars, but used ones are often available for sale from one of the men returning from work in the Cancun area resorts for roughly $50US.

First time boat owners must begin by buying a used boat (*lancha*) and motor. The cost of a new lancha ($4,000US) and 60 hp Yamaha motor ($6,200US) are out of reach for aspiring captains. Prices for used lanchas may be half the price of new ones. Each lancha is also equipped with a large insulated ice box (*nevera*) that costs about $550US when new. A new air compressor will cost $2,900US if bought in Mérida. Because these are so expensive, all captains become well acquainted with repairing them and I saw very few relatively new air compressors. Most appeared disturbingly old and rusty, despite the yearly external paint job each is given. A new regulator for breathing, attached hose (manguera) and weight belt cost about $200US. Finally, the speargun, which deploys the spear with a thick rubber band, spears, hook and glove cost roughly $110US. All together, if a captain was to purchase the new equipment above to start his own operation, would require almost $14,000US.

No fisherman is able to obtain the credit to begin with all new equipment. Used equipment is traded and sold among all the fishermen in the community. As crews change members, additional equipment often becomes available. Used equipment may cost from one half to two-thirds the price of new equipment, sharply reducing the initial investment. There is also a small shop in town that sells parts for the compressors and motors, as well as some basic dive gear. Their prices are just as high as in Mérida, and they often have only low quality dive equipment.

New Technology: GPS

Until recently, lobster boats used natural navigational clues, such as triangulation with onshore landmarks, to return to previously successful lobster caves. Now, nearly

every boat uses a GPS unit to return, often daily, to locations where divers found lobsters. Captains record the coordinates of successful sites in closely guarded notebooks. Such secrecy has been identified as a type of adaptive strategy employed by fishermen where competition for resources exists (Acheson 1981). Many boats now move from one recorded coordinate to another, achieving high lobster harvests. Less time is thus devoted to “trawling” a diver along the bottom behind the boat, searching for rocky structures on the nearly uniform algae covered substrate.

Fishermen report that their catches are decreasing, even as technological investments (such as GPS units) are increasing. Fishermen are thus increasing their investment despite feeling that returns are decreasing overall. The new technology generates an initial increase in harvests for crews that invest in a GPS unit. The technology offers clear advantages by reducing the amount of time and fuel spent searching the bottom for the structures in which lobsters are found. Nevertheless, such technologies, coupled with an increase in the population of resource users, increases extraction pressure on the population of the resource.

Fishermen are aware that their individual catches initially increase with the use of new technology such as GPS. They also recognize that eventually the use of such technology by all results in more competition for the same amount of lobsters. Without secure rights to the future of the resource, we can expect that overexploitation and maladaptive practices will occur. When some fishermen begin to use a new technology and are able to increase their harvests, other fishermen inevitably experience pressure to adopt the new technology as well. In an open access resource situation, as one fisherman makes the *rational* decision to maximize his yield, other fishermen follow. Each adds

more conceptual sheep to the common pasture. Thus, Hardin's model "Tragedy of the Commons" (1968) appears applicable to Los Flamencos' lobster fishermen.

A highly respected and successful fisherman in Los Flamencos told me that while he uses a GPS device, its use has destroyed everything ("*El loram ha destruido todo.*"). When I asked him what he would change about lobstering, he told me that the fishermen should stop using GPS devices. He acknowledged, however, that few fishermen now know how to use natural navigational clues to find lobsters. Such a loss of knowledge, or lack of acquisition of knowledge by those entering the fishery, is usually a one-way street that leads to further market integration and dependence (Heyman 2005).

Local Knowledge

Knowledge of the marine environment is representative of how fishermen perceive and understand their resources. Much has been written on the local marine knowledge among small-scale fishing communities (Cordell 1974). This knowledge arises out of experience with the environment in which the resource is harvested. The relationship between knowledge and successful resource management has also been recognized (Berkes et al. 2000). Such knowledge, however, is only developed over time and is based on experience.

The relative newcomer status of many of Los Flamencos' fishermen and the relatively short history of lobster harvests likely correlate with the lack of a detailed taxonomy of marine species. In other studies of small-scale rural fishing communities, detailed taxonomies exist as part of the local knowledge of people's resources (Pollnac 1981, Morrill 1967). In order to assess the presence of a local taxonomy, two methods were employed.

First, fish commonly found in the vicinity of the rocky structures where lobsters are captured were photographed underwater. Upon return to the cooperative's office, the images were displayed on a laptop computer. As fishermen arrived to be paid for the day's harvests, they were asked, in groups and singly, to identify the fish in the photos. A random sample was not used in the selection of participants.

Various fish representing several different families of the scientific system of classification were identified as either 'reef fish' (*pez arrecife*) or 'yellow fish' (*pez amarillo*). Only one non-commercial species was named: *chunkai* (family: Pomacanthidae; common name: angelfish). Two distinct species from this family were both identified as 'chunkai' by all fishermen.

Prior to the start of the lobster season, I joined one crew for a day of grouper fishing. The capture of grouper involves the use of a line, 300 feet long, baited with a piece of *pico rojo* (ballyhoo) at every three feet. As the fishermen pull in the line, numerous undesirable fish were thrown back. The fishermen had a name for every one of these "trash" fish. Therefore, knowledge does exist among fishermen for species of non-commercial importance, but fish that are regularly encountered while diving for lobsters are not named by the divers.

The second method employed for investigating local knowledge was freelisting. I asked fifteen of the interviewed fishermen to list all the names of fish they could think of. As was predicted, commercial species dominated the list. The top three most frequently named fish were three species of grouper. The first two were named by fourteen of the respondents and the third was named by thirteen respondents. Of the 24 fish that were named by five or more fishermen, five of these were species of grouper (Table 5-3).

Grouper definitely proved to be the most salient fish in the repertoire of the participating fishermen.

Table 5-3. List of the 24 fish species named by five or more fishermen in a freelist exercise. Five of the 24 fish are species of grouper (**bold**), which speaks to the importance of this species to the fishermen. Approximate English common names are given, but fish were not present for identification at time of exercise. The last column shows the values in pesos that the cooperative pays to fishermen as of May 18, 2005. Multiple prices signifies different values according to the weight of an individual fish. Heavy fish are worth more. Only one of the most frequently named fish has no commercial value.

Times Mentioned	Fish Named by Respondent	Common English Name	Price in Pesos per kg
14	**MERO**	Grouper (red)	29.55/17.85/12.90
14	**CABRILLA**	Grouper (spotted)	(same as Mero)
13	**ABADEJO**	Grouper	(same as Mero)
12	BOQUINETE	Hogfish	16.95/14.25
12	PICUDA	Barracuda	11.55/8.85
11	CORVINA	Sea Bass	14.25/7.50
11	PARGO	Snapper	16.95
11	MOJARRA	Porgy	12.90-3.00 (many species)
11	CHACCHI	Grunt	4.35
9	ROBALO	Snook	40.35/29.55/14.25
9	CANANE	Yellow-tail snapper	20.55/17.85
8	**NEGRILLO**	Grouper (black)	(same as Mero)
7	RUBIA	Red-tail snapper	17.85/12.45
7	CHUNKAI	Angelfish	(Not harvested)
7	SARGO	Sheepshead or Sea Bream	5.25/3.00
6	CARITO	King Mackerel	12.90/12.00
6	TIBURON	Shark	14.25 (5.25/kg whole)
6	SIERRA	Mackerel	12.45
5	CORONADO	Amber Jack	10.65
5	ESMEDREGAL	Cobia	17.85/4.80
5	**CHERNA**	Grouper (Goliath)	26.85
5	PAMPANO	Pompano	23.25/16.05
5	COJINUDA	Jack or Blue Runner	.75
5	PEZ LORO	Parrotfish	7.05

The fourth most frequently named fish, with 12 mentions, was the hogfish. This species, not caught on lines, is the most commonly speared fish. Most fishermen claim a

preference for eating hogfish over grouper, citing the delicate texture of the meat. Barracuda tied hogfish with 12 mentions, although it was always named on the list after hogfish. Thus, I conclude that hogfish is a more important fish to the respondents than is barracuda.

It is also worth noting that the non-commercial species named were primarily the 'trash' species caught on the long-lines; that is, the fish that are caught while fishing for grouper but are thrown back. Interestingly, 'yellow fish' (*pez amarillo*) was also listed by two fishermen, although this does not seem to refer to a specific fish, but rather, to any of several fish from multiple families. This identification of fish as either 'yellow fish' or 'reef fish' follows the responses mentioned above, regarding the fishermen that viewed photographs.

I was surprised, however, that only one fisherman named pico rojo, the species used for bait when fishing for grouper with the longlines.

Although I did not systematically test the cultural knowledge regarding mollusks, numerous species of such edible snails were proudly named for me at social gatherings. A local taxonomy for the various species of conch and snails (*caracoles*) seemed to have high cultural consensus. Federal law prohibits the capture of these species, yet they are avidly regarded as local delicacies. Occasionally, fishermen would seek me out to show me some new species of caracol that they had harvested that day, wanting to teach me its name. Women, as well, were always able to recognize the different species of mollusks.

I began to look at fish knowledge when I realized that the fishermen seemed to know less about the species they encountered when diving than when line fishing. My brief investigation of knowledge concerning marine species supports the idea that a

greater knowledge of the marine environment exists for those target species that have a longer history of use by community members. The relative lack of knowledge in the lobster fishery is likely due to its recent adoption and focus on a high value, luxury commodity designated for export. Lack of knowledge is evidenced in the naming of fewer neighboring species, as well as the reliance on technology such as GPS instead of natural navigation.

The lobster fishery differs from the grouper and octopus fishery in two main ways. The lobster fishery has a shorter history, which likely correlates with the lack of named fish that are frequently encountered. Also, the lobster fishery was initiated from outside of the community as a form of regional economic development; the fishery did not arise out of a local-based initiative. Consequences of this may be evidenced in the opportunistic nature of the fishery where outsiders have been attracted to a lucrative and easily entered fishery.

Perceptions of the Cooperative

The fishermen's cooperative is an organization initiated by the state concurrent with the introduction of harvesting lobsters for export. Therefore, the cooperative members' perceptions and attitudes toward the cooperative are important in understanding their relationship with the fishery. Again, data was collected among the members of the original cooperative and not from the smaller cooperative.

I first asked, in an open-ended question, what the fishermen thought the benefits were of being a member of the cooperative. Some informants mentioned multiple benefits and I indexed the responses into categories. The most frequently cited benefit, with 24 mentions, was social security that members are entitled to from the state. Loans for equipment and repairs (16 mentions) and legal status for harvesting lobster (16

mentions) were the next most frequently noted benefits. Six fishermen specifically noted that the cooperative helps them if they get sick, which is in turn related to social security. Four members noted support (*apoyo*) as a benefit, although they noted support differently: one for the fishermen, two from the cooperative, and one for equipment. Two respondents noted that the cooperative gets the fishermen the price for lobster, and two others mentioned the end of the year bonus (*remanante*), when they are reimbursed approximately $5 per kilogram of lobster they have caught during the season. Finally, two respondents responded that there were no benefits to being a member of the cooperative (Table 5-4).

Based on the responses above, the fishermen feel that the cooperative benefits them by providing various forms of economic assistance. I also the fishermen what they thought was the *function* of the cooperative. The majority of responses repeated the benefits mentioned above, such as providing social security, helping members economically, and granting legal status for the harvest of lobsters. There were, however, 11 responses that identified the function of the cooperative as a group of people that work together. Additionally, two respondents mentioned species management and protection as functions of the cooperative.

Table 5-4. Summary of the different benefits cited for being a member of the fishermen's cooperative. State subsidized social security was the most frequently mentioned benefit of cooperative membership.

Benefits	**Number of Mentions by Respondents**
Social Security	24
Loans for equipment, repairs	16
Legal right to lobster harvests	16
Help when sick	6
"Apoyo" (help), generally	4
Negotiate price for lobster	2
End of year refund/bonus	2
No benefits	2

Summary

Data from the interviews display an overall pessimistic attitude toward the future and stability of the fishery. Fishermen feel that their catches are decreasing over time, and that there will not be enough lobster for all the fishermen in the future. They identify problems such as the harvest of undersized lobsters, yet many admit to engaging in the practice. They feel pressure to adopt the use of technology such as GPS even as its use is recognized as destructive for the fishery. Such technology even seems to overpower the benefits of environmental knowledge of their resource.

The fact that members seem to emphasize their own interests does not negate the possibility for cooperative action (Fox 1993). What is needed, however, is a recognition of a shared interest in the resource. Now, the fishermen seem to view lobsters purely as an economic opportunity, rather than as a part of their community and their future livelihoods. This likely has to do with the "frontier" like atmosphere of the fishery, which was "discovered" as a resource some 35 years ago.

Cooperative's Harvest Data

Although most fishermen expressed pessimism in regards to their harvests before the season began, the first few weeks of the season proved successful for nearly all members. During the first month of the season, 2005, 59% of those sampled caught more than their total for the opening month of July 2004. Five individuals in the sample caught less than they did during the opening season of the year before. However, three of these individuals are elected members of the cooperative and were not fishing daily this season. One of the fishermen who caught more during 2005 served as a cooperative official the previous year, and was therefore not fishing full time in 2004. Finally, six individuals caught roughly the same weight as last year.

In the above figures, an individual was determined to have caught more or less only if it was in excess of 5 kg. If the totals of each month were within 5 kg of each other, they were designated as having stayed the same. The average difference among the sampled fishermen between the first months of lobster season 2004 and 2005 was an increase in 23.4 kilograms. Therefore, despite the fishermen's perceptions of decreasing harvests prior to the beginning of the season, catches during the first month of the season actually increased by about $400-$529US[4] per crew compared with the previous year.

The total harvest of the cooperative for the month of July 2004 was 8,235 kg; for the same month in 2005, the total reached 12,949 kg, representing an increase of 157%. It should be noted that the cooperative buys lobster from any independent fisherman, so the total yield does not reflect the harvests of members only.

Overall, individual cooperative members realized an increase in harvests for the first month of the season compared to last year despite perceptions of decreasing yields. The first month of the season represents the bulk of the year's harvest. Subsequent months see a steady fall in harvest weights. Catches continue to decline until the end of the season when only undersized lobsters are harvested.

Furthermore, while yields increased compared to the beginning of the previous year, more fishermen had continued to enter the fishery. By including only two seasons, these statistics do not speak to the health of the fishery as a whole, nor to the stability of the resource. Harvest totals for the cooperative were unavailable for the years preceding 2004, due to the conflict surrounding the division of the cooperative. Statistics for all the

[4] The difference in price represents the difference in what the cooperative pays a crew for their catch. The fishermen initially receive 180 pesos per kilogram of lobster tails, representing an average increase of $400 per crew, which will become $529 after the crew receives their end of the year reimbursement of 50 pesos per kilogram.

cooperatives of the entire Yucatan coast for the years 1976-1995 are presented in Figure 5-4. While the data shows an overall increase in the total weight of harvested lobster, care should be taken when looking at such statistics. The number of fishermen, and thus pressure on the resource, continues to increase. Therefore, while overall harvests

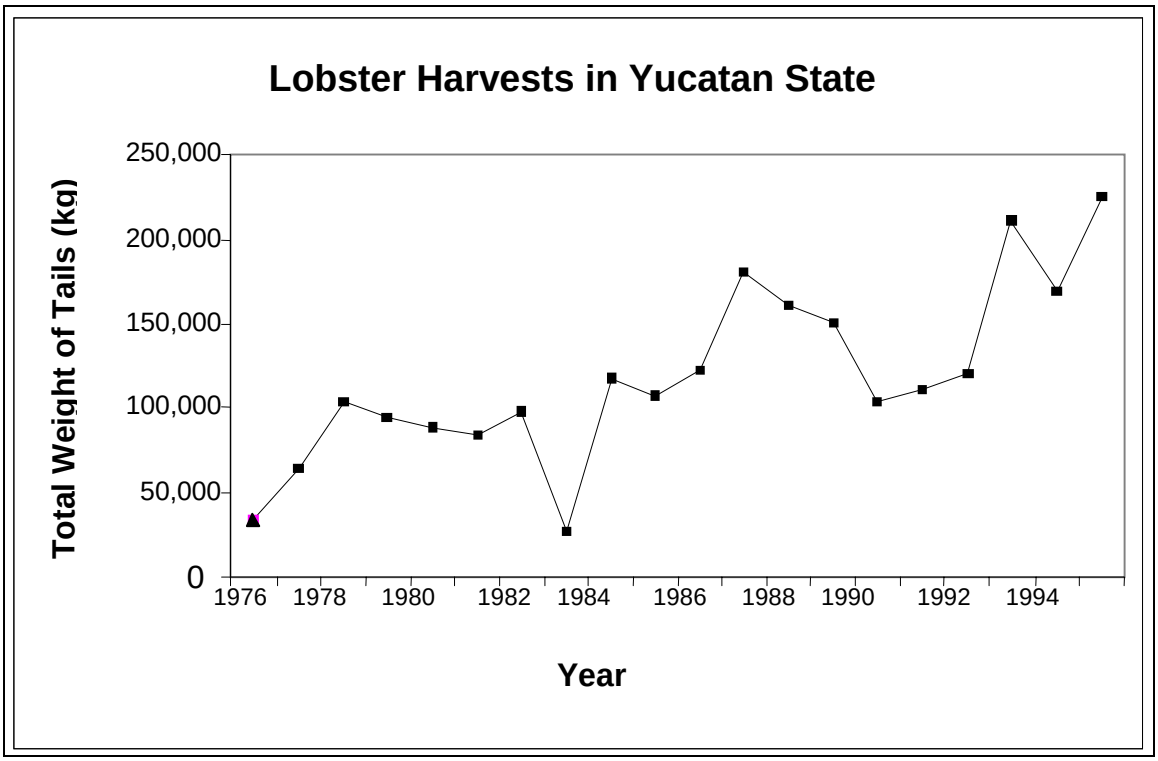

Figure 5-4. History of total spiny lobster harvests by weight in tails for the state of Yucatan, Mexico. Includes all reported harvests from all lobster cooperatives along the entire Gulf coast of the state of Yucatan (Harvest data from FAO 2000). Data would not include illegal harvests of undersize lobsters, nor any sales to black market buyers.

have increased over time, the average yield per fisherman, socios and libres, is unknown. Unrestricted extraction pressure has as yet unknown consequences on the population cycles of lobster, which are known to fluctuate (see chapter 4 on lobster ecology).

Etic analysis: Contradictions and obstacles to cooperation

The final data set to be included in this analysis is based on my observations, informal conversations with fishermen, and participation on lobster trips. I use these observations to interpret the descriptive statistics from the interview data above.

A set of contradictions exists within the lobster fishery, which all local actors seem aware of. Despite the fact that the harvest of small lobsters is reported as the primary problem in the fishery, I saw all crews in possession of small lobsters. The lobsters are first measured when the boat returns to the dock. The crew separates the catch to be delivered to the production facility. Undersized lobsters remain behind on the boat, while legal-sized lobsters are delivered to the production facility to be weighed. If a fisherman thinks a tail is almost of legal size, he will stretch it out flat on a hard surface, and then attempt to press down on the shell, cracking it in an attempt to elongate it slightly to a legal length. I observed the cooperative officials in the production facility attempting to lengthen tails in this way, too, thereby allowing more of the members' harvests to pass inspection.

Those individuals who weigh the harvests in the production facility are also responsible for measuring the tails. Even though the crew should have measured the lobsters prior to delivery, numerous undersized specimens are found at this stage. Some of the staff return the lobsters to the respective fisherman. Others discretely ask to keep the undersized tails and I never observed a fisherman refusing the request.

Whether or not small lobsters that escape harvest actually remain in the region during the closed season remains unknown. Nevertheless, the fishermen regard these small lobsters as part of the following season's recruitment of legal size lobsters. Thus, I was told, the harvest of undersized lobsters brings a low price now, and further lowers the

potential future harvests for all. This also seems to invoke the tragedy, where the benefits realized by one self-interested actor results in a cost shared by all in the community.

Once harvested, undersized lobsters cannot be sold for export. The sale of undersized lobsters on the local black market brings less than half the price of legal size lobsters. The final consumer, however, does not benefit from this devaluation. Lobster is priced as a luxury food item throughout the peninsula.

A second contradiction is that all cooperative members must sell their lobsters to the cooperative. Failure to do so results in a series of penalties, ultimately resulting in expulsion from the cooperative. However, from time to time, the elected officer responsible for enforcement of the cooperative's rules allows the members to sell their catches elsewhere. This occurred during fieldwork, when the regional distributor lowered the price he paid for grouper. In protest, the enforcement agent granted permission to the members to sell their harvests elsewhere.

Another time, late one night, I happened to observe the elected officers of the cooperative selling a truckload of lobster tails to a Cancun exporter. The visiting exporter arrived with his truck, offering a higher price than that paid by the contracted exporter in Mérida. Therefore, the cooperative sets rules for the members but those rules are flexible based on economic considerations. It was unclear where the additional profit, from selling to the Cancun exporter, would go.

Yet another contradiction lies in the licenses required for the capture of all marine species. While licenses are required to catch all species, the details of such regulations are far from transparent. One young fisherman assured me that all fishermen had to have licenses for the species they harvested. He proudly showed his to me: a laminated card

that stated he had completed a two-day safety course for driving the lanchas used by the fishermen. His license had nothing to do with the legal harvesting of any marine species. Other fishermen reported having a license to fish a particular species, and felt that the license they possessed would suffice for any species they then chose to catch. I was also informed that it was rare for the authorities to enforce fishing licenses. I was told that on the rare occasion that a license is checked, the only imposed penalty was to be sent back to shore.

Contradictions, then, are found in the interpretation by members and the cooperative of the rights to harvest lobsters. I found that the same behaviors fishermen regarded as maladaptive for the fishery as a whole, were justified on an individual basis. Legal rights to the resource were another area open to interpretation. As long as the fishermen feel that others will engage in maladaptive practices, individual fishermen feel pressure to engage in such behaviors as well. Insecure access to the fishery and the anticipation of dismal future returns, despite concrete harvest data substantiating successful catches, have led to an atmosphere dominated by self-interest rather than cooperation. A lack of knowledge about the particular fishery that is directly geared to the global market is further evidence of a frontier environment. Here, fishermen seem to target the resource for immediate financial opportunity as opposed to a long-term communal involvement in lobstering as a livelihood.

The next chapter turns to look at how lobsters have been constructed as a value-added commodity on the global market, and what this means for local extraction. While the tragedy is one possible outcome of such competition for a high-value, limited resource, it is not inevitable. As the perception of a resource's scarcity becomes apparent

to a group of users, rights of access guided by communal property rights may evolve (Berkes 1992). Such a change, in fact, is occurring in the community.

CHAPTER 6
MANAGEMENT

This chapter connects the ethnographic data presented previously with broader conceptual issues faced by natural resource communities in producing for the global market. The ethnography of lobster diving was followed by an overview of ecology of the spiny lobster and their habitat. The results of interviews conducted with the members of the fishing cooperative were then presented, with attention focused on how the fishermen perceived their access to and the future of spiny lobsters as a natural resource.

In the discussion that follows, I define spiny lobster, the primary resource of the fishermen of Los Flamencos, as a luxury export commodity. I will first dissect the term *luxury export commodity* before turning to look at how the construction of a resource into a luxury export commodity relates to resource users' perceptions of the resource as a commodity. I will then return to the concept of common property resources and resource management. I will identify how Los Flamencos' spiny lobster resource fits into the various systems of access for common property resources. The regulation of access to CPRs is termed *management*. I argue, however, that it is only through consideration of the holistic local context that management be designed and implemented. I conclude, then, that successful resource management is a product of the total system, and must factor in the vested interests of all actors and users, at multiple scales. Successful resource management, then, comes from the cooperation and participation among a group of users.

Luxury Export Commodities

Nontraditional Export Commodities

Agricultural reforms throughout Mexico's food production sector coincided with the founding of the spiny lobster fishery in Los Flamencos (Fox 1993). Such reforms followed a trend that was occurring in other parts of the world as well: the promotion of *nontraditional* exports.

Nontraditional exports usually refer to agricultural and aquacultural products. Nevertheless, the following discussion of nontraditional products is applicable to any commodity, including natural resources. Nontraditional exports refer principally to a commodity, defined as anything produced for sale in a market (Polanyi 2005). *Production* of a commodity may involve farming or the extraction of a natural resource.

Coffee, cotton, sugar, bananas, and beef are recognized as the five 'traditional' export crops of Central America based on their relatively long history of export production to the U.S. and western European countries (Conroy et al. 1996, Tucker 1992). 'Nontraditionals' are thus classified in relation to traditional exports due to their status as the newcomers (Tucker 1992). The introduction of 'nontraditional' exports was presented as a way for rural populations to diversify their exports at a time of regional economic crisis (Conroy et al. 1996). These new exports tend to have a higher value on the global market, but are usually more perishable and dependent on prompt transport.

The definition of a 'nontraditional' export is problematic. Barham et al. (1992) cite three different types of commodities, each entailing a different relationship between product and market as 'nontraditional': a commodity that has not previously been produced in a country before; a product previously produced for domestic consumption which is now exported; and the creation of a new market for a traditionally produced

commodity. The examples given by Barham et al., such as the production of snow peas in Guatemala, have one thing in common not explicitly stated: rather than emphasizing the production of food *staples* for the global market, *luxury* items, that is, high priced commodities, are being produced, thereby providing elite consumers with more choices (Thrupp 1995). While Barham et al. (1992) depict the multitude of commodities that are encompassed under the term 'nontraditional,' they fail to fully explore some of the implied connotations that are the focus of this chapter.

'Nontraditional' export commodities have been heavily promoted in many countries targeted by structural adjustment policies in the last two decades (Thrupp 1995, Barham et al. 1992, Callejas Romero 1991). For example, under the programs promoting 'nontraditional' export crops, countries were required to accept currency devaluation. This practice, aimed at attracting international investors, effectively raises the costs of the new agricultural inputs that rural farmers come to depend on (Conroy et al. 1996). The argument presented for the diversification into 'nontraditional' crops lies in the possibilities for rural people to profit off the high cost that international consumers are willing to pay for certain goods (Stonich and Bort 1997). However, the reality has been far different: unequal power structures maintain the previous economic hierarchy that exists, and rural producers are often unable to match the distorted expectations that a global elite market places on product quality (Little and Dolan 2005). Other factors, such as the importance of timing a harvest to meet transportation structures, runs counter to local rhythms of production and often interfere with existing subsistence production.

In Norton et al.'s (1978) explanation of 'traditional' versus 'nontraditional' exports, the difference lies in the *dynamic* growth rates of the 'nontraditional' crops of the

exporting countries. Growth rates are defined here in relation to their increases in the percentage of total exports from the country, with no mention of the social or ecological changes that occurred at the local level. The focus on national statistics of economic growth at the expense of consideration for the social and ecological impacts is typical of such analyses (Stonich and Bort 1997). Export success is assessed at the national level, neglecting consideration of economic changes and impacts at the local producer's level.

Another difference between 'traditional' and 'nontraditional' exports lies in the colonial history of 'traditional' exports. The concept of 'traditional,' in reference to coffee, cotton, sugar, bananas, and beef represents 'traditional' forms of exploiting local labor under colonial rule. 'Traditional' does *not* reflect agricultural practices in place prior to colonial conquest. In fact, rural people's labor for 'traditional' export plantations resulted in the loss of communal lands to an elite minority where production was under the control of national or international structures (Stonich 1993).

Wheat and rice are 'traditional' exports outside of Latin America where they fed growing industrial populations (Wolf 1997). Such 'traditional' staple crops both revolutionized agriculture at the local level of production, while at the same time built global networks of food crop commodities. Again, 'traditional' is in relation to the contemporary diversification of export crops. 'Traditional' refers only to export crops that have been in global trade since colonialism.

One contradiction in Barham et al.'s (1992) definition of 'nontraditional' above, is that the same crop can be classified as 'traditional' or 'nontraditional,' depending on its place and status in the market. Bananas are usually classified as a 'traditional' crop of Latin America (Callejas Romero 1991, Norton et al. 1978), where they have been

produced on large plantations in Latin America by primarily foreign companies (Wolf 1997), principally for export since the 19th century (Palmer 1932). However, under Barham et al's definition, bananas become a 'nontraditional' export when a new market is created for them in a previously unexploited country such as the Soviet Union (1992). What is important in the shift to 'nontraditional' status, here, is the creation of a new market. Again, the emphasis is on providing consumers with a new product, thereby, creating new consumers.

'Nontraditionals' are presented as an economic development strategy to aid small-scale, rural producers. In reality, exporters favor large-scale over small-scale producers (Hallam et al. 2004). This preference reinforces unequal power structures already in place at the local level (Stonich 1993, Tucker 1992, Paus 1988). While the designation of 'nontraditional' is problematic, it is a feature that refers to specific changes in local social and political arenas (Little and Dolan 2005).

Nontraditional *Export* Commodities

While nontraditional export products are promoted as a form of economic development for the rural poor, such goals are frequently distorted in preference for capital-intensive, high value commodities, as evidenced in the growing shrimp mariculture industry (Stonich and Bort 1997). This is particularly problematic when such producers are dependent on a volatile global market. All too often, small-scale rural producers enter the global market at an economic disadvantage (Stonich and Bort 1997).

The demands of wealthy northern consumers undoubtedly contributed to the promotion of nontraditional exports in Mexico. It is to this market of elite consumers that such products are sold. This class of consumers has now come to expect year-round availability of seasonal vegetables. The origin of such products (asparagus from Peru,

broccoli from Guatemala, and exotic fruits from several other Latin American countries) is not likely noted by consumers when purchased.

The fish counter represents the same sort of global marketplace, selling fish both farmed and caught wild from multiple oceans. Consumers in wealthy countries have come to expect this availability of choice. The new health ideology in northern countries also involves the ideology of abundant variety, resulting in choice (Thrupp 1995). Fish are often marketed as healthy, low-fat alternatives to terrestrial animal meats. Thus, a relationship exists between elite consumers' demands for choice and the rural peoples who produce such commodities.

The preference in the U.S. for extensive choices is related to changes in consumption patterns (Roseberry 1996). The focus on the individual in our capitalist society carries over to an encouragement that having choices is a good thing. "Have it your way" is more than just a catchy fast-food chain slogan; it speaks to the foundation of American capitalism. Our multitude of choices necessitates the availability of a wide variety of goods. As a society, we no longer eat according to what may feasibly be produced in a particular season, as the entire spectrum of food choices can be in season at any time *somewhere* in the world. This global movement of food products has made possible this alteration of dietary patterns. Such a global system of food distribution first began with staple grain crops that make up the bulk of caloric intake (such as wheat and rice, Wolf 1997). The trend has since shifted from staples to supplementary foods, what may be termed "luxury" goods. The types of foods now preferred by northern consumers favor a diversity of fruits and vegetables over the traditional bulk of staple grains (Thrupp 1995).

Production of these new goods comes largely from the global south. Ironically, the exported goods may rarely be used for subsistence in the areas of production. How many Guatemalan families could survive solely on snow peas, if the export transporter fails to pick up the harvest on time? Could Gambian families survive on the chili peppers they produced if exporters deem the crop is of inferior quality for the global market (Little and Dolan 2005)?

***Luxury* Export Commodities**

The useful, and only inferred, part of the definition of 'nontraditional' lies in the *luxury* status of the commodities it encompasses. A luxury is defined as "that which is non-essential and unnecessary for survival" (Friedman 1994). The specialty vegetables such as snow peas and chili peppers, as well as cut flowers and farmed shrimp all fall under the designation of nontraditional and are commodities aimed at globally elite consumers. Wild-caught commodities such as lobster, shrimp and shellfish, as well as non-edible beauty product ingredients such as shea butter (Chalfin 2004) are also *luxury* exports.

Another aspect of a luxury commodity is evidenced in the disproportionate difference between the use and exchange value for the producer. A luxury export commodity has a high exchange value if the producer is able to get the often-perishable commodity to market in time. These same commodities, however, have a low use value for the small-scale producer. That is, if the producer is unable to get the perishable good to market, it has very little value in serving the needs of the producer. It is only through exchange that such commodities have value for these producers. Thus, rural farmers in Ecuador have little use for a field of cut flowers if the truck to Quito does not arrive at the right time.

Arjun Appadurai cites Simmel's definition of valuable as, "those objects … that resist our desire to possess them" (in Appadurai 1986:3). The law of demand is complex due to the drive of both desire and need (Appadurai 1986). The difference between desire and need is another aspect of a luxury export commodity. Luxury commodities are produced to satisfy desires rather than needs (Stonich and Bort 1997). While the definition of human needs is a complex issue (Ignatieff 1984), the difference lies in the availability of a substitute. Consuming fruit year-round for healthy vitamins may be a dietary *need*, but consumers desiring strawberries in mid-winter represents a luxury.

Such desired commodities often have a value attached that is culturally based. Lobster is one of the most dramatic examples of such a commodity, where consumption is a sign of (economic) class. There is nothing inherent in lobster that makes it more valuable than chicken. Both are a source of protein. Within the global class of wealthy northern consumers, however, lobster is a delicacy. Its consumption is reserved for the elite class. This luxury classification of lobster is ultimately defined by those who are able to *afford* to eat it. The demand for lobster, then, is based on desire for something that eludes possession; consumers must pay dearly in order to possess the status of dining on lobster.

To the fishermen of Los Flamencos, one kilogram of lobster tail is worth roughly $25; many times more than the $1.60 a kilogram paid for grouper. Because of this enormous exchange value, all lobsters that can be sold are sold. The only lobsters consumed in the homes of fishermen are undersized or taken out of season. That is, they have no exchange value on the market outside of the community. In my time in Los Flamencos, I rarely saw fishermen dining on lobster at home. When friends and family

from outside the community came to visit, frozen tails would be thawed and served. Non-community members regarded dining on lobster as a delicacy, and local families were always proud to be able to serve such a treat.

The luxury status of eating lobster is a creation from outside of the community. The fishermen of Los Flamencos like lobster. It tastes good. As one fisherman told me, however, chicken is to fishermen, what lobster is to non-locals. The fishermen can eat lobster whenever they want. They just go pluck it from the sea. Chicken, however, must be bought with hard earned money and is more expensive than beans and tortillas. To a lobster fisherman, then, chicken is of greater value because it resists possession more than lobster (Appadurai 1986).

Spiny lobster production by the fishermen of Los Flamencos is an example of a luxury export commodity. It is a *nontraditional* commodity, based on the definition discussed above, but is more accurately described as a luxury export commodity. The socio-political context of unequal power relations between producer and consumer and the status of the produced goods in the global market are not sufficiently acknowledged in the designation of *nontraditional* exports. Ultimately, what is accomplished under the promotion and production of *luxury* export commodities is the material fulfillment of wealthy northern consumers.

Exploitation of a Luxury Export Commodity

Spiny lobster is the natural resource with the highest exchange value in Los Flamencos. The fishermen, however, complain that the price they are paid should be higher. Part of their frustration comes from hearing that another buyer (in Cancun, for example) pays more. But the fishermen also perceive the resource, lobster, as valued like gold. That is, they recognize the high exchange value of lobster, and regard themselves as

integral to the production process. Their compensation, therefore, should follow accordingly.

The ideological construction of lobster as a luxury commodity has concrete implications for the way the resource is perceived and exploited by a natural resource community. This construction is directly related to the fishermen's perceptions of its value at the local level.

At the same time, the cultural construction of lobster as a luxury commodity, and its resultant value, attracts a steady stream of newcomers to the fishery. In the last 10 years, the permanent population has increased from less than 1,500 people to over 2,000, an increase of 33%. There is no available data on the number of non-permanent fishermen who come to the community for the first two months of the season, only for the opportunity to harvest lobsters. If "lobsters are like gold" then immigration to Los Flamencos is like the Gold Rush of 1849 for California. And just like the gold rush, the stories of the possible wealth in lobsters are often grander than the reality.

Like gold, lobsters are found as a common property resource. Access to common property resources exists in various forms: open access, communal property, private property, and state owned (Feeny et al. 1990), with combinations of these forms frequently in use.

The spiny lobster fishery of the north Yucatan coast is principally open access. A fisherman, new to the area, has little difficulty joining a lobster crew as a manguerero. There is no evidence of the closed social networks of the sort seen among the Maine lobster gangs, for example, described by Acheson (1974). If the new fisherman had sufficient capital, he could purchase his own boat and begin harvesting lobster freely. I

never heard of this happening, however, as individuals with such amassed capital would elect to work as a buyer rather than a fisherman.

That resource access remains open in nature is reinforced by the cooperative, which will buy lobster from any “free” fisherman at a lowered price. The cooperative, therefore, benefits from this practice of buying from non-cooperative members, because the lobsters are still sold to the buyer for full price. The cooperative keeps the difference in value that would otherwise be paid to a cooperative member. Tolerance in the community for the black market buyers also reinforces the open access nature of the resource.

State regulations technically specify by whom, when, and how the fishery may be accessed. Foreigners may not harvest lobsters in Mexican waters. The state regulates who may harvest lobster, and grants concessions and permits for doing so. While the state has instituted such declarations of rights, however, it does not claim the lobsters for the state and does not enforce the regulations that designate rights. It requires the reporting of harvest quotas to a state agency, but does not set a limit on such harvests. Finally, the state has instituted two regulations that restrict access to the resource for everyone in the form of a closed season and minimum catch size. These regulations are nominally respected, but widely violated.

While it could be argued that access to fishing capital is one factor of access control in the fishery, this is not sufficient to prevent newcomers from entry. The ease with which newcomers may join established crews attests to the open access system. In fact, I found no evidence of communal property access control in Los Flamencos since the beginning of harvesting lobsters. The perception that the abundance of the resource is

declining, however, has driven the cooperative to experiment with a new form of communal property access control.

The cooperative and its members have decided to close the end of lobster season early. Instead of harvesting lobsters through the end of February, the cooperative will attempt to enforce the closing of the season at the end of January 2006, for the first time.

The harvest of spiny lobsters has a relatively short history in Los Flamencos, dating only to 1970. In this time, harvests have fluctuated from year to year, with harvests increasing overall despite some years of significantly lower yields (refer to Figure 5-4). Now, however, the fishermen are beginning to feel the limits of their resource's abundance on their future livelihood. This is the point at which adaptive management strategies may be adopted (Berkes et al. 2000), such as the new attempt at an early season closure. Such strategies arise when a local community of resource users applies their own knowledge and perceptions of a resource to its dynamic context (such as changing availability). Such adaptations have been frequently observed within fishing communities (see local management discussion below). The question becomes: will the adoption of such adaptive strategies occur in a capitalist system, with a resource produced as a luxury export commodity, among a group of people with no secure future access to the resource?

Management

The forms of access controls of common property resources presented above (Feeny et al. 1990) are also interpreted as forms of *management*. That is, each of the four forms of access (private property, state property, open access, and communal access) may be explained as management at different scales, or the lack thereof of management.

State-owned forms of common property resources entail government control of who has access to the resource and are applied as laws. Private property is controlled by

an individual or small group that decides how a resource is used. The system of controlling rights to access of communal property resources is also called *local management*. That is, control of access to communal resources is determined at the local level. Open access resources are defined by the lack of regulation, and therefore, lack of management of the resource.

Management is a hegemonic concept that connotes control over people, things or nature. This concept is exemplified when Wingard, writing about fishery management, states, "several management strategies have been employed, including operational *controls*, effort *controls*, and catch *controls* (Wingard 2000:11; italics added). These may focus on controlling labor or technological inputs, with the expected result of affecting resource abundance.

When people, things or nature are deemed of value, they are termed resources. Things and nature are often common property resources, and access to their use is regularly controlled through management.

Management is broadly defined as: the conducting or supervising of something (as a business) and the judicious use of means to accomplish an end (Merriam-Webster 2005). In the first definition, what is conducted or supervised in fisheries management is the *behavior* of fisherfolk in how they interact with their environment. The example of what would be supervised, "as a business," points to another aspect of management: that it is principles of *business* that guide management. Businesses reproduce themselves through the ultimate goal of increasing profit margins by exploiting available labor or capital, and this may be in conflict with the reproduction of community or social relations. Secondly, the *means* are mechanisms of control, and the *end*, is maximizing

production for market consumption. The reference to judicious, or rational, means of accomplishing the goal suggests that irrational behavior must be replaced by rational behavior, with those in charge of management ultimately defining what is rational and irrational. The goal is ultimately the preservation of viable resource stocks from which the market may continue to distribute.

The two main forms of formal regulation of fisheries, according to the FAO, are restrictions on technology, by limiting types of gear such as net mesh size, and the imposition of a closed season (Shotton 2000) which limits labor inputs. Both of these involve restrictions on fisherfolk themselves, based on the assumption that all act as *rational* individuals; that is, they are assumed to be unwilling or unable to control their own behavior, and to limit their catches in the reality of decreasing resources (Jennings et al. 2001).

This assumption, that fisherfolk will act as rational, gain seeking individuals, has been debated by maritime anthropologists in their critiques of fisheries management. State-level fisheries management is based on neo-classical economic theories (Acheson 1981), as evidenced in the Schaeffer curve (chapter 2). This model depicts the relationship of increasing effort and extracting more fish, thereby adding more sheep to the common pasture. At some point, however, any further investment, through capital increase, technology, skill or labor, will only result in a proportional decrease in fish returns for the individual, the unit of analysis in both the Schaeffer curve and the tragedy. All of the herders now have too many sheep in the pasture. This most basic model in fisheries management, then, is essentially a re-representation of Hardin’s Tragedy.

Durrenberger (1997) shows how the behavior of fishermen does not always follow what the Schaeffer model predicts. Where the model of rational behavior predicts that fishermen will leave the fishery when it becomes unprofitable to fish, Durrenberger argues that the identity of being a fisher restricts them socially from a change in occupation, and drives them to work harder (to intensify). He also cites how state regulations to decrease pressure on a fishery by instituting a boat-quota actually led to an increase in pressure, as no fisher would leave the quota unfilled.

Economizing and Rational Behavior

Wilk describes an example of non-economizing behavior from his own research in California (Wilk 1996). There, people behaved *irrationally* about home weatherization and energy efficiency. Despite what economists would predict, Wilk found that there were other factors involved in the decision-making process besides rational maximizing: family politics, perceptions of the energy industry, or simply that the new behavior didn't fit into the recognized categorization of household duties. Thus, the assumption that people always act in a rational, maximizing manner is not universal. Economic models that predict such behavior fail to consider the importance of identity and other cultural factors, as well as the reluctance of people to adopt a lower standard of living (Herskovits 1940).

Herskovits also argues that what constitutes rational behavior is found in the realm of a society's values (Herskovits 1940). Rational behavior seeks to maximize, however, *what* is maximized depends on the values of a community. Herskovits cites the example of West African peoples who consume foodstuffs during dry season feasts to such an extent that caloric intake is inadequate for the subsequent hard work of preparing the fields during the early rainy season. From a Western hoarding perspective, the rational

choice would be to store food for the beginning of the rainy season. However, Herskovits points out that what is being maximized is not the duration of the food supply, but human satisfaction, a reflection of what is valued in the particular culture. This also recalls the fisherman in Los Flamencos, who was unable to feed his family one week, yet bought his son a cellular phone as soon as he earned money from lobsters the following week.

The neo-classical fisheries management model identifies a point of maximum sustainable yield as the desired goal. Any investment beyond this point would mean wasted labor or capital (according to Catton 1980, the carrying capacity has been breached); anything before it means the resource is being underexploited, and the fishing community would benefit from development. One problem with this model is that fish stocks are in a constant state of population flux; they are not constant (Acheson and Wilson 1996). Therefore, management, or control, that is based solely on mathematical formulas will not be able to adjust for the changing dynamics of on-the-ground (or in-the-water) populations.

The new buzzword in fisheries management, from the perspective of social scientists, is *adaptive* management, where an ongoing dialogue takes place between state regulators and local users as to the current state of the fishery and the need for flexible regulations.

The singling out of a particularly high market-valued species for management regulations poses another problem for *managing* fisheries. Control is exerted over a particular species in a dynamic ecosystem. This neglect of the total marine ecosystem includes neglect of how species interact with one another. In the case of the fishermen in Los Flamencos, Mexico, the three target species represent three connected trophic levels:

grouper eat octopus and lobster, and octopus eat lobster (Arreguín-Sánchez 2000). This trophic relationship inverted represents the market value of the three species: lobster has the highest value followed by octopus, then grouper. Attempts to manage any one of these species, that is, attempts to regulate seasonal harvests, may impact other species as well.

Management reifies the separation between humans and nature, by placing humans in control over nature, which must be brought under control. Management of people results in a type of class division, where managers are responsible for controlling the productive labor of non-managers. Management is also a way of negotiating individual and group interests in a contextually determined "just" way.

Management may also be analyzed through Antonio Gramsci's theory of cultural hegemony. Gramsci uses the term hegemony to mean, "political leadership based on the consent of the led, a consent which is secured by the diffusion and popularization of the world view of the ruling class" (Bates 1975). Those in power are able to reproduce and perpetuate a system of inequality that is in place, by normalizing it. People accept the hierarchical arrangement of the ruling class because that is just the way things are. A moral economy is reinforced, establishing values which favor the elites. Those in power indoctrinate those without, that management of their labor or access to nature is necessary.

This concept reveals management as a mechanism of control. Management reproduces the power division between controller and controlled, normalizing the enforcement of rules. Here, "the judicious means to accomplish an end," from the definition of management above, proclaims the fairness of management in order to attain

an accepted goal. Management is necessary and offers protection for the common good. It is a normative concept that justifies the structure of power behind it. The state wants to control individual rational users because they are not seen as capable of limiting their own profit-seeking behavior. Consumers and producers accept this with almost full consent.

Rule-breaking occurs, of course, but the penalties for breaking management regulations are also accepted, albeit grudgingly. Rule-breakers are aware of the possibility of getting caught. The rules are still broken with an awareness of the penalties: financial penalties for fishing lobster out of season, for example. The risk of getting caught is weighed against the benefits of rule-breaking. Behaviors of conformity are still the norm in societies where people offer spontaneous consent (Bates 1975).

Why is Management Deemed Necessary?

Management policymakers assume that resource users are rational, self-interested individuals. That is, it is assumed that due to the ubiquitous drive for personal gain, they will exploit a resource to depletion unless deterred by state-mandated penalties. Blame for resource depletion, then, falls solely on individual resource users. This view also assumes that individual interests have primacy over those of the community. Numerous other factors, however, contribute to resource depletion.

Management is seen as necessary when a resource's abundance is threatened and its perpetual availability on the market is curtailed. There is no need to manage what is abundant or has low value. Seawater is not managed, but watersheds increasingly are. Fish that have no exchange value, such as the bycatch mass from shrimp bottom trawling, are not managed. The state regulates through management those resources that are of value to members outside of the community of local users. Here, I speak of resources as

commodities, based on Appadurai's definition of a commodity: any thing intended for exchange (Appadurai 1986:9). Production may be limited to the act of extraction from the environment. Other resources, which have so far resisted commodification such as coral reefs and terrestial parks, may have *cultural* value and be managed and protected. (It could be argued that protected areas do have a market value, especially when businesses lobby the government to protect those areas where a profit is made from tourism.)

A resource is a commodity when it has an exchange value in the market. Threats to the consistent supply of a commodity to the market may warrant state management. Lobster, for example, is under governmental management throughout its natural distribution. It has a high global market value compared to most other marine resources. Incidentally, comparing the countries where lobster populations exist, it is the management regulations of the more powerful state, the U.S., which has its regulations adopted by the less economically powerful states, including Mexico and Belize. This is an example of cultural hegemony working laterally among states at the global level. The need for regulating lobster and the form that management should take were standardized (and so, normalized) by the dominant power.

Prior to the institution of state management regulations, a resource had either a use value only, with producers consuming the resource, or an exchange value limited to local market consumption. At some point, because of intensification on the resource, the availability of the resource has been affected. In this situation, local level users are often blamed (Blaikie and Brookfield 1987), even if the local users are supplying the resource to the global market. It is assumed that state-level management, or regulations, are needed to monitor local users, who are incapable of managing their own behavior

(Jennings et al. 2001). There are different theories about what drives intensification, which deserve to be explored.

Rocha describes two models of intensification (Rocha 2000). In the first, based on the work of Ester Boserup (1965), intensification results from both increased population pressure and the drive to maintain an established lifestyle. In contrast, and influenced by neoclassical economic theory, intensification occurs due to a drive for profit. Under this model, both producers and consumers benefit, while non-intensifying producers do not benefit. These two models also represent the opposing sides of the formalist-substantivist debate. The model of intensification based on lifestyle and demographic needs represents a substantive rationality of household reproduction, while intensification based on a drive for profit exemplifies the rational gain seeking of formalist theory. Each then has a different focus: one on society and the other on the individual. Both theories may have validity, as one speaks to the social and the other to the individual: population increases and attempts to attain or maintain a particular lifestyle at the social level, coupled with the opportunities that profit may provide to the individual, could all lead to intensification of pressure to maximize production of a finite resource.

Gudeman's definition of economy also reflects this social-individual tension. Gudeman (2001) argues that an economy is made up of two realms, the up-close community and the far-distant market, that are in a dialectical relationship with one another. This has significance for the enforcement of management regulations. Management from the far-distant realm functions through market terms like profit and fines, whereas, as discussed below, management from up-close functions on social terms. The contradiction between the individual and social relations to nature may also be

described as shortsighted or long-term, respectively (Hanna and Jentoft 1996). Examples such as Hardin's "Tragedy of the Commons" (1968) depict purely individualistic and opportunistic behavior. Unless social organization has irreparably broken down (Berkes et al. 1991), we should expect the social relations of the community to explore outlets of cooperation (Hanna and Jentoft 1996).

Another claim of the need for management rests with the theorized relationship between poverty and environmental degradation (Blaikie and Brookfield 1987). This argument furthers the assignment of blame for resource depletion on local users. Escobar argues that those who point to this association ignore the larger processes of marginalization, which force people to intensify their use of resources (Escobar 1995). While a population increase may lead to intensification and subsequent degradation of a resource's abundance, state management is not usually concerned with the subsistence use of resources. It is when there is a demand for the resource outside of the community (for exchange in the market) that the state steps in to manage. If blame is to be laid, the demands of the market should be addressed. When there is a high market demand on a resource, prices outside a community will rise, and local resource extractors may step up production to meet this demand. This new demand does not have a system of checks and balances in place. Prior to global market demand, local use would have been limited to use value or local market consumption. The role of the market as a driver of demand deserves more attention.

When continued intensification, through population, labor or technology, eventually affects the abundance of a resource, and its availability to the market, the state will begin to control the resource through management. Here again, it is those resources

that are deemed valuable (they possess an exchange value based on desire) that warrant management. As mentioned above, the presence of cultural valuation of a non-commodity may prompt management initiatives. An example would be the management of tuna fishermen who are required to use dolphin-safe nets. The management regulation is to protect dolphins, a species without an exchange value for the tuna fishers[5].

Management is another way people interact with their environment. This analysis of management has stressed the elements of *control* and *power* that the term embodies. Therefore, through the forms of management discussed above, a one-way relationship with the total environment results where resources and resource users must be controlled by those in power. The normative goals of the state are aided by the spontaneous consent of the people (Bates 1975) who support management that supplies them with desired commodities for human satisfaction. The stable supply of luxury goods in the market and the management behind it, then, has become the new opiate of the masses.

Local Management

The goal of resource management pertains to sustaining the abundance and availability of a resource for consumers. Some communities that depend on a particular resource, however, exercise a form of management that is locally driven and enforced through culturally defined norms of behavior.

In contrast to the previous discussion of management, which may be referred to as top-down, maritime anthropologists recognize numerous behaviors of local users as *local*

---

[5] Dolphins do have an exchange value in their acquisition for aquariums, for example. These allow the general public familiarity with the animals, which may be partially responsible for the dolphin-safe nets, as the public demands (desires) that the anthropomorphic animals be protected. *Shark*-safe cans of tuna are not likely marketable.

management, originating bottom-up. The difference refers to the origination of management regulations, whether from the State (top-down and outside) or from within the community of resource users itself (bottom-up and inside). Both rotational grazing and shifting cultivation are cited as examples of local management in terrestial ecosystems (Blaikie and Brookfield 1987). Behaviors recognized as local management of fisheries include social pressure to avoid intensifying technology (Crawford 1995); control of information on prime fishing locations (Forman 1967); and hereditary rights to fishing zones (King 1997, Sutherland 1986). What these have in common is the exclusion of outsiders from access to the resource, and enforcement carried out at the local level. Often, the behaviors are not formal rules among the fishing community, worded in an overt way. Instead, they are codified in a system of understood behaviors, reproduced in everyday practice (Ostrom et al. 1994), which serve to limit use of the resource. Social pressure, through the stigmatization of violators (Crawford 1995), or sabotage of offenders' fishing gear (Acheson 1987) are the penalties for violations, standing in contrast to the fines or license revocation which is the norm for top-down state management.

Local management strategies originate at the local level and are enforced there as well. Control comes from within the community of users, which stands apart from Gramsci's cultural hegemony model, where a class division is sanctioned and rulers instill their values in the form of normalized mechanisms of control. Essentially, local management equates with the type of access control referred to as communal property. This type of access is characterized by a group of owners who are engaged in a system of access regulation.

This is not to create an artificial sense of homogeneity or egalitarianism within a community. Communities encapsulate identities, which often nest inside each other (Anderson 1991). A group of resource users may follow different forms of behavior depending on their identity within various communities. Robben (1989) provides an example of differing identities of fishermen within the larger fishing community of Camurim, Brazil. Boat fishermen and canoe fishermen interpret the economy differently, and occupy separate communities within the larger community of Camurim. Within the community of canoe fishermen, some are members of cooperative corporate groups, called *turmas*. A turma may agree to use a particular size of net mesh, which is large enough to allow juvenile fish to escape. Other independent canoe fishermen that are not part of a turma do not follow this practice and catch the smaller fish. Members of a turma must follow the community's rules, but benefit through a system of reciprocity: the group as a whole takes care of those members with smaller catches, or who have personal emergencies. If a turma member breaks the group's rules governing fishing, he will be alienated from both the group and its benefits. Control in this example does not come from an external agent of power, but from the social group in which one is a member. Behavior is controlled, but it is based on the cooperation and participation of a social group.

Ecologists have been accused of overemphasizing competition, and undervaluing cooperation (Berkes 1992). Resource users are metaphorically depicted as competing with other individuals for limited resources. They attempt to harness nature, rather than interacting with it in a mutual system of cooperation. The important components of local management, which distinguish it from state management, are found in cooperative and

participatory behaviors. Local management connotes the involvement and responsibility of users for the availability of their resource. External management attempts to exert power over local users, by restricting the users' access to resources and by attempting to control the populations or abundance of resources. The benefits for compliance are not always contextually clear. Idealistically, fisherfolk should benefit from a greater stock abundance for all. The perceived benefit in reality is more likely the avoidance of financial penalties.

It should not be assumed that all local users are involved in local management. The users' perceptions of their resource are important, as well as the use to which resources are put. For example, in a community that has traditionally harvested fish, a highly perishable resource, maximizing the harvest is limited to what fishers are capable of using or storing. For a community without the means to preserve such a resource, the take limits will likely be relatively low. When an external market demand is introduced, the community may never have approached the carrying capacity of this resource. The community never needed to exploit the resource beyond immediate use or local exchange values. Adaptive strategies to resource limitations have not been implemented nor tested. Now, realizing a high exchange value, the resource, abundant in the past, is subject to possible overexploitation.

An alternative to intensification which is not taken into consideration by fisheries management models is diversification (McCay 1978). Diversification in the event of resource abundance limitations is a technique of risk management (here, attempting to control and limit the risk of decreasing catches). McCay argues that as an adaptive strategy, it has primacy over intensification, because it is theorized as less costly and

more reversible than intensification (McCay 1978). Diversification may result when state management restricts local users. In Maine, lobster fishers have diversified into the tourist industry during the closed lobster season (Acheson 1998). Due to the tension between the need for a year-round income and the inability to catch lobsters for part of the year, they have diversified their economies while still maintaining their identities as lobster fishers.

In order for communal property restrictions to be in place, the need to preserve the resource's abundance must be perceived. That is, users must have perceived the limits of a resource's carrying capacity (Catton 1980). A value is attached to what is restricted. Even if the resource is not being exploited immediately, the communal property regulations of access keep others from using it. By restricting access to a resource, local users are exercising a mechanism of control, or management. The control, however, comes from within the community where the responsibility for enforcement rests as well.

In a fishing community with communal property access rights, restrictions apply to outsiders taking fish, likely a particular species, and not to passing through the waters. This may seem like an obvious point, but what is restricted, is taking what has value. The restrictions may be based on spatial fishing territories, but enforcement of communal property rights is limited to extraction only (Acheson 1987).

Community and Cooperation

A resource that is managed communally by some form of access restrictions infers some sense of community that enforces the restrictions and cooperation among the group. The presence of community or cooperation does not assume homogeneity, nor mean that the personal interests of individual actors no longer exist. A community is not necessarily

about *in*tegration, so much as the *agg*regation (Cohen 2000, author's italics) of its members' interests.

I use the term *community* to refer both spatially and occupationally, to the group of fishermen that are members of a single fishing cooperative (Smith and Hanna 1993). *Cooperation*, I use to refer to behavior practiced by individuals in a group that adopt the advantages of working together at the expense of continually adding their own sheep to the common pasture (Hardin 1968). Cooperation has been termed "helping behavior" (Peck and Feldman 1986). The individual actors may or may not interpret this cooperation as economically rational behavior. Also, the actors may not participate willingly, but rather, conform due to social pressure.

A community engaged in cooperation around a communal property resource is engaged in a social system where their ownership in the future of the resource is shared. It is in the interest of all individuals in the community, to prevent the resource from collapsing.

Regardless of the scale of the fishing operation, a high level of independence exists among most individual fishermen. Poggie (1980) emphasizes the importance of independence among fishermen as well as the importance of a fisherman's identity. The forms of social organization of a fishing community must negotiate this need for independence. Often, attempts to manage fishermen externally are perceived as threats to their autonomy (Poggie 1980) and the moral economy they adopt that reinforces their livelihood (Durrenberger 1997). Because of this independence, fishermen will be more receptive to those mechanisms of control in which they have input.

Local users are empowered as part of the decision-making process when they participate in their own management, rather than marginalized to a position of (consented) submission to state regulators. The behaviors included under the concept of local management may be better described as *community cooperation*.

Cooperation may also entail separate organizations working together, such as the cooperative of Los Flamencos and the Mexican state authorities. Such a system may be termed *co-management* (Berkes et al. 1991). Under co-management, local resource users and state authorities, ideally, benefit from each other's perspective. Resource users are aware of the status of the resource at the local level. Officials at the state level ideally have the power and resources to enforce regulations; provided that enforcement is in the interest of the state. Again, cooperation works best when common interests are identified (Fox 1993).

Future of Lobstering in Los Flamencos

The fishermen of Los Flamencos perceive a bleak future for their spiny lobster resource. Based on such perceptions, one of two outcomes may be predicted. The fishermen will continue to harvest lobster as they have been doing, in an atmosphere of competition where newcomers are able to continue entering the fishery. The second possible outcome is that the fishermen will realize a shared interest and implement cooperative action.

Cooperative formation is one example of local management where fishers form groups to decide on fishing policy (Poggie 1980). Los Flamencos' cooperative was an introduced organization, however, rather than one initiated locally. As such, the fishermen's perception of their cooperative is of an institution through which they gain personal economic benefits, as opposed to an institution of community interest. As the

fishermen begin to recognize a common interest in the future availability of lobsters, the perception of the cooperative may become an institution through which the fishermen are able to exercise group control over access to the resource. Hopefully, this may occur despite the fact that the fishermen do not represent a homogenous group.

The implementation of behaviors that entail community participation and cooperation, or local management, may enable the fishermen of Los Flamencos to adapt to the finite limits of their common property resource. The first instance of such organized cooperation in Los Flamencos was set to begin in February 2006, almost six months after I departed the field. The cooperative, with the support of its members, had elected to close the lobster season early. Each of the cooperative's directors told me that each year, at the end of the season, only small lobsters were harvested. The early closing of the season is a way to halt this practice. The proposed season closure would end the season at the end of January instead of February.

In interviews, members repeatedly expressed approval of the self-imposed regulation. The fishermen told me that they anticipated their fall harvests to be larger if small lobsters are allowed to grow through the closed season. The idea is that if fishermen are not able to sell lobsters to the cooperative, and the cooperative enforces the new rule and prevents the sale of lobsters elsewhere in the community, then fishermen will not harvest lobsters. The cooperative and its members will assume responsibility for enforcement of the rules. The new rule would apply to all fishermen and not just cooperative members. If there is no exchange value for lobsters, then even those that view the fishery purely for opportunistic gain will realize no benefit from the harvest of lobsters.

The implementation of a form of local management is not free from obstacles. The federal law for the end of the lobster season did not change. Therefore, there are no legal penalties for violation of the new regulation. Enforcement would be limited to dock patrols by the cooperative and fishermen. During the closed season, it is not permitted to snorkel or dive in the waters where lobsters may be harvested without the cooperative's approval. If a boat were to depart from the dock with a compressor on board, this would be interpreted as a clear violation. New forms of local enforcement are sure to be tried and tested for the first time.

Despite the cooperative's attempts to take control of their resource, low harvests are a possibility that may occur due to natural processes in the life cycle of the spiny lobster. Such events may or may not correlate with human activity. Low harvests at the beginning of the season following the administration of the new regulation, however, may bode poorly for its continuation.

As I finish writing this thesis, I am unable to vouch either for the success or failure of the community's new initiative. By conducting this research prior to the initiation of a local management initiative, this thesis provides the beginning of a longitudinal study. While on the surface, the lobster resource of Los Flamencos appears to support tragedy, this oversimplification would be an injustice to the fishermen. Either their efforts will succeed and they will develop new forms of communal management, or the resource will collapse. Should the resource collapse, however, it will be due to a more complex set of factors than exist in the tragedy, where individual actors economize in a vacuum of social relations.

The community perceives the stress on their resource. The stability of future access to the resource is uncertain. Their subjugation to a middleman that controls much needed fishing capital seems to have reached a breaking point. The initiation of the new local regulation and the reality of a new production facility are the first steps toward local management control and autonomy.

I plan to return to Los Flamencos to conduct further research among the fishermen on their changing access rights of common property resources. The open access resource may yet become communal property. Dire perceptions of the future of the fishery may lead toward successful cooperative action. The members of the cooperative are empowering themselves in their attempts to move away from the exploitative relationship with the regional buyer. As the fishermen begin to take control of the resource in their own hands, I predict that cooperation will ultimately result.

CHAPTER 7
CONCLUSION

The lobster fishermen of Los Flamencos harvest a common property resource of which they have unsecured access. Due to the open access nature of the resource, the community is witnessing a steady increase in the number of fishermen each year. Newcomers are drawn to the fishery because of the high value of lobster in a region where incomes are otherwise low. The combination of ease of entry into the fishery and the lack of overall knowledge of the marine environment provide further evidence of its opportunistic nature. The high capital investments and contractual obligations of the fishermen's cooperative to a single buyer, however, have led many fishermen to be perpetually indebted to a single patron who effectively controls much of the industry.

State regulations exist to regulate access to the resource, but fail due to a lack of enforcement at the state level and a lack of compliance at the local level. Competition is more evident than cooperation at the local level, even among the cooperative members. Thus, the fishermen have a negative perception of the future of their fishery, resulting in a near anarchic attitude to harvest as much as they can today.

Hardin's Tragedy *of the Commons* is the classic explanation of common property resource collapse, the premise of which is mirrored in the fisheries management model of the Schaeffer curve. Both the tragedy and the Schaeffer model depict the rational actions of an economizing, competitive individual with no social connections in regards to other users. While such a representation may describe behaviors in a purely capitalist industry, they overlook social structures that exist in small-scale communities. In fact, such

fishermen do not behave as predicted by such models, and they do not engage in production outside of a social system. Thus, while the issues surrounding the harvest of lobsters in Los Flamencos could be consigned as a classic example of the tragedy, the local situation, in fact, presents an example of how the tragedy narrative fails to explain the exploitation of a common property resource.

Critiques of the tragedy have focused on its assumption of common property resources as open access. In fact, many common property resources are not open access, but are harvested within some system of community control, identified as communal property. Such systems are characterized by the exclusion of outsiders from exploiting a community's resource, and regulation of use by the users of the community itself. The tragedy has also been criticized for assuming that resource users are always self-interested actors. Again, resource users are able to recognize a common interest in the maintenance of the resource for future use by all, and cooperate to manage their resources.

Common property resource situations are more complex than the above models allow, and involve factors both internal and external to the group of local users. Local history, group dynamics, and conflicts must be incorporated into the analysis. Other factors, such as the ecology of the resource, should also be considered before assuming the overexploitation of the resource. By examining the local context and including these issues in the analysis, a more holistic picture results. Thus, a political ecology framework that incorporates the above factors will best address local resource use and overexploitation in a common property scenario.

In the case of Los Flamencos, the harvest of spiny lobsters was introduced to the community as a form of economic development only 35 years ago. The cooperative was also initiated by state level actors at this time. Therefore, neither the fishery nor the cooperative arose out of a community-based initiative of participatory action. The community, which previously harvested octopus and grouper among other fish species, began to grow quickly as a result of profits from the production of lobsters.

Because the lobster fishery was initiated in the community as an export venture, it has always had a capitalist market orientation, as opposed to many other fisheries that originate for subsistence or local market production. This relates to the entry of the fishery by many, purely for the financial benefits it entails, as opposed to being a part of the livelihood that comes with being a community member. Such a distinction is further evident in fishermen's generally poor knowledge of lobster ecology, especially when compared to knowledge of grouper ecology. Despite these trends in the growth of the lobster fishery, the fishery remains small in scale.

Furthermore, the ecology of the resource will influence perceptions and extraction practices. In the case of the spiny lobsters, their populations go through natural cycles that may result in years of abundance followed by years of diminished harvests. To the fishermen who need to sustain their families and livelihood, this can lead to overexploitation in lean years. Also, the local population of spiny lobsters, and their reproduction, is linked to the species populations in other heavily fished areas, such as Florida and Cuba, because the larval stages of the species moves with the plankton in the currents. Thus, overexploitation would be unlikely to be a local phenomenon, but would be a result of overharvesting throughout the species´ entire range.

Conflicts within the original cooperative's political structure have resulted in the division into two cooperatives. Such a split further points to the fact that fishermen are not a homogenous group. Even within the original cooperative, since the split, differing perceptions of the fishery and interest in what the fishery can provide exist. Thus, some fishermen view the fishery more opportunistically, and leave the community for other well-paid work for much of the year, while other fishermen consider themselves a part of the community and are more concerned about having a future livelihood in the local area. This pattern may be related to the high rate of immigration to the community for the harvest of lobsters. While some fishermen are native to the area and remember fishing before lobstering began, many arrived in the community as adolescents. These are not two isolated groups, but a trend seems to exist that reveals the distinction.

A further factor to consider is the relationship of the local level producers to the intermediary who exports their product to the global market. The cooperative is contractually obligated to sell their entire lobster harvest to a single exporter in Merida. This exporter is essentially the cooperative's landlord, as he owns both the buildings the cooperative works out of and the local ice factory. Over time, many fishermen have become indebted to this buyer, as he loans the capital the fishermen require to purchase and repair boats and equipment. The buyer also controls the price paid for their harvests and the fishermen realize the exploited position they are in. Their relationship to the regional buyer further reveals that the fishermen do not exist in an isolated system. Their indebtedness to this actor who mediates between themselves and the global market influences how they exploit their resource. Often, fishermen feel pressured to engage in

maladaptive practices, such as the harvest of undersized lobsters, because they must produce to pay off their debts.

The fishery would not likely exist were it not for the value of lobster on the global market. The tastes of elite consumers have been culturally constructed to value lobster over other foods. This value has more to do with its luxury status than with the natural supply and availability. Therefore, the fishermen are ultimately driven by the desires of global consumers who can both demand and afford to buy such a luxury export commodity. To neglect the role of actors at this scale is to allow blame to be placed solely on rural producers and to avoid laying responsibility on those who demand the production of such a commodity.

The fishermen of Los Flamencos have reported perceptions of declining returns for investments. They see that more and more people are entering the fishery. They predict that their future harvests will be less than they now produce. Local regulations governing use would not have been necessary prior to such perceptions of the limits of the resource's carrying capacity. What is abundant needs no limitations on use. Now that the fishermen are aware that their resource may be feeling its limits, they are at a crossroads of sorts. Will the community, with a history of internal conflicts, continue to harvest as individuals until the resource is exhausted? Or, will they begin to cooperate through the initiation of a system of communal property?

The fishermen within the institution of the cooperative have, in fact, begun to implement their first local management strategy. In response to the realization that most lobsters harvested in the final month of the season are undersized, they have decided to close the season early. This action rests on the belief that if they spare these small

lobsters, there will be more lobsters of good size when the season reopens. Whether or not this holds true according to the natural movements of individual lobsters, they have instituted a policy based on observations at the local level. The community of fishermen is attempting to take control of the resource on which their livelihoods depend. By instituting the early closing of the lobster season, the members will begin to take on the responsibility of enforcing regulations governing the extraction of the resource.

The cooperative and its members are also attempting to curtail the cycle of dependence that exists with the regional exporter in Merida, by opening their own production plant. They are reacting against the exploitative relationship with the buyer and have sought a way to produce and export their harvests. The process of ending the relationship with the exporter will take time, and he surely will not assist them in their independence. Nevertheless, these new events show that the fishermen are not passive victims to their circumstances.

While the situation now seems optimistic, the fishermen will need to overcome obstacles such as the conflicts that exist among the factions of the cooperative. Also, the issue of the current population of non-cooperative fishermen and new immigrants will need to be addressed. Future ethnographic research is needed to examine conflict resolution in the community.

“Lobsters are like gold” came to mean more than occurred to me initially. The high value of lobsters makes them literally like gold to a fisherman in an otherwise poor rural area. To small-scale producers, something of such high exchange value that has little use value for the producers is comparable to striking gold. One cannot subsist on it, but for some reason, as a thing, it has enormous value. Such value of a natural resource on the

global market shapes rural communities in unique ways. From immigration to conflict, the local dynamics will experience change. Ultimately, the members of the community are set to determine their own future.

LIST OF REFERENCES

Acheson, James M.

1998 "Lobster Trap Limits: A Solution to a Communal Action Problem," *Human Organization* 57(1):43-52.

1997 "The Politics of Managing the Maine Lobster Industry: 1860 to the Present," *Human Ecology* 25(1):3-27.

1987 "The Lobster Fiefs Revisited: Economic and Ecological Effects of Territoriality in the Maine Lobster Industry," In *The Question of the Commons: The Culture and Ecology of Communal Resources*. B.J. McCay and J.M. Acheson, ed. Pp. 37-65. Tucson: The University of Arizona Press.

1981 "Anthropology of Fishing," *Annual Review of Anthropology* 10:275-316.

1974 "Territories of the Lobstermen," *Annual Editions: Readings in Anthropology* 75/76:108-113.

Acheson, James M., and James A. Wilson

1996 "Order out of Chaos: The Case for Parametric Fisheries Management," *American Anthropologist* 98(3):579-594.

Acosta, Charles A., and Mark J. Butler IV

1997 "Role of Mangrove Habitat as a Nursery for Juvenile Spiny Lobster, *Panulirus argus*, in Belize," *Marine and Freshwater Research* 48:721-727.

Alexander, Richard B., Richard A. Smith, and Gregory E. Schwarz

2000 "Effect of Stream Channel Size on the Delivery of Nitrogen to the Gulf of Mexico," *Nature* 403(February 17, 2000):758-761.

Andersen, R.

1980 "Hunt and Conceal: Information Management in Newfoundland Deep-Sea Trawler Fishing," In *Secrecy*. S.K. Tefft, ed. Pp. 205-228. New York: Human Sciences Press.

Anderson, Benedict

1991 *Imagined Communities*. New York: Verso.

Appadurai, Arjun

1986 "Introduction: Commodities and the Politics of Value," In *The Social Life of Things: Commodities in Cultural Perspective*. A. Appadurai, ed. Pp. 3-63. Cambridge: Cambridge University Press.

Arce, A. M., and de León, M. E.
2000 "Biology" In *FAO Fisheries Report 619*. Regional Workshops on the Assessment of the Caribbean Spiny Lobster (*Panulirus argus*), Report on the FAO/DANIDA/CFRAMP/WECAFC, Havana, Cuba, 2000, Pp. 17-25. FAO (Food and Agricultural Organization).

Arreguín-Sánchez, Francisco
2000 "Octopus-Red Grouper Interaction in the Exploited Ecosystem of the Northern Continental Shelf of Yucatan, Mexico," *Ecological Modelling* 129:119-129.

Baisre, J.A.
2000 *Chronicle of Cuban Marine Fisheries (1935-1995): Trend Analysis and Fisheries Potential*. Rome: FAO (Food and Agriculture Organization) of the United Nations.

Barham, Bradford, Mary Clark, Elizabeth Katz, and Rachel Schurman
1992 "Nontraditional Agricultural Exports in Latin America," *Latin American Research Review* 27(2):43-82.

Bates, Thomas R.
1975 "Gramsci and the Theory of Hegemony," *Journal of the History of Ideas* 36(2):351-366.

Bengtsson, Lennart
2001 "Hurricane Threats," *Science* 293(5529):440-441.

Berger, Dianne K., and Mark J. Butler IV
2001 "Octopuses Influence Den Selection by Juvenile Caribbean Spiny Lobster," *Marine and Freshwater Research* 52:1049-1053.

Berkes, Fikret
1992 "Cooperation from the Perspective of Human Ecology," In *Common Property Resources: Ecology and Community-based Sustainable Development*. F. Berkes, ed. Pp. 70-88. London: Belhaven Press.

Berkes, Fikret, Johan Colding, and Carl Folke
2000 "Rediscovery of Traditional Ecological Knowledge as Adaptive Management," *Ecological Applications* 10(5):1251-1262.

Berkes, Fikret, Peter George, and Richard J. Preston
1991 "Co-Management: The Evolution in Theory and Practice of the Joint Administration of Living Resources," *Alternatives* 18(2):12-18.

Bernard, H. Russell
1967 "Kalymnian Sponge Diving," *Human Biology* 39(2):103-130.

Bertelsen, Rodney D., and Thomas R. Matthews
2001 "Fecundity Dynamics of Female Spiny Lobster (*Panulirus argus*) in a South Florida Fishery and Dry Tortugas National Park Lobster Sanctuary," *Marine and Freshwater Research* 52:1559-1565.

Blaikie, Piers, and Harold Brookfield
1987 *Land Degradation and Society*. New York: Methuen & Co.

Boserup, Ester
1965 *The Conditions of Agricultural Growth: The Economics of Agrarian Change under Population Pressure*. Chicago: Adeline Press.

Briceno Perez, Javier
2005 "Neigan que haya Marea Roja," In *Diario de Yucatan LOCAL*. Pp. 1. Mérida.

Burkholder, JoAnn M.
1998 "Implications of Harmful Microalgae and Heterotrophic Dinoflagellates in Management of Sustainable Marine Fisheries," *Ecological Applications* 8(1):S37-S62.

Callejas Romero, Cecilia
1991 *Social and Economic Consequences of Nontraditional Exports: The Plantain Industry in Honduras*. Dissertation, University of Florida.

Catton, William R. Jr.
1980 *Overshoot: The Ecological Basis of Revolutionary Change*. Urbana: University of Illinois Press.

Chacko, Tomy
1998 "Artisanal Fishing along the Alleppey Coast, Southwest India," *Human Organization* 57(1):60-62.

Chalfin, Brenda
2004 *Shea Butter Republic: State Power, Global Markets, and the Making of an Indigenous Commodity*. New York: Routledge.

Childress, Michael J., and William F. Herrnkind
1996 "The Ontogeny of Social Behavior among Juvenile Caribbean Spiny Lobsters," *Animal Behaviour* 51:675-687.

Cobb, J. Stanley
1997 "Oceanic Processes Affecting Lobster Larvae: Report from a Workshop," *Marine and Freshwater Research* 48:771-775.

Cochran, Kathryn Ann
1997 *Fishery Co-Management: The Case of the Punta Allen Spiny Lobster Fishery*. Master's thesis, University of Florida.

Cohen, Joel E.
2000 "Population Growth and Earth's Human Carrying Capacity," In *Consumption, Population, and Sustainability: Perspectives from Science and Religion*. R.L. Petersen, A.R. Chapman, and B. Smith-Moran, ed. Washington, D.C.: Island Press.

Conroy, Michael E., Douglas L. Murray, and Peter M. Rosset
1996 *A Cautionary Tale: Failed U.S. Development Policy in Central America*. Boulder: Lynne Rienner Publishers.

Cordell, John
1978 "Carrying Capacity Analysis of Fixed-Territorial Fishing," *Ethnology* 17(1):1-24.
1974 "The Lunar-Tide Fishing Cycle in Northeastern Brazil," *Ethnology* 13(4):379-392.

Cordero, E. Sosa, V. Rios Lara, A.M. Arce, and M. Cabrera Vasquez
2001 "La Pesqueria de la Langosta en Mexico (Yucatan y Quintana Roo)," In *FAO Fisheries Report No. 619: Report on the FAO/DANIDA/CFRAMP/ WECAFC*, Regional Workshops on the Assessment of the Caribbean Spiny Lobster (*Panulirus argus*). W.C.A.F. Commission, ed. Pp. 227-237. Rome: FAO (Food and Agricultural Organization).

Crawford, James P.
1995 *"The Trawler Wreck All": Political Ecology and a Belizean Village*. Master's thesis, Virginia Tech.

Djohani, Fili
1997 "Abatement of Destructive Fishing Practices in Indonesia: Who Will Pay?" Fifth Annual World Bank Conference on Environmentally and Socially Sustainable Development, Washington, D.C., 1997, Pp. 25-29. The World Bank.

Dore, Elizabeth
2003 "Debt Peonage in Granada, Nicaragua, 1870-1930: Labor in a Noncapitalist Transition," *Hispanic American Historical Review* 83(3):521-559.

Durrenberger, E. Paul
1997 "Fisheries Management Models: Assumptions and Realities or, Why Shrimpers in Mississippi Are Not Firms," *Human Organization* 56(2):158-166.

Durrenberger, E. Paul, and Gisli Palsson
1987 "Ownership at Sea: Fishing Territories and Access to Sea Resources," *American Ethnologist* 14(3):508-522.

Ehrhardt, N.M.
2000 "The Atlantic Spiny Lobster Resources of Central America," In *Spiny Lobsters: Fisheries and Culture*. B.F. Phillips and J. Kittaka, ed. Pp. 153-168. Malden, MA: Blackwell Science.

EPA (Environmental Protection Agency)
2006 Gulf of Mexico Program: http://www.epa.gov/gmpo/habpage.html January 2006.

Escobar, Arturo
1995 *Encountering Development: The Making and Unmaking of the Third World*. Princeton, NJ: Princeton University Press.

FAO (Food and Agricultural Organization)
2002 Report of the Second Workshop on the Management of Caribbean Spiny Lobster Fisheries in the WECAFC Area Havana, Cuba, 30 September - 4 October 2002, Havana, Cuba, 2002. Vol. No. 715, Pp. 273. Rome: Food and Agriculture Organization.

FAO (Food and Agricultural Organization)/Western Central Atlantic Fishery Commission
2001 "Report on the FAO/DANIDA/CFRAMP/WECAFC Regional Workshops on the Assessment of the Caribbean Spiny Lobster (*Panulirus argus*)" In *FAO Fisheries Report*. Pp. 381. Rome: Food and Agriculture Organization.

Feeny, David, Fikret Berkes, Bonnie J. McCay, and James M. Acheson
1990 "The Tragedy of the Commons: Twenty-Two Years Later," *Human Ecology* 18:1-19.

Firth, Raymond
1966 *Malay Fishermen: Their Peasant Economy*. New York: W.W. Norton & Company, Inc.

Forman, Shepard
1967 "Cognition and the Catch: The Location of Fishing Spots in a Brazilian Coastal Village," *Ethnology* 6(4):417-426.

Fox, Jonathan
1993 *The Politics of Food in Mexico: State Power and Social Mobilization*. Ithaca: Cornell University Press.

Frank, Andre Gunder
2000 "The Development of Underdevelopment (1969)," In *From Modernization to Globalization: Perspectives on Development and Social Change*. J.T. Roberts and A. Hite, ed. Pp. 159-168. Malden, MA: Blackwell Publishing.

Friedman, Jonathan
1994 *Consumption and Identity*. Chur, Switzerland: Harwood Academic Publishers.

Garcia-Hernandez, Jaqueline, Leticia Garcia-Rico, Martin E. Jara-Marini, Ramon Barraza- Guardado, and Amy Hudson Weaver
2005 "Concentrations of Heavy Metals in Sediment and Organisms during a Harmful Algal Bloom (HAB) at Kun Kaak Bay, Sonora, Mexico," *Marine Pollution Bulletin* 50:733-739.

Germonpré, P., P. Dendale, P. Unger, and C. Balestra
1998 "Patent Foramen Ovale and Decompression Sickness in Sports Divers," *Journal of Applied Physiology* 84(5):1622-1626.

Goolsby, Donald A., William A. Battaglin, Brent T. Aulenbach, and Richard P. Hooper
2001 "Nitrogen Input to the Gulf of Mexico," *Journal of Environmental Quality* 31:329-336.

Gordon, H. Scott
1998 "The Economic Theory of a Common-Property Resource: The Fishery," In *Managing the Commons*. J.A. Baden and D.S. Noonan, ed. Bloomington: Indiana University Press.

Gudeman, Stephen
2001 *The Anthropology of Economy: Community, Market, and Culture*. Malden, MA: Blackwell Publishers Inc.

Hallam, David, Gill Lavers, Pascal Liu, Paul Pilkauskas, George Rapsomanikis, and Julie Claro
2004 "The Market for Non-traditional Agricultural Exports," In *FAO Commodities and Trade Technical Paper* 3. Pp. 163. Rome: FAO (Food and Agriculture Organization) of the United Nations.

Hanna, Susan, and Svein Jentoft
1996 "Human Use of the Natural Environment: An Overview of Social and Economic Decisions," In *Rights to Nature: Ecological, Economic, Cultural, and Political Principles of Institutions for the Environment*. S.S. Hanna, C. Folke, and K.G. Maler, ed. Pp. 35-56. Washington, D.C.: Island Press.

Hardin, Garrett
1968 "The Tragedy of the Commons," *Science* 162:1243-1248.

Hernandez, Alvaro, and Willett Kempton
2003 "Changes in Fisheries Management in Mexico: Effects of Increasing Scientific Input and Public Participation," *Ocean and Coastal Management* 46:507-526.

Hernandez Arana, Hector A., Richard M. Warwick, Martin J. Attrill, Ashley A. Rowden, and Gerardo Gold-Bouchot
2005 "Assessing the Impact of Oil-related Activities on Benthic Macroinfauna Assemblages of the Campeche Shelf, Southern Gulf of Mexico," *Marine Ecology Progress Series* 289:89-107.

Herrnkind, W. F.
2005 "New Lobster on the Block: How Artificial Shelter Experiments Revealed Key Processes of Caribbean Spiny Lobster Recruitment." Fisheries and Aquatic Sciences Department Seminar Series, University of Florida, October 2005.
1985 "Evolution and Mechanisms of Mass Singlefile Migration in Spiny Lobsters: Synopsis," In *Migration: Mechanisms and Adaptive Significance*. M.A. Rankin, ed. Pp. 197–211. Contributions Marine Science Suppl., Vol. 27.

Herrnkind, William F., Mark J. Butler IV, John H. Hunt, and Michael Childress
1997 "Role of Physical Refugia: Implications from a Mass Sponge Die-off in a Lobster Nursery in Florida," *Marine and Freshwater Research* 48:759-769.

Herskovits, Melville J.
1940 *Economic Anthropology*: Alfred A. Knopf, Inc.

Heyman, Josiah
2005 "The Political Ecology of Consumption: Beyond Greed and Guilt," In *Political Ecology across Spaces, Scales, and Social Groups*. S. Paulson and L.L. Gezon, ed. Pp. 113-132. New Jersey: Rutgers University Press.

Hill, Marquita K.
2004 *Understanding Environmental Pollution*. Cambridge: Cambridge University Press.

Ignatieff, Michael
1984 *The Needs of Strangers*. New York: Picador USA.

Jennings, Simon, Michel J. Kaiser, and John D. Reynolds
2001 *Marine Fisheries Ecology*. Oxford: Blackwell Science Ltd.

Jordan, David Starr
1929 "Poisonous Fishes in Samoa," *The American Naturalist* 63(687):382-384.

Kanciruk, P.
1980 "Ecology of Juvenile and Adult Palinuridae (Spiny Lobsters)," In *The Biology and Management of Lobsters: Volume II: Ecology and Management*. J.S. Cobb and B.F. Phillips, ed. Pp. 59-96, Vol. 2. New York: Academic Press.

King, Thomas D.
1997 "Folk Management among Belizean Lobster Fishermen: Success and Resilience or Decline and Depletion?" *Human Organization* 56(4):418-426.

Kittaka, J., and J.D. Booth
2000 "Prospectus for Aquaculture," In *Spiny Lobsters: Fisheries and Culture*. B.F. Phillips and J. Kittaka, ed. Pp. 465-473. Oxford: Blackwell Science.

Knight, Alan
1986 "Mexican Peonage: What Was It and Why Was It?" *Journal of Latin American Studies* 18(1):41-74.

Little, Peter D., and Catherine S. Dolan
2005 "Nontraditional Commodities and Structural Adjustment in Africa," In *The Anthropology of Development and Globalization: From Classical Political Economy to Contemporary Neoliberalism*. M.Edelman and A. Haugerud, ed. Pp. 206-215. Malden, MA: Blackwell Publishing.

Lipcius, R.N., and D.B. Eggleston
2000 "Ecology and Fishery Biology of Spiny Lobsters," In *Spiny Lobsters: Fisheries and Culture*. B.F. Phillips and J. Kittaka, ed. Pp. 1-41. Oxford: Blackwell Science.

Macdiarmid, A.B., and J. Kittaka
2000 "Breeding," In *Spiny Lobsters: Fisheries and Culture*. B.F. Phillips and J. Kittaka, ed. Pp. 485-507. Malden, MA: Blackwell Science.

Mackinson, Steven
2001 "Integrating Local and Scientific Knowledge: An Example in Fisheries Science," *Environmental Management* 27(4):533-545.

McCay, Bonnie J.
1978 "Systems Ecology, People Ecology, and the Anthropology of Fishing Communities," *Human Ecology* 6(4):397-422.

McCay, Bonnie J., and James M. Acheson
1987 "Human Ecology of the Commons," In *The Question of the Commons: The Culture and Ecology of Communal Resources*. B.J. McCay and J.M. Acheson, ed. Pp. 1-34. Tucson: The University of Arizona Press.

McDaniel, Josh
1997 "Communal Fisheries Management in the Peruvian Amazon," *Human Organization* 56(2):147-152.

McGoodwin, James Russell
1990 *Crisis in the World's Fisheries: People, Problems, and Policies*. Stanford, CA: Stanford University Press.

Merriam-Webster
2005 Online dictionary: http://www.m-w.com/ November 2005.

Morel, Francois M.M., Anne M.L. Kraepiel, and Marc Amyot
1998 "The Chemical Cycle and Bioaccumulation of Mercury," *Annual Review of Ecological Systems* 29:543-566.

Morrill, Warren T.
1967 "Ethnoicthyology of the Cha-Cha," *Ethnology* 6(4):405-416.

Norton, Roger, Carlo Cappi, Lehman Fletcher, Carlos Pomareda, and Molly Wainer
1978 "A Model of Agricultural Production and Trade in Central America," In *Staff Working Paper No. 276*. Pp. 82. Washington, D.C.: The World Bank.

Ostrom, Elinor, Roy Gardner, and James Walker
1994 *Rules, Games, and Common-Pool Resources*. Ann Arbor: The University of Michigan Press.

Ostrom, Elinor, and Edella Schlager
1996 "The Formation of Property Rights," In *Rights to Nature: Ecological, Economic, Cultural, and Political Principles of Institutions for the Environment*. S.S. Hanna, C. Folke and K.G. Maler, ed. Pp. 127-156. Washington, D.C.: Island Press.

Palmer, Jesse T.
1932 "The Banana in Caribbean Trade," *Economic Geography* 8(3):262-273.

Patton, John S., Mark W. Rigler, Paul D. Boehm, and David L. Fiest
1981 "Ixtoc 1 Oil Spill: Flaking of Surface Mousse in the Gulf of Mexico," *Nature* 290:235-238.

Paus, Eva
1988 "Economic Development in Central America and the Caribbean: The Role of Nontraditional Exports," In *Struggle Against Dependence: Nontraditional Export Growth in Central America and the Caribbean*. E. Paus, ed. Pp. 1-17. Boulder: Westview Press.

Peck, Joel R., and Marcus W. Feldman
1986 "The Evolution of Helping Behavior in Large, Randomly Mixed Populations," *The American Naturalist* 127(2):209-221.

Phillips, B.F., and L.H. Evans
1997 "Aquaculture and Stock Enhancement of Lobsters: Report from a Workshop," *Marine and Freshwater Research* 48(8):899-902.

Phillips, B.F., and A.N. Sastry
1980 "Larval Ecology," In *The Biology and Management of Lobsters*. J.S. Cobb and B.F. Phillips, ed. Pp. 11-57, Vol. 2. New York: Academic Press.

Poggie, John J.
1980 "Maritime Anthropology: Socio-cultural Analysis of Small-scale Fishermen's Cooperatives—Introduction," *Anthropological Quarterly* 53(1):1-3.

Poggie, John J., and Richard B. Pollnac
1991 *Small-Scale Fishery Development: Sociocultural Perspectives*. Kingston, Rhode Island: The International Center for Marine Resource Development.

Polanyi, Karl
2005 "The Self-Regulating Market and the Fictitious Commodities: Labor, Land, and Money," In *The Anthropology of Development and Globalization: From Classical Political Economy to Contemporary Neoliberalism*. M. Edelman and A. Haugerud, ed. Pp. 99-103. Malden, MA: Blackwell Publishing.

Pollnac, R.B.
1981 "The Ethnoicthyology of Small-Scale Fishermen of Puntarenas, Costa Rica: Taxonomy," In *Small Scale Fisheries in Central America: Acquiring Information for Decision Making*. J.G. Sutinen and R.B. Pollnac, ed. Pp. 229-241. Rhode Island: International Center for Marine Resource Development.

Pomeroy, Robert S., and Fikret Berkes
1997 "Two to Tango: The Role of Government in Fisheries Co-management," *Marine Policy* 21(5):465-480.

Rabalais, Nancy N., R. Eugene Turner, and Donald Scavia
2002a "Beyond Science into Policy: Gulf of Mexico Hypoxia and the Mississippi River," *BioScience* 52(2):129-142.

Rabalais, Nancy N., R. Eugene Turner, and William J. Wiseman, Jr.
2002b "Gulf of Mexico Hypoxia, A.K.A. 'The Dead Zone,'" *Annual Review of Ecological Systems* 33:235-263.

Robben, Antonius
1989 *Sons of the Sea Goddess: Economic Practice and Discursive Conflict in Brazil*. New York: Columbia University Press.

Rocha, Jorge M.
2000 "Small Rural Agricultural Producer's Household Demographic Composition and Participation in the Market Economy as Factors Influencing Cognitive Valuation and Usage of Natural Resources in Ancash, Peru." Dissertation, University of Florida.

Romanoff, S.
1992 "Food and Debt among Rubber Tappers in the Bolivian Amazon," *Human Organization* 51(2):122-135.

Roseberry, William
1996 "The Rise of Yuppie Coffees and the Reimagination of Class in the United States," *American Anthropologist* 98(4):762-775.

Sabella, James C.
1980 "José Olaya: Analysis of a Peruvian Fishing Cooperative that Failed," *Anthropological Quarterly* 53(1):56-63.

Scheuer, Paul J., Wataru Takahashi, Junzo Tsutsumi, and Tamao Yoshida
1967 "Ciguatoxin: Isolation and Chemical Nature," *Science* 155(3767):1267-1268.

Scott, James C.
1976 *The Moral Economy of the Peasant: Rebellion and Subsistence in Southeast Asia*. New Haven: Yale University Press.

Sen, Sevaly, and Jesper Raakjaer Nielsen
1996 "Fisheries Co-management: A Comparative Analysis," *Marine Policy* 20(5):405-418.

Shotton, Ross
2000 "Use of Property Rights in Fisheries Management," In *FAO Fisheries Technical Paper* 404/1. Pp. 342. Rome: FAO (Food and Agricultural Organization).

Silvano, R.A.M., and A. Begossi
2005 "Local Knowledge on a Cosmopolitan Fish Ethnoecology of *Pomatomus saltatrix* (Pomatomidae) in Brazil and Australia," *Fisheries Research* 71:43-59.

Smith, Courtland L., and Susan S. Hanna
1993 "Occupation and Community as Determinants of Fishing Behaviors," *Human Organization* 52(3):299-303.

Stonich, Susan C.
1995 "Development, Rural Impoverishment, and Environmental Destruction in Honduras," In *The Social Causes of Environmental Destruction in Latin America*. M. Painter and W.H. Durham, ed. Pp. 63-99. Ann Arbor: The University of Michigan Press.
1993 *"I am Destroying the Land!": The Political Ecology of Poverty and Environmental Destruction in Honduras*. Boulder, CO: Westview Press.

Stonich, Susan C., and John R. Bort
1997 "Globalization of Shrimp Mariculture: The Impact on Social Justice and Environmental Quality in Central America," *Society and Natural Resources* 10(2):161-179.

Stuster, Jack
1978 "Where 'Mabel' May Mean 'Sea Bass'," *Natural History* 87(9):65-71.

Sutherland, Anne
1986 *Caye Caulker: Economic Success in a Belizean Fishing Village*. Boulder, CO: Westview Press.

Thrupp, Lori Ann
1995 *Bittersweet Harvests for Global Supermarkets: Challenges in Latin America's Agricultural Export Boom*. Washington, D.C.: World Resources Institute.

Townsend, Ralph, and James A. Wilson
1987 "An Economic View of the Tragedy of the Commons," In *The Question of the Commons: The Culture and Ecology of Communal Resources*. B.J. McCay and J.M. Acheson, ed. Pp. 311-326. Tucson: The University of Arizona Press.

Tucker, Stuart K.
1992 "Equity and the Environment in the Promotion of Nontraditional Agricultural Exports," In *Poverty, Natural Resources, and Public Policy in Central America*. S. Annis, ed. Pp. 109-141. New Brunswick: Transaction Publishers.

Tzec Valle, Gabino, and Javier Briceno Perez
2005 "Confusa Version de Marea Roja," In *Diario de Yucatan LOCAL*. Pp. 1. Mérida.

Ucan Salazar, Felix
2005 "Descartan que haya Marea Roja," *Diario de Yucatan LOCAL*. June 15, Pp. 1. Mérida.

U.S. Library of Congress
1997 *Mexico: A country study*. Washington, D.C.: Federal Research Division

Van Dolah, Frances M.
2000 "Diversity of Marine and Freshwater Algal Toxins," In *Seafood and Freshwater Toxins: Pharmacology, Physiology, and Detection*. Luis M. Botana, ed. Pp. 19-43. New York: Marcel Dekker, Inc.

Wahle, Richard A.
1997 "Consequences of Fishing, with Regard to Lobster Fisheries: Report from a Workshop," *Marine and Freshwater Research* 48:1115-1119.

Wallerstein, Immanuel
2000 "The Rise and Future Demise of the World Capitalist System: Concepts for Comparative Analysis (1979)," In *From Modernization to Globalization: Perspectives on Development and Social Change*. J.T. Roberts and A. Hite, ed. Pp. 190-209. Malden, MA: Blackwell Publishing.

Warner, Gary
1997 "Participatory Management, Popular Knowledge, and Community Empowerment: The Case of Sea Urchin Harvesting in the Vieux-Fort Area of St. Lucia," *Human Ecology* 25(1):29-46.

Watling, Les, and Elliott A. Norse
1998 "Disturbance of the Seabed by Mobile Fishing Gear: A Comparison to Forest Clearcutting," *Conservation Biology* 12(6):1180-1197.

Wilk, Richard R.
1996 *Economies and Cultures: Foundations of Economic Anthropology*. Boulder, CO: Westview Press.

Wingard, John D.
2000 "Finding Alternatives to Privatizing the Resource: Community-Focused Management for Marine Fisheries," In *Communities and Capital: Local Struggles against Corporate Power and Privatization*. T.W. Collins and J.D. Wingard, ed. Pp. 5-29. Athens: The University of Georgia Press.

Wolf, Eric R.
1997 *Europe and the People Without History*. Berkeley: University of California Press.

BIOGRAPHICAL SKETCH

A native Floridian, Ava Lasseter earned her B.F.A. with highest honors in photography from the University of Florida in 1995. After graduating, Ava spent several years traveling and working overseas. She taught English in both Saudi Arabia and Japan, before working as a SCUBA divemaster for two years in Thailand. Ava returned to Florida where she entered the graduate program in anthropology at the University of Florida as an Alumni Fellow. With a focus on ecological issues, she is interested in the relationship between fishing communities and their marine resources. After completing her thesis as part of her Master of Arts degree, she plans to continue with the PhD program in anthropology.