BEYOND COLLECTIVE ACTION: A MULTI-SCALE ANALYSIS OF SUSTAINABILITY IN THE MANGROVE FISHERY COMMONS OF COASTAL ECUADOR

by

CHRISTINE MARIE BEITL

(Under the direction of Bram Tucker and Julie Velásquez Runk)

ABSTRACT

For decades, the conversion of coastal mangrove forests for shrimp aquaculture in Ecuador has exacerbated harvesting pressures on mangrove cockles (*Anadara spp.*), bivalve mollusks collected by artisanal fishers for subsistence and commercialization. Bridging human ecology with conventional theories about collective action and the commons, this dissertation explores the intricate relationship between individuals, institutions, and the environment in mangrove-associated fisheries of coastal Ecuador. I use ethnographic and fishery data, statistical analysis, and geographic information systems (GIS) to evaluate the social and ecological effects of customary norms, policy change, common property arrangements, and collective action on the cockle fishery and its mangrove habitat. Drawing on 21 months of multi-sited fieldwork from 2006 to 2010, I demonstrate that the problem of the commons largely depends on scale, characteristics of resource systems and their social histories, and the differential nature of collective action problems. Government-granted community stewardships for mangrove conservation represent new institutional arrangements and ways of valuing mangroves

that empower artisanal fishers; however, they have simultaneously created a new hierarchy of access, which may potentially undermine fishery sustainability. Finally, I illustrate how customary norms in artisanal fishing shape spatial aspects of the fishing effort and ensure reliable returns, even in the absence of formal property arrangements often presumed to promote sustainability. Such forms of internal regulation have important policy implications; although they may be undermined on larger scales and in the context of political, economic, and environmental change. I conclude that a more robust understanding of the commons problem requires theoretical and methodological revision that moves beyond traditional institutional and collective action perspectives rarely linked directly to environmental outcomes in the literature. I further argue for a more holistic definition of the commons problem that accounts for the different ways in which resources are valued by diverse actors (determining their exploitation, management, or conservation) and how *subtractability* and *exclusion* issues should be analyzed in their broader social, political, and ecological context. This dissertation contributes to interdisciplinary research on the complex causes and consequences of environmental change and provides foundational frameworks for the study of sustainability, environmental governance, and political ecology of the commons.

INDEX WORDS: Commons theory, collective action, institutions, property rights, open-access, fisheries, mangroves, shrimp aquaculture, coastal landscapes, interdisciplinary research, human ecology, environmental anthropology, political ecology of the commons, sustainability science, community-based management, *Anadara tuberculosa* and *A. similis*, catch-per-unit-effort (CPUE)

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# DEDICATION

I dedicate this dissertation to all artisanal fishers and coastal communities throughout the world that are confronted by degradation, overexploitation, and global environmental change.

In memory of Robert E. Rhoades for his commitment to sustainability science and applied anthropology.

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Many people ask me how I became interested in the coastal commons and the mangrove cockle fishery in Ecuador. My fascination for the culture and environment of Ecuador began many years ago when I first stepped off the plane into the steamy atmosphere of Guayaquil's international airport in 1997 as a study abroad student. But the truth is that I had never heard of mangrove cockles during my time as a student in Ecuador. It wasn't until I began my exploratory dissertation research in Muisne during the summer of 2006 that I met Helen Wittler, a German biologist conducting her master's research on mangrove cockles. As I told her about my interest in studying the social and ecological impacts of shrimp farming on coastal communities and fishery-based livelihoods, she invited me to tag along and assist her with recording biological data while chatting informally with many different cockle collectors (*concheros*). Through these casual conversations, I learned that their struggles were much more complicated than coping with the legacy and impacts of shrimp farming on their livelihoods. Their dependence on a declining resource reified a reality which many people around the world are familiar—the problem of the commons.

Many *concheros* in Ecuador are generous, collaborative, and willing to share their stories, despite their initial timidity. After two years working with several *concheros* in the provinces of Esmeraldas and El Oro, I have gained a deep appreciation for their insights about the world, and the ways in which they have inspired me to continue learning about different people, environments, and livelihood challenges. If not for their

willingness to collaborate and tolerate what may have seemed to them as absurd interview questions, this research would not have been possible. Above all, I am indebted to my friends in the field for working with me as field guides and research assistants, and most importantly, for their friendship. In particular, I thank my friends in Isla Costa Rica, Adolfo Cruz, Sonia Cruz, Estela Cruz, and Miguel Cruz; and in Muisne, Adrian Vargas and family and William Chila and family. I am also grateful to the Asociación Isla Costa Rica for their collaboration and implementation of the community cockle monitoring project and to everyone else in Isla Costa Rica for their generous hospitality, curiosity, and always helping me feel at home and *enseñada* (accustomed to) to life on the island.

Much of the success of this project is also attributed to the assistance and friendship of my colleagues at several Ecuadorian institutions, in particular, the Instituto Nacional de Pesca (INP) who invited me to accompany them on their monthly excursions to monitor the fishery in five major ports, which in many ways facilitated my broader understanding of the social, ecological, and political context of the fishery. I am especially grateful to Elba Mora and Juan Moreno for sharing their expertise, orienting me to different field sites, and helping me coordinate research activities and workshops with *concheros*. I am further indebted to Elba for introducing me to Adolfo Cruz from Isla Costa Rica and to Juan for referring me to Adrian Vargas in Muisne who exceeded my needs and expectations as an excellent guide and field assistant.

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Doing dissertation research is a process of discovery and invention, exploration and verification, and trial and error. But field research and writing a dissertation is only a small part of a much broader process of learning, researching, teaching, and socializing.

My journey as a scholar has been wrought with many challenges as I overcame insecurities and achieved accomplishments along the way, all due to the unwavering support and encouragement from many individuals.

I am most indebted to my dissertation committee, in particular my committee chairs, the late Robert Rhoades, and my co-chairs Bram Tucker and Julie Velásquez Runk. Bob Rhoades's multi-disciplinary perspectives on both theories and practices of development and resource management have significantly inspired my research throughout many stages. Losing my mentor while I was in the field was not only a shock, but also an emotional challenge during my final years in the program. Bob Rhoades warmly received me upon my entry into the Ph.D. program in 2005, supported me through many stages, and always encouraged me to go out on a limb facilitating my curiosity, exploration, and creativity to carry on his scholarly legacy through the study of sustainability science. His belief in me as a scholar and his unconditional encouragement has gotten me through some of the most challenging moments as a graduate student. I am indebted to Bram Tucker and Julie Velásquez Runk for stepping up as dissertation committee co-chairs and guiding me through the final hour. They have provided invaluable support and mentorship since the beginning as my committee members, and in this final stage, they worked closely with me to help me analyze my data, write my results, and ultimately define myself as a scholar.

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program in Fiji. Even though Ted Gragson joined my committee much later, I would like to acknowledge his constructive feedback during early stages of my research and in the final drafts of this dissertation. To Tommy Jordan, I would like to express my gratitude for his willingness to work with me and his patience, particularly in my struggles with GIS. I am also grateful to Kim Love-Myers in Statistics for always being eager to help and making the sincere effort to understand both my data and research design. Additionally, I acknowledge several other faculty members from whom I gained much deeper understanding about anthropology and interdisciplinary scholarship as a student in their classes, as their teaching assistant, or through informal conversations, in particular, Brent Berlin, Virginia Nazarea, Sergio Quesada, John Chamblee, Bob Matthews, Uttiyo Raychaudhuri, Mikell Gleason, and Derrick Lemons.

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# CHAPTER 1

# INTRODUCTION

## Research Problem Description and Justification

Global trends like population growth, urbanization, development, and rising market demand for seafood products have been transforming coastal zones and their associated artisanal fisheries for decades. Coastal mangrove forests have been among the most vulnerable forest types to such forms of global change for their widespread undervaluation that has often led to their conversion for other uses (Cormier-Salem 2006; FAO 2007; Alongi 2002; Valiela, Bowen, and York 2001). In Ecuador, mangrove deforestation for shrimp aquaculture has exacerbated harvesting pressures on mangrove cockles (*Anadara tuberculosa* and *A. similis*), bivalve mollusks harvested from the roots of mangrove trees at low tide by artisanal fishers for subsistence and commercialization (Figure 1.1). Initially, I set out to investigate the social and ecological impacts of shrimp farming on local livelihoods, a world-wide problem well-documented in the literature (Dewalt, Vergne, and Hardin 1996; Primavera 1997; Cruz-Torres 2000; Martinez-Alier 2001; Stonich 1995; Stonich and Vandergeest 2001). I was inspired by stories about local resistance movements and the subsequent growth of civil society, and I speculated about the ways that collective action may have differentially facilitated the ability of coastal communities to overcome problems of environmental degradation in Ecuador. During my exploratory research in 2006, I was invited to tag along with a biologist conducting her master's research on mangrove cockles. From numerous informal conversations with

different cockle collectors (hereafter referred to as *concheros*), I learned that their struggles were much more complicated than coping with the legacy of shrimp aquaculture. Their dependence on a declining resource reified a reality which many people around the world are familiar—the problem of the commons.


Figure 1.1: (Left) A *conchero* gathering cockles in the mangroves. (Right) Each of the two principal species gathered for subsistence and commercialization in Ecuador with their postlarvae attached: *A. tuberculosa* (above) commonly referred to as *concha prieta, la negra*, *la hembra*, or in Colombia, *piangua*; and *A. similis* (below) commonly referred to as *el macho* or *la mica* in Ecuador.

Anthropological theories about human-environment interactions have much to contribute to interdisciplinary research on the commons with broader relevance for sustainability science. Common pool resources are generally characterized by joint ownership, entitlement by multiple users, or a certain degree of open-access, which makes them vulnerable to overuse, or as Garrett Hardin (1968) put it, a "tragedy of the commons." Commons theory has advanced understanding about the ways in which people and communities are able to self-organize for the maintenance or improvement of resource systems (Feeny, Hanna, and McEvoy 1996; Ostrom 1990; Agrawal 2001; McCay and Acheson 1987; Ostrom et al. 2002). Much of this research has emphasized the crucial role of institutions and collective action (Ostrom 1990; Agrawal 2001), or the

ability of individuals to coordinate their actions (Smith 2010); property rights (Hanna and Munasinghe 1995; Bromley and Feeny 1992; McKean 2000); or customary norms that do not fit institutional approaches to studying the commons (Wagner and Talakai 2007; Acheson 1987). Despite the multitude of case studies about common property and folk management of marine systems, relatively few studies use biological and social data at the same time to more holistically address questions about sustainability in a social, economic, and ecological sense (Pollnac and Johnson 2005; Berkes 2005). Additional challenges concern the problem of scaling up local lessons (Berkes 2005; Ostrom et al. 1999) and the spatial nature of the commons problem (Giordano 2003). In this study, I bring together perspectives from human ecology and conventional theories about collective action in the commons to explore the intricate relationship between individuals, institutions, and the environment in mangroves and their associated fisheries of coastal Ecuador.

Like many common pool resources, fisheries are a classic commons problem characterized by their *subtractability* and *excludability*, in which resource extraction by some users compromises the ability of other users to maximize their returns and the exclusion of users is difficult (Ostrom et al. 1999; Feeny, Hanna, and McEvoy 1996). These characteristics as a common pool resource often undermine social, ecological, and economic aspects of sustainability in fisheries. Recent studies by Ecuador's National Fisheries Institute (INP, Spanish acronym) have shown evidence of increasing harvesting pressures in the cockle fishery in Ecuador (Mora and Moreno 2009; Mora, Moreno, and Jurado 2009, 2011). Top-down regulatory measures prohibiting the harvest and commercialization of shells less than 45mm in length have been in place since the year

2001.[1] However, in certain small communities with special community-managed mangrove concessions called *custodias* (literally "stewardships"), local associations have their own defined rules and regulations concerning use and access to mangrove fishery resources, similar to the common property regimes described by Ostrom (1990).[2]

As a different kind of common pool resource system, the sustainability of coastal mangrove forests in Ecuador has been undermined for different reasons than mangrove-associated fisheries. Largely undervalued for the prospect of export-led growth promised by the rapid development of shrimp aquaculture, about one-fourth of Ecuador's coastal mangrove forests have been converted into shrimp farms since the early 1980s (Bailey 1988; Martinez-Alier 2001; Parks and Bonifaz 1994; CLIRSEN-PMRC 2007). Poorly enforced Forestry laws and the heterogeneous nature of the coastal zone with its conflicting jurisdictions has enabled the most politically and economically powerful people from Ecuador and abroad to promote the rapid expansion of the shrimp industry as a producer of one of the country's top exports behind bananas and oil. Much of the landscape degradation has further marginalized the poorest fishermen on the coast who have traditionally depended on mangrove resources and fisheries for their livelihoods. These larger-scale processes of mangrove landscape degradation have exacerbated the problem of the commons in mangrove-associated fisheries. Many artisanal fishermen throughout Ecuador have associated the declining fish stocks with shrimp farming.

In this research, I seek to understand how collective action is one of many mechanisms to overcome the problem of the commons in artisanal fisheries and their broader mangrove habitat. Specifically, the research questions are:

[1] Acuerdo Ministerial No. 170, published in *Registro Oficial* No. 453, del 14 de noviembre de 2001.
[2] Acuerdo Ministerial No. 172 published in *Registro Oficial* No. 208 en el 20 de enero de 2000.

1) How does collective action, in the form of grassroots resistance movements, local institutions, common property arrangements, and cross-scale institutional interactions contribute to social, economic, and ecological sustainability?
2) If it is possible to meet the goals of collective action by improving or maintaining the resource base, then how are the benefits distributed for the common good?
3) How do other forms of social organization like customary norms in fishing contribute to sustainable interactions between people and resources, and how might those arrangements be undermined on larger scales or by broader social, political, and environmental change?

The presence of *custodias* (community-based mangrove stewardships) and local fishing associations allows me to test several hypotheses about the effects of institutions and different management strategies on the behavior of individuals toward common pool resources while situating them in their ethnographic context. Moreover, the changing policy environment concerning the ways that mangroves are valued and exploited (from their destruction during the 1980s and 1990s to their conservation from 2000 to present) has made Ecuador an ideal location to study complex interaction between people and resources. First, I ethnographically explore customary norms in the fishery, how fishing space is socially produced, and implications for sustainability (St. Martin 2004). Second, I draw upon Ruttan's (2008) distinction of the two ways to measure the success of collective action: 1) *provisioning of goods*, measured by assessing the quality of the resource base; 2) *collective action problem*, or measuring the degree to which individuals obey the rules-in-use or participate in management regimes. Finally, I use Ribot and Peluso's (2003) theory of access to develop a political ecology of the commons.

By studying two kinds of common pool resource systems (mangroves and mangrove-associated fisheries), I demonstrate that sustainable commons are not limited to institutional arrangements and that institutions alone do not guarantee the ability of user groups to overcome collective action problems in the commons. In turn, collective action is largely shaped by environmental conditions, characteristics of resources and their social histories, and interactions between different actors. The benefit of studying two distinct resource systems in parallel ways has elucidated the need to more broadly define the commons problem beyond subtractability and exclusion issues toward a more holistic definition that accounts for the differential ways in which common pool resources are valued and subsequently exploited, managed, or protected. This research contributes to the growing scholarly interest in the complex causes and consequences of environmental change (Janssen et al. 2006; National Research Council 1999; Young et al. 2006) and further aims to provide a foundation for the establishment of frameworks for the study of environmental governance, sustainability, and the political ecology of the commons. Moreover this ethnographic account of the Ecuadorian cockle fishery contributes to the commons literature in Latin America (Velez 2011; Gibson, McKean, and Ostrom 2000; Lu 2001) and marine resource management in the region (Gallardo Fernandez and Friman 2011). Given the precarious state of natural resources worldwide, this research also has significant practical implications for policies concerning sustainable coasts and fisheries.

Methods

Drawing on social and ecological data gathered during 21 months of multi-sited fieldwork from 2006 to 2010, I triangulate ethnographic methods with catch-per-unit-

effort (CPUE) and Geographic Information Systems (GIS). After exploratory research in 13 different communities and major ports for cockle landings, I selected four study areas for more in-depth ethnographic research and the collection of CPUE data (Figure 1.2). Additionally, I supervised the community-based collection of fishing effort data from January to June 2010 by the local fishing association in Isla Costa Rica, El Oro Province (see Chapter 3 and Beitl and Cruz 2010).

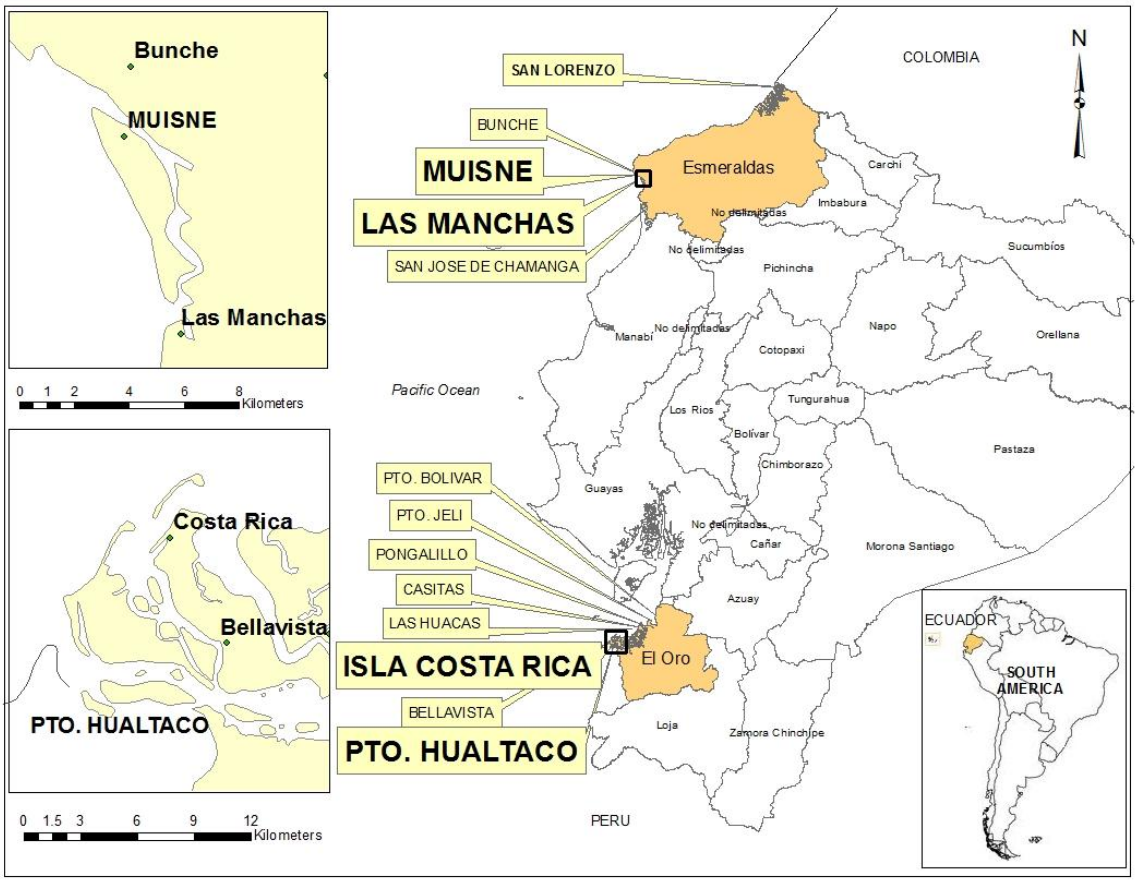


Figure 1.2: Map of the four main study areas (in bold) and additional study areas for exploratory research in the provinces of Esmeraldas and El Oro.

After much exploratory research during the summers of 2006 and 2008, and in February and March of 2009, I designed a semi-structured questionnaire to be administered to *concheros* in the four study areas (n=153). Many of the questions were

based on theoretical constructs from the literature and my observations during the exploratory phases (Johnson 1998). Some questions were adapted from Ecuador's National Fisheries Institute surveys. The final questionnaire was divided into four parts: 1) information about the catch, gathering grounds, and activity of cockle collecting; 2) baseline demographic information; 3) perceptions about change in mangroves and the cockle fishery over the last ten years; 4) participation in activities considered various forms of collective action and household level livelihood strategies (Appendix A). I counted and measured the length of every shell in each catch with a digital Vernier caliper, occasionally measuring the catch by the same person on one or more different trips. This resulted in a sample of shells gathered from 71 different gathering grounds over the four study areas (n=12,433). I created a separate set of open-ended questions for members of associations to facilitate my understanding about group motivations, expectations, and the historical context of civil society (Appendix B). In each study area, I conducted at least one focus group with 3 to 25 participants to present preliminary results for verification and to generate further discussion about social organization and the state of common pool resources on the Ecuadorian coast.

Finally, I gained much understanding about the ethnographic context through my extended homestay in Isla Costa Rica; informal conservations with a variety of actors; participatory mapping of gathering grounds with a Garmen Etrex Vista Global Positioning System (GPS); and participant observation in diverse livelihood strategies, such as gathering cockles, clams, snails, and crabs and fishing with different artisanal methods like gill-net, line and hook, purse seine, and cast-net. In Muisne only, I participated in one harvest on a small-scale shrimp farm. I interviewed artisanal fishers,

middlemen and marketers of mangrove products, government officials, representatives from non-government organizations (NGO), members of local fishing associations and cooperatives, activists, shrimp farmers, and biologists from various institutions and communities throughout the coast.[3] I further elaborate on methods of data collection, sampling, and analysis in the methods sections of each chapter.

Chapter Objectives

In Chapter 2, I review current research on the commons and its implications for interdisciplinary research and coastal management. Since much of commons theory has been developed by social scientists around a typology of property regimes, I argue for the need to combine social and ecological data and for greater attention to issues of scale beyond local common property institutions. I discuss the ways in which collective action theories and ethnographic research on the commons as embedded cultural systems are well-positioned to address some of the gaps in commons theory. Since collective action theories focus on individuals as units of analysis, it can be studied at multiple levels and across scales. I further suggest that more attention to open-access, free-for-all situations (even if analyzed on a micro-scale) can provide important insights about human-environmental interactions at larger scales where actors, resources, and property arrangements are heterogeneous and often transcending explicit boundaries.

Chapter 3 provides an in-depth ethnographic description of the fishery and builds on the notion of the commons as embedded systems (McCay 2002; Wagner and Talakai 2007). By combining GIS, CPUE, and ethnographic analysis, I explore how fishing space is socially produced (St. Martin 2004), how customary norms develop over time, and implications for fishery stability. I argue that decisions about where to fish are

[3] For a full list of participating institutions, see the Acknowledgments section of this dissertation.

shaped by social norms, habit, traditions, networks, organization of labor, ecological conditions, and mutual respect among cockle collectors. Such informal forms of social organization have traditionally ensured relatively reliable and equitable returns for cockle collectors, even in the absence of property arrangements often presumed to promote sustainability. This internal regulation of the fishery may be undermined on larger scales and under conditions of broader social and political change.

In Chapter 4, I use Ostrom's (2011) Institutional Analysis and Development (IAD) framework to analyze how common property institutions in Isla Costa Rica effectively regulate the cockle fishery through sustainable management that promotes habitat health, higher catch-rate returns, and economic benefits. Through a statistical analysis of shell length and catch size under different management regimes in Isla Costa Rica and in the neighboring study area of Puerto Hualtaco in El Oro Province, I present evidence for significantly larger catch and shell sizes harvested from the *custodias*. In my conclusions, I caution that *custodias* are not evenly distributed among cockle collectors; as a result, problems of overexploitation may have been deflected to near-by open access areas with no formal institutional arrangements.

In Chapter 5, I analyze the relationship between collective action and the environment focusing on the similarities and differences between contribution and subtractability problems in collective action. Specifically, I compare whether there are differences between members of associations and independent *concheros* in their participation in activities that contribute to mangrove conservation and in their fishing behavior as two distinct collective action problems. I find that institutions for collective action foster greater participation in mangrove conservation (contribution), but do not

seem to influence fishing behavior (subtractability). I suggest that these ambiguous outcomes are attributed to the dissimilar physical characteristics and social histories of each resource system and the differential nature of collective action problems.

In Chapter 6, I evaluate the social implications of *custodias* for sustainability to develop a framework for studying the political ecology of the commons. I draw on Ribot and Peluso's (2003) theory of access to illustrate the ways in which *custodias* have exacerbated social tensions in the struggle over resources and territory, an unintended consequence of an innovation that was originally implemented as a solution to mangrove degradation and overexploitation. The chapter critically explores the social and political dimensions of policy change that resulted in the community mangrove concessions by drawing attention to the ways that common property arrangements can act as political agents in their own right, as also pointed out by Reddy (2002). I further discuss the ways that policy change may have played a role in shaping a tragedy of enclosures by displacing independent cockle collectors.

In Chapter 7, I summarize the major findings and their contributions to commons theory, sustainability science, and political ecology. I contend that a more robust understanding of the commons problem requires theoretical and methodological revision that moves beyond conventional institutional and collective action perspectives rarely linked directly to environmental outcomes in the literature. I further argue for a more holistic definition of the commons problem that accounts for the different ways in which resources are valued by diverse actors and how *subtractability* and *exclusion* issues should be analyzed within their broader social, political, and ecological context. I conclude the chapter with suggestions for future research.

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# CHAPTER 2

# COLLECTIVE ACTION AND SUSTAINABILITY IN THE COASTAL MANGROVE FISHERY COMMONS

## Introduction

Research on the commons has advanced significantly over the past several decades since the ecologist Garrett Hardin (1968) proposed that natural resources will collapse in the face of population growth. While there is merit to the argument that many resources are susceptible to overuse and degradation, the main critique of Hardin's argument by social scientists has been his assumption that all resources are open for a free-for-all and humans are anti-social agents acting independently of their social, cultural, and ecological context. Strengthened by a multitude of case studies illustrating the ways in which people and communities are able to self-organize, the broad body of literature on the commons has often emphasized diverse institutions or embedded cultural practices that evade a "tragedy of the commons" and sometimes enable social, economic, and ecological sustainability (McCay and Acheson 1987; Gibson, McKean, and Ostrom 2000; Ostrom 1990; Agrawal 2001; Feeny, Hanna, and McEvoy 1996).

A central theme within the commons literature has concerned questions of sustainability and conditions under which people are able to coordinate their actions to avoid the tragedy. In the commons literature, sustainability is broadly conceived as the maintenance (or improvement) of a resource system, shared facility, or institution to ensure a continued flow of benefits for each user (Ostrom et al. 2002; Agrawal 2001).

Social aspects of sustainability in the commons generally refer to issues of equity, the distribution of costs and benefits, and differential abilities to pay or contribute to maintenance (Ostrom et al. 2002: 26). This chapter reviews the current state of the literature on commons theory and concludes with future directions for interdisciplinary research on coastal and marine commons.

## Commons Definitions and Theory

The term commons generally refers to resources, facilities, or property institutions that involve "some aspect of joint ownership or access" (Ostrom et al. 2002: 18). Common pool resources are natural or human-made, and are often characterized by their wide-range accessibility by multiple users and two fundamental problems: 1) excludability, or the difficulty of excluding other users; and 2) subtractability, or the ways in which users reduce resource availability for other individuals harvesting from the same source (Ostrom et al. 1999; Buck 1998). Because of these characteristics, the commons are vulnerable to free-riding in the form of overuse by individuals without concern for negative effects on other users, and their lack of contributions to maintaining or improving the resource base (Ostrom et al. (1999: 279).

Commons theory has operated around a typology of property-rights systems that affect the governance of resources and potentially mitigate free-riding or overuse: 1) private property; 2) government property; 3) common property; and 4) open access (Ostrom et al. 1999; Feeny et al. 1990). Of the four categories, the literature has given the most attention to common property theory since it was largely a reaction to Hardin's (1968) confusion about the differences between common property and open-access. It is important to keep in mind that these categories are conceptual and that resource systems

are often contain a mixture of property rights arrangements in reality (Satria, Matsuda, and Sano 2006; Wagner and Davis 2004; Feeny et al. 1990). Furthermore, since open-access is defined as "the absence of enforced property rights" (Ostrom et al. 1999: 279), the other three property rights systems (government, private, and common property) are arguably all susceptible to some degree of open-access.

As mentioned, the main contribution of commons research has been the development of common property theory concerned with how it is possible to mitigate problems of overuse and free-riding under appropriate institutional arrangements (Ostrom 1990; Agrawal 2001; Ostrom et al. 1999). Distinct from common pool resources, a common property regime refers to a system of collective ownership in which resource rights are controlled by a group (Satria, Matsuda, and Sano 2006). Property rights are more generally defined as a set of social relations that define rules of use, affect decision-making powers over resources and interactions between people (Gibson, McKean, and Ostrom 2000; Bromley and Feeny 1992). Thus, common property regimes are not much different than private property (McKean 2000) and there has been great interest in the ways that property rights possibly contribute to sustainable governance of the commons (Bromley and Feeny 1992; Hanna and Munasinghe 1995, 1995; Richards 1997; Schlager and Ostrom 1999; Hanna, Folke, and Mäler 1996).

Common property scholars have long maintained that strong local institutions can play an important role in resource conservation and management (Ostrom et al. 1999; Ostrom 1990; Smith and Berkes 1991; Smith and Berkes 1993; McCay and Acheson 1987; Agrawal 2001; Becker 1999, 2003; Becker et al. 2005; Hanna, Folke, and Mäler 1996; Agrawal and Gibson 1999). For example, strong local organization, experience

with coastal disasters, local understanding of ecology, and collaboration through partnerships has led to successful forest preservation in Ecuador (Becker 2003). The local common property arrangements under the *ejido* system in Southeast Mexico have contributed to sustainable landscapes, low deforestation rates, and improved livelihoods for forest communities (Bray et al. 2004; Bray et al. 2003). The revitalization of customary marine tenure systems may have contributed to conservation of marine resources throughout the South Pacific to varying degrees (Johannes 2002; Aalbersberg, Tawake, and Parras 2005; Aswani 2005). As argued by Ostrom (1990), the presence of traditional institutions can facilitate strong local organization. On the other hand in some cases, local institutions can be strengthened in relatively short periods of time to build resource rights and new rules designed to mitigate overexploitation (Smith and Berkes 1993; Beitl 2011).

Commons research to date has been a mixed bag of success stories and failures (Ostrom et al. 2002). Because of the large emphasis on property rights and institutions in the literature, Agrawal (2001) has argued for the systematic analysis of case studies to evaluate the sustainability of governance systems to advance common property theory. His proposed model for case-comparative analysis identified 35 factors broadly classified into four general categories incorporating information about resource characteristics, community characteristics, institutional arrangements, and contextual factors. While it is important to understand institutional mechanisms and social relations concerning the commons, there have been relatively few case studies that combine both ecological and social data (Anderies, Janssen, and Ostrom 2004; Berkes 2005; Pollnac and Johnson 2005). Questions about epi-phenomenal conservation and whether people cooperate for

gain or restraint within the commons still remain relatively unexplored (Ruttan 1998). Furthermore, there is a need to theorize open-access and the social, cultural, and environmental factors that affect the distribution of resource users in free-for-all situations (Moritz et al. 2010), since all kinds of property arrangements may be subject to some degree of open-access.

Finally, a long-standing question has concerned the issue of scaling up the lessons learned about the commons from localized case studies to understand human-environmental interactions at various levels and within their larger social, political, economic, and ecological contexts (Berkes 2005; Ostrom et al. 1999). As argued by Giordano (2003: 365), "the commons problem is geographic in nature, in that the phenomenon is predicated on the relationships between the spatial domains of resources and resource users." I argue that more attention to open-access situations, even if analyzed on a micro-scale, can provide important insights into the nature of human-environmental interactions across scales where actors, resources, and property arrangements are heterogeneous and often transcending explicit boundaries. In the following sections, I will discuss the ways in which theories of collective action and ethnographic investigation of the commons as embedded cultural systems are well-positioned to address some of these gaps in commons theory.

Collective Action and Cooperation in the Commons

Collective action has been widely accepted as the foundation behind successful governance of the commons (Ostrom 1990; Kurien 1995; Ostrom, Gardner, and Walker 1994). For a long time, much of the common property literature has tended to overlook individual-level factors contributing to collective action behind the institutional

arrangements (Folke and Berkes 1995). Largely influenced by rational choice perspectives concerning individual costs and benefits (Olson 1965; Hardin 1982), collective action is broadly defined as cooperation among individuals or coordination of individual actions for a common goal (Ostrom 1998; Smith 2003). Similar to common pool resource dilemmas described by Ostrom et al. (1999), collective action has been conceptualized from two analytical perspectives: 1) an individual's contribution of time or resources for collective benefit (Hardin 1982; Tilly and Tilly 1981; Beard 2007; Olson 1965); 2) overuse of common pool resources without concern for negative impacts on others (Ostrom, Gardner, and Walker 1994; Ostrom et al. 1999).

Much of the collective action literature has sought to understand the conditions under which cooperation and collective action outcomes are likely. Russell Hardin's (1982) theory of collective action has emphasized the importance of individuals within groups. Since collective action is concerned with individual-level analysis, it should explain the internal factors that contribute to group heterogeneity that allows cooperation to emerge in some cases but not in others (Hardin 1982). A focus on individual-level contributions can elucidate intra-community variation and existing inequalities with implications for how benefits of collective action are distributed (Beard 2007).

Specifically addressing the free-rider problem, Olson (1965) has argued that large groups are less likely to achieve collective action than small groups, which has been supported by many case studies of common property regimes (Ostrom 1990; Agrawal 2001). As argued by Folke and Berkes (1995), individual resource use is usually regulated by some form of institutions, social controls, or sanctions. Beyond the ways in which cooperative behavior and reciprocity may be mediated by formal and informal

institutions (Agrawal 2001; Ostrom 1990), some evolutionary perspectives have suggested that cooperation is regulated by a psychological system manifested through guilt, human emotion, friendship, dislike, moralistic aggression, gratitude, sympathy, trust, suspicion, and trustworthiness (Trivers 1971; Kurzban 2003).

Significant advances along these theoretical lines have been made in experimental economics and game theory that examine individual-level differentiation in collective action and the ways in which collective action and cooperation are conditional (Fischbacher, Gachter, and Fehr 2001). Key findings from experimental research demonstrate that collective action is likely to increase with trust and negotiation (Ostrom 1998; Ostrom and Walker 2003; Ledyard 1995), reciprocity (Axelrod and Hamilton 1981), communication (Smith 2010), or the ability to punish non-cooperators (Boyd and Richerson 1992; Fehr and Gachter 2000). Other experimental research in the field has investigated cross-cultural variability in the propensity of individuals to cooperate (Henrich et al. 2005; Henrich et al. 2004; Cardenas and Ostrom 2004).

Despite the wealth of research on common property institutions and collective action, very few examine human-environmental interactions directly to evaluate specifically the effects of collective action or cooperation on environmental outcomes (Rustagi, Engel, and Kosfeld 2010). Most experimental designs are limited to hypothetical scenarios about public goods without incorporating empirical field observations linking human behavior to resources. This is important since some research has shown that experimental games are not robustly correlated with empirical ethnographic observations; therefore the use of games as a method should complement, but not replace ethnographic research (Gurven and Winking 2008).

Embeddedness and the Political Ecology of the Commons

Looking beyond property rights systems and collective action, other researchers have studied the commons as embedded cultural systems that do not always conform to institutional perspectives or rational choice theories (Wagner and Davis 2004; Peters 1987; McCay and Jentoft 1998; McCay 2002; Wagner and Talakai 2007). From this perspective, property rights are only a piece of the puzzle, embedded within cultural contexts and broader economic, social, and political relations that are subject to change at particular historical junctures (McCay and Jentoft 1998). Customary marine tenure systems are good examples of embedded systems that have traditionally regulated their resources through kinship-based access rights, territoriality, or resource taboos (Cinner, Marnane, and McClanahan 2005; Colding and Folke 2001; Acheson 1987). While resource users may be motivated to sustain their resources and cultural meanings of their livelihoods as embedded cultural systems (Wagner and Davis 2004; McCay and Acheson 1987), their traditionally self-regulating commons systems are often vulnerable to exogenous threats of migration, markets, or policy change (Acheson and Brewer 2003; Johannes 1978; Thomas 2001; Cinner 2005; Cinner and McClanahan 2006).

McCay (2002) has argued that approaching the study of the commons as embedded cultural systems is not much different than event ecology (Vayda and Walters 1999; Walters and Vayda 2009) or political ecology perspectives on the commons (Campbell 2007; Reddy 2002; Greenberg 2006). McCay (2002) suggests it is necessary to build on existing institutional perspectives on the commons to explore the local factors and their broader political and economic context. She suggests that event ecology advocates one such bottom-up approach to explore the causes and consequences

associated with particular events. She further suggests that political ecology, with its attention to power relations, can elucidate processes at multiple levels that affect the state of the commons at multiple scales.

Political ecologists have contributed to understanding the commons through an analysis of material and ideational struggles over common pool resources (Reddy 2002; Campbell 2007; Greenberg 2006; Martinez-Alier 2001; O'Flaherty 2003). Rather than adopting the tragedy of the commons narrative, Greenberg (2006) has suggested a "tragedy of commoditization" in the Upper California Gulf fisheries where certain resources have been privileged over others through the process of zoning. Similarly, Martinez-Alier (2001) has suggested a "tragedy of enclosures" where the expansion of shrimp farming in Ecuador has been driven largely by insatiable global demand for cheap shrimp. Campbell (2007) has analyzed conservation discourse at various scales and its effects on local rights of access to sea turtle eggs. Others have analyzed the ways in which common property institutions can act as political agents (Reddy 2002) with the power to "include and exclude simultaneously" (O'Flaherty 2003).

As argued by Campbell (2007), both common property theory and political ecology are well-positioned to strengthen each other's theoretical propositions. She suggests that common property theory allows for a more nuanced analysis of different kinds of property rights while political ecology brings attention to differential power relations and addresses questions about who decides on the rules, rights of access, and entitlement. While Campbell's call for a focus on differential power and property rights with attention to sociopolitical and geographic scale provides a useful analytical

framework for conservation policy and practice, the same argument can be made for sustainable commons more generally.

The Commons and the Issue of Scale

The nature of the commons problem is inherently spatial with "particular spatial characteristics related to resource domains and rights assignment" that may be understood differently depending on scale (Giordano 2003: 367). For about a decade, researchers of the commons have raised questions about whether local lessons can be scaled up from single resource systems to understand global complexity in the commons (Berkes 2005; Ostrom et al. 1999). While the natural sciences have long worked with spatial and temporal dimensions of heterogeneity, the social sciences have been less explicit in addressing issues of scale (Gibson, Ostrom, and Ahn 2000). As the previous section has shown, political ecology perspectives on the commons have begun to move in this direction. On the other hand, like common property theorists, many political ecologists may have fallen into what Brown and Purcell (2005) call "the local trap," in which policies and processes at the local scale may not have the same desirable effects at larger scales. Thus, more attention to scale would not only benefit political ecology (Purcell and Brown 2005), but also commons theory (Ostrom et al. 1999).

Despite the spatial nature of the commons problem based on relationships between the spatial domains of the resources and the resource users, there has been relatively little input from geographers in the development of commons theory (Giordano 2003). As argued by Giordano (2003), a focus on "exclusivity" from the property rights framework ignores the transboundary and migratory or open-access nature of many common pool resources. He further argues that the typology of ownership is problematic

since the ownership unit itself is singular, but the owners can be singular or multiple, which has implications for understanding and addressing problems at multiple scales. Finally, he suggests that the commons problem arises when the resource rights of two or more users overlaps or intersects within a resource domain, which is most common in open-access situations or with migratory and fugitive resources (Giordano 2003). Examples of migratory and fugitive resources can be seen in Campbell's (2007) work on sea turtles and Berkes's (2005) discussion about tuna fisheries.

Scaling up local understanding of human-environmental interactions is further complicated by increasing heterogeneity of users, user groups, institutions, and technologies used to exploit multiple species. The management of migratory marine resources for example transcends local boundaries in which users have the opportunity to develop shared values, mutually agreed-upon rules to effectively impose sanctions on those who break the rules (Berkes 2005). The benefit of collective action theory is that it is not necessarily limited to common property institutions and can be studied at multiple scales (micro, meso, and macro) and through cross-scale interactions. Examining the effects of collective action on the environment at multiple levels and across scales would contribute to understanding sustainability in the commons and the resilience of social-ecological systems more generally (Adger 2003; Berkes, Colding, and Folke 2003; Adger et al. 2005; Berkes 2002).

The Coastal Mangrove Fishery Commons

Coastal mangrove forests and their fisheries represent a classic commons problem. Fisheries and coastal zones have only recently been understood as complex, adaptive systems, and as much a social problem as an ecological problem (Finlayson and

McCay 1998; Hanna 1998; Jentoft, McCay, and Wilson 1998; Jentoft 2000; Pálsson 1998; Pomeroy 1995). In many places around the world, coastal mangrove forests are considered critical habitats that have traditionally provided a number of goods and environmental services to coastal communities (Walters et al. 2008; Snedaker 1986; Kovacs 1998; Mera Orcés 1999; Glaser 2003; Kaplowitz 2001; Ronnback 1999; Acharya 2002). Due to their historically widespread undervaluation, many mangrove forests around the world are under threat from urbanization, agriculture, and aquaculture (Alongi 2002; Southgate and Whitaker 1994). It is estimated that almost half the world's mangroves have been lost to shrimp farming (Valiela, Bowen, and York 2001).

The loss of coastal mangrove forests has significant implications for other fisheries and non-commercial species that depend on mangroves for a portion of their life cycle (Barbier 2000; Parks and Bonifaz 1994) and the human communities that depend on them for their livelihoods and subsistence (Acharya 2002). Social conflicts, the erosion of resource rights, economic disparity, and livelihood loss associated with mangrove destruction have been widely documented in the literature (Stonich and Vandergeest 2001; Stonich 1995; Cruz-Torres 2000; Dewalt, Vergne, and Hardin 1996; Primavera 1997). Such chronic environmental degradation increases vulnerability and threatens social-ecological resilience in coastal areas (Adger et al. 2005).

New co-management and participatory approaches in coastal and fisheries management have begun to include local communities and implement cross-scale institutional collaborations (Pomeroy 1995; Jentoft, McCay, and Wilson 1998; Jentoft 2000; Guest 1999). Such paradigm shifts in resource management can largely benefit from commons theory. This is particularly important for coastal policy in countries like

Ecuador, which is moving in the direction of integrated coastal management (Robadue 1995; Olsen, Ochoa, and Robadue 2003; Olsen and Christie 2000; Christie 2005).

## Conclusion: Frameworks for the Future and Interdisciplinary Research

Commons research has generated a wealth of social science theories about conditions for cooperation and different kinds of social arrangements that affect the resources upon which many people's livelihoods depend. As this chapter has shown, research on the commons has contributed much to understanding social organization, institutions, and decision-making or cooperation in the commons. However, the role of environmental drivers and ecological constraints remain poorly understood, as relatively few studies have attempted to systematically explore how institutions, cooperation, or culture affect ecological systems (Bray et al. 2004; Bray et al. 2003; Atran et al. 2002; Rustagi, Engel, and Kosfeld 2010). Issues of scale and questions about the degree to which local lessons are applicable to global challenges remain inadequately theorized (Berkes 2005; Ostrom et al. 1999; Giordano 2003). Better understanding of the relationship and feedback between collective action and the environment is needed to understand different kinds of human adaptations to environmental change, and the resilience and vulnerability of systems (Adger 2003; Nelson, Adger, and Brown 2007; Endter-Wada and Keenan 2005).

Increasing concerns about global change, economic disparity, and environmental degradation have provided a foundation for new paradigms in science which seek to integrate multi-disciplinary perspectives to link social and ecological systems for a broader understanding of the human dimensions of environmental change (Berkes, Colding, and Folke 2003; Berkes, Folke, and Colding 1998; Biersack and Greenberg

2006; Kates et al. 2001; National Research Council 1999; Young et al. 2006; Abel and Stepp 2003). Future frameworks for analysis should attempt to bridge systemic perspectives with consideration of the role of individuals through the combination of multiple methods including ethnographic, ecological, and econometrics. More attention to power relations behind critical decision-making will advance understanding about the political ecology of the global commons. Interdisciplinary approaches may not only build on previous studies and advance theories about collective action and the commons (Ostrom et al. 2002; Berkes 2005; McCay and Acheson 1987; Agrawal 2001; Vollan and Ostrom 2010), but may also provide critical implications for sustainable development policy concerning the management of forests, fisheries, water, and other kinds of commons (Kates et al. 2001).

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# CHAPTER 3

# NAVIGATING OVER SPACE AND TIME: A GEOGRAPHIC INFORMATION SYSTEMS (GIS) APPLICATION AND ETHNOGRAPHIC ANALYSIS OF THE FISHING EFFORT IN AN ECUADORIAN MANGROVE ESTUARY [4]

[4] To be submitted to *Human Ecology*.

Abstract

Current research in fisheries science and maritime anthropology aims to increase understanding about the heterogeneous nature of marine resources, dynamism in coastal and marine systems, and how fishing space is socially produced by property rights, cultural norms, and broader political-economic processes. Using Geographic Information Systems (GIS) as a data management and visualization tool, I combine fishing effort data with ethnographic information about mangrove cockle fishers in Isla Costa Rica, Ecuador to explore the fishing effort over time and space and how fishing space is socially produced through customary norms. Results suggest that the fishing effort is patterned by individual preferences shaped by norms, habits, friendships, tradition, organization of labor, ecological knowledge, and access. Such preferences ensure relatively stable returns for each fisherman, even in the absence of institutions presumed to promote sustainability. Understanding how cultural aspects of the fishing effort may internally regulate artisanal fisheries has important management implications, especially in countries like Ecuador where resources for effective management are scarce. I conclude with a discussion about new adaptive challenges and the ways in which the sustainability of the fishery may be undermined on larger scales and in the face of socio-economic, political, and environmental change. This research contributes to the "spatial turn in fisheries science," the spatially-explicit nature of the commons problem, and how open-access situations do not always result in a tragedy of the commons.

Keywords: human ecology, artisanal fisheries, fishing effort, catch-per-unit-effort (CPUE), mangrove cockles, *Anadara spp*., commons theory, open-access, sustainability, Geographic Information Systems (GIS).

Introduction

Research in fisheries science and maritime anthropology has moved beyond simplistic understanding of human-environment interactions characterized by the Gordon-Schaefer model of maximum sustainable yield (MSY) toward an understanding of the heterogeneous nature of marine resources, the complex dynamism of coastal systems, and how fishing space is socially produced by property rights, cultural norms, and broader political-economic processes (St. Martin 2004; Acheson, Wilson, and Steneck 1998; Finlayson and McCay 1998; McCay and Jentoft 1998).[5] Coastal and maritime anthropologists have contributed much to understanding the human dimensions of marine science and fisheries by debunking assumptions that fishermen are non-cooperating, optimizing rational actors operating independently of their socio-cultural contexts (Acheson 1981; McGoodwin 1990; McCay 1978; Berkes 2001; Pollnac 1980). Other studies have examined the social, cultural, or institutional structures that affect fishing effort or potentially regulate marine resources, such as customary marine tenure (Johannes 1978; Aswani 2005); territoriality (Acheson and Gardner 2004; Acheson 1987; Begossi 2001; Levine 1984); occupational pluralism associated with environmental variability or economic change (Griffith and Valdés Pizzini 2002; Endter-Wada and Keenan 2005); and other constraints that affect individual decisions about whether to fish (Guest 2003). Research about human interaction with marine resources can provide important insights for the design of effective coastal management policies that can be applied to artisanal fisheries and other coastal resources throughout the world.

[5] See Ostrom et al. (2002) for a description and further critique of the Gordon-Schaefer-model of maximum sustainable yield (MSY).

It has long been argued that fisheries represent a classic commons problem (Gordon 1954), in which resource extraction by one or more users reduces its availability for other users and the exclusion of users is difficult to enforce (Feeny et al. 1990; Ostrom et al. 1999). Such a situation is a recipe for a potential tragedy of the commons. Largely a reaction to the tragedy of the commons argument and Garrett Hardin's (1968) assumptions that humans act independently of their social and environmental contexts, much of commons theory has focused on the role of property rights as a mechanism for maintaining or improving resource systems (Ostrom 1990; Schlager and Ostrom 1999; Hanna, Folke, and Mäler 1996; Hanna and Munasinghe 1995, 1995; Bromley and Feeny 1992; Berkes 1996; Agrawal 2001). However, institutional perspectives focusing narrowly on a typology of property rights (government, private, common property, and open-access) have often overlooked other kinds of cultural factors affecting resources that are embedded in broader social-ecological contexts (McCay 1978; McCay and Jentoft 1998; McCay and Acheson 1987; McCay 2002; Wagner and Talakai 2007) and the ways that many commons reflect mixed property regimes in reality (Satria, Matsuda, and Sano 2006; Wagner and Davis 2004). Many customary marine tenure systems throughout the South Pacific are maintained as embedded cultural systems, in which users sustain their livelihoods, access, and social relations through regular use in ways that do not fit the tripartite classification of property rights: public, private, and common property (Wagner and Davis 2004; Wagner and Talakai 2007). Moreover, all property arrangements are susceptible to some degree of open-access, defined by Ostrom *et al*. (1999: 279) as "the absence of enforced property rights," in which a collapse of the resource base is implied. Despite the voluminous case studies that have contributed to

common property theory and folk management of marine systems, relatively few studies use both social and ecological data at the same time (Berkes 2005; Pollnac and Johnson 2005). There still remains a need to theorize about the spatially explicit nature of the commons problem (Giordano 2003) and the ways in which open-access situations do not always result in a tragedy (Moritz et al. 2010).

Without necessarily referring to environmental resources as a commons, human ecologists have theorized about how other forms of social organization regulate resource use (Acheson 1987; Begossi 2001) and alternatively, how human organization responds to resource abundance and availability (Acheson and Gardner 2004; Dyson-Hudson and Smith 1978). Territorial defense has been a key concept in Acheson's work on the Maine lobster fisheries, in which the differential productivity of fishing grounds is a result of internal regulation based on fierce rivalry among lobstermen (Acheson 1987; Acheson and Brewer 2003). Others have argued along similar lines that territoriality expressed through secrecy or active defense has been a way of controlling access to marine resources in the high seas (Durrenberger and Palsson 1987). Alternatively, harvesters with relatively equal access respond to fluctuating resource abundance through mobility and a series of individual decisions about where to fish. Patch choice and patch time allocation models used in human behavioral ecology have been powerful tools for explaining how individual decisions are shaped by the environment by examining the relationship between mobility and resource availability, patchiness, and seasonality (Chimello de Oliveira and Begossi 2011; Sosis 2002; Aswani 1998; Thomas 2007). Framed as an alternative to the prey-choice model that predicts the kinds of prey that foragers pursue to increase their mean return rate, the patch-choice model is more

appropriate for conditions of ecological patchiness where prey are distributed in a nonrandom fashion (Sosis 2002). As observed by Sosis (2002), fishers respond to environmental variability. They predictably rotate around patches preferring areas with the highest profitable returns and move on to the next most profitable patch when the returns fall below the average. In other words, fishers alternate fishing grounds based on their knowledge and experience with patch productivity on a previous day (Sosis 2002; Chimello de Oliveira and Begossi 2011).

Patch-choice models suggest some degree of environmental determinism; however, Sosis's (2002) findings raise interesting questions relevant to the social production of fishing space through customary marine tenure, common property arrangements, or territoriality. He notes, despite the high explanatory power of the patch choice model, his data failed to explain why two particular patches of low profitability were exploited. As also once argued by Cashdan (1983), animal behavioral models often fail to capture the role of culture in explaining variation in territorial preferences and interactions with resources. Moreover, while patch-choice models use individual-level data, the results are often aggregated and analyzed at the population level, thereby obscuring important individual-level cultural nuances that allow individuals to explain their preferences in their own words and whether those preferences are nested within a system of customary marine tenure based on kinship (Wagner and Talakai 2007) or forms of territoriality based on active perimeter defense, communication, mutual respect, or avoidance (Cashdan 1983; Levine 1984; Acheson 1987).

In this paper, I use ethnographic analysis, catch-per-unit-effort (CPUE) data, and Geographic Information Systems (GIS) to explore individual preferences and rotation by

fishers for mangrove cockles (*Anadara tuberculosa* and *A. similis*.), bivalve mollusks harvested by artisanal fishers in coastal mangrove wetlands in Ecuador. The research is guided by two central questions. First, how are individual preferences patterned in the fishing effort over time and space? Second, how do individual fishers (hereafter referred to as *concheros*) explain those preferences? The overall aim is to explore how fishing space is socially produced and the implications for sustainability. I use GIS as a tool to visualize the fishing effort and ethnographic data to explore how *concheros* navigate their preferences throughout an estuary mostly characterized as an open-access system. This research contributes to understanding about the implications for common pool resources in the absence of formal property rights (Moritz et al. 2010), the "spatial turn in fisheries science," (St. Martin 2004) and the spatially explicit nature of the commons problem (Giordano 2003).

In the following sections, I first provide an ethnographic description of the cockle fishery. Then I present maps from the community of Isla Costa Rica in Ecuador illustrating aggregation of the fishing effort *over* space followed by a map depicting variation in individual fishing effort *within* space (St. Martin 2004). When aggregated, fishers cluster around the most productive patches, in line with optimal foraging theories about patch choice (Aswani 1998; Sosis 2002; Chimello de Oliveira and Begossi 2011). However, examining individual-level effort over time illustrates that certain *concheros* habitually harvest areas that are less productive as areas they describe as "their own." I draw upon ethnographic interviews, observations, and focus groups to further explore these preferences and how the *concheros* explain the patterns. Finally, I discuss

implications of these forms of "territoriality" for fishery stability and new challenges in the context of social, political, economic, and environmental change.

Ethnographic Setting: Collecting Cockles in the Mangrove Margins

In Ecuador, cockles are harvested by artisanal fishers from the roots of mangrove trees in three to six hours during the low tide period. In the last ten years, declining shell and catch sizes have indicated harvesting pressures (Mora and Moreno 2009; Mora, Moreno, and Jurado 2011), most likely attributed to habitat fragmentation associated with the conversion of mangrove wetlands for shrimp aquaculture (MacKenzie 2001; Ocampo-Thomason 2006). Among the most affected areas include the southern part of Esmeraldas Province and the Archipiélago Jambelí in El Oro Province (Figure 3.1).

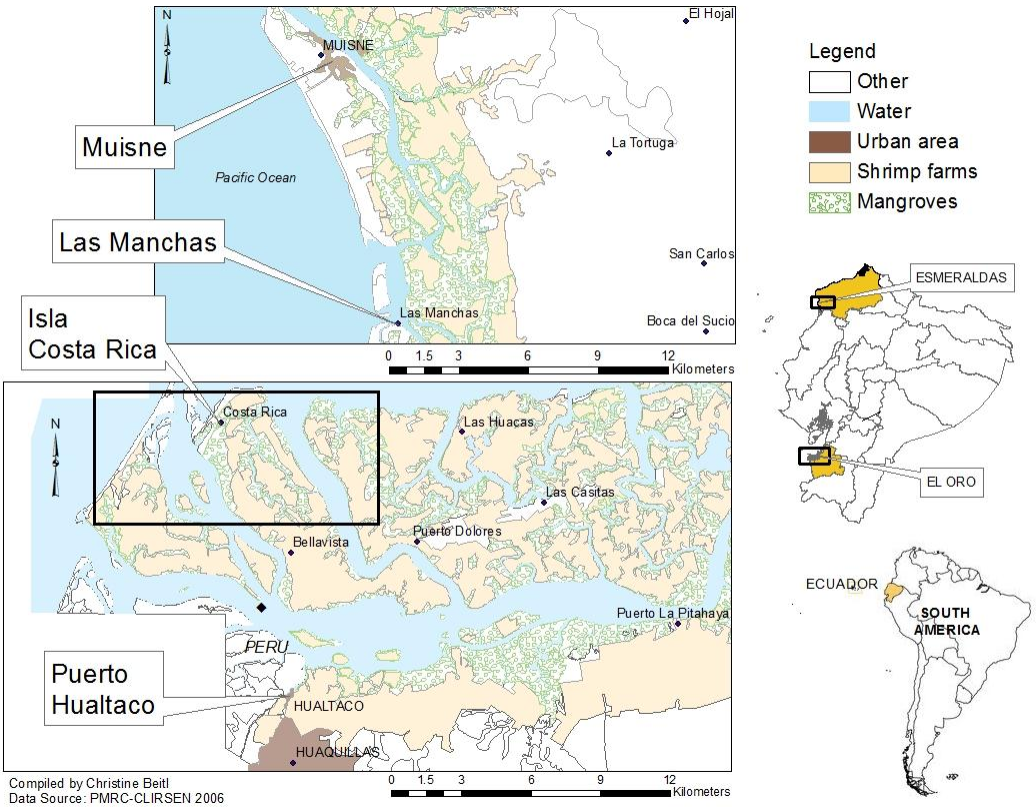



Figure 3.1. Map of the study areas. This paper draws on ethnographic research conducted in the provinces of El Oro and Esmeraldas. Isla Costa Rica in El Oro Province is the main study area for the analysis of the fishing effort over time and space.

In a day's work, many *concheros* secure their rubber boots and gloves, bundle their bodies and heads in clothing, and arm themselves with mosquito repellent to protect against the hot sun or cold rain and wind, aggressive insects, biting snakes, and stinging fish that burrow in the mud. A net bag called a *jicra* is used in El Oro to gather the shells while in Muisne, Esmeraldas, *concheros* use anything from traditional gathering baskets to buckets, plastic bags, half soda bottles, their pockets, or their boots. The *faena* (work period) usually lasts about three hours for most, but many *concheros* work until they "*completar*," or reach a rounded number of 25, 50, or 100 shells, depending on their goal for the day, level of skill, and luck. After finding a suitable patch and enduring a crouched position as they weave through a thicket of low-lying branches, maneuvering over and around the prop roots, or sinking in thigh-deep mud, the *conchero* will have gathered anywhere between five to 250 shells that sell for $7-22 per 100 shells, depending on the province. In El Oro, cockles sell for $12-22/100 shells depending on quality (size of shells) and seasonal demand. In Esmeraldas, shells sell for $7-12/100 shells. Prices increase when demand is highest during the holidays of Easter week and Christmas, when Ecuadorians flock to the beaches and demand traditional coastal cuisine.

Tides play a key role in decisions about where and when to fish, and for how long. As one man from Isla Costa Rica commented, "our whole way of life here on the island is dictated by the tides."[6] Spring tides (full moon) and neap tides (new moon) alternate on a cycle of eight-day periods. Because of this, customary norms suggest that one to two weeks is sufficient time to allow the cockle beds to fallow after a harvest. The larger swell of spring tides are associated with a longer lag time between rising and falling tides, allowing shell collectors to travel further out into areas with less harvesting

[6] All quotations are my translations from Spanish.

pressure where shells may be larger in size or in quantity. Since shells are sold by the number and not the weight, some shell collectors opt to work only during spring tides. In Isla Costa Rica, gill-net fishing is usually done during high tides and cockle collecting during low tides.

Since the tidal periods change by the hour during each day, the neap tides may permit two low tides during daylight hours in certain times of the month. In Isla Costa Rica, some people harvest twice in one day during neap tides when the daylight hours permit. The lunar cycle and tidal periods also influence decisions about cockle collecting in Muisne, Esmeraldas. People in Muisne refer to spring tides as "*agua buena*," or "good water," and neap tides as "*agua mala*," or "bad water" when many *concheros* decide to stay home or dedicate their time to other livelihood strategies. Those who decide to collect cockles during the shorter "*agua mala"* period usually stay close to the community. In most places, cockle collecting is done during daylight hours during low tide, but in Muisne, many *concheros* complain about drug-addicted youth who harvest unsustainably and sometimes work in the middle of the night during spring tides when the full moon provides enough light to gather shells and earn just enough money to satisfy their fix.

In many ways, changing tidal patterns have shaped customary rules of rotation among gathering grounds similar to the organizational patterns of fishing effort associated with seasonality in other fisheries (Aswani 1998). However, there is no reliable data for the effects of seasonality on the fishing effort within the cockle fishery. Studies by the Instituto Nacional de Pesca (INP) estimate the annual fishing effort within five major landing areas in the provinces of Esmeraldas and El Oro, but these studies are

based on one-day monthly observations that might not be representative of the rest of the days in the month and do not capture any seasonal variation in effort as a response to socio-economic conditions or cockle biology. It is believed that cockles spawn during the months of February to April and September to December, indicated by the highest density of mature individuals based on samples gathered throughout the year (Mora, Moreno, and Jurado 2011) and observations made by *concheros,* but it is unknown whether *concheros* respond to this seasonal variation. Based on these understandings about cockle biology, the Subsecretaría de Recursos Pesqueros (SRP) mandated a closed season from February to March, but this policy was abandoned in 2008 due to a lack of effective enforcement. From the *conchero's* perspective, it is a resource that can be harvested year-round with reliable returns and monthly fluctuations in the fishing effort may reflect livelihood switching associated with seasonality in other fisheries or other economic opportunities.

Since there are no reliable data on the effects of seasonality on the fishing effort, an in-depth ethnographic analysis, even if only on a micro-scale, could provide useful insight to fishery managers. In addition to the lunar cycle and tidal periods, seasonal cockle collecting and daily fluctuations in the fishing effort might also be affected by the economic context. The increase in prices during Christmas and Easter provides incentives for part-time *concheros* who typically prefer other livelihood strategies. Other researchers have noted that the cockle fishery may be a last resort when other livelihood options are not available (Ocampo-Thomason 2006; Velásquez Runk et al. 2007). In San Lorenzo and Muisne in the province of Esmeraldas, and in Hualtaco in El Oro Province, I spoke to several *concheros* who preferred other kinds of work over cockle collecting. Some

researchers have asserted there is a social stigma associated with cockle collecting (Kuhl and Sheridan 2009). However in my experience in several ports and communities, I found many *concheros* simply saw it as a job. For some, particularly in the smaller communities and among members of local fishing associations, there was a great sense of pride and job satisfaction. Similar to other studies about fishermen (McGoodwin 1990; Griffith and Valdés Pizzini 2002), many *concheros* in Ecuador prefer the freedom of fishing and collecting cockles over being "peons" in wage-labor positions.

This sense of pride in cockle collecting may have been reinforced in recent decades with the growth of civil society, policy changes recognizing the rights of "ancestral" mangrove communities, and social movements resisting the expansion of shrimp aquaculture on the Ecuadorian coast. After decades of unregulated expansion of the shrimp industry, the Subsecretario de Gestión Marina y Costera under the Ministry of Environment began granting *custodias* (mangrove concessions) to local fishing associations in 2000 for community-based conservation of mangroves and the sustainable use of mangrove resources. To date, almost 38,000 hectares of mangroves have been allocated to 41 community associations in all five coastal provinces, with the majority located in the Archipelago Jambelí in El Oro Province and throughout the Mataje Cayapas Reserve in northern Esmeraldas (Rosero Moya and Santillan Salas 2011).

As one of the first recipients of a *custodia*, the Asociación Isla Costa Rica with about 60 members (including the wives of *concheros* who do not collect shells) has managed their 519.79-hectare concession since 2000. Because of this, Isla Costa Rica reflects a mixed property system, in which all four property arrangements highlighted in the commons literature are present: 1) public/ government (all mangrove, beach, and

waterways); 2) private (shrimp farms concessions); 3) common property (concession of the Association Isla Costa Rica); and 4) open-access (all gathering grounds outside the *custodia* shared with *concheros* from adjacent communities) (Figure 3.2).

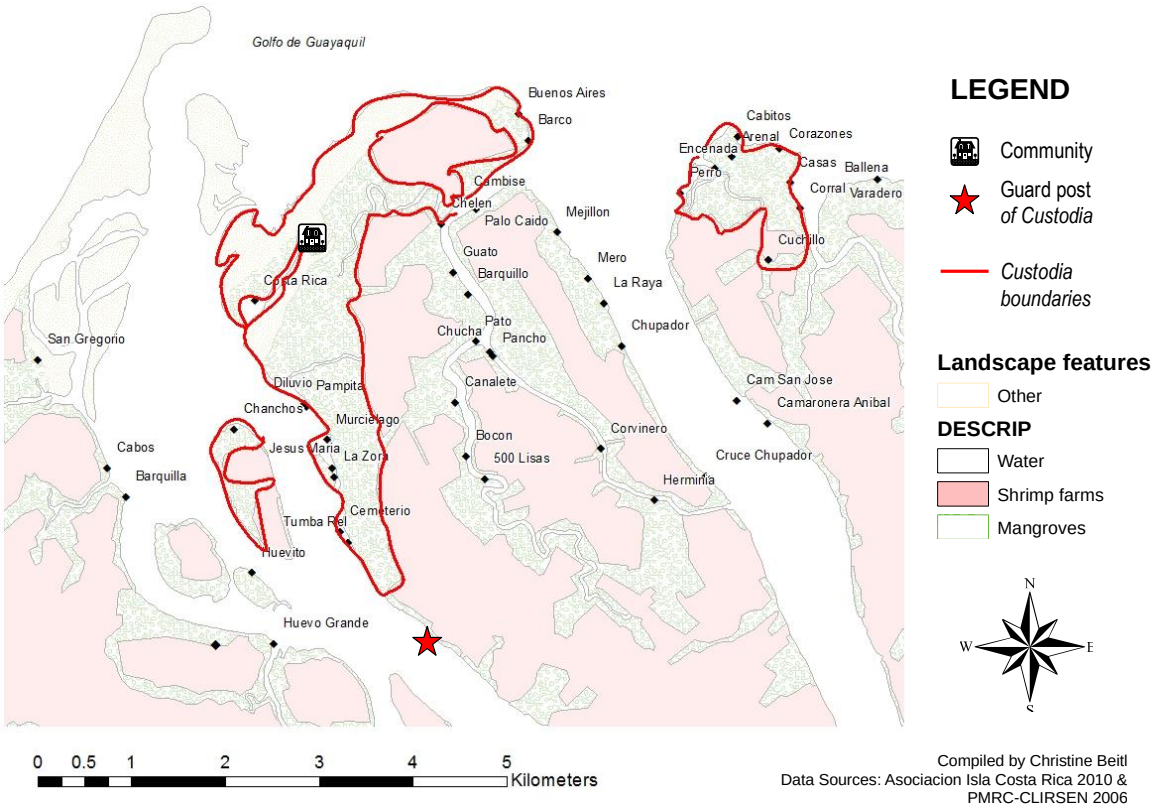



Figure 3.2. Gathering grounds and mixed "property" arrangements in Isla Costa Rica. 1) Government (mangrove, beach, and waterways); 2) private (shrimp farm concessions); 3) common property (community concession utilized exclusively by residents of Isla Costa Rica; 4) open-access (all mangrove areas shared with neighboring communities).

Based on traditional knowledge and experience with the productivity of gathering grounds, as well as biological knowledge about the species presented by external organizations in workshops, the association has designated certain cockle beds within their *custodia* for periodic closures: Chanchos, Diluvio, Costa Rica, Cemeterio, Jesus Maria, and Manoas (Figure 3.2). All other gathering grounds in the *custodia,* as well as those classified as open-access are harvested daily. The fishery-managed areas are

harvested for ten days after 30-day closure periods, with the exception of Manoas harvested every Saturday. The areas function much like a common property regime with locally designed rules, monitoring, sanctioning of cheaters and trespassers, and a rotating guard system by members of the association to prevent encroachment by outsiders.[7] During the early years, the Asociación Isla Costa Rica actively defended its *custodia* against *concheros* from Puerto Hualtaco most likely harvesting their own ancestral gathering grounds around the neighboring community of San Gregorio, which was abandoned in the 1950s due to subsidence. Today, *concheros* from Hualtaco and Isla Costa Rica share open-access areas. While many *concheros* from Hualtaco respect the boundaries of Isla Costa Rica's *custodia*, they continue to occasionally face violent confrontations with the proprietors of other newly established concessions throughout the archipelago (Beitl 2012).

Methods

The micro-scale analysis of the fishing effort over time and space draws primarily on catch-per-unit-effort (CPUE) data gathered by the Asociación Isla Costa Rica from January 15 to June 30, 2010 as part of our agreement for a "community-based monitoring project."[8] Located about 45 minutes from the Port of Hualtaco on the Peruvian border, Isla Costa Rica is a small fishing village of about 300 inhabitants largely dependent on mangrove resources. I chose Isla Costa Rica for analysis for the willingness of the local fishing association to actively participate in data collection and for the time I was able to build rapport with community members through my extended stay in the village and

[7] For a description of characteristics of common property regimes, see Ostrom (1990).
[8] Per our agreement, these data are now the intellectual property of the Asociación Costa Rica and future research using this dataset should note the appropriate citation (Asociación de Mariscadores Pescadores Artesanales y Afines "Costa Rica" 2010).

participant observation of community activities and livelihoods. For broader understanding about the challenges facing cockle fishers in Ecuador, I carried out additional interviews and observations from January 2009 to December 2010 in three other field sites, Puerto Hualtaco in El Oro and Muisne and Las Manchas in the province of Esmeraldas (see Figure 3.1).

Similar to the concept of "return rates" used in optimal foraging theory for its ability to estimate relative resource abundance (Aswani 1998), I use the definition of CPUE from fisheries science, which refers to a measure of the density of the population size of a target species where "large CPUEs indicate large populations since many individuals are caught for every unit of fishing effort" (NOAA n.d.). The INP in Ecuador also uses fishery-level analysis to monitor the cockle fishery, defining CPUE as the average number of shells per unit of effort, where effort is defined as the total number of *concheros* and each unit refers to each trip of each individual *conchero*.

To document and explore individual-level preferences for different gathering grounds among *concheros*, I began with exploratory fisher diaries in Isla Costa Rica (n=10) followed by two separate focus groups to gain understanding about who decides to go where and why. These focus groups helped me design the questions for the semi-structured interviews in the three other field sites. With two key informants I used an Etrex Vista Global Positioning System (GPS) to map the location of the gathering grounds during high tide.[9] The map was verified by the ten fisher diary participants.

The idea for the community-based monitoring project grew out of conversations with Adolfo Cruz, the president of the association (Beitl and Cruz 2010). We agreed that

[9] All points were marked at the entrance to small creeks more accessible by motor-powered boat during high tide.

the documentation of the sustainable harvest of shells over time would provide supplemental support for their application to renew their 10-year concession. It would also provide a rich dataset for researchers to explore relationships between fishing effort and catch sizes over time. In this project, one field assistant collected daily CPUE data over 166 days (after excluding Sundays and holidays) from 27 voluntary participants (members of the association and their sons, representing about half of the estimated number of *concheros* in Isla Costa Rica), resulting in 2,160 observations of activity in 60 different gathering grounds. Participants provided information about the site of extraction, CPUE, the number of hours worked, number of shells used for personal consumption or mariculture, number left in the mangrove, the number sold, and their alternative activity if they did not go cockle collecting. In addition to CPUE data, the field assistant documented the total fishing effort each day by counting the number of fishermen from March to June.

I entered all the CPUE data into an Excel spreadsheet and exported it to SPSS 17.0 for cross-tabulation of collector by gathering ground to create a pivot table. I imported the pivot table into GIS 9.2 and joined it with the GPS points of gathering grounds to create a new layer file capable of depicting the intensity of individual-level fishing effort by site over time. To further prepare the data for analysis, I divided the fishing grounds into four major zones (Figure 3.2): 1) sites around San Gregorio (Zone 1); 2) sites around Chelén Estuary often referred to as "*aquí atrás*" or "right here behind" the community (Zone 2); 3) the area of the *custodia* harvested on a daily basis called *Sector Corazones* (Zone 3); and 4) the fishery-managed areas of the *custodia* harvested for ten days after 30-day closure periods.

I used analysis of variance tests (ANOVA) to compare differences in CPUE between the four zones. Additional ethnographic analysis draws upon interviews, observations, and focus groups in all four study areas, Muisne, Las Manchas, Hualtaco, and Isla Costa Rica. In semi-structured interviews in all four study areas (see Figure 3.1), I asked people the name of their favorite gathering ground and reasons for their preference (n=153). In each of the focus groups (n=7), three to 25 participants helped me further understand how people become accustomed to certain areas. Moreover, I gained much understanding about decisions from participant observation in all four study areas.

Results

Table 3.1 registers the names of the 60 gathering grounds divided into four zones. The table includes information about average CPUE at each site, total number of trips (fishing effort), distance from the community, and the number of times that site was cited in an interview as "preferred" by *concheros* from Isla Costa Rica and the neighboring port of Hualtaco. The mean catch is 79 shells per unit of effort ranging from 20 to 250 shells (n=2,160) with significant differences between the four zones (ANOVA: $F = 35.90$; $df = 3$; $p = 0.000$; n = 2,146).[10] Encenada (Zone 3) is the most popular site with the highest frequency of trips, followed by three gathering grounds in the fishery-managed areas of the *custodia*, and finally, San Gregorio (Zone 1). The most frequented cockle beds in Zone 2 are Chelén, followed by Guato and Manoas. Many of the other gathering grounds in Zone 2 along the Chupadores Estuary were cited as a preference by about one-third of the *concheros* interviewed in Hualtaco (n=33), suggesting they are open-access areas harvested by *concheros* from different communities.

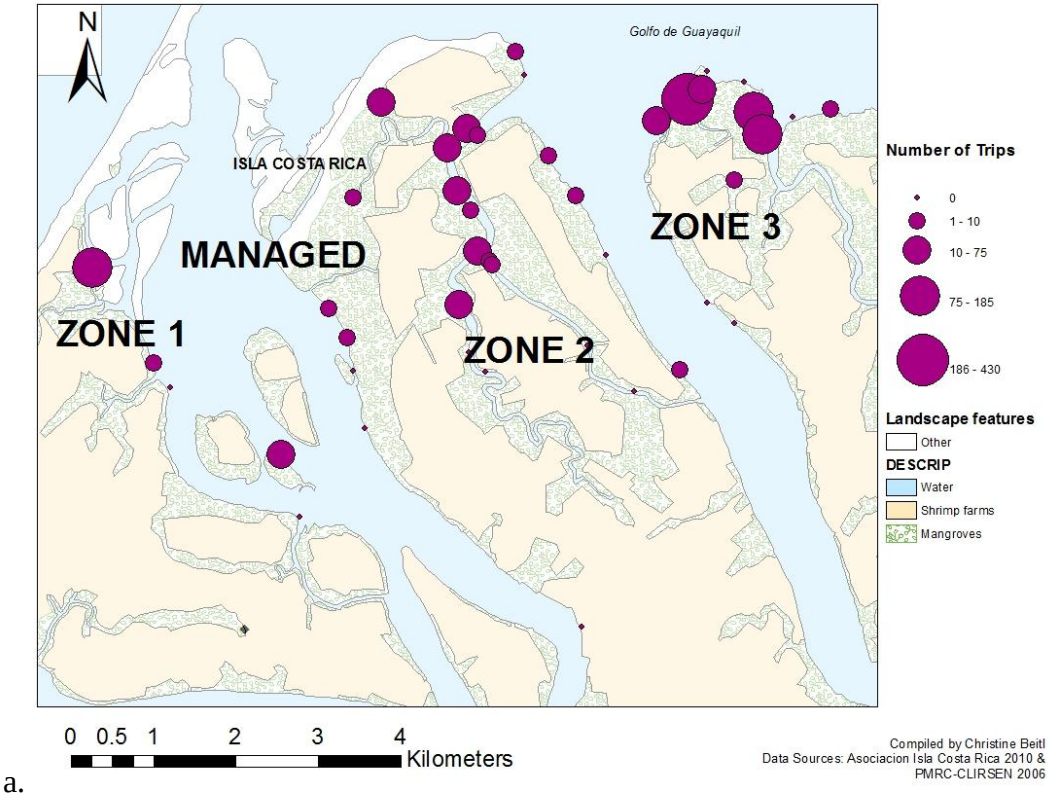
[10] Note that trips with incomplete information were dropped from the analysis of CPUE by zone.

Table 3.1. Names and characteristics of all gathering grounds frequented by residents of Isla Costa Rica over 5.5 months. Table includes: average catch-per-unit effort (CPUE) and fishing effort (total trips), distance from community, and the number of times each site was mentioned as a preferred spot during the interviews in Isla Costa Rica (CR, n=58) and Hualtaco (H, n=33). * denotes the coordinates were not mapped with a GPS.

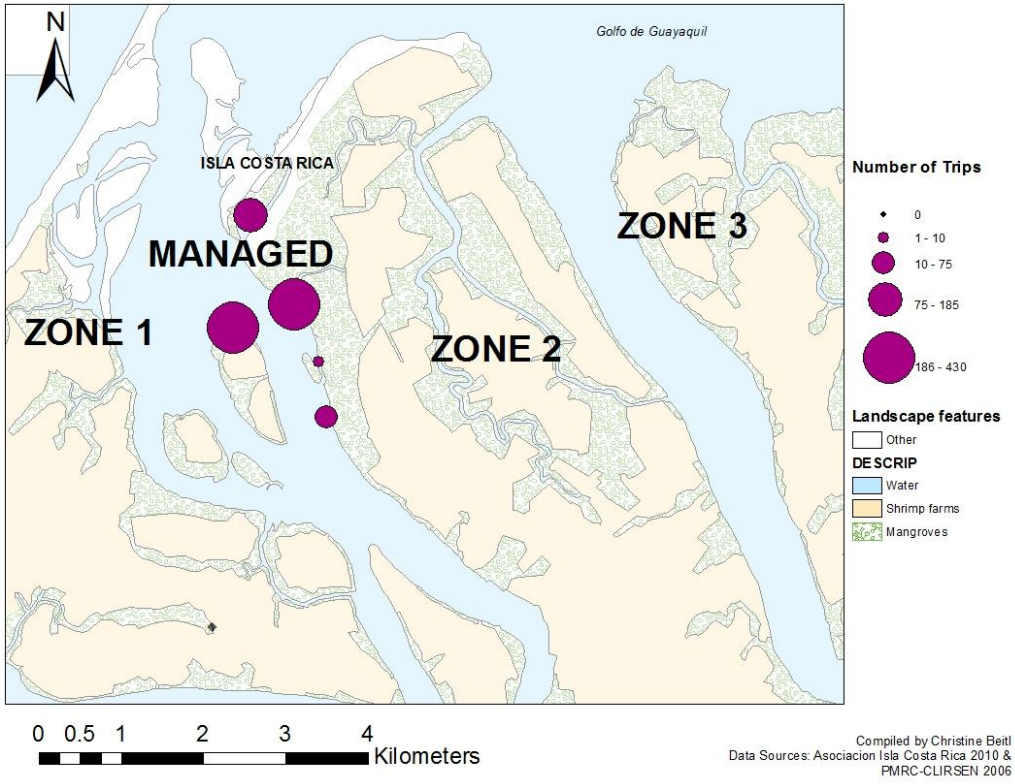
| GATHERING GROUNDS | Mean CPUE (number of shells per unit of fishing effort, or trip) | | Total Number of Trips | Distance from Community (km) | Number of times cited in interviews as "preferred" |
|---|---|---|---|---|---|
| | Mean CPUE | Std. Deviation | | | |
| ***Grounds in Zone 1: Areas around San Gregorio*** | | | | | |
| Barquillo | 69 | 41.89 | 5 | 2.533 | 1 (CR), 1(H) |
| Cabos | 63 | 10.79 | 7 | 2.404 | 1 (CR) |
| Huevito | 71 | 24.55 | 77 | 2.896 | 2 (CR) |
| San Gregorio | 71 | 23.67 | 146 | 2.407 | 4 (CR), 1 (H) |
| Silverio * | 118 | 60.1 | 2 | | |
| Total Zone 1 | 71 | 24.64 | 237 | | |
| ***Grounds in Zone 2: Areas near the Community and "Aquí Atrás"*** | | | | | |
| Buenos Aires | 62 | 7.21 | 3 | 3.476 | |
| Cambise | 77 | 43.78 | 18 | 2.531 | 1 (CR) |
| Canalete | 63 | 17.31 | 21 | 2.4 | |
| Canto * | 57 | 19.57 | 30 | | |
| Canton * | 45 | 21.21 | 2 | | |
| Chelen | 58 | 25.46 | 71 | 2.164 | 3 (CR) |
| Chucha | 97 | 12.37 | 7 | 2.558 | |
| Chupadores | 53 | 26.3 | 4 | 3.949 | 3 (CR), 13 (H) |
| Cruce Chupador | 110 | . | 1 | 5.183 | |
| Guato | 77 | 27.19 | 61 | 2.13 | 1 (CR) |
| Juanillos * | 50 | 14.14 | 2 | | 1 (CR) |
| La Zora | 60 | 17.32 | 3 | 2.084 | |
| Manoas | 65 | 21.56 | 45 | 0.964 | |
| Mejillon | 40 | 14.14 | 2 | 3.292 | |
| Mero | 87 | 23.83 | 7 | 3.566 | |
| Murcielago | 80 | . | 1 | 1.683 | |
| Palo Caido | 48 | 18.11 | 8 | 2.532 | |
| Pancho * | 74 | 35.27 | 6 | 2.614 | |
| Pato | 63 | 33.18 | 31 | 2.405 | |
| Raya | 75 | . | 1 | 3.705 | |
| Tumba Rel | 115 | 49.5 | 2 | 2.791 | |
| Vial * | 100 | . | 1 | 0.89 | |
| 500 Lisas | | | | 3.136 | 1 (CR), 1(H) |
| Pampita * | 78 | . | 1 | 1.274 | 1 (CR) |
| Piedredo * | 145 | . | 1 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Sango * | 101 | 20.51 | 2 | | | |
| Sanja * | 75 | . | 1 | | | |
| Sortija * | 28 | . | 1 | | | |
| Vacon * | 82 | . | 1 | | | |
| Total Zone 2 | 67 | 28.59 | 330 | | | |
| ***Grounds in Zone 3: "Sector Corazones"*** | | | | | | |
| Arenal | 80 | 21.07 | 44 | | 5.331 | |
| Casas | 81 | 22.87 | 143 | | 5.864 | 5 (CR) |
| Corral | 84 | 24.17 | 95 | | 5.908 | 2 (CR) |
| Cruce de Corazones | 149 | 68.49 | 5 | | 5.964 | 6 (CR) |
| Cuchillo | 100 | . | 1 | | 5.196 | 2 (CR) |
| Encenada | 79 | 27.71 | 451 | | 5.149 | 16 (CR) |
| Pato Corazones * | 63 | 30.55 | 3 | | | |
| Peligro | 75 | . | 1 | | | |
| Perro | 79 | 32.38 | 21 | | 4.689 | 2 (CR) |
| Varadero | 225 | . | 1 | | 6.916 | |
| Ballena | | | | | 6.781 | 2 (CR) |
| Cogollo * | 48 | 3.54 | 2 | | | |
| Desague * | 75 | . | 1 | | | |
| Lagarto * | 80 | . | 1 | | | |
| Llanto | 150 | . | 1 | | 7.538 | 1 (CR), 1(H) |
| Total Zone 3 | 81 | 27.6 | 770 | | | |
| ***Fishery-Managed Areas of the Custodia*** | | | | | | |
| Cemeterio | 111 | 38.19 | 22 | | 2.646 | |
| Chanchos | 100 | 34.7 | 330 | | 1.396 | 1 (CR) |
| Costa Rica | 72 | 27.19 | 178 | | 0.1619 | |
| Diluvio | 74 | 27.02 | 270 | | 1.223 | 1 (CR) |
| Jesus Maria | 75 | 26.71 | 10 | | 1.981 | |
| Total Managed Areas | 85 | 33.64 | 810 | | | |
| ***Unknown Locations*** | | | | | | |
| Cruce * | 103 | 16.43 | 5 | | | |
| El Cruce * | 65 | 25 | 3 | | | |
| Gabino * | 140 | . | 1 | | | |
| Toldo * | 80 | . | 1 | | | |
| Marranco * | | | | | | 1 (CR) |
| ***Total (all sites)*** | **79** | **31.15** | **2160** | | | |

Figure 3.3 illustrate two phases of the aggregated fishing effort by those 27 participants from January to June 2010. Specifically, Figure 3.3 (a) depicts the 30-day periods when the managed areas are closed and Figure 3.3 (b) illustrates the 10-day periods the managed areas are open for harvest. The site Manoas harvested every Saturday is included in Figure 3.3 (a). Despite its relatively further distance from the community (see Table 3.1), Zone 3 is the most popular area in which the fishing effort is highest, represented by the larger bubble sizes. This zone is also associated with a higher CPUE than the other areas. As part of the community's *custodia* harvested on a daily basis, this area is not likely shared with *concheros* from adjacent communities. On a daily basis, boats carrying up to 15 passengers bring members from the community to the gathering ground of their choice within the zone. Interestingly, the sites Mero, Mejillón, and La Raya in Chupadores are less popular among *concheros* from Isla Costa Rica, despite their proximity to the community. These gathering grounds are not part of the community's *custodia* and are shared with *concheros* from Puerto Hualtaco.




a.




b.

Figure 3.3. Concentration of fishing trips during two phases: a) days that the managed areas are closed; b) days that the managed areas are open.

Figure 3.5 graphically illustrates the relationship between fishing effort (number of trips) and catch-per-unit-effort (CPUE). The figure shows that despite the high number of fishing trips to Zone 3 and the managed areas, a relatively stable harvest of shells per person is maintained across all sites. In fact, the average CPUE is slightly higher in these two zones compared with Zones 1 and 2 with statistically significant differences (Table 3.1). These results would suggest that a higher productivity of gathering grounds is able to sustain a higher fishing effort. However, like Figures 3.3 and 3.4, this figure also fails to explain why less productive areas in Zones 1 and 2 and harvested and by whom.

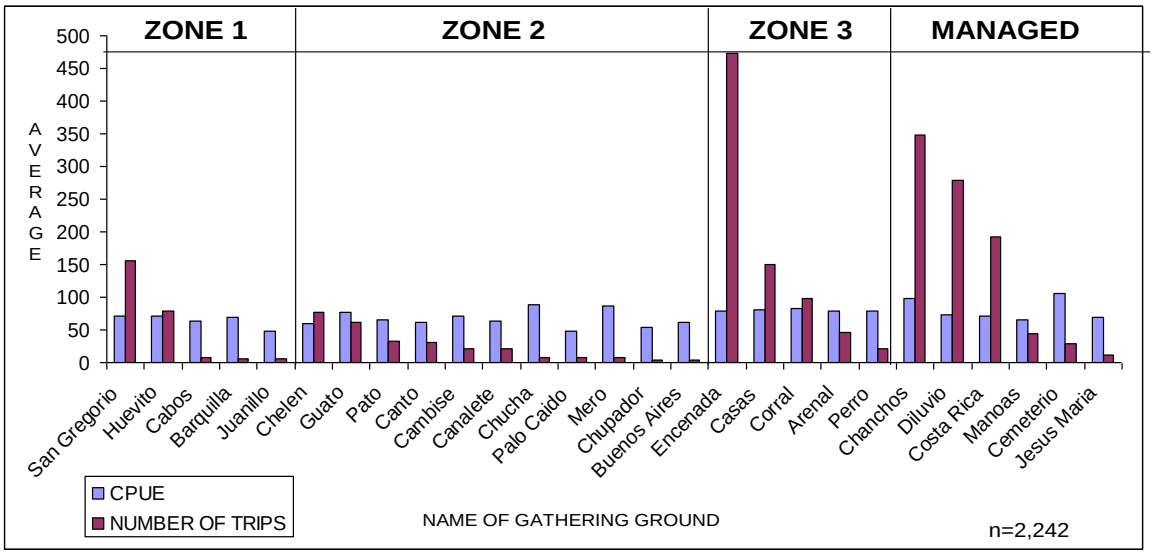



Figure 3.4. Relationship between fishing effort (number of trips) and CPUE (mean catch per unit of effort) by site and zone in Isla Costa Rica. * Note that only the most popular sites with three or more trips are presented.

In an examination of the fishing effort by individuals, it becomes clear that certain *concheros* tend to harvest from the same zones, even if they are not the most productive (Figure 3.6). Each individual was color-coded in three primary colors according to his apparent "preference" from the data (zone associated with his highest frequency of trips over time). These apparent preferences for certain gathering grounds and zones correlate

with their stated preferences in interviews (n=20). The 13 *concheros* with the highest frequency of trips to Zone 3 were coded a shade of blue; the four who prefer Zone 2 were coded red; and one who preferred Zone 1 was coded yellow. Individuals who harvest from two or more zones with relatively equal frequencies were coded their respective secondary colors, orange (Zones 1 and 2), green (Zones 1 and 3), and purple (Zones 2 and 3). The three people who harvest the managed areas almost exclusively were coded white. To explain these individual preferences, I turn to the ethnographic data.

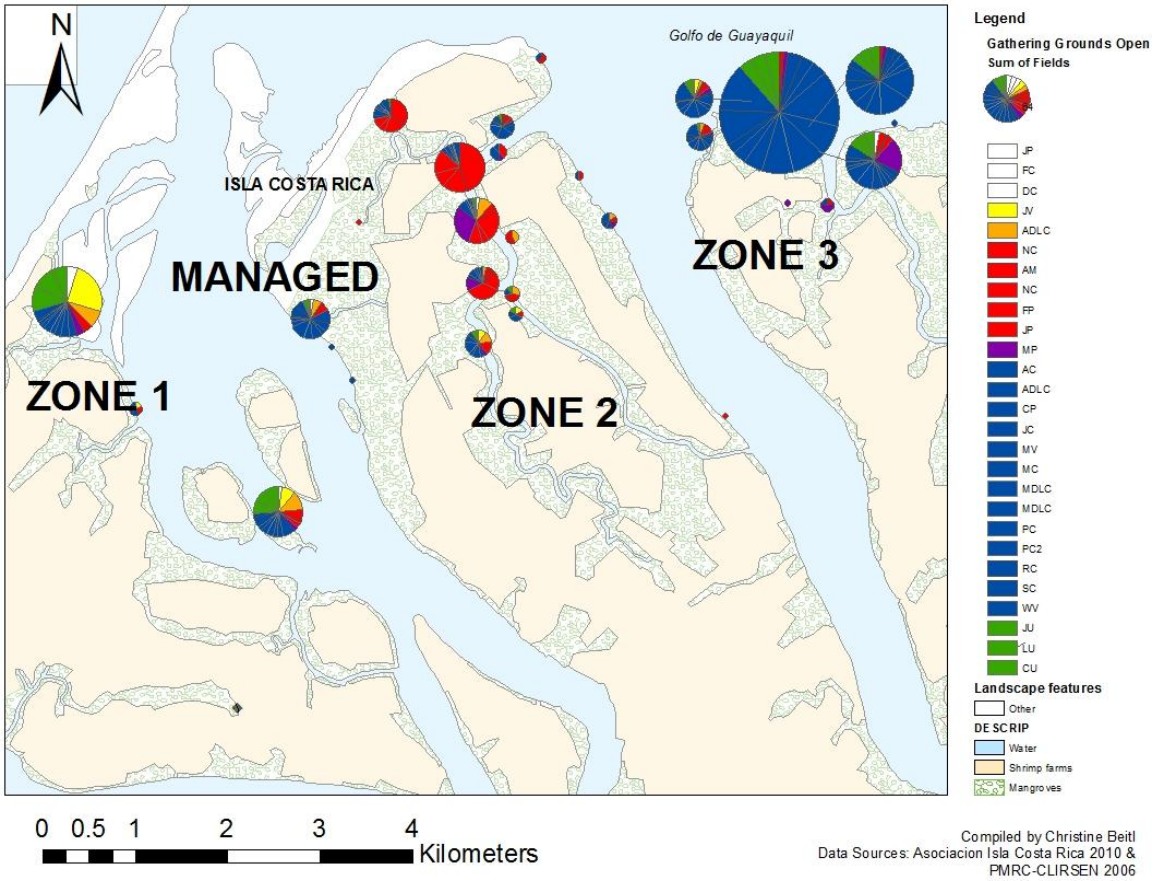



Figure 3.5. Distribution of individual fishing effort (number of trips by individuals) within space and over time in open-access areas in Isla Costa Rica.

Since the reasons for preferring certain gathering grounds over others are not unique to Isla Costa Rica, I summarize explanations from the interviews across all four study areas in Table 3.3. Free responses were coded and quantified in the table and the categories are not mutually exclusive since the questions were open-ended. Common reasons included: "more shells" (n=41), "bigger shells" (n=22), or "closer" (n=15). When I left the question more open-ended, some people responded similarly, but others answered with responses like, "*estoy enseñado*" or "I am used to going there" or "*allí cojo,"* or literally "That's (the spot) I take." I also heard "it's my area" and "it's where I always get shells." A *conchero* from Muisne summed up what I heard from many others: "*todos cogen su rutina*" or "everyone makes their own routine." Those who did not have specific reasons for frequenting certain gathering grounds simply suggested that they go wherever they are taken by the boat, their family, or their group of friends. The 10% (n=153) that did not have preferences typically responded this way—that all the gathering grounds are the same. Further discussions during conversations and the focus groups revealed other insights into how these customary norms are developed. Some people commented on ecological conditions in gathering grounds and how they typically avoid areas where the mud is too soft or too hard. Others expressed their knowledge about the kinds of shells that are harvested from different kinds of ecological conditions (i.e. small shells from soft mud and larger shells from harder substrate, or in the *préstamos* along shrimp pond walls). They discussed the ways in which these preferences are linked to the shell sizes they target and the expectations of their buyers with whom they have often developed a relationship over time.

Table 3.2. Response categories explaining site preferences from interviews (n=153). * Note categories are not mutually exclusive.

| Response category | Number | Explanation |
|---|---|---|
| More shells | 41 | More shells. One can harvest them faster and return home quicker. |
| Bigger Shells | 22 | Bigger shells. Some explained the reason for this is because there is less competition in these areas. |
| "Enseñado" | 19 | “That's where I always go" or "that's my area" or "that's where everyone goes." They have been going there since childhood and it was where their relatives, friends, or "their ancestors" showed them. |
| Closer | 15 | Those who liked to work close to home did not like paying for the trip (usually $1-2 depending on the distance). |
| Boat brings us there | 14 | "That's where we always go" (Isla Costa Rica) or "wherever they take me" (Puerto Hualtaco). |
| Preferred sites not viable | 13 | Preferred gathering grounds were no longer viable or accessible because of shrimp farms, *custodias,* too much competition, or overexploitation. |
| Ecological reason | 9 | Includes explanations like, "larger areas" or "better habitat for cockles" or they find the substrate easier gather shells quickly. |
| Company | 6 | Depends. They go wherever the others go. |
| No reason | 4 | Did not know why they preferred the areas they cited. |
| Safer | 1 | (Isla Costa Rica) Safer from piracy or other malicious people. |
| Other | 4 | "I like to go where few others go" or "few outsiders." |
| No preference | 13 | “All sites are the same” and they go "everywhere," "different places," or "wherever they take me." "We alternate among cockle beds depending on the tidal period." "You go to your site and search for cockles. If someone else is already there, you move on." |

Becoming *Enseñado:* The Social Production of Fishing Space

At first glance, the aggregated effort across space appears to suggest that *concheros* tend to frequent the most productive zones with the highest CPUE, in accordance with other studies (Sosis 2002; Chimello de Oliveira and Begossi 2011; Aswani 1998; Thomas 2007). However, further analysis of variation in the number of

trips *within* space indicates that the same fishers habitually harvest areas that are less productive as areas they have claimed as "their own." The ethnographic exploration of the fishery reveals that preferences are shaped by social norms, habit, customs, traditions, friendship, organization of labor, access, and ecological reasons other than actual CPUE or distance to gathering grounds. The notion of being "*ensenado"* or "used to" certain areas largely explains not only why less productive gathering grounds are harvested, but also why those areas are harvested by the same people every time.

People become "used to" certain areas for several reasons. The most common explanation is that one becomes *enseñado* after harvesting the same gathering grounds for many years. As many *concheros* commented in the interviews in all four study areas, "it's where I (or we) have always gone" or "that's where everyone goes." Sometimes a *conchero* may claim to have discovered those areas on his own, but more often, *concheros* explain they have long harvested those areas in the footsteps of their ancestors, their father, grandfather, uncle, elder brother or cousin, or a friend with whom they most prefer to fish. In Isla Costa Rica, the mangrove areas in Zone 3 are described as more extensive and a better habitat for cockles, even though the shells may be smaller in size. In comparison, other extensive mangrove areas near the community in Zone 2 are dominated by mangrove crabs (*Ucides occidentales*), which few *concheros* in Isla Costa Rica harvest for commercialization. Thus, cockle beds in Zone 3 are perceived as more abundant and productive, "constant and secure," and "far enough from the port that there is less competition with *concheros* from Puerto Hualtaco." Because Zone 3 is officially part of the association's concession, many *concheros* from Hualtaco respect the boundaries as friends and distant relatives of people who presently live in the

archipelago. People from Isla Costa Rica say that their forefathers have always harvested mangrove resources in Zone 3 and that is how they were able to include it as part of their legal *custodia* designated for daily harvest by members of the community.

Another way one becomes *enseñado* is through regular use as they follow their friends and family or join the passenger boat in a daily routine. Boat captains in Isla Costa Rica frequently carry groups of 10-15 *concheros* from the community to Zone 3, which is another reason why the fishing effort is significantly higher than other sites closer to the community. The cost of the trip is $1-2 and some *concheros* prefer not to pay. Instead, they frequent sites accessible by foot or they use their own canoe. Some *concheros* prefer to work alone "without the distraction of conversation" thereby avoiding the larger groups who travel together to their respective gathering grounds. When I asked people who predominantly harvest shells from Zone 2, they commented that "only a few of us know those areas" and "I know those areas," which allows them to harvest successfully. It is not clear whether people become *enseñado* to certain areas because of their success or whether their perception of success grows out of the process of becoming *enseñado*. What is clear is that very few *concheros* in all four study areas say that they have no preference at all.

The benefit of being one of the few who harvest less the popular areas is that they gain intimate knowledge about the location of the best spots: when they were harvested last, who else is harvesting them, and whether the others harvest in a sustainable manner (leaving a few small shells for regeneration rather than taking everything they can find). *Concheros* say that it is not necessary to plow through the mud "with two hands" or use a machete to scrape or cut the mangrove roots in order to find shells. A good *conchero* will

leave the mud relatively undisturbed, neatly inserting his/her hands through the small holes that suggest there is life below the mud. In small communities like Isla Costa Rica and Las Manchas, *concheros* believe that encroaching outsiders are responsible for destructive harvesting practices that disrupt essential cockle habitat. Such suspicions about outsiders have also been observed in the small communities around San Lorenzo on the Colombian border (Ocampo-Thomason 2006).

Just as a *conchero* becomes *enseñado* to harvesting the same areas with the same group of people, he/ she also gets used to different conditions and the ways in which cockle beds are ecologically distinct. For example, the consistency of the mud or the density of the mangrove branches and roots affect the relative ease and ability for some *concheros* to gather shells. Some people prefer the harder soils despite the dangers of cutting and scraping their hands on mangrove roots and decaying branches buried in the mud. Others prefer softer soils characteristic of younger mangrove colonies and abandoned shrimp farms, despite the danger of sinking up to one's waist and losing a boot. One *conchero* from Isla Costa Rica prefers to work in the *préstamos,* which refer to shrimp ponds walls. He believes that the effluents from the shrimp ponds nourish the filter-feeding cockles, which is why he always harvests shells that are larger in size, even if his catch contains fewer shells than what others gather from Zone 3. He is *enseñado* to Zone 2 and over the years has established cordial relations with the shrimp farmers in the area who permit his access to the pond walls for cockle collecting.

Even though shells sell by the number and not by the size or weight, some buyers will only purchase catches considered "good quality," referring to the size of shells and larger proportion of *A. tuberculosa,* considered more palatable than *A. similis*. The price

is also sometimes negotiated based on the buyer's evaluation of catch quality. Thus, a larger catch size does not always signify more profitable economic returns for all *concheros.* The sale and negotiations of price largely depend on the relationship between cockle collectors and their buyers. As these relationships often develop over time, certain buyers also become *enseñado* to purchasing catches of a particular quality.

Division of Space: Territoriality *versus* Mutual Respect

Throughout much the Ecuadorian coast, the mangrove cockle fishery is characterized as an open-access fishery in which competing users and user groups have equal access based on a first-come, first-serve basis. Only in the communities of Las Huacas (near Isla Costa Rica) and Las Manchas in Esmeraldas, I observed expressions of territoriality or perimeter defense to maintain fishery sustainability similar to what Acheson (1987) described. For example, if a *conchero* arrives at a site that someone else has gotten first, he might feel agitated, but there is not much he can do other than simply accept it and think to himself, "*me ganó el puesto*" or "he beat me to it" before moving on to a different area. One man from Isla Costa Rica explained that new migrants from the highlands are changing the spatial order and division of gathering grounds. But without formal ownership or control over access, there is little he can do about this increasing competition.

On one hand, the social division of space in the open-access areas around Isla Costa Rica is based on mutual respect among members of the community and outsiders from Hualtaco. It is interesting to note that despite their proximity to the community, certain gathering grounds in Zone 2 were cited by people in Hualtaco as their preferred spots to which they are *enseñado*. Consequently, these areas are frequented less by

*concheros* in Isla Costa Rica. This suggests cordial relations, mutual respect, and passive communication among *concheros* from distinct communities. As noted earlier, many of these *concheros* from Hualtaco who travel as far into the archipelago as Isla Costa Rica are distant relatives whose families have migrated to the port in the last 50 years. Friendships with outsiders are further maintained through the larger fishing federation to which many local associations belong. When the Asociación Isla Costa Rica celebrated their 10-year anniversary during my residency in November of 2009, they invited several associations from Hualtaco, friends and relatives from neighboring communities, and employees on local shrimp farms to join in the festivities consisting of soccer matches by day and dancing, eating and drinking into the night.

In contrast to the experience of mutual respect among many *concheros* from Puerto Hualtaco and Isla Costa Rica, many individuals reported territorially defensive behavior in the community of Las Huacas adjacent to Isla Costa Rica. Stories about violent confrontations abound that people from Las Huacas are "mean" and "criminal-like." Men from Las Huacas are infamous for beating those who trespass into their areas; they confiscate their catches and sometimes steal their personal belongings like *jicras*, caps, money, wristwatches, or other jewelry. Informants in Muisne also relayed accounts of similar confrontations with people from Las Manchas, reputed for their territorial behavior and threatening outsiders with machetes, a claim the people from Las Manchas do not deny. However, this territorial behavior may be unique to only certain communities and not generalizable to all *concheros* in Ecuador. Generally *concheros* in Ecuador are non-confrontational and with the exception of the new *custodias*, the fishery

is characterized as a free-for-all in which fishing space is divided among people who are *enseñado* to their customary grounds.

Timing, Rotation, and Fishery Sustainability

The sustainable use of renewable natural resources not only depends on the quantity extracted, but also on the amount of time needed for the resources to regenerate. With each harvest, small shells are often left behind to promote propagation and spawning. This traditional understanding about the biology of cockles is passed down from one generation of *concheros* to the next and often reinforced in workshops sponsored by biologists from NGOs and government organizations. Mobility over space and rotation among gathering grounds is key to fishery stability. Many *concheros* alternate among a set of preferred spots to which they are *enseñado,* ideally leaving sites to rest for a period of 15-30 days. Traditionally, decisions about where to harvest are coordinated with changing tidal periods. During the shorter hours of low tide associated with the eight-day neap tide period, many *concheros* harvest areas close to home or decide not to harvest at all. According to customary knowledge, two weeks is sufficient time for a gathering ground to regenerate a supply of shells for the next harvest.

The fishery-managed areas of the *custodia* in Isla Costa Rica represent an institutionalized effort to rotate among cockle beds and ensure a sustainable harvest. During the ten-day period that they are open, the other cockle beds around the community are given time to recuperate. The fishery-managed areas are associated with the highest number of fishing trips, suggesting that many *concheros* abandon their other livelihood activities in order to participate. Despite the highest levels of effort, there are

no signs of harvesting pressures. The average CPUE from these sites are higher (Table 1) and shell lengths are significantly larger than open-access areas (Beitl 2011).

Adaptive Challenges in Mangrove-Associated Fisheries

Several challenges confront the sustainability of mangrove-associated artisanal fisheries in Ecuador. *Concheros* have expressed their concerns about increasing competition, encroachment by outsiders (highlanders, foreigners, or other communities), enclosure by shrimp farming or *custodias*, and pollution (urban contamination, shrimp farm discharge, and the illegal use of cyanide or dynamite in fishing). Some *concheros* have been displaced by these processes. Moreover, the impacts of climate change are poorly understood. As each *conchero* in Isla Costa Rica has a set of his own preferred gathering grounds, he is able to calculate a timely fallow period to ensure the sustainable exploitation of particular spots. However, many *concheros* are worried that no one leaves the sites to rest for as long as they should anymore. Furthermore, the timely rotation among gathering grounds is more challenging to coordinate as more people enter the fishery and in larger communities like Muisne and Puerto Hualtaco.

Shrimp farms have displaced many *concheros* from their preferred gathering grounds since the 1980s and continue to contribute to other annoyances that make cockle collecting more difficult and dangerous. In addition to occasional confrontations between shrimp farmers and *concheros*, many people in Muisne complain about "*pica pica,"* a skin irritation associated with a particular kind of algae found around shrimp ponds. Other *concheros* in Muisne believe that the venomous fish they call "*peje sapo"* is more abundant in the mud around the shrimp farms. Environmentally, shrimp farms have disrupted the hydrology of the estuaries, making some areas impassable by motorboat

and changing the consistency of the mud in gathering grounds. Shrimp aquaculture is also associated with occasional fish kills and other pollutants that may affect biological processes of settlement and growth of cockle larvae. Climate change may pose further challenges to fishery stability as the wet, rainy seasons associated with cockle spawning are growing shorter.

In the future, many *concheros* may adapt to social and environmental change by leaving the fishery to pursue other livelihood strategies. Livelihood switching and "occupational pluralism" is common in many fisheries around the world, despite the immense sense of pride and job satisfaction many fishers have (McCay 1978; Griffith and Valdés Pizzini 2002; McGoodwin 1990). If the fishing effort is reduced, harvesting pressures may be alleviated with further implications for fishery sustainability. On the other hand, a strong sense of pride or identity as a fisher might restrict people's ability to be resilient and adaptive in the face of broader social and environmental change (Coulthard 2008). This does not necessarily suggest fishery stability is threatened. Ecuador's recent policy changes in favor of mangrove conservation, its history of activism, and international attention to social justice by organizations like Greenpeace may all contribute to increased mangrove restoration in the years to come. These processes may have further strengthened the deep sense of pride among many *concheros* as "ancestral users of mangroves," contrary to the social stigma suggested by Kuhl and Sheridan (2009). Because of this, many *concheros* hope to protect mangroves and fishery-based livelihoods so they may pass the traditions down to their children. All of these broader-scale processes also have implications for maintaining healthy habitat and fishery stability.

Conclusions

While the fishing effort often clusters around areas where resources are most abundant (Sosis 2002; Chimello de Oliveira and Begossi 2011; Aswani 1998), this paper has shown that many individuals are *enseñado* to particular locations regardless of their productivity. Such cultural aspects of the fishing effort contribute to understanding about how space is socially produced in fishing communities (St. Martin 2004) and the ways in which open-access situations do not always result in a tragedy of the commons (Moritz et al. 2010). First, the absence of property rights does not signify an absence of social relations. The process of becoming *enseñado*, or accustomed to, certain fishing grounds in Ecuadorian mangrove-associated fisheries develops over time into a set of customary norms based on individual preferences, social relationships, and regular use, illustrating the ways in which many fishery commons are embedded systems (Wagner and Davis 2004; Wagner and Talakai 2007; McCay 2002). People harvest areas where their friends and family frequent or their forefathers have gone before them. Over time, many become accustomed local ecologies and the companions that work with them. In the process, they often build relationships with others who share the area, including *concheros* from neighboring communities, shrimp farmers, and merchants of mangrove resources. Sometimes interactions among *concheros* are hostile expressions of territoriality, but most of the fishery is characterized as a free-for-all, open access system based on mutual respect. Second, the sustainability of this system over time is maintained through regular use, ecological knowledge, mobility, and implicit coordination among the different actors who share space in the fishery commons. However, such forms of internal regulation are

potentially undermined by increasing fishing effort, habitat destruction, pollution, enclosure, and climate change.

The use of GIS as a data management and analytical tool contributes to a deeper understanding of social-ecological patterns of complex human-environmental interactions with potential management applications (Aswani and Lauer 2006; St. Martin 2004). It is a powerful tool for illustrating the spatial nature of the commons problem (Giordano 2003) and the way people divide up social space. The data gathered through this partnership with Asociación Isla Costa Rica provide a base for further investigation about the relationship between fishing effort and CPUE. Further analysis of these data will make it possible to replicate approaches and verify findings of previous research on decisions about patch-choice (Sosis 2002; Chimello de Oliveira and Begossi 2011), contributing to more robust understanding about complex interaction between cultural factors and environmental variability over space. While this micro-scale analysis of the fishing effort in Isla Costa Rica has produced an ethnographic account of the cockle fishery in Ecuador, the fishing effort on larger spatial and temporal scales and how it may respond to economic uncertainty and environmental variability remains yet to be explored.

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# CHAPTER 4

# COCKLES IN CUSTODY: THE ROLE OF COMMON PROPERTY ARRANGEMENTS IN THE ECOLOGICAL SUSTAINABILITY OF MANGROVE FISHERIES ON THE ECUADORIAN COAST[11]

[11] Beitl, C.M. 2011. *International Journal of the Commons.* 5(2):485-512. Reprinted here with permission of publisher.

Abstract

Scholars of common property resource theory (CPR) have long asserted that certain kinds of institutional arrangements based on collective action result in successful environmental stewardship, but feedback and the direct link between social and ecological systems remains poorly understood. This paper investigates how common property institutional arrangements contribute to sustainable mangrove fisheries in coastal Ecuador, focusing on the fishery for the mangrove cockle (*Anadara tuberculosa* and *A. similis*), a bivalve mollusk harvested from the roots of mangrove trees and of particular social, economic, and cultural importance for the communities that depend on it. Specifically, this study examines the emergence of new civil society institutions within the historical context of extensive mangrove deforestation for the expansion of shrimp farming, policy changes in the late 1990s that recognized "ancestral" rights of local communities to mangrove resources, and how *custodias*, community-managed mangrove concessions, affect the cockle fishery. Findings from interviews with shell collectors and analysis of catch-per-unit-effort (CPUE) indicate that mangrove concessions as common property regimes promote community empowerment, local autonomy over resources, mangrove conservation and recovery, higher cockle catch shares, and larger shell sizes, but the benefits are not evenly distributed. Associations without *custodias* and independent cockle collectors feel further marginalized by the loss of gathering grounds, potentially deflecting problems of overexploitation to "open-access" areas, in which mangrove fisheries are weakly managed by the State. Using Ostrom's Institutional Analysis and Development (IAD) framework, the explicit link between social and ecological systems is studied at different levels, examining the relationship between collective action and the

environment through quantitative approaches at the fishery level and qualitative analysis at the level of the mangrove landscape. Implications for coastal and fishery management are discussed in the conclusions.

Keywords

Sustainability, common property, collective action, social-ecological systems, co-management, community-based natural resource management (CBNRM), Ecuador, artisanal fisheries, mangroves, *Anadara tuberculosa, A. similis*

Introduction

Recent scholarship in sustainability science draws attention to the role of collective action and common property institutional arrangements in the study of social-ecological systems (Berkes 2005; Ostrom 1990; Kurien 1995; Bray et al. 2004; Berkes, Folke, and Colding 1998). Common property scholars have long maintained that collective action and strong local institutions can play an instrumental role in resource conservation, stewardship, or management (Agrawal 2001; Bray et al. 2004; Bromley 1992; Feeny et al. 1990; Feeny, Hanna, and McEvoy 1996; McCay and Acheson 1987; Ostrom 1990; Smith and Berkes 1993; Smith and Berkes 1991; Rebellon 2004). The collective action behind common property arrangements has the potential to serve as a mechanism for averting Garrett Hardin's (1968) "tragedy of the commons" if individuals successfully organize, cooperate, communicate, and trust one another for the benefit of resources and equitable distribution. Since the debut of Ostrom's influential book *Governing the Commons: Evolution of Institutions for Collective Action* (1990) outlining eight design principles for the governance of common pool resources, several case studies have applied the framework in an attempt to strengthen propositions about the sustainable management of resources (Gibson, McKean, and Ostrom 2000; Acheson 1989; McCay and Acheson 1987; Agrawal 2001; Bray et al. 2003). One of the main contributions of this research has emphasized the importance of local actors and institutions, which has particular relevance to recent paradigm shifts in coastal and fisheries management from "top-down" to "participatory" co-management policies that empower local communities as legitimate stakeholders (see Pomeroy 1995; Guest 1999).

While studies of common property have provided valuable insights into the internal processes of social organization, few have examined the outcomes most pertinent to the concept of sustainability. Questions still remain about the inherent assumptions of environmental stewardship implied by much of the common property literature (Lu 2001; Pollnac and Johnson 2005; Ruttan 1998; Ruttan and Borgerhoff Mulder 1999), especially since too often, little attention is given to ecology in relation to property rights (Berkes 1996). Only with the exception of a few studies (for example, see Bray et al. 2004; Acheson 1987; Smith and Berkes 1991), the direct link between social arrangements and the environment remains poorly understood, especially pertaining to the management of common pool resources (Anderies, Janssen, and Ostrom 2004), and despite calls in the policy arena to understand the human dimensions of environmental change (National Research Council 1999).

In this paper, I employ Ostrom's (2011) Institutional Analysis and Development framework (IAD) to investigate the link between social processes that have contributed to mangrove wetland recovery, and how the outcome of certain local institutional arrangements contributes to the sustainability of the mangrove cockle fishery (*Anadara tuberculosa* and *A. similis*) on the Ecuadorian coast. Given concerns about overexploitation of mangrove cockles in the last 10 years (Mora and Moreno 2009; Mora, Moreno, and Jurado 2009; Elao and Guevara 2006) and its possible relationship to larger landscape processes of mangrove deforestation for the expansion of shrimp farming (Ocampo-Thomason 2006), the primary goal of this study is to assess the role of *custodias*, ten-year concessions granted by the State to local associations for community-based stewardship and sustainable management of mangrove resources. At the time of

this research, the Ecuadorian State has granted concessions to 34 communities in all five coastal provinces, with the majority concentrated in the provinces of El Oro and Esmeraldas. Working in partnership with an external institution for technical assistance, local associations have been able to petition for a 10-year concession since the year 2000 by providing maps, a copy of the association's agreement, a list of members, designated officers, and a management plan detailing the "sustainable use of resources" (Bravo 2007), often guided by rules highly reflective of Ostrom's (1990) design principles. This study is confined to two specific questions. First, how do *custodias*, as a common property regime, promote environmental stewardship and sustainability in a social, ecological and economic sense? Second, does the common property regime and local valuation of that system suggest a viable institutional framework upon which to base conservation and management initiatives? The general aim of this study is to link social and ecological systems and explore the management implications for mangrove fisheries.

Globally distributed throughout tropical coastal areas, mangrove wetlands supply a variety of goods to coastal communities such as fuelwood, commercial timber, charcoal, construction materials, thatch, fish, mollusks, crustaceans, medicinals, tannin, honey, incense, paper, and dyes for cloth (Glaser 2003; Kaplowitz 2001; Kovacs 1998; Walters et al. 2008; Mera Orcés 1999; Snedaker 1986). In addition to the goods for direct human use, mangrove wetlands are increasingly recognized for their multiple environmental services: nutrient cycling, erosion control, sediment trapping, groundwater recharge, water purification, storm surge/ tsunami buffering, carbon sequestration, microclimate stabilization, and essential habitat, shelter, and nursery service for commercial, recreational, and subsistence fisheries (Brander, Florax, and Vermaat 2006;

Ronnback 1999). Due to their previous stigmatization as unproductive "barren wastelands" (Selvam et al. 2003: 794) and a general lack of understanding about their environmental services, mangrove wetlands worldwide have been undervalued, often leading to their draining for agriculture, urbanization, and tourism or conversion to other uses (Valiela, Bowen, and York 2001; Alongi 2002). While the deforestation rates of mangroves are generally decreasing, they still remain significantly higher than other forest types (FAO 2005). According to Valiela *et al.* (2001), mariculture contributes to about 52% of global mangrove loss and shrimp farming is the most significant type of aquaculture associated with mangrove deforestation.

The vulnerability of mangroves to destruction further reflects global policies and institutions that have favored export-oriented development like shrimp farming over local tradeoffs (Martinez-Alier 2001). While shrimp mariculture offers the potential for economic development by increasing export earnings and generating employment in urban centers, the local reality in marginalized coastal communities has been dramatic landscape change and decreasing water quality (Barbier 2003; Cruz-Torres 2000; Dewalt, Vergne, and Hardin 1996; Southgate and Whitaker 1994; Stram, Kincaid, and Campbell 2005). Along with ecological degradation, mangrove deforestation has also resulted in numerous social impacts such as community displacement, the loss of livelihoods, the erosion of resource rights, the reorganization of local economies, and an increase in economic disparity and social conflict (Primavera 1997; C-CONDEM 2007; Cruz-Torres 2000; Dewalt, Vergne, and Hardin 1996; Stonich 1995; Stonich and Vandergeest 2001). In some places around the world, including Ecuador, resistance movements have

emerged in defense of mangroves (Stonich and Bailey 2000; Cruz-Torres 2000; Martinez-Alier 2001).

According to the IAD framework, it is necessary to identify the structural variables (biophysical conditions, attributes of community, and rules-in use) that provide the context for the emergence of particular "action situations" and how the outcomes of those actions, in turn, feed back into the context, causing shifts in the structure. In Ecuador, after decades of mangrove clearing associated shrimp aquaculture (CLIRSEN-PMRC 2007), shrimp has risen to one of the top exports, despite set-backs in production due to White Spot Syndrome Virus (WSSV), a disease in cultured shrimp that devastated the industry in 1999. I argue that these events, along with both global and Ecuadorian resistance movements in defense of mangroves, and their consolidation into new civil society institutions, have partially served as a catalyst for the policy changes in the late 1990s that recognized the ancestral rights of local communities to mangroves and granted *custodias* to the first local associations in Esmeraldas and El Oro by the year 2000. In this paper, I focus on the mangrove concessions and their effects on the cockle fishery as the "action situations" that have contributed to the reversal of trends in mangrove cover from deforestation to reforestation and changed the nature of property relations among mangrove cockle collectors, thereby affecting the state of the resource.

Isla Costa Rica, El Oro, Ecuador, one of the study sites for this research, was one of the first communities to receive a *custodia* in the year 2000 (Figure 4.1). The management plan has two main objectives: 1) mangrove conservation and restoration; 2) specific guidelines for the sustainable management of the cockle fishery (Bravo 2006). With regard to the first objective, each *socio* (member of the local association) is

expected to report encroachment by expanding shrimp farms to the appropriate authorities and participate in periodic reforestation projects. While local mangrove restoration projects by 34 local associations throughout the coast are unlikely to make a big impact on a national scale, there are other institutions working toward the recovery of mangrove systems.

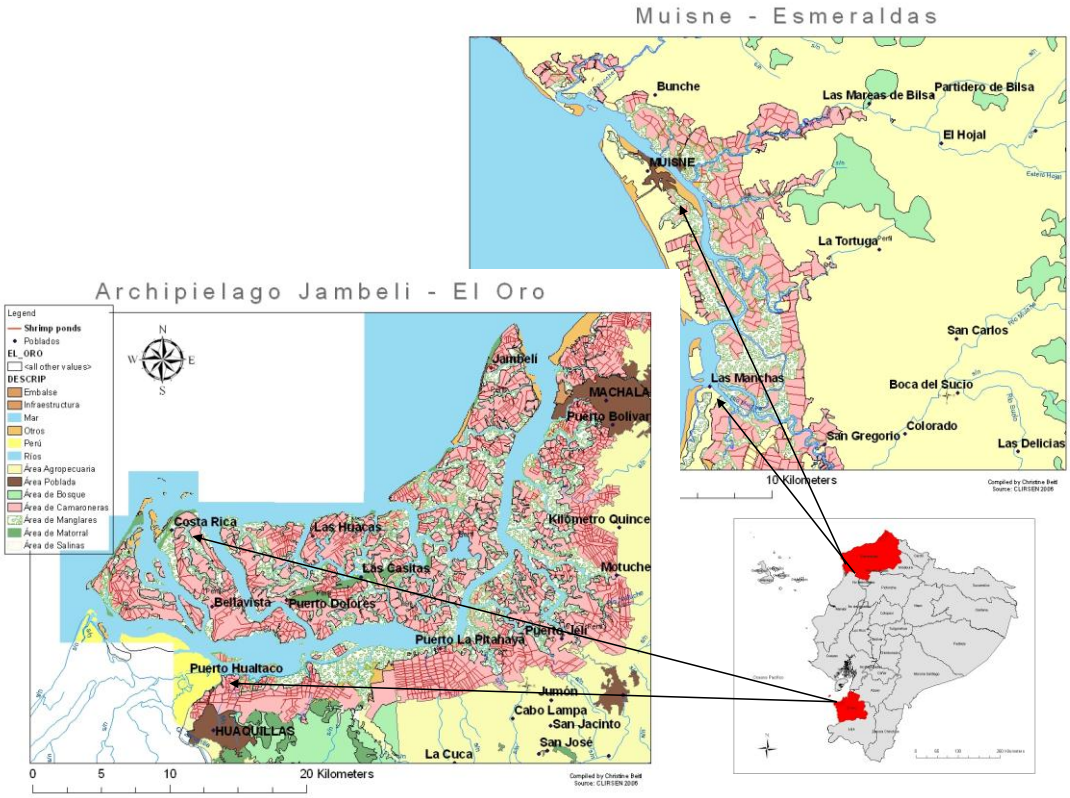

Figure 4.1: Shrimp Farming and Mangroves in the two study areas in the provinces of El Oro and Esmeraldas.

As pointed out by Berkes (2005; 2006), the scaling up of local processes is particularly challenging for coastal and marine resources, but local institutions can reduce their vulnerability to external threats by engaging in cross-scale collaborations, such as co-management and social movement networks (Berkes 2002). Through the new cross-scale collaborations, changes in Ecuador have been implemented at multiple levels for broader-scale impacts. The new Presidential Decree 1391 is designed to regulate the

shrimp industry and requires shrimp farmers to relinquish a certain percentage of their ponds to the government for the recuperation of lost mangrove habitat. Shrimp farmers sponsor reforestation projects carried out by local associations and other sectors of civil society. These processes, in turn, are also expected to further alter the biophysical variables that provide the context for mangrove fisheries and the institutions that govern them.

A central concern of this study has been about the impact of mangrove loss on artisanal fisheries such as the mangrove cockle, a bivalve mollusk locally known as *concha prieta* in Ecuador and *piangua* in Colombia. Cockles have a broad range throughout mangrove-covered areas in Pacific littoral zone from Mexico to Peru (MacKenzie 2001), and high cultural and economic value in the mangrove communities of Ecuador and Colombia (Kuhl and Sheridan 2009; Ecobiotec 2009; Rebellon 2004; Mera Orcés 1999; Ocampo-Thomason 2006). It is traditionally harvested for subsistence by women and children in the Afro-Ecuadorian communities of Esmeraldas province, and by men and young boys throughout the rest of the country. The earliest records of its commercialization date back to a fisheries census conducted by the Instituto Nacional de Pesca (INP) in the 1970s (INP 1971). As a stationary resource, it is particularly vulnerable to habitat destruction and overexploitation. Studies have shown declining catches and shell sizes throughout the Ecuadorian coast in the last decade (Mora and Moreno 2009; Mora, Moreno, and Jurado 2009; Elao and Guevara 2006). The Subsecretaría de Recursos Pesqueros (SRP) established the first measures to regulate the fishery in 2001 by Ministerial Agreement No. 170 which recommended a closed season during the period of reproduction from February 15 to March 31, along with a prohibition

of capturing shells smaller than 45mm. The closed season was difficult to enforce and ended in 2008. The updated Ministerial Agreement No.005 has called for the ratification and enforcement of regulations regarding the commercialization of shells below 45mm. Since July 2008, SRP inspectors are increasingly being stationed in major disembarkation areas to randomly monitor the fishery by confiscating shells smaller than 45mm and returning them to their habitat. However this form of control does little to prevent collectors from hiding small shells in their backpacks or clothing and the fishery continues to decline. As a common pool resource, the fishery is challenged generally by the problem of *subtractability*, or multiple users compromising one another's ability to maximize his/her share, and *exclusion,* or the difficulty of limiting resource use by the exclusion of outsiders (Ostrom et al. 1999; Berkes 2005).

With regard to managing the fishery in Isla Costa Rica, the second objective of the *custodia*'s management plan has designated certain areas for periodic closure, rotation, monitoring, controls, and vigilance. Similar to some of the design principles described by Ostrom (1990), maps of the concessions have clearly defined the boundaries of the *custodias* (principle 1). Second, all *socios* have made collective choice arrangements to abide by the rules regulating the allowable size (45mm) and the monthly closure of certain areas to allow ecological processes such as larval dispersal, settlement, and growth (principles 2 and 3). Third, a rotating guard system is obligatory to prevent access by outsiders (principle 4). Fourth, those who fail to fulfill the guard obligations are sanctioned by losing their privileges to the closed areas during harvest periods, with the penalty increasing upon multiple offenses (principle 5). Fifth, conflicts between *socios* are resolved in monthly association meetings and intruding outsiders are reported to the

local authorities in Hualtaco (principle 6). Finally, these tenure rights exist for a 10-year period with potential for renewal from the Ministry of Environment Forestry Department, and up until the time of this study, *socios* from Isla Costa Rica have enjoyed immunity from cockle confiscation by SRP authorities in Hualtaco (principle 7).

Other fisheries internally regulated along similar lines have shown social, economic, and ecological benefits for those involved (Acheson 1987). However, small-scale, locally-managed fisheries are still vulnerable to exogenous forces such as economic shifts, policy changes, or demographic changes (Acheson and Brewer 2003; Cinner 2005; Curran and Agardy 2002; Thomas 2001). In community-based natural resource management and co-management situations, it is not only necessary to study the institutional arrangements that promote sustainable catches, but also examine the local valuation of such management regimes to assess its social viability and potential persistence in spite of external forces that undermine their effectiveness. In Ecuador, as the mangrove landscape recovers simultaneously with the expansion of new institutions favoring local involvement and empowerment, there is opportunity to explore the three tenets of sustainability. The presence of a variety of management regimes in the study areas of El Oro allows for the testing of hypotheses about the effectiveness of different management strategies in a social, ecological, and economic sense.

In the following sections, I will present results that illustrate the relationship between the institutional arrangements of the *custodia* in Isla Costa Rica and their effects on the resource through a comparative analysis of three types of management regimes: 1) *Custodia Managed Fishery,* areas tightly managed by rotation and fishery closures in Isla Costa Rica; 2) *Custodia Open Fishery,* areas of the concession in which the fishery is not

tightly managed because of limited resources (human capital, lack of boats and money for gas); 3) *Absence of Custodias,* areas outside the concession frequented by collectors from Isla Costa Rica, neighboring communities, and the Port of Hualtaco and where access is defined by a first-come, first-serve basis. I posit that the loosely organized social movements in defense of mangroves of the early 1990s partially contributed to establishment of *custodias* that today permit some collectors to reap social and economic benefits while compromising other collectors' agency and ability to fish sustainably. I do not contend that *custodias* as a form of common property is a panacea for fishery management, but I argue it is an innovative policy intervention that has great potential to support local autonomy over resources while promoting community empowerment and healthy mangrove habitat for higher cockle catch shares and larger shell sizes.

## Methods

### Study Site

The research reported here was conducted in two study sites in the province of El Oro, Isla Costa Rica and Puerto Hualtaco (see Figure 4.2). Isla Costa Rica is a small fishing village of 310 inhabitants within a network of mangrove islands that form part of the Archipiélago Jambelí. The majority of households depend on mangrove resources for their livelihood and subsistence and 70% depend on cockle collecting. Almost half of all 70 households have one or more individuals collecting full time, 5-6 days a week, 2-4 hours per day. The daily fishing effort fluctuates between 15-30 collectors per day depending on tides and the lunar cycle, economic decisions, personal obligations,

holidays, and health/ physical wellbeing of the collector.[12] Most collectors are between the ages 14 and 40, despite Ecuador's labor laws that prohibit minors from working. But with access to secondary education 45 minutes away by boat and sometimes not accessible at all because of tides, those who have not migrated out to live in the nearest city of Huaquillas for study tend to work as fishers or cockle collectors on the island. Since many of them learn the activity at an early age, children as young as 6 years old have been seen digging in the mud alongside their parents or siblings during school vacations. Few collectors are older than 60 because of the physical demands of the activity, spending hours wading through knee-deep mud and climbing over branches while maintaining a crouched position to duck through the maze of low-lying branches. Many residents engage in livelihood switching as an adaptation to seasonality in fisheries and economic demand. Very few of them have ever worked on the near-by shrimp farms, even just for the three-day harvest every three months.

[12] Proyecto de Monitoreo Comunitario del Recurso Concha Prieta. Coordinado por Christine Beitl, Adolfo Cruz y Sonia Cruz, Isla Costa Rica, enero - junio de 2010 (Asociacion de Mariscadores Pescadores Artesanales y Afines "Costa Rica" 2010).

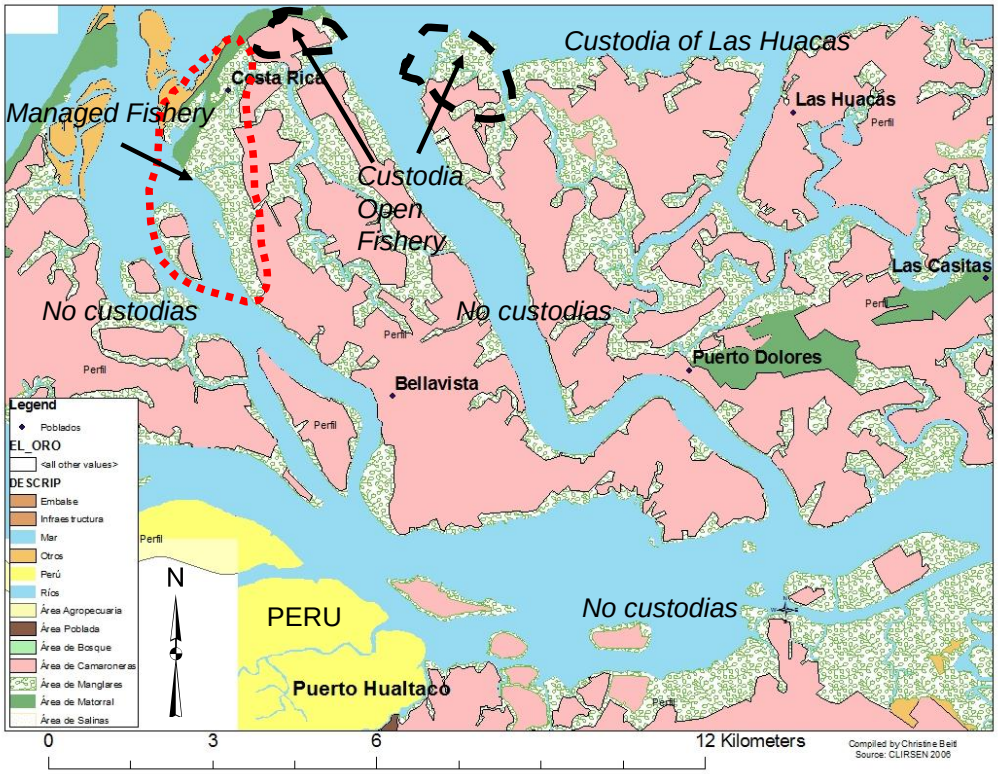


Figure 4.2: Property Regimes in Isla Costa Rica and around Puerto Hualtaco. Note that the boundary lines around the areas of Isla Costa Rica's *custodia* are not definitive.

In Isla Costa Rica, there are two local associations, Asociación Costa Rica and Nueve de Octubre. Over 50% of collectors on the island are members of one of the two local associations. The majority who are not *socios*, are their wives and children under the age of 18. Asociación Costa Rica is in charge of the 519.79 hectare *custodia* and they have made arrangements to include two men from the other association who are primarily dedicated to full time cockle collecting. Thirteen families practice cockle mariculture in holding pens of different sizes lined up in a creek directly in front of their houses. Both associations have collectively-managed holding pens. Most collectors go out on a daily basis in one or two boats carrying 10-15 passengers to an area, leaving 1-4 collectors in various spots along the estuary. Others go out alone or in small groups of 2-5 on foot or

in their personal motor-powered canoes. Shells are held for one to three days before being brought to Hualtaco for sale.

Puerto Hualtaco is the main landing site and jump-off point for collectors from the city of Huaquillas, about a ten-minute bus ride from the port. INP estimates an average daily fishing effort of 254 collectors per day distributed among 9-10 motor boats and a few paddle canoes. Many shell collectors in Hualtaco are men or children of men originally from the rural mangrove communities in the archipelago who have migrated out within the last 1-2 decades to improve educational and employment opportunities for their families while maintaining their traditional livelihoods and identities as shell collectors. Others are migrants and children of migrants from the province of Loja in the Highlands whose migration to the coast is related to booming opportunities in the shrimp sector during the 1980s. The collectors are men ranging in age from 17-50. Being residents of an urban area, their livelihood switching is related to economic opportunities in other employment sectors that come and go. Some of them take up 3-day employment opportunities on the shrimp farms every 3 months for the harvest. One of the local associations has an agreement with a local shrimp farmer to secure those kinds of arrangements for the *socios.* Others may work in shrimp packing and processing facilities every two weeks during spring tides. There are five local associations predominantly made up of cockle collectors. Like the two associations in Isla Costa Rica, they are actively involved with larger-scale federations embedded within the national-level fisheries civil society organization, FENACOPEC, which in theory gives them access to government institutions for greater participation, and in some cases, access to credit. The majority of collectors interviewed in Hualtaco (n=33) work 5-6 days a week, joining one

of the nine large boats carrying up to 30 collectors into the archipelago as far as Isla Costa Rica.

Data Collection and Analysis

Initially, I explored social aspects of the fishery as part of an ethnographic study of cockle collectors for dissertation research carried out from January 2009 to December 2010 in the provinces of El Oro and Esmeraldas, Ecuador. After three months of observations and exploratory interviews in the five major ports most important for cockle landings, and participant observation in Isla Costa Rica, I designed a semi-structured questionnaire to be administered in four sites, one large and one small community in each province.[13] To control for geographical differences and because of the presence of *custodias*, only the results from the two El Oro sites are presented here and comparative references are qualitatively made to the Esmeraldas sites. The questionnaire was divided into five sections: 1) informed consent; 2) information about cockles, including observations of CPUE and shell sizes; 3) baseline demographic information; 4) perceptions of change in mangroves and the fishery; 5) participation in civil society activities, social movements, and other forms of collective action.

In Isla Costa Rica, I interviewed collectors in their homes at their convenience and counted the total number of shells while measuring their length with a 150mm digital vernier caliper before or after the interview (21-170 shells/ collector). Of the 58 cockle collectors interviewed, 41 had their CPUE measured, in some cases, more than once. On

[13] Biologists from the Instituto Nacional de Pesca of Ecuador played an instrumental role in orienting me to different field sites, introducing me to research contacts, and advising me with general information about the fishery throughout the duration of this research. INP is a public research institution whose mission is to provide the service of technical and scientific investigation to the fisheries-aquaculture sector to inform policy for the sustainable development of the fisheries to achieve its "optimal rational use" (Mora, personal communication 2010).

a data sheet, in addition to CPUE and shell size (mm), I recorded information about the site, time and resources spent, and the number of shells the collector planned to use for subsistence or as seed for their *corral* (mariculture holding pen). Additionally, I took four trips with different collectors to the gathering grounds for participant observation and also to test my own skills harvesting. All together, I interviewed 58 residents of Isla Costa Rica, including fishers, cockle collectors, and women, resulting in 69 observations that included both interview and CPUE data, including those who allowed me to measure their CPUE on different occasions from multiple harvest sites.

In Puerto Hualtaco where the fast-paced pressures of market activity are much more intense, I carried out interviews in landing areas while two local field assistants measured all the shells of the catch (35-170 shells/ collector) and recorded the data in a log sheet, which was later matched with the interview. Both members of local associations and independent collectors were randomly recruited with the help of cockle buyers and field assistants as they disembarked.[14] On a few occasions without local field assistants, colleagues from INP randomly selected informants and measured shells while I conducted interviews. Some of the interviews were recorded with a digital voice recorder. On one occasion, I accompanied a group of collectors to the gathering grounds for observation, but remaining in the boat with its owner, the president of the provincial-level federation of local associations in El Oro. All together, there were 33 interviews, in which only one did not include CPUE data.

Throughout the process of data collection, I presented results to informants on several occasions in Isla Costa Rica to invite feedback and generate further discussion. When data collection was finished, I organized two workshops in collaboration with INP

[14] Of the 36 recruited in Puerto Hualtaco, only three declined to participate.

to present their findings about the state of the fishery on a national level and the findings of my study at a more in-depth local level. Both associations in Isla Costa Rica were invited to the first workshop held on the island. In Hualtaco, two representatives from each of the five associations and the larger federation were invited along with other *socios* and independent collectors who participated in my study. In addition to the individual interviews in Isla Costa Rica (n=58) and Puerto Hualtaco (n=33), the discussions at the workshop are particularly relevant to this study's assessment of the social viability of the *custodias* as a management regime for the cockle fishery.

In both sites, I confirmed with each informant that their sample was complete and not mixed with another collector's. To prepare the data for analysis, samples suspected to have been measured improperly were first removed from the database. Since I failed to consistently clarify with the informant whether shells were removed for personal consumption or the corral during the early phases of the project, several cases were dropped for more conservative analysis. Only two of the observations in this analysis (n=102) were cases in which the CPUE had been mixed between two collectors; however, since this analysis is not concerned with individual-level characteristics that may bias shell catches and sizes, they are unlikely to affect the results. In only two cases in Isla Costa Rica, the collector reported to have already removed a marginal amount of small shells before CPUE measurement (7 and 10 shells) for his corral. To correct this problem, I adjusted the CPUE data by adding the number they reported to have removed, estimating shell size based on the lowest shell size of their catch.

To test the claim that CPR arrangements are beneficial for resources, I examined the size frequency distribution of shells for the harvest sites, which were each coded and

classified into one of the three types of property regimes: 1) *Custodia Managed Fishery*; 2) *Custodia Open Fishery*; 3) *No Custodias,* including sites around both Isla Costa Rica and Puerto Hualtaco (see Figure 4.2). A positively-skewed size frequency distribution with central tendency concentrated in the lower range would indicate signs of overexploitation and stress. The differences in mean size of both species *A. tuberculosa* and *A. similis* by type of property regime were examined by carrying out a comparison of means test and one-way analysis of variance (ANOVA) test (n=6,565). I also compared the proportion of large shells to small shells by site for more robust results than those provided by average sizes alone, further illustrating descriptive information about the condition of the gathering grounds and the differences between them. A *post hoc* pair-wise comparison was then conducted to determine between which sites specifically the differences lie.

The institutional robustness of common property arrangements in relation to sustainability could be better understood by examining its social viability in addition to the impacts on the resource. In the interviews, I enquired about perceptions of change in the fishery, concerns about overexploitation, whether informants agree with the *custodias,* and whether they believe that everyone should have the right to work in mangroves. Data from semi-structured interviews were coded into dummy variables to calculate the percentage of responses in agreement with the topics of enquiry and later to compare whether differences in opinions could be explained by field site, comparing Isla Costa Rica and Hualtaco. I employed a two-way measure of association cross-tabulation to test for significant differences between the two sites.

Results

The distribution of *A. tuberculosa* shell sizes differs significantly depending of the type of management regime from which they were harvested (Figure 4.3).

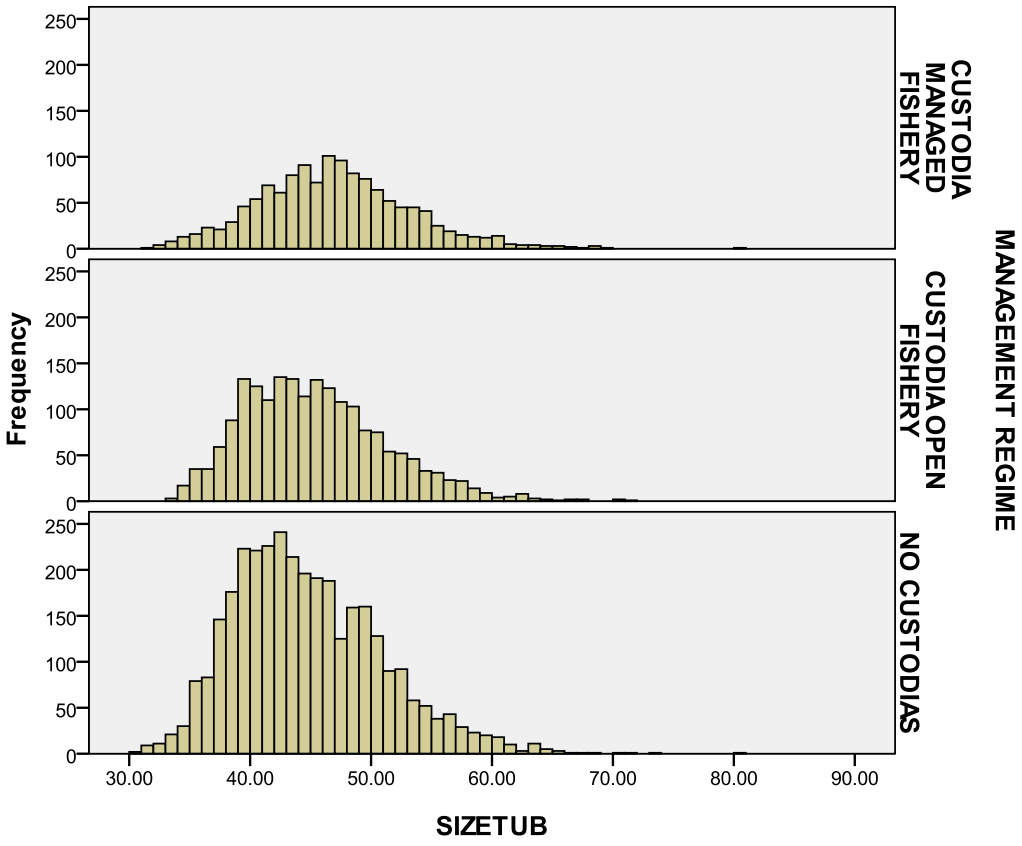


Figure 4.3: Size frequency distribution of *A. tuberculosa* captured from three types of management regimes in El Oro, Ecuador (n=6,565). There are significant differences in shell sizes between the three types of management regimes ($F$ = 61.665) and ($p$ = .000).

The areas of the *custodia* in which the fishery is managed by periodic closures and rotation between sites have a normal distribution of shell sizes with low skewness, indicating that some collectors are harvesting small shells and not abiding by the rules concerning the minimum allowable size for commercialization. The other two areas within and outside the *custodia* where the fishery is not managed and open on a first-come, first-serve basis, are more similar in their distribution of shell sizes. The positive

skew of those two types of management regimes indicates that shells extracted from "open-access" situations in which with fishery is not managed tend to be smaller in size, thereby supporting the hypothesis that areas where the fishery is not managed are more likely to exhibit signs of overexploitation.

In addition to shell size, the average number of shells harvested per hour also differed significantly between the three property regimes (Figure 4.4). In the fishery-managed areas of the *custodia*, collectors are able to harvest 34 shells per hour. In the areas of the *custodia* not managed for the fishery, collectors harvest an average of 28 shells her hour, closer in average to nearby open-access around Isla Costa Rica and Hualtaco (26 shells per hour). Since the average number of shells per hour did not have a normal distribution in all three sites, I used non-parametric tests to evaluate whether those differences were significant. The Kruskal-Wallis test showed significant differences between the different types of management regimes (n=98, chi sq= 6.031, $df$ =2, $p$=.049). To test specifically between which management regimes the differences lie, I employed a Wilcoxon rank-sum test recommended for non-normally distributed data (Figure 4.1). As suspected, the most significant differences lie between the parts of the *custodia* where the fishery is managed according to strict rules of rotation and access (group 1) and the open-access areas around outside the *custodia* that are accessed on a first-come, first-serve basis (group 3).

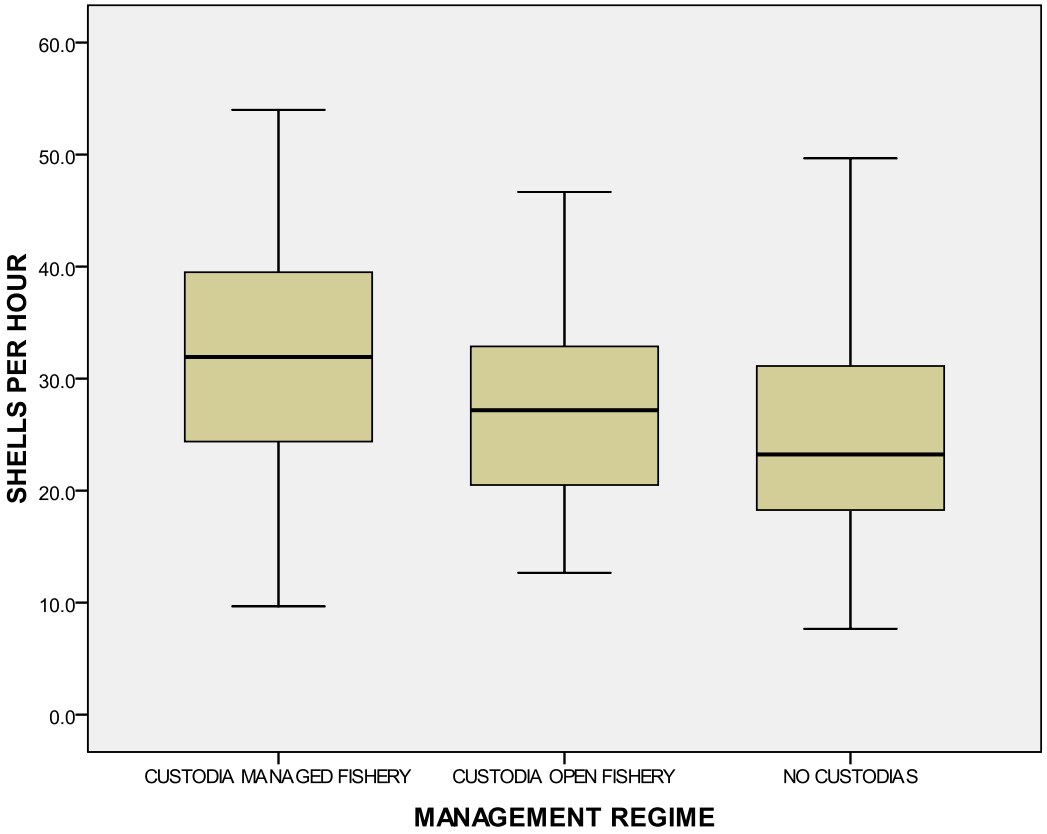


Figure 4.4: The number of shells gathered per hour differs significantly between the three property regimes: 34/hour in the managed areas of Isla Costa Rica, 28/hour in the areas of the *custodia* where the fishery is not managed and 26/hour in open access areas of around Hualtaco and Isla Costa Rica (n=98, chi-sq= 6.031, *df*=2, *p*=.049).

Table 4.1: Results of non-parametric two-sample Wilcoxon rank-sum test for differences in the number of shells harvested per hour according to the type of management regime. Significance indicated by * at 0.05 level.

| Comparison of average shells/ hour between management regimes | Difference between means (shells/ hr) | N | *z*-test | *p*-value |
|---|---|---|---|---|
| Custodia Managed Fishery and Custodia Open Fishery ( groups 1,2) | 6 | 50 | -1.536 | 0.124 |
| Custodia Managed Fishery and No Custodias (groups 1,3) | 8 | 66 | -2.462 | 0.014* |
| Custodia Open Fishery and No Custodias (groups 2,3) | 2 | 80 | -0.933 | 0.351 |

Finally, the results of this study suggest that there is a relationship between resources and the social arrangements that govern them, thereby supporting my hypothesis about the role of common property arrangements in the sustainable management of mangrove cockles (Figure 4.2). In the areas of Isla Costa Rica's *custodia* that are rotated around closure periods of 6-30 days, one is more likely to harvest a slightly higher quantity and larger shells than in the open-access areas both within and around the *custodia*. Moreover, those areas of the *custodia* have a higher abundance of large shells in proportion to small shells.[15] A *post-hoc* 2-sample *t*-test confirmed significant differences between each of the paired sites for each variable at a level of .000 for all variables except CPUE<36mm ($p$= .004).

[15] For purposes of simplification, this ratio was calculated only for *A. tuberculosa* since it is ecologically more abundant in many of the harvest areas and culturally more important.

Table 4.2: Relationship between property regime and cockle shell size (mm) in El Oro, Ecuador. Significance indicated by * at the 0.05 level and ** indicates significance at the .001 level.

| PROPERTY REGIME | DESCRIPTION | n | MEAN CPUE IN SHELLS PER HOUR * | MEAN SIZE *A. TUBER-CULOSA* (mm) ** | MEAN SIZE *A. SIMILIS* (mm) ** | CPUE <45mm (%) ** | CPUE <40mm (%) ** | CPUE <36mm (%) * |
|---|---|---|---|---|---|---|---|---|
| **CUSTODIA MANAGED FISHERY** | Five harvesting sites that are closed for periods of 6 to 30 days/ month. The guard is stationed in front to prevent intrusion by outsiders. | 1315 | 34 | 46.96 | 47.96 | 39% | 12% | 3% |
| **CUSTODIA OPEN FISHERY** | Areas within the concession that are monitored for mangrove protection only, but the fishery is not regulated and shells are harvested on a daily basis by collectors from Isla Costa Rica and occasionally from Hualtaco. | 1919 | 28 | 45.35 | 47.46 | 51% | 19% | 3% |
| **NO CUSTODIAS** | Areas outside of the concession that are harvested on a daily basis by collectors from Isla Costa Rica and Hualtaco. This category includes all sites ranging from Hualtaco to Isla Costa Rica. | 3331 | 26 | 44.75 | 45.93 | 56% | 23% | 5% |
| **TOTAL** | | **6565** | **28** | **45.37** | **46.7** | **52%** | **20%** | **4%** |

The second proposition, that *custodias* are not only beneficial for the resource but also for the community of resource users, is only partially supported by the results here (Figure 4.3). In both sites, Isla Costa Rica and Hualtaco, the majority of informants agreed that over the last ten years, the cockle fishery has been declining, making their work more difficult. Over 90% of the informants in both sites were concerned about overexploitation and the possibility that this resource will soon become economically extinct. However, not all informants agreed the reasons for overexploitation or potential solutions, particularly with regard to *custodias*.

In both Isla Costa Rica and Hualtaco, informants were concerned about the loss of gathering grounds, but there were significant differences in their opinions about the reasons for the loss of those areas. In Isla Costa Rica, 31% attributed the loss of gathering grounds to shrimp farms while only 3% in Hualtaco cited that as the primary cause. In contrast, 80% of collectors interviewed in Hualtaco attributed the loss of gathering grounds to *custodias*, while 52% recognized that as a problem in Isla Costa Rica. Not surprisingly, in Isla Costa Rica, 100% of those interviewed were in favor of the *custodias*, even though they had lost some of their gathering grounds to the concession of the near-by community Las Huacas (see Figure 4.2).

Collectors in Hualtaco had conflicting opinions about *custodias*. Generally there was a widespread perception of benefits among those affiliated with associations and others who may have experienced larger shell and catch sizes first-hand by trespassing. Despite the perception of benefits, many informants in Hualtaco felt they were running out of places to harvest shells. Finally, when asked if everyone should have the right to work in mangroves, the "yes" response was significantly higher in Hualtaco than in Isla

Costa Rica with answers like, “yes, we are all Ecuadorians” and “of course, how can anyone make themselves an owner of mangroves?”

Table 4.3: Percent of informants that agree with various statements concerning the social viability of *custodias* as a management regime for the mangrove cockle fishery in Isla Costa Rica and Hualtaco.

| | ISLA COSTA RICA | | HUALTACO | | Two-way cross-tabulation measures of association | |
|---|---|---|---|---|---|---|
| | Mean | N | Mean | N | $X^2$ | *p*-value* |
| Perceived difference in the cockle fishery over the last 10 years | 100% | 33 | 94% | 32 | 2.128 | 0.145 |
| Concern about overexploitation | 97% | 37 | 91% | 32 | 1.399 | 0.237 |
| Conflict with another cockle collector | 61% | 31 | 38% | 32 | 3.566 | 0.059 |
| Conflict with shrimp farmer | 40% | 30 | 65% | 31 | 3.674 | 0.055 |
| Harvest areas lost in general | 93% | 29 | 97% | 32 | .463 | 0.496 |
| Gathering grounds lost to shrimp farms | 31% | 29 | 3% | 30 | 8.038 | 0.005* |
| Gathering grounds lost to *custodias* | 52% | 29 | 80% | 30 | 5.261 | 0.022* |
| Perceived benefits of *custodias* | 100% | 30 | 79% | 28 | 7.170 | 0.007* |
| Universal rights to mangrove resources | 79% | 24 | 97% | 29 | 3.954 | 0.047* |

## Discussion

### Benefits of Common Property Arrangements for the Resource

The results of this study confirm some of the assumptions that the common property literature has made about the stewardship of resources. The findings illustrate that shell and capture sizes are significantly related to the ways in which the cockle

fishery is managed. The arrangements outlined in Isla Costa Rica's management plan reflect one way of dealing with the challenges of governing common pool resources: *subtractability* and *exclusion* (see Ostrom et al. 1999). The results confirm that the design principles governing common pool resources are beneficial for the state of the resource as a relatively closed system, open only to members of the Asociación Isla Costa Rica. In the areas of Isla Costa Rica's *custodia* that are rotated around closure periods of 6-30 days, one is more likely to harvest a slightly higher quantity and larger shells than in the open-access areas both within and around the *custodia*. Moreover, those areas of the *custodia* have a higher abundance of large shells in proportion to small shells. Therefore, a collector may be driven by economic incentives to harvest and respect the rules of those areas since larger shells are considered by buyers to be "better quality" and sell for a higher price on the market. Since the *socios* perceive social, ecological, and economic benefits, they have further incentive to cooperate along the lines of the collective choice arrangements they have agreed upon as a group. While the rules concerning the extraction of small shells below the size limit of 45mm is written into the management plan and largely understood by *socios,* there is no enforcement of these rules; rather, it is enforced by an honor system. Many collectors do not take small shells not only for ecological reasons and their understanding of ecological processes of larval dispersion and growth rates, but also because small shells are more difficult to sell. They may only harvest a handful of small shells to "*completar*," or reach a round number since the price is determined by number and size rather than by actual weight.

While personal economic incentives for not harvesting small shells other than as seed for the corral or to "*completar*" were not directly addressed in this analysis, the

social repercussions for not following the rules may be just as compelling. This is demonstrated by the high levels of cooperation around the rotating guard system. Everyday, two of the forty *socios* are obligated to lose a day's work on a rotating basis to sit in a boat in front of Isla del Puerco, an ideal location for monitoring the five fishery-managed harvest sites of the *custodia*. Those who deflect from this obligation are sanctioned by not being allowed to participate in the harvest of the areas during the open periods. For each offense, the sanctions become more severe, eventually resulting in his permanent exclusion from the monthly harvests. According to the president of the association, no one has ever violated the rule more than once.

An alternative explanation for the significant differences in shell sizes between the types of management regimes may be reflective of ecological processes independent of human interaction beyond the scope of this study. For example, *A. tuberculosa* prefers harder soils characteristic of older, more well-established mangrove forests while the abundance of *A. similis* is more attributed to soft, saturated mud characteristic of young mangrove colonies. Furthermore, collectors have their "ecological" preferences about sites, which further contributes to differences between sites and fishing effort.

Another explanation for the differences in shell sizes between the types of management regimes could be explained by the fishing effort, the number of collectors on a given day. The data show a gradual decline in shell size and the number of shells captured per hour with the fishery-managed areas of the *custodia* ranked first (group 1), the open-fishery areas of the *custodia* ranked second (group 2), and the open-access areas around Isla Costa Rica and Hualtaco ranked third (group 3). While the *t*-test (for shell size) indicates that the shell size differences are significant between all of the pairs, the

more conservative *z*-test (for shells per hour) illustrates that the differences between groups 1 and 2 and the differences between groups 2 and 3 were insignificant. According to the *z*-test, the significant differences in the number of shells harvested per hour lie between the fishery-managed *custodias* (group 1) and open-access areas outside the *custodia* (group 3). This may suggest that group 2 is a hybrid regime, although it is technically just as much "open-access" for cockle collecting as any of the other areas around Hualtaco and open to anyone on a first-come, first-serve basis. Possible reasons why the averages in the second group seem to be a middle ground could be attributed to a lower fishing effort, given its distance from Puerto Hualtaco. On the other hand, the lower fishing effort in the non-fishery-managed areas of the *custodia* could be attributed to political boundaries established by the concession. Generally, after ten years asserting their territorial rights over their *custodia,* the areas in concession are generally respected by collectors from Hualtaco. Trespassing is not very common even though there would be no sanctions in the open fishery areas of the *custodia*. If the latter explanation is the case, then it lends further support for the assertion that *custodias* are beneficial to mangrove fisheries by the successful delineation and assertion of boundaries.

One final point worth mentioning is that all shells harvested by collectors from Isla Costa Rica would be significantly larger on average if it weren't for the corrals. Those who have corrals collect small cockles as seed, justifying the exploitation of shells below the legal size limit with the approval of other *socios,* although not all agree with the practice of cockle mariculture particularly for concerns about overexploitation. Practicing cockle mariculture is essentially an individualistic endeavor rather than a collective action which could potentially undermine the sustainability of the cockle

fishery in Isla Costa Rica if too many families establish their own holding pens collecting small shells as "seed" (Beitl 2010). Currently, only 13 families have their own corral and some harvest them as few times as twice a year when demand is highest during Christmas and Easter holidays. Other users may harvest them more frequently (once every three months), or a handful on a weekly basis to *completar* when work days are unfruitful.

Social Implications of Common Property Arrangements for Mangrove Fisheries

As these results show, the benefits of the *custodias* are widely perceived by both collectors in Isla Costa Rica and to some degree by the collectors in Hualtaco. For the people in Isla Costa Rica, the *custodias* have allowed them to defend their livelihoods, traditions, identity, and the ecosystems upon which their families have depended for generations. By their 2005 mid-term evaluation, strengthening local organization and mangrove recovery were two of the outcomes listed as successful in the report (Bravo 2007). In the interviews, many expressed satisfaction with the perceived economic benefits. Naturally, a healthy habitat with more productive cockle harvest areas is beneficial to the resource users, but only for those who have access. *Socios* from Isla Costa Rica have access to gathering grounds that allow them to harvest an average of 8 more shells per hour than collectors from Hualtaco. This implies a significant increase in income of 30-40% based on a 3-hour work period and an average total CPUE of 86. Moreover, since the shells in those gathering grounds are larger, they can sell them for a higher price on the market. It also suggests that their work is easier for them, in that they can gather the same amount of shells in less time, allowing them enjoy their leisure time or dedicate themselves to another activity such as fishing, which potentially increases their income even further. Thus, the *socios* in Isla Costa Rica are very satisfied with the

economic benefits of the *custodias*, providing further incentive to cooperate around the use of the resource and respect the rules governing their mangrove areas in custody.

In addition to highly localized benefits, Isla Costa Rica's experience with the concession has generated pride and a sense of ownership that contradicts what many other shell collectors believe are universal rights to work in mangroves, "as long as you do not destroy them," as the shrimp farming industry has done. Despite the existence of laws that have protected mangroves, between 1969-2006, the original mangrove cover decreased by 26.5%, correlating with the growth of shrimp farming (CLIRSEN-PMRC 2007). The first shrimp farms in Ecuador were built in the salt flats and uplands during the 1970s and early 1980s. Often compared to "gold-rush fever" in other parts of the developing world (Jermyn 2000; Cruz-Torres 2000), the shrimp industry in Ecuador expanded rapidly in both geographical extent and political power, disrupting environmental services and displacing artisanal fishers while producing one of the nation's most important exports. Artisanal fishers with little political power or economic resources could do very little but to stand by and watch their fishing grounds be bulldozed away.

Between 1969 and 1995, the Archipiélago Jambelí lost almost half of its original mangrove cover to shrimp aquaculture (Bravo 2006). While local employment on shrimp farms tends to be seasonal and temporary, other sectors in packing, processing, and transportation boomed throughout the 1990s, mobilizing the migration of people to rural fishing villages and urban centers where the industry thrived. Urban centers like Muisne and Huaquillas benefited from the boom until 1999 when WSSV devastated the industry, closing hatcheries, processing and packing plants, and halting infrastructural

development. Many people displaced by the crash of the shrimp industry in 1999 had no other choice in a precarious economic situation but to take up artisanal fishing until other employment became available. Between the degraded mangrove habitats and increased number of collectors, artisanal fisheries like that of the mangrove cockle, began to decline. *Custodias* have provided the appropriate legal backing for local communities with little economic and political power to defend the resources and environments upon which their families have depended for generations, resulting in stronger local institutions and empowerment.

Now the very *custodias* that were established to defend the resource rights of ancestral communities serve as a new form of enclosure that denies fishing territory to those not affiliated with local associations. In the two study sites in El Oro, the incidence of conflict between shell collectors was higher than the two study sites in Muisne where there are no *custodias* (Beitl 2011). In the early years of Costa Rica's *custodia,* conflicts among collectors from Hualtaco were more frequent as they were trying to assert their territory. Now, ten years after the granting of the concession, many of the collectors from Hualtaco have amicable relations with Isla Costa Rica, but continue to have conflicts with newly establishing *custodias* of Las Huacas and Pongalillo. Some informants in Hualtaco even attributed the decline of cockles directly to the problem of *custodias*. While in the past, gathering grounds were lost to shrimp ponds, today, collectors in Hualtaco are concerned about the loss of territory to *custodias* which are "spreading like a fever in the province of El Oro since now, everyone seems to be asking (the government) for a concession" (Mora, personal communication).

Broader Implications of Common Property for Mangrove Conservation and Recovery

"Scaling up" the common property arrangements by granting *custodias* to several coastal communities presents new challenges, as argued by Berkes (2005). This is especially true of Ecuador's coastal zone, which like many others, is a heterogeneous social-ecological landscape characterized by diverse institutions and overlapping jurisdictions (Jentoft 2000). This case study of the *custodias* in El Oro is a good example of how local institutions can be strengthened by cross-scale interaction (Berkes 2002) and represents a step in the direction of understanding complexity and implementing integrated coastal management in Ecuador (Christie 2005; Olsen, Ochoa, and Robadue 2003; Olsen and Christie 2000; Robadue 1995). On a larger scale beyond the common property arrangements of the mangrove fishery within the *custodia*, each *socio* is obligated to defend and participate in mangrove reforestation projects. Since the establishment of Isla Costa Rica's concession in the year 2000, there have been two offenses by a local shrimp farmer wishing to expand his operation. As a "nested enterprise" (Ostrom's design principle 8), members of the association worked with local authorities, non-government organizations, and the Universidad Técnica de Machala (their partner institution) to press charges and later replant the mangrove areas that were cleared, thereby further promoting healthy mangrove habitat for more productive fisheries beyond the boundaries of their *custodia*. These pockets of community-based conservation are likely to be occurring in the other 34 *custodias* on the Ecuadorian coast.

Overall, the granting of mangrove concessions to local associations has been part of a slight shift in the broader political economic structure that has traditionally favored shrimp exports over local artisanal fisheries, resulting in widespread welfare impacts for

the coastal communities where mangroves were cleared for shrimp farming. What started out as loosely organized grassroots resistance movements by activists and poor fishers with few resources in defense of mangroves, eventually consolidated into new civil society organizations, local fishing associations and cooperatives, multi-tiered institutional interactions, and the policy changes that gave rise to *custodias* throughout the country. These outcomes provide further feedback into the context, contributing to the recovery of mangroves in some areas, the strengthening of local communities and civil society, and new collaborations between institutions, which will eventually mobilize new action situations.

## Conclusion

The establishment of community-managed mangrove concessions may represent a potential solution to a crisis of overexploitation of mangrove fisheries in Ecuador, but could result in what Martinez-Alier (2001) referred to as a "tragedy of enclosures" ironically in reference to shrimp farming. As independent collectors and *socios* without concessions are increasingly losing their ground, their ability to harvest shells sustainably is compromised, possibly deflecting problems of overexploitation to open-access areas where shell sizes are significantly smaller, as this study has demonstrated. In order for these new local institutions to endure climate change and other exogenous forces, the issue of conflict between user groups will have to be addressed. On the other hand, Ecuador's mangrove concessions represent one of the many valiant innovations to restore degraded coastal wetlands and improve the productivity of the artisanal fisheries that depend on healthy mangrove habitat. Communities that benefit from the mangrove concessions are empowered by the process and gaining more local autonomy over their

resources in the face of broader social, economic, and environmental changes that continuously threaten to undermine their livelihoods, identity, and wellbeing. The co-management arrangements allow local associations to interact with other institutions at multiple scales for greater participation and reinforcement of ancestral rights to mangrove resources.

Combining social and ecological methods is a useful tool for assessing sustainability. The IAD framework is moving in this direction beyond institutional analysis towards a broader understanding of social-ecological systems (Ostrom 2011). This study's application of the IAD framework, confirms certain kinds of social arrangements can promote sustainable resource use on a local level, while also identifying certain vulnerabilities. This is particularly important considering that much of the literature still focuses on the negative anthropogenic impacts on the environment instead of interactions considered beneficial, dynamic, and adaptive from a social-ecological systems perspective (Bray et al. 2004; Berkes, Folke, and Colding 1998; McCay and Acheson 1987). One limitation of this research is that it has only been able to qualitatively speculate about the role of these local-level processes as they relate to the broader mangrove landscape. Further analysis should more systematically examine the relationship between these local-level processes and broader patterns of landscape change as Bray and others have done in Mexico (2003). Similar research endeavors that attempt to study the direct link between social and ecological systems at multiple scales call for interdisciplinary action and collaboration under the same theoretical framework. Such research in sustainability science not only advances theories that integrate social and

natural sciences, but also provides useful analytical tools for sustainable development and conservation policy (Kates et al. 2001).

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# CHAPTER 5

# ADDING THE ENVIRONMENTAL CONTEXT TO THE COLLECTIVE ACTION PROBLEM: LOCAL INSTITUTIONS AND THE MULTI-LEVEL FISHERY COMMONS OF COASTAL ECUADORIAN MANGROVES[16]

[16] To be submitted to *World Development*

Abstract

Critical to the success of common pool resource governance is the ability to create institutional arrangements and the degree to which individuals comply with the rules that hypothetically promote sustainable resource use and management though collective action. In recent years, increasing concerns about harvesting pressures in the Ecuadorian cockle fishery (*Anadara tuberculosa* and *A. similis*) and the destruction of its mangrove habitat provided an impetus for the expansion of civil society and local associations for fishers and other ancestral users of mangrove resources. In this paper, I explore the interaction between different kinds of collective action and environmental governance outcomes in two distinct resource systems: mangroves and their associated fisheries. Results suggest that membership in local associations correlates with slightly higher concern about overexploitation in fisheries and contributions to collective actions that may benefit mangrove forests in the long run. However, there are no differences in fishing behavior, measured by average shell sizes of an individual's total catch. These ambiguous results about the relationship between collective action and the environment are best explained by the differential physical characteristics and social histories of each resource system and the variable nature of collective action problems (*subtractability vs. contribution)*. These findings address gaps in commons theory and further contribute to understanding about how institutions for collective action function internally, ecological constraints on fishing behavior, and reciprocal feedback between human organization and the environment.

Keywords: fisheries, mangroves, coastal management, collective action, commons, sustainability, institutions, environmental governance, catch-per-unit-effort (CPUE)

Introduction

Much of the research on the commons has been generated by social science perspectives concerning collective action and common property theories formulated around critiques of Garrett Hardin's (1968) tragedy of the commons, in which self-interested humans would eventually destroy the resource base of the planet. Commons scholars often point out that individual resource use is mediated by institutions, social controls, or sanctions (Folke and Berkes 1995) and many field studies have examined structural conditions under which self-organization for the sustainable governance of resources is possible (Ostrom 1990; Agrawal 2001; Basurto and Ostrom 2009). Broadly defined as cooperation for a common goal, theories about collective action emphasize the importance of individuals and their ability to coordinate their actions to overcome social dilemmas (Hardin 1982; Smith 2010, 2003; Olson 1965; Ostrom 1998; Kurien 1995). Experimental research on collective action and cooperation has further advanced understanding about the conditions under which collective action is likely (Ostrom 1998; Ledyard 1995; Boyd and Richerson 1992; Ostrom and Walker 2003). However, the direct relationship between collective action and the environment is poorly understood. With the exception of a few studies (for example, see Rustagi, Engel, and Kosfeld 2010), experimental models have been limited to hypothetical scenarios without empirical field observations that link human behavior to actual common pool resources. This paper addresses a gap in the commons literature that has often underemphasized the importance of resource characteristics, user group characteristics, and the external context (Agrawal 2001) and further contributes to understanding about the relationship between collective action and environmental sustainability (Berkes, Colding, and Folke 2003; Vollan and

Ostrom 2010; Adger 2003; Adger et al. 2005; Ostrom et al. 2002). Collective action theory is well-positioned to address this gap since it concerns the behavior of individuals toward resources and one another, elucidating insights about complex feedback between humans and the environment with important implications for policy.

In recent decades, mangrove deforestation for the expansion of shrimp farming in Ecuador has exacerbated harvesting pressures on mangrove-associated fisheries like mangrove cockles (*Anadara tuberculosa* and *A. similis*). In the early 1990s, grassroots resistance movements began to consolidate into a burgeoning civil society sector made up of non-government organizations, cooperatives, and associations for artisanal fishers and "ancestral" users of mangrove resources. Some fishing cooperatives and associations organized to address problems in artisanal fishery sector development while others focused more on environmental activism, social justice, and the defense of mangrove habitats. By 1999, the government began to recognize the ancestral rights of mangrove users and created policies that granted *custodias* (community-managed concessions) to formally organized local associations of fishers and "ancestral users" as strategy towards community-based conservation of mangrove forests and sustainable resource management.[17]

Since the social, ecological, and economic benefits of *custodias* have been widely perceived by many cockle collectors and exalted by government agencies to outweigh any costs (Coello, Vinueza Burgos, and Alemán 2008; Bravo 2007), some government officials believe in a need to mandate the participation by all cockle collectors in local associations so that open-access fishery areas in Ecuador can be converted into common

[17] Currently, 37,818 hectares of mangroves are held in 41 concessions with the ultimate goal of increasing authorized areas to 47,000 hectares for community-based conservation (Rosero Moya and Santillan Salas 2011).

property to simultaneously address problems of deforestation and overexploitation of mangrove-associated fisheries. However, many non-associated, independent cockle collectors are wary of institutions and prefer not to participate, contributing to growing tensions between those who have concessions and those who do not, potentially undermining the sustainability of the fishery (Beitl 2012). Thus, there is a need to verify popular claims by members of associations and certain government officials that independent cockle collectors harvest shells in a less sustainable manner and that participation in civil society organizations more effectively enables people to overcome resource dilemmas.

The diverse scholarly literature on collective action fundamentally points to two different kinds of collective action problems. The first kind of collective action problem refers to an individual's *contribution* of time or resources for collective benefit (Hardin 1982; Beard 2007; Tilly and Tilly 1981; Olson 1965). The second kind of collective action problem is described in the common property literature as *subtractability*, or an individual's withdrawal of resources from a common pool, which compromises other users' maximizing potential (Ostrom, Gardner, and Walker 1994). These two slightly different analytical angles are distinguished by the characteristics of resources or how group rules concerning use of those resources and benefits are defined. The two kinds of collective action problems are unified by the common theme of sociality and whether individuals are able to coordinate their actions to achieve a common goal for the greater good of society. Experimental research has shown that trust, reciprocity, reputation (Axelrod and Hamilton 1981; Ostrom 1998; Ostrom and Walker 2003), communication (Smith 2010), and the ability to punish defectors (Boyd and Richerson 1992) are among

the multiple factors that influence people's willingness and ability to cooperate. However, as pointed out by Ruttan (2008), it is important to be explicit as to how "success" is measured and distinguish between the *collective action problem* and the *provisioning of goods*, which are not necessarily related (Ruttan 1998). In other words, the success of collective action may be measured by 1) the degree to which individuals obey the rules in use or participate in the process or design of management regimes; or 2) the abundance, quality, or general condition of the resource base or institutions for sustainable governance (Ruttan 2008). In this paper, I focus on the first distinction since I have addressed the latter elsewhere (Beitl 2011).

The research presented here explores environmental governance in two distinct resource systems, mangroves and their associated fisheries. I test whether there are any differences at the individual level between members of associations (hereafter referred to as *socios*) and independent cockle collectors 1) in their fishing behavior; and 2) in their participation in activities that promote mangrove conservation. Specifically, the research is guided by two questions derived from *contribution* and *subtractability* problems in the collective action literature. First, how does membership in a local institution affect contributions to collective action related to mangrove conservation and sustainable resource management? Second, using the average shell size of a catch as a proxy for sustainable fishing behavior, does membership promote more "responsible fishing" in the mangrove cockle fishery commons? The general aim is to explore how these two kinds of collective action problems manifest similarly or differentially at multiple resource levels. I argue for the need to consider the multiple dimensions of the commons problem and

how differential characteristics of resource systems and social actors may ultimately define the ways in which collective action and environmental outcomes interact.

In the following sections, I provide background information about coastal degradation and the ways that new local institutions for collective action have emerged in this context. Then I describe the four study areas, as well as methods of data collection, participant recruitment, and analysis. Next, I present results from various statistical tests examining differences between *socios* and independent cockle collectors and the environmental context that permits collective action. In my discussion, I analyze the complex interaction and feedback between institutions, individuals, and environmental resources and how the issue of trust poses a challenge for collective action. Finally, I argue for a redefinition of the commons problem and discuss implications for policy.

## The Mangrove Commons and Institutions for Collective Action in Ecuador

Globally distributed throughout tropical coastal wetland areas, mangrove forests provide numerous goods such as fish, mollusks, crustaceans, charcoal, commercial timber, medicines, tannin, honey, incense, paper, and dyes for cloth (Kovacs 1998; Walters et al. 2008; Snedaker 1986; Mera Orcés 1999; Kaplowitz 2001; Glaser 2003) and environmental services like nutrient cycling, erosion control, storm surge buffering, carbon sequestration, and critical habitat for multiple species (Ronnback 1999; Brander, Florax, and Vermaat 2006; Barbier 1993). Due to their characteristics as a commons with "open-access" conditions (Barbier, Strand, and Sathirathai 2002) and their widespread undervaluation (Cormier-Salem 2006), many mangrove wetlands worldwide have been drained for urbanization, agriculture, and tourism, or converted for shrimp aquaculture (Valiela, Bowen, and York 2001; Alongi 2002). While deforestation rates have subsided,

mangrove clearing is still significantly higher than other forest types (FAO 2005). Shrimp aquaculture is one of the most significant causes of mangrove loss (Valiela, Bowen, and York 2001). Much research has documented environmental impacts of shrimp farming, such as poor water quality and landscape degradation (Southgate and Whitaker 1994; Dewalt, Vergne, and Hardin 1996; Cruz-Torres 2000; Barbier 2003; Stram, Kincaid, and Campbell 2005), and social impacts like community displacement, erosion of resource rights, economic disparity, and social conflict (Stonich 1995; Stonich and Vandergeest 2001; Dewalt, Vergne, and Hardin 1996; Primavera 1997; C-CONDEM 2007).

The loss of mangroves in Ecuador has had significant impacts on fisheries for mangrove cockles (*Anadara tuberculosa* and *A. similis*) and crabs (*Ucides occidentalis* and *Cardisoma crassum*), important resources that have traditionally supported livelihoods in coastal communities, particularly in the provinces of Esmeraldas and El Oro (Ocampo-Thomason 2006; Mora, Moreno, and Jurado 2011; Mera Orcés 1999; MacKenzie 2001). There are an estimated 5,000 cockle collectors in Ecuador (hereafter referred to as *concheros),* the highest number of artisanal fishers that target the resource in its range from Mexico to Peru (MacKenzie 2001). Esmeraldas Province in northern Ecuador supports the majority of *concheros* in the country, most likely due to the extensive coverage of mangroves largely protected in reserve areas along the Colombian border (Flores and Licandeo 2010). Throughout the rest of the coast, about 26% of Ecuador's mangrove forests were converted primarily for shrimp farming and to a lesser degree urbanization between 1969 and 1995 (CLIRSEN-PMRC 2007). The loss of original mangrove cover is 74.6% in Muisne, Esmeraldas (Bravo 2007) and 48% in the Archipiélago Jambelí in El Oro (Bravo and Altamirano 2006).

Extensive mangrove deforestation in Ecuador has provoked outrage among activists and communities who began to organize in defense of mangroves in the early 1990s. In Muisne and other communities in the northern province of Esmeraldas, grassroots resistance movements formed local associations of "ancestral users" of mangrove resources, which later facilitated participatory development projects and greater interaction between local communities and government agencies such as the Programa de Manejo de Recursos Costeros (PMRC). In the last few years, participation in local organizations has declined as PMRC projects in the region came to an end because of institutional reorganization. One grassroots non-government organization (NGO) in Muisne, Fundación de Defensa Ecológica (FUNDECOL), continues to work with local associations throughout the Muisne-Cojimíes Estuary to lead community development projects, network with other "ancestral user" associations in other communities throughout the country, and create national and international awareness campaigns for mangrove conservation, social justice, and the defense of livelihoods.

In the southern province of El Oro, several communities throughout the Archipiélago Jambelí began establishing local fishing associations and cooperatives in the early 1990s to gain government recognition of their "right to work" as artisanal fishers in the face of the rapidly expanding shrimp industry. Over the years, these local organizations have gained more government support in their struggle with shrimp farmers over mangrove resources and access to government credit and technical assistance for fishery sector development. Several local associations are now members of an umbrella federation of artisanal fishing organizations of the south, which is nested within a larger,

national federation that works closely with government agencies to organize meetings and events that facilitate participatory processes in the development of fishery policy.

For decades, artisanal fishers have been harvesting cockles year-round for subsistence and commercialization with reliable returns. However in the last 10 years, concerns about harvesting pressures have increased. Studies by the Instituto Nacional de Pesca (INP) have shown declining catch and shell sizes since 2004 when they first began monitoring the fishery in the five major ports for cockle landings shown in Figure 5.1 (Mora and Moreno 2009; Mora, Moreno, and Jurado 2009, 2011). Harvesting pressures have most likely been further exacerbated by the legacy of shrimp farming over the last several decades (MacKenzie 2001; C-CONDEM 2007; Ocampo-Thomason 2006). Based on recommendations from INP, the Subsecretaría de Recursos Pesqueros (SRP) imposed top-down measures prohibiting the commercialization of shells less than 45mm in length and implemented a closed season from February 15 to March 31 during the period of reproduction.[18] However, the fishery closure policy was abandoned in 2008 due to lack of effective enforcement. In July 2008, the SRP began to increase the presence of inspectors in the major ports to confiscate shells below the legal size limit and return them to their habitat. Small communities with mangrove concessions (*custodias*) sometimes enforce the size regulations among other rules concerning use, rotation among cockle beds, periodic closures, and restricted access by outsiders to promote the sustainable extraction of mangrove cockles (Bravo and Altamirano 2006; Beitl 2011).

[18] Acuerdo Ministerial No. 170, *Registro Oficial* No. 453, del 14 de noviembre de 2001.

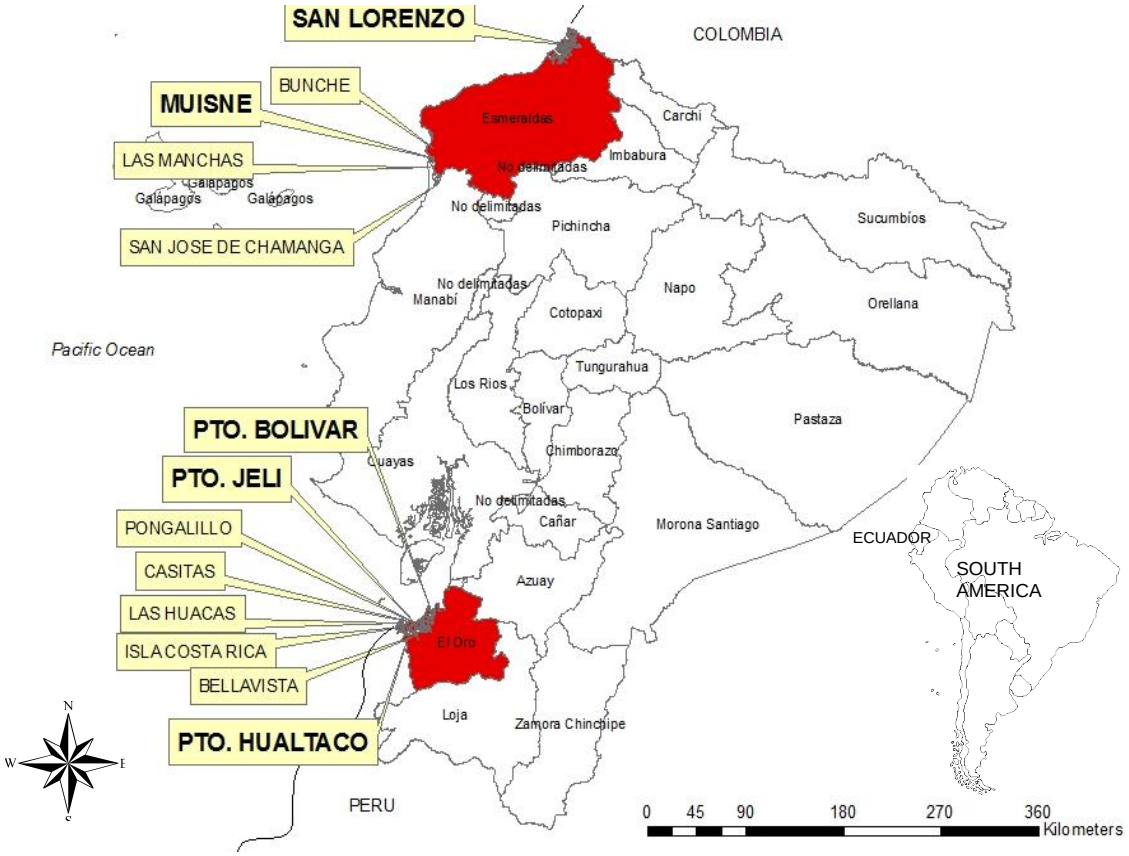


Figure 5.1. The five major ports (in bold) for cockle landings monitored by Instituto Nacional de Pesca (INP) and eight additional communities in Esmeraldas and El Oro where I carried out exploratory interviews and observations for this research.

In its literal translation, *custodia* refers to guardianship, stewardship, or vigilance. In Ecuador, *custodia* is the name given to a particular property arrangement defined by a 10-year concession held by local associations for community-based conservation of mangroves and sustainable management of mangrove resources. The idea for *custodias* originated from conversations between PMRC biologists and a group of organized women cockle collectors in a small community near Muisne who wondered how shrimp farmers were able to appropriate mangroves which remained an open-access public good for everyone else (Bravo, personal communication). In the year 2000, Ministerial Agreement 172 granted the first *custodias* to local associations in the provinces of

Esmeraldas and El Oro.[19] In order to apply for a *custodia*, a community or group of "ancestral users" must be formally organized and capable of submitting maps, the names of officers, a list of members, a copy of the association's agreement, and a detailed management plan (Bravo 2007). Each local association devises its own management plan for the sustainable use of selected mangrove resources in collaboration with an external NGO or university that provides a minimum of two years of technical assistance. Given the benefits often cited, such as mangrove protection, the strengthening of property rights and local institutions, increased local empowerment, and economic gains associated with effective local enforcement of harvesting rules (Bravo 2007; Coello, Vinueza Burgos, and Alemán 2008; Beitl 2011), several associations in El Oro have submitted applications for a *custodia* of their own, which would not have been possible without first organizing into a local association or cooperative formally recognized by the State.

In addition to the potential acquisition of a *custodia*, another important benefit of organizing into local associations for *concheros* in Ecuador has been increased access to government and non-government agencies for technical and financial assistance, loans, subsidies, participation in the design of policies, and economic development in rural coastal communities. The new Presidential Decree 1391 calling for a regulation of the shrimp industry will most likely create more opportunities for cross-scale collective action and collaboration between multiple sectors of society for the recuperation of lost mangrove habitat.[20] Under the new institutional arrangements that emerged from this

[19] Acuerdo Ministerial No. 172 *Registro Oficial* No. 208 en el 20 de enero de 2000.
[20] Executive Decree No. 1391 of the 15 of Octubre 2008, published in *Registro Oficial* 454 de 27 de octubre de 2008. Under this executive decree, shrimp farmers had until March 31, 2010 to submit their application to legalize their lease occupying historical mangrove areas under the condition that they relinquish a certain percentage of their shrimp farm depending on the year of its construction and the total area occupying former mangrove habitat. For example, if the shrimp pond illegally occupies 10 ha of mangroves or less, the farmer would be responsible for reforesting 10%. For 11-50 ha of illegal occupation,

policy, shrimp farmers have already begun to sponsor reforestation projects carried out by local fishing associations and other civil society organizations in which participants are financially compensated for their contribution.

## Methods

### Description of Study Areas

This paper draws on field research conducted in one large community and one small community in each of the two provinces Esmeraldas and El Oro from January 2009 to December 2010 (Figure 5.2). All four sites have been significantly affected by the conversion of mangrove forests for shrimp aquaculture since the 1980s and cockle collecting has been an important commercial activity and livelihood strategy among local residents. Each of these sites is distinguished by the size of the community, total average fishing effort (defined by the Instituto Nacional de Pesca as the total number of *concheros* on a particular day), levels of participation in civil society or activism, and organization of labor for cockle collecting (see Table 5.1).

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he must reforest 20%. For 51-250 ha, he must reforest 30% within a year from submission of the application. Shrimp farms occupying areas declared as protected areas by the Ministry of Environment must be abandoned immediately at the cost of the shrimp farmer, unless its construction took place before the area was formally declared protected.

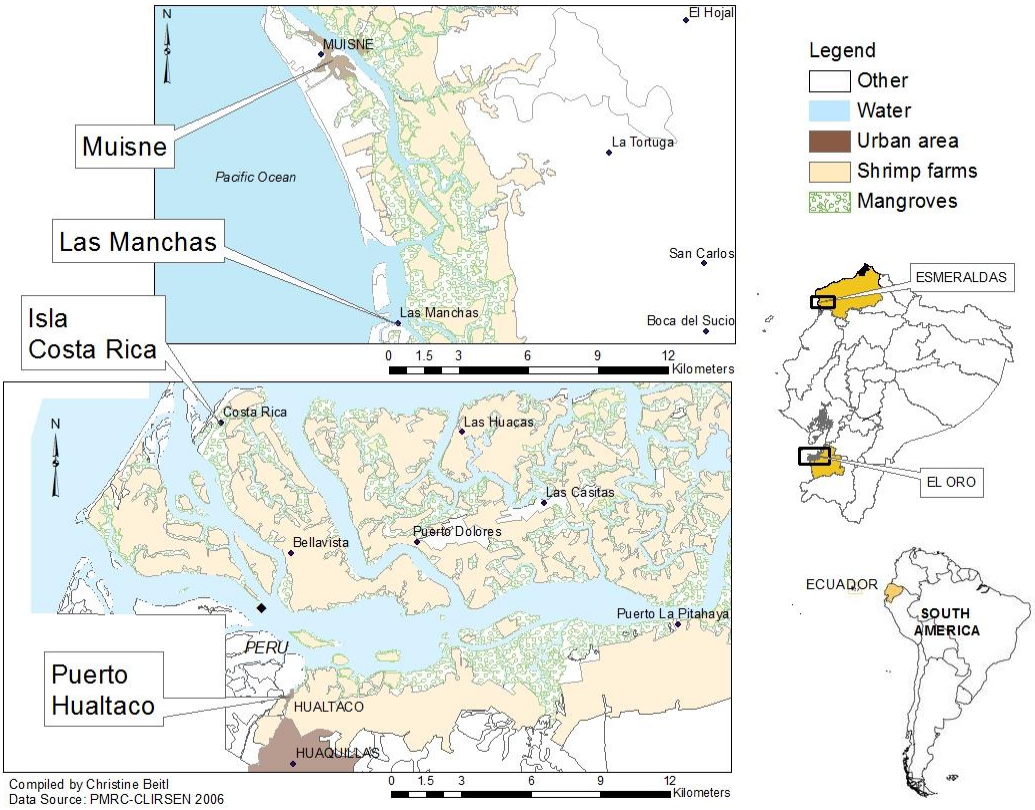


Figure 5.2. Four study areas for semi-structured interviews and catch-per-unit-effort (CPUE) data collection in Esmeraldas and El Oro.

Table 5.1. Summary of study area characteristics and number of interviews in the provinces of El Oro and Esmeraldas.

| Province | Study Area | Popu-lation | Average Fishing Effort[21] | Number of Local Associations[22] | Percent Affiliated with Associations (from interviews |
|---|---|---|---|---|---|
| El Oro | Isla Costa Rica | 316 | 15-30 | 2 | 60% (58) |
| El Oro | Puerto Hualtaco | 40,000 (est.) | 192 | 8 | 64% (33) |
| Esmeraldas | Muisne | 7,000 (est.) | 55-80 | 9 | 4% (47) |
| Esmeraldas | Las Manchas | 50 (est.) | 10-20 | 1 | 13% (8) |

[21] Estimates are from Instituto Nacional de Pesca and fieldwork.

[22] This is not meant to be a comprehensive survey of local associations and cooperatives. It is possible there are other local institutions that were not made known to me through my research contacts or informants. If this is the case, it is likely that those organizations have very little to do with mangrove forests or their fisheries; rather they may focus on other fisheries or other activities.

In each of the two small communities, Isla Costa Rica and Las Manchas, the fishing effort is generally lower, despite their high dependence on mangrove resources for their livelihoods. Participation levels in local institutions or other community activities are also higher, even though local associations are more prevalent in the larger communities of Muisne and Hualtaco. In places like Muisne, membership in local institutions has dwindled in recent years due to growing disappointment and mistrust in one another, the government, and non-government organizations. Puerto Hualtaco is a large, heterogeneous community with an active civil society sector characterized by the presence of several local fishing associations and cooperatives and a canton-level federation of local associations. Cockle collectors in Hualtaco are predominantly men between the ages of 18 and 50 originally from rural communities throughout the archipelago or migrants from the highlands whose families were drawn to the coast during the shrimp boom in the late 1980s.

Data Collection and Participant Recruitment

The data for this study was gathered through observations of catch and shell sizes and a series of open-ended and structured questionnaires and in each of the four study areas (Figure 5.2). After three months of participant observation in Isla Costa Rica and exploratory interviews and observations in several communities and the major ports for cockle landings, I designed a semi-structured questionnaire divided into the following sections: 1) information about cockles and gathering grounds and catch-per-unit-effort (CPUE); 2) baseline demographic information; 3) semi-structured questions about change in mangroves and the fishery over time; 4) participation in civil society activities, social movements, and other forms of collective action (Appendix A). Some of the questions

were adapted from surveys done by the Instituto Nacional de Pesca (INP). Other questions were derived from my preliminary observations of the fishery, ethnographic research in Isla Costa Rica, and theoretical concepts about collective action and the commons. Additionally, I provided a supplemental set of questions for representatives from different associations about the history of their organization, motivations for organizing, and the main challenges they faced as a group (Appendix B).

The general questionnaire was administered to *concheros* orally after obtaining informed consent and permission to measure the length of all shells in their catch using a digital Vernier caliper (n=153). In Isla Costa Rica, I recruited participants (n=58) often with the help of the president of the association and his wife. In Puerto Hualtaco, local intermediaries, field assistants, and occasionally INP biologists helped me randomly select *concheros* as they disembarked (n=33). In Muisne, my field guide Adrian Vargas and I randomly recruited informants from a boat situated in the middle of the estuary at the end of the low tide period, offering refreshments and to tow people's canoes into port in exchange for their participation (n=47). In Las Manchas, Adrian and I recruited informants during five different visits (n=8), one of which we engaged in participant observation with a family. The semi-structured questions always invited elaboration depending on time, perceived patience, willingness, and age of the participants. I enquired about their perceptions of change in catch and shell size over the last ten years, the reasons why they believed the fishery was changing, whether they were concerned about overexploitation, whether they trusted that other resource users abide by the rules of use regarding shell size, and whether they believed *custodias* were a viable solution to overexploitation. I further enquired about their participation in reforestation or other

community projects, workshops about mangroves or mangrove resources, *mingas* (other community-level work parties), or activism related to mangrove conservation and defense. Immediately before or after the interview I measured the length of all the shells in each individual's catch gathered from 71 different cockle beds across the four study areas. I recorded the information with the help of one or more field assistants or a digital voice recorder in the case of Muisne.

Variables and Data Analysis

In this research I used INP's definition of CPUE, which is the number of shells per unit of effort where effort is defined as the total number of *concheros* on a particular day. Since both customary norms and fishery regulations prohibit the harvest and commercialization of shells less than 45mm in length, I use the average shell size per individual catch as a proxy measure for the "sustainability" of their fishing behavior and whether individuals comply with the rules-in-use. Thus, larger shell sizes within a catch indicate "responsible fishing" (as defined by local users and government officials) or a more sustainable harvest.

For the independent variables, I coded fixed responses from the interview questions into dummy variables. I also coded free responses of informants when they offered to elaborate. Membership in an association refers to present members not including children of *socios* or former *socios*. Using SPSS 17.0 statistical software, I employed a chi-square likelihood ratio test to explore whether there were differences between *socios* and independents in their perceptions about mangroves, the state of the fishery, and their participation in different kinds of collective action. Then, controlling for age of the collector, community size, lunar cycle, and province, I used regression

analysis to determine whether *socios* and independents differed in their harvesting behavior (average shell size within each catch). I coded each observation as spring tide or neap tide based on the tide table published by Instituto Oceanográfico de la Armada (INOCAR n.d.). Community size can be considered a proxy for fishing effort since the larger communities of Hualtaco and Muisne have a higher estimated fishing effort than the smaller communities Isla Costa Rica and Las Manchas. I also included in the model the number of small shells that were collected as seed for mariculture since this is likely to affect the results in the two small communities where holding pens were present.

Finally, to further test the effects of site characteristics and ecological constraints on harvesting, several individuals agreed to let me measure the shell sizes in their catch gathered from two or more sites on different occasions (n=20). I used ANOVA to determine whether differences in shell sizes gathered by the same individual on separate fishing trips were significant.

Results

Membership in local associations fosters a higher propensity of individuals to contribute to different kinds of collective action (Figure 5.3). *Socios* are more likely than independents to participate in different projects like mangrove reforestation, community mariculture, workshops, and political activism related to the defense of mangrove wetlands against the "predatory capitalism" associated with shrimp farming. It is no surprise that the differences are statistically significant since many of these kinds of activities are organized by civil society institutions for their members, often in collaboration with other sectors (government, non-government organizations, or private enterprises). Many of the independents I interviewed said they had participated in

reforestation projects and community-level activism in the past when shrimp farms first began to encroach on mangrove habitat and there was a stronger sense of trust in community organizers.

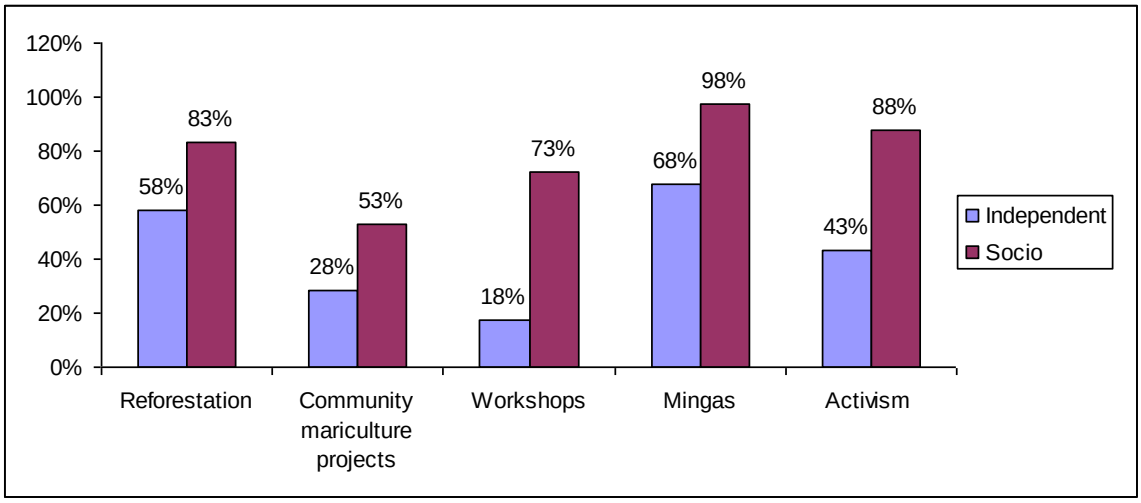


Figure 5.3. Differences between *socios* and independents in levels of participation as a contribution to collective action. Differences are significant at the 0.05 level.

Table 5.2. Two-way cross-tabulation and chi-square analysis comparing differences between *socios* and independents in their opinions regarding the state of mangrove fisheries. Statistical significance at .05 indicated by *.

| Variables | Independent Collectors | | Association Members | | *Df* | $X^2$ | *p*-value | N |
|---|---|---|---|---|---|---|---|---|
| | % | n | % | n | | | | |
| Perceive difference in catch sizes over the last 10 years | 87 | 76 | 96 | 55 | 1 | 3.476 | 0.056 | 131 |
| Believe a difference in catch is explained by lack of awareness * | 15 | 62 | 37 | 52 | 1 | 7.402 | 0.007 | 114 |
| Worried about the future of the fishery * | 78 | 74 | 96 | 52 | 1 | 7.880 | 0.005 | 126 |
| Claim to leave small shells in the mangrove | 68 | 73 | 62 | 52 | 1 | 0.420 | 0.450 | 125 |
| Trust that other users leave small shells in the mangrove * | 20 | 65 | 27 | 43 | 1 | 4.375 | 0.043 | 108 |
| Believe *custodias* are beneficial for the resource * | 62 | 53 | 85 | 47 | 1 | 6.594 | 0.010 | 100 |
| Suggest *custodias* are a solution for overexploitation * | 5 | 61 | 37 | 46 | 1 | 17.712 | 0.000 | 107 |

Overall, there were only slight differences between *socios* and independents in their perceptions about the state of the fishery and solutions (Table 5.2). The majority of all informants recognized the problem of declining catch and shell sizes over the last ten years. However, *socios* expressed higher concern about overexploitation, with 37% of them attributing the problem to "lack of awareness" compared to only 15% of independents. The independents, in turn, favored other explanations, including habitat destruction, increased competition, too many outsiders, lack of employment, or other factors. *Socios* were more likely to believe that institutional arrangements of a *custodia* would serve as a potential solution to overexploitation, suggesting they have a positive impression of the role of *custodias* in managing the resource.

The majority of all informants expressed their lack of trust that other *concheros* obey laws and customary norms concerning the harvest of shells smaller than 45mm. Some *socios* elaborated that only other *socios* can be trusted to abide by laws concerning size limitations and that independent *concheros* are the ones who do not "fish responsibly." Yet many *concheros*, both *socios* and independents alike, justified the collection of a handful of small shells for personal consumption, to *completar* (or reach a round number). In both small communities, *concheros* justified the collection of small shells from the wild as "seeds" for culturing cockles in their holding pens until they reach a marketable size.

While membership promotes contributions to collective action that may promote mangrove conservation, it has little effect on the subtractability problem in the fishery commons. Table 5.3 summarizes the results of the regression model explaining variations in shell size. Membership in an association correlates with a marginally larger shell size

after controlling for age of the *conchero,* lunar period, community size, the number of shells used as seed for mariculture, and geographic differences between provinces, but the relationship is not significant. Instead, environmental variables appear to affect the average size of shells gathered by individuals, regardless of whether they are members of associations or not. Shells collected during spring tide periods are larger by 1.25mm and shells in larger communities with a higher fishing effort are smaller by 1.86mm. Furthermore, shells harvested in Esmeraldas are significantly larger than those in El Oro.

Table 5.3. Summary of regression model results explaining variation in shell size. Independent variables of statistical significance at the .05 level are indicated by *. ($R^2$ = 0.179; Adj $R^2$ = 0.142; *df* = 6; F = 4.847, *p* = 0.000, n = 139).

| Independent Variables | B | Std. Error | Beta | T | sig. |
|---|---|---|---|---|---|
| (Constant) | 44.1014 | 0.860 | | 51.289 | 0.000 |
| Association member | 0.810561 | 0.537 | 0.157 | 1.510 | 0.133 |
| Age | -0.00183 | 0.016 | -0.010 | -0.113 | 0.910 |
| Lunar cycle * | 1.251941 | 0.457 | 0.224 | 2.741 | 0.007 |
| Community size * | -1.8566 | 0.472 | -0.364 | -3.930 | 0.000 |
| Province * | 1.499963 | 0.532 | 0.294 | 2.820 | 0.006 |
| Number of shells used for mariculture * | -0.09422 | 0.027 | -0.307 | -3.519 | 0.001 |

To further verify how environmental constraints in different gathering grounds may compromise an individual's ability to harvest sustainably I compared the differences in shell sizes gathered by the same individual during one or more trips. For 15 out of 20 indviduals, there were significant differences in their catch's shell sizes gathered on two or more separate trips (unpublished data). This suggests that gathering grounds are highly variable and that each collector gathers what the environment provides, regardless of whether he/she is a member of an association or not.

Motivations Mobilizing Collective Action and the Creation of Institutions

An analysis of whether membership in civil society organizations influences common pool resources should not be interpreted without consideration of the context of group-level motivations for organizing, personal incentives for joining, relationships among members, and perceived accomplishments of the association. Understanding motivations and inner workings of institutions is especially important considering that not all kinds of collective action or cooperation signify benefits for the environment (Ruttan 1998). Moreover, consideration of the historical context and group-level motivations for organizing provides further insight into group solidarity and other challenges local associations confront in the face of coastal resource degradation.

On the Ecuadorian coast, civil society began to flourish throughout the 1990s and early 2000s as many fishers and ancestral users organized in response to the widespread environmental degradation and social justice issues associated with shrimp farming. In Muisne and Las Manchas in Esmeraldas Province, the destruction of mangroves was the main impetus for mobilization and consolidation into civil society institutions. As one *socio* explained in an interview, by organizing they were able to contribute to the recovery of lost mangroves and ultimately create a better future for their children. One of my key informants in Muisne mused, "Without collective action, if we hadn't formed a group to resist the expansion of shrimp farming, we would have no mangroves today." He further lamented that the reason why resource problems persist in Muisne is because cockle collectors are disorganized compared to other fishers in other places.

Many associations in El Oro started out for similar reasons—to defend their livelihoods and the environment against the shrimp industry. As one community leader in

Isla Costa Rica explained in his own words, "collective action" is the backbone of small communities that have very little material wealth. During the late 1980s when shrimp farming began to encroach on mangroves in Isla Costa Rica, the community organized to protest before eventually forming alliances with activist networks in other parts of the country. In the early years, there were disagreements about how to deal with the problem of shrimp farmers' encroachment. These community divisions led to the establishment of two separate fishing associations, which are presently both officially recognized by the State. Today, almost all households in the community are affiliated with one of the two local associations, which play an important role in village life.

Many associations in Hualtaco also share historical roots in activism, but those that organized more recently also had other motives associated with networking, government alliances, and fishery sector development. As such, local associations in El Oro have enjoyed the benefits of participating in a larger network of associations and federations that work together with government and non-government agencies to overcome problems in artisanal fishery sector development, overexploitation, and mangrove degradation. For example, an informant in Hualtaco, El Oro explained that his association organized informally in 2000 by the prospect that they would gain support from the government as the conversion of mangroves for shrimp farming became a pervasive threat to their livelihoods. Now, as a formal organization since 2005, they have been able to obtain fishing boats, loans, and credit, and participate in educational workshops sponsored by government agencies. Another institution in Hualtaco, Asociación 10 de Agosto, organized in 1992 for similar reasons. When the shrimp farming sector started to clear mangroves, everything became more difficult for them.

Guard dogs prohibited access to gathering grounds and sometimes guards fired gun shots. It was no longer acceptable to fish at night since shrimp farmers would have them arrested, believing they were thieves. The Asociación 10 de Agosto organized so that they would have more power to denounce unjust shrimp farmers and "have the freedom to work." One member said he joined not only because it enabled him to work, but he also took pride in his belief that it was for the greater good and the benefit of everyone.

Another incentive for local associations to organize has been their eligibility to apply for a *custodia.* Many associations in Hualtaco are hopeful for their own concession. At the time of this research, the Asociación 10 de Agosto was one of the few associations in Hualtaco that had already received a *custodia* of 197 hectares in May of 2010, which they were in the process of defining rules-in-use and management. They aspired to create enclosures for cockle culture in the *custodia*; however as city-dwellers who do not live directly in the mangroves, it would have been difficult for them to guard against trespassing and theft. The problem, one *socio* from 10 de Agosto argued, was a general "lack of awareness" among *concheros* about problems of overexploitation.

In contrast, Asociación Isla Costa Rica has been successfully managing its *custodia* since the year 2000 by locally agreed-upon rules and the exclusion of outsiders enforced by the mandatory participation by each *socio* in a rotating guard system. Those who fail to fulfill their guard duty are denied participation in the monthly harvest of the profitable fishery-managed areas of the *custodia*. According to the president of the association, no one has ever violated rules about guard duty more than once, illustrating the ways collective action and cooperation may be conditioned by the threat of sanctions (Boyd and Richerson 1992). On rare occasions people may defect from guard duty and

allow trespassers to slip by, but overall, the *socios* in Isla Costa Rica have successfully managed their *custodia* through these forms of collective action. Their success may also in part be attributed to their relative isolation and cordial social relations with *concheros* from Hualtaco who respect the boundaries of the *custodia* and the informal division of fishing space within open-access areas around the community (see Chapter 3). In this way, the case of Isla Costa Rica's *custodia* exemplifies both measurements of success differentiated by Ruttan (2008). In addition to success measured by the degree to which individuals participate in the management regime, the success measured by *collective goods provisioning* has also been confirmed by larger shell and catch sizes harvested from the fishery-managed areas of the *custodia* (Beitl 2011).

Trust, Participation, and Contributions to Collective Action

Often cited in the literature as a crucial factor behind successful collective action is the role of trust (Cook and Cooper 2003; Eckel and Wilson 2003; Hardin 2003; Ostrom 2003) and ability to contribute to collective action based on wealth or social status (Beard 2007; Ruttan 2008; Jones 2004). One of the associations in Hualtaco founded in 2008 explained that their motivations for organizing were specifically to obtain their own *custodia* to control against the open-access conditions of the fishery that have allowed people to fish wherever they want. He cited the benefits of being able to collaborate with government agencies and participate in fisheries policy. He said the main challenges were continued mangrove deforestation and getting people to "fish responsibly," especially Peruvians who illegally cross the border to harvest from Ecuadorian mangroves. However, I interviewed several other representatives from the same association who spoke of other collective action challenges related to lack of trust in the association itself.

One member whose sentiments were echoed in separate interviews with others stated, "We are always asked to collaborate and participate, but the benefits only go to a few individuals rather than the whole association."

Similarly, not trusting other members of certain institutions may partially explain the reason why participation in civil society has been declining in Muisne and some local associations are no longer active. Some of the former *socios* I interviewed in Muisne were suspicious that the benefits of membership were only reaped by a select few. Others simply didn't have the time or the resources to pay their membership dues or participate in civil society activities. Moreover, many of independent *concheros* in Muisne distrusted the local NGO, contending that they created certain levels of dependency and "used" people from the associations to advance their own interests. Many *concheros* commented that the local NGO is corrupt and "profiting from the poor," because they receive large sums of international donations while *concheros* remain destitute in the face of a declining resource. Increasing distrust in local institutions by *concheros* and other artisanal fishers has made it challenging for people in Muisne to coordinate their actions in recent years, especially those efforts led by the local NGO and its affiliates.

When I asked people about their reasons for not contributing to other collective actions like mangrove reforestation or participation in workshops, similar issues of trust and feelings of exclusion were raised. Many claimed they did not know about events or they were not "invited." One independent *conchero* in Muisne suspected that those activities are "only for the *socios*—they already have their people picked out." Another man in Hualtaco expressed interest in joining an association so that he would be able to participate in different activities, but he did not have the money to pay membership dues,

thereby supporting Beard's (2007) findings that wealth status may pose another barrier to collective action. Others simply had no interest in participating at all despite their recognition that these kinds of events may contribute to the collective good of mangrove restoration with indirect benefits for the fisheries.

For those *concheros* in both provinces who may have at least partially overcome financial barriers or their suspicions of institutions, different kinds of incentive structures facilitate collective action. Sometimes they receive actual economic incentives for their participation (like a day's wage in a reforestation or reimbursement for travel costs to a demonstration or conference). Other times their participation is voluntary and they are incentivized by maintaining a good reputation for being collaborative. *"¡Colabora!"* or "Collaborate!" is often the command used by *socios* to encourage a financial contributions, participation, or collaboration of any kind. Recognizing the power of social capital, many *socios* proudly boast about their ability to collaborate with one another, government officials, or researchers like myself. Those who voluntarily contribute to any kind of collective action assert they are doing it for the greater good, for the benefit of mangrove conservation, or as their obligation as a member of an association. Higher levels of participation entitle them to bragging rights and trust by other members they are good *socios*, well-respected for their collaborative nature and dependability.

Subtractability and Different Kinds of Collective Actions Compared

While this research demonstrates that *socios* are more likely to contribute to collective action because of the institutional structures that facilitate communication about events and shape their decisions to participate, membership appears to have little effect on fishing behavior. As there are no differences between *socios* and independents

in their average shell size, it might seem that institutions have a different effect on fishery resources than the larger landscape level. The mixed effects of collective action could be due to the physical characteristics of the resources (mangroves vs. cockles) and environmental constraints, the different social histories of each resource system and causes of their decline, or the differential nature of the two kinds of collective action (*contribution* vs. *subtraction*).

Larger communities are characterized by higher fishing effort and greater degree of heterogeneity among user groups and gathering grounds. Many *concheros* harvest what the environment provides, regardless of whether they are members of associations or not. Both *socios* and independents express interest in respecting the shell size regulations of 45mm, but feel they have no choice but to "*completar*" in order to make their daily income of $10-20 to support their families. If that means harvesting shells below the legal size limit because that is what the cockle bed provides, then they take the chance that part of their catch will be confiscated by the authorities.

In contrast to contributions to collective action through participation, *concheros* in the fishery commons are able to more effectively conceal their non-cooperation around the use of common pool resources. Those who witness the breaking of rules concerning size regulations understand the challenges of harvesting shells under ecological constraints and would not likely turn in to the authorities their friends who accompany them on their fishing trips. Because of this, top-down controls like those already in place may be the only effective way of enforcing the size regulations of 45mm. On the other hand, membership in an association may increase one's access to community-managed gathering grounds with larger shell sizes, which lends further justification for the creation

of more *custodias* as common property regimes that locally regulate use and access in ways that affect the quality and quantity of resources. However, the larger shell and catch sizes harvested in *custodias* may be more a function of ecological conditions produced by management practices rather than a reflection of "responsible" fishing behavior where personal incentives to free ride are suppressed. As argued by Ruttan (1998; 2008), it is important to distinguish between the ways in which the success of collective action is measured, especially since the two measures of success may not always be related.

Another possible explanation for why there are no differences in fishing behavior between *socios* and independents may have to do with trust (Cook and Cooper 2003; Eckel and Wilson 2003; Hardin 2003). In addition to increased competition, *concheros* in the larger communities who do not know one another are left with little incentive to trust others to follow the rules-in-use. As one man from Muisne explained, "the problem is that if I don't take the small shells, someone else will come along and do it, so it's better to take everything for myself." The same problem is prevalent in Hualtaco where another *conchero* commented, "nobody gives the gathering grounds a rest anymore because if they do, someone will come along tomorrow." In Hualtaco and Isla Costa Rica, s*ocios* were quick to blame independents for overfishing and free riding much in the way people from small communities were likely to blame outsiders. As Table 5.2 shows, very few *concheros* trust other users to leave the small shells in the mangroves, but if *socios* have any inclination to trust anyone, they tend to trust only other *socios* to fish responsibly. During a focus group in Hualtaco, *socios* accused all independents of being free riders because "they do not take the time to participate in workshops" or "educate themselves about problems in the fishery" and "they are the ones who harvest unsustainably."

While the crucial role of trust is important for both kinds of collective action problems, the mixed outcomes may also be explained by contextual factors that facilitate collective action, the social history and physical characteristics of each resource, and who is held responsible for their decline. While many *concheros* are united in their beliefs holding the shrimp industry accountable for the destruction of mangroves, they are divided in their opinions about who is responsible for the decline of the fishery. Some blame other *concheros* for "lack of awareness" or irresponsible fishing behavior. Others blame the shrimp industry for having destroyed the habitat upon which cockles depend. In contrast, the depletion of mangroves is unequivocally the fault of shrimp farmers.[23] As many *concheros* were victims of the process, some informants romantically recounted stories of subversion when artisanal fishers and activists joined forces in the late 1980s to resist the powerful shrimp industry, break pond walls and dykes, and threaten shrimp farmers with machetes. However, as people lost confidence in the local NGO in Muisne over the years, the community spirit of activism has also disintegrated. Among the most indifferent *concheros* today is a sense of hopelessness and resentment against those local activists who fervently advocated their cause many years ago. Today Muisne, divided between hope and indifference, is now a difficult place for the local NGO to encourage participation and the coordination of collective actions around mangroves and their associated fisheries. These sense of hopelessness and rampant individualism are much less pronounced in the southern province of El Oro where many *concheros* enjoy a slightly higher standard of living, better prices for their catch, and like other artisanal fishers, the benefits of government attention and support.

[23] More recently in Muisne only, some *concheros* blame charcoal producers (also considered ancestral users) for mangrove destruction most likely because of recent events in which a group of charcoal producers cleared an area considered very productive cockle beds.

Conclusions

This paper points to the need to redefine the commons problem beyond collective action problems of subtractability and exclusion. This multi-level analysis of two common pool resource systems (cockles and mangroves) reveals that the commons problem depends largely on the physical characteristics of the resource, the historical context and explanations for its decline, and the differential nature of collective action problems. The main findings suggest that institutions for collective action are likely to encourage participation in activities that contribute to mangrove conservation, rehabilitation, and defense, as well as the management of common property regimes like *custodias*. However, collective action institutions seem to have less influence over fishing behavior or ecological conditions on broader scales in the Ecuadorian mangrove cockle fishery beyond the boundaries of *custodias*. Trust is a unifying factor behind both kinds of collective action. Just as a lack of trust discourages cooperation in the commons, a lack of trust in institutions discourages participation and compliance with institutional rules. Thus, a first step in redefining the commons problem calls for greater attention to the characteristics of users, characteristics of resources, and the external environment in which they are nested (Agrawal 2001).

Second, the benefit of studying collective action problems in two different resource systems has pointed to another dimension of the commons problem related to social histories of each resource system and the differential ways that resources are valued and subsequently exploited. The causes of mangrove and cockle fishery decline are quite distinct, but highly related. In the case of mangroves, it is important to consider differential power relations and undervaluation by those with the power to convert them

for shrimp aquaculture (Martinez-Alier 2001). Thus, the solidarity needed to mobilize collective action among those disenfranchised by the process of mangrove deforestation is qualitatively different than the subtractability and exclusion problem that characterizes mangrove-associated fisheries. Mobilizing collective action in the fishery context is faced with a different set of challenges concerning questions of access (Beitl 2012). As the relationship between collective action and the environment is not unidirectional, the context under which people mobilize for collective action in turn has great implications for the effects of collective action on environmental resources.

A common policy prescription in the common property literature is a need to create institutions for collective action and the sustainable governance of resources (Smith and Berkes 1993; Becker 1999; Becker et al. 2005; Gibson, McKean, and Ostrom 2000; Ostrom 1990; Smith and Berkes 1991). In Ecuador, civil society organizations have generally encouraged participation by fishers and ancestral users in mangrove conservation and fishery management. As guardians of the *custodias,* members of associations have also contributed to sustainable fisheries within the boundaries of their legal concessions and are playing an increasing role in mangrove forest conservation. Fostering trust and solidarity, particularly among those who share a stake in the fate of fishery resources, will continue to challenge the strength and effectiveness of civil society organizations in the governance of coastal resources.

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# CHAPTER 6

# SHIFTING POLICIES, ACCESS, AND THE TRAGEDY OF ENCLOSURES IN ECUADORIAN MANGROVE FISHERIES: TOWARDS A POLITICAL ECOLOGY OF THE COMMONS[24]

[24] Beitl, C.M. 2012. *Journal of Political Ecology.* 19:94-113. Reprinted here with permission of publisher.

Abstract

After decades of mangrove deforestation for the development of shrimp farming, the Ecuadorian state began to officially recognize the ancestral rights of traditional users of coastal mangrove resources in the late 1990s. This article traces the trajectory of coastal policy change and the transformation of mangrove tenure regimes from an implicit preference for shrimp aquaculture to a focus on conservation and sustainable development with greater community participation through the establishment of community-managed mangrove areas called *custodias*. I argue that while the *custodias* have empowered local communities in their struggle to defend their livelihoods and environment against the marginalizing forces of global shrimp aquaculture, the implementation of common property arrangements for mangrove fishery management has changed the nature of property rights, the distribution of resources, and social relations among collectors of mangrove cockles (*Anadara tuberculosa* and *A. similis*). I suggest a need to develop a political ecology of the commons, an analytical approach applied here to examine the fundamental shift in the nature of the struggle over mangrove resources, from artisanal fishers *versus* shrimp farmers to a struggle between *compañeros:* members of associations versus independent cockle collectors. Such a shift in the struggle over resources threatens to undermine the sustainability of the fishery. I conclude that shifting access may be an important underlying factor contributing to a tragedy of enclosures in Ecuador's mangrove cockle fishery.

Keywords

Political ecology; property rights; common property; access; tragedy of enclosures; shrimp aquaculture; mangroves; artisanal fisheries; *Anadara spp.*, Ecuador

Introduction

Over the last several decades, a large percentage of coastal mangrove wetland forests in Ecuador have been cleared for the development of shrimp aquaculture despite the existence of forestry laws protecting mangroves since the 1980s. The current Ecuadorian Forestry Law stipulates that mangroves are public goods of the State, "not subject to possession or any other kind of appropriation, and can only be exploited by way of authorized concession."[25] Since 1985, the cutting, burning, and exploitation of mangroves has been prohibited (Bravo 2007: 27). These policies were weakly upheld in light of export-led growth and global demand for cheap shrimp cocktail that drove the conversion of public mangrove areas into private shrimp farms throughout Ecuador and many other parts of the developing world, resulting in widespread environmental degradation, welfare impacts, and social conflict (Bailey 1988; Stonich 1995; DeWalt, Vergne, and Hardin 1996; Primavera 1997; Cruz-Torres 2000; Stonich and Vandergeest 2001; Gunawardena and Rowan 2005; Lutz 2006) and what Martinez-Alier (2001) has called a "tragedy of enclosures." However, in 1999, White Spot Syndrome Virus, a disease in cultured shrimp, halted the further expansion of shrimp ponds into vital mangrove habitat. By the year 2000, the Ecuadorian State began to recognize the "ancestral" rights of "traditional user groups" to mangrove resources, paving the way for *custodias,* ten-year community-managed concessions. As of July 2011, a total of 37,818 hectares have been granted to 41 different communities as part of the national strategy toward community-based conservation and management of mangrove resources (Rosero

[25] (Author's translation). The original text of the Forestry Law *Titulo 1, Capitulo 1, Art. 1* published *in Registro Oficial* No. 418 (September 10, 2004) states: "Los manglares, aun aquellos existentes en propiedades particulares, se consideran bienes de Estado y están fuera del comercio, no son susceptibles de posesión o cualquier otro medio de apropiación y solamente podrán ser explotados mediante concesión otorgada, de conformidad con esta Ley y su reglamento."

Moya and Santillan Salas 2011). After decades of struggle and conflict between shrimp farmers and artisanal fishers who have lost their fishing grounds to aquaculture, fishing communities in Ecuador now have the legal backing to defend their livelihoods, guard their mangroves against further destruction, and promote sustainable mangrove fisheries. This article will demonstrate, however, that the establishment of *custodias* has changed the nature of the struggle over mangrove resources from artisanal fishers versus shrimp farmers to a struggle between *compañeros*, those who have *custodias* and those who do not.

Given recent concerns about overexploitation in recent decades and its likely relationship to shrimp farming (Ocampo-Thomason 2006; C-CONDEM 2007), I focus on the fishery for the mangrove cockle (*Anadara tuberculosa* and *A. similis*), a bivalve mollusk harvested from the roots of mangrove trees by artisanal fishers. The general aim of this study is to bridge theoretical perspectives from political ecology and commons theory to evaluate shifting policies and the implications for social relations among mangrove fishers in Ecuador. While the establishment of common property arrangements under government-granted *custodias* appears to promote sustainable cockle collecting, the very *custodias* designed to empower local communities in defense against mangrove destruction may now serve as a new form of enclosure that denies access to independent cockle collectors not affiliated with any local association and further threatens to undermine the ecological sustainability of the fishery (Beitl 2011). As also pointed out by O'Flaherty (2003), it is important to not only consider the relationships between local communities and their local ecologies as discrete areas governed by a set of property relations, but also the larger socio-ecological and historical context in which

those property regimes are embedded. Furthermore, property relations only represent one set of mechanisms by which actors gain, control, and maintain access to resources, which is highly likely to shift over time, thereby affecting the ability of people to benefit from resources (Ribot and Peluso 2003).

I begin this discussion by reviewing the literature on the commons, property rights, and access, making the case why the political ecology perspective is relevant to the study of the commons. Then I discuss two important economic sectors in Ecuadorian mangrove forests, the shrimp farming sector and the artisanal mangrove fishery sector, and the degradation narrative that has linked them together (C-CONDEM 2007). In my examination of policy shifts from an implicit preference for shrimp aquaculture development to the recognition of ancestral rights of artisanal fishers, I analyze the social and ecological implications of the common property institutional outcomes associated with *custodias* for the artisanal fishers the concessions were originally designed to protect and defend. I conclude by suggesting a need to develop a political ecology of the commons, a domain of inquiry that has not been explicitly discussed in the literature. A political ecology approach can elucidate the ways in which material struggles over access to common pool resources tend to shift in response to changing policies, which is best illustrated in the case of the Ecuadorian mangrove cockle fishery. Such broader understanding of the socio-political dimensions of social relations of the commons can provide important insights for policies moving toward integrated coastal management through decentralization and community participation (Robadue 1995; Olsen and Christie 2000; Olsen, Ochoa, and Robadue 2003; Christie 2005).

The Commons, Property Rights, and Access through a Political Ecology Lens

Much of the literature on common pool resources has pointed to two defining characteristics that make them difficult to manage: 1) *subtractability*, referring to the way that resource extraction by one user takes away from the ability of another user to maximize his/her potential gain; and 2) *excludability*, or difficulty in keeping away outsiders (Buck 1998; Ostrom *et al*. 1999). Because of these characteristics, different types of commons (grazing lands, forests, fisheries, wetlands, oceans, the atmosphere) have been considered vulnerable to collapse based on assumptions widely popularized by the tragedy of the commons model, that humans exploit the commons to maximize their personal gain without any form of social organization, communication, or consideration for other users (Gordon 1954; Hardin 1968). One of Garrett Hardin's (1968) solutions to the tragedy was to create ownership through property rights and privatization that would hypothetically give people the necessary incentives to protect resources. Over the last several decades, the tragedy of the commons model has provoked widespread reaction and discussion about property rights in various disciplines concerned with the governance of the commons (see for example, McCay and Acheson 1987; Ostrom 1990; Bromley and Feeny 1992; Hanna, Folke, and Mäler 1996; Ostrom *et al*. 1999; Gibson, McKean, and Ostrom 2000; Agrawal 2001; Dolsak and Ostrom 2003; Berkes 2005).

Property rights are defined broadly as a set of social relations, mutually recognized claims and decision-making powers over resources (Gibson, McKean, and Ostrom 2000; Wagner and Davis 2004). Property regimes are the structures or institutions that define the rules of use of resources and interactions between people (Bromley and Feeny 1992;

Agrawal and Gibson 1999), and are among the many institutions in society that influence human interaction, economic performance, and development (North 1990) in their ability to either promote or inhibit the stewardship of environmental resources (Hanna and Munasinghe 1995). Common property has been defined as a social institution distinct from open access, private, or government-owned property (Feeny *et al*. 1990; Ostrom *et al*. 1999). In common property regimes, resource use rights are "controlled by an identifiable group" in a system of "collective ownership" (Satria, Matsuda, and Sano 2006: 228). As argued by McKean (2000), common property regimes function much like private property, except that ownership is shared. The distinction between these property regime categories is essentially conceptual since resource systems are often hybrid regimes or mixed systems in reality (Feeny *et al*. 1990; Wagner and Davis 2004; Satria, Matsuda, and Sano 2006; Beitl 2011).

Others have pointed out that commons systems are essentially "embedded" cultural systems, not adequately understood by rational choice economics or institutional frameworks (Wagner and Davis 2004; Peters 1987). As embedded cultural systems, resource users are motivated to sustain their social relations and cultural meanings in the interest of their livelihoods and the resource bases upon which their livelihoods depend, and access rights are maintained through regular use (Wagner and Davis 2004). Such embedded systems are reflective of many customary marine tenure regimes throughout the Pacific Islands and traditional fisheries throughout the world (Johannes 1978, 2002; Acheson 1987; Mera Orcés 1999; Thomas 2001; Wagner and Talakai 2007; Cinner 2005).

External threats and internal breakdown of common property regimes due to migration, markets, policy change, or unfavorable policy environments in favor of private or government control have long been a concern within the literature on the commons and traditional management systems (Johannes 1978; Richards 1997; McKean 2000; Curran and Agardy 2002; Acheson and Brewer 2003; Cinner 2005). Greenberg (2006) has suggested a "tragedy of commoditization" rather than a tragedy of the commons in the case of the Upper California Gulf fisheries where certain resources have been privileged over others through the process of zoning or territorialization of management regimes. Similar to the "tragedy of enclosures" argument proposed by Martinez-Alier (2001), Greenberg highlights the contradictions of capitalism in which growth driven by global demand undermines the very sustainability of the resource base, an observation also made by Parks and Bonifaz (1994) in the case of Ecuadorian shrimp farming. According to Greenberg, the tragedy begins when nature is dispersed across multiple governance structures into discrete management regimes privileging political and economic principles over a more holistic ecosystem approach to management. O'Flaherty (2003) has also pointed out the problems with discrete management zones in the case of communal land tenure in Zimbabwe, suggesting that a "tragedy of property" results from the legacy of a colonial political economy that undermines African land use within communal tenure systems.

For the reason that much of the common property literature emerged as a polemic to Garrett Hardin's tragedy of the commons (McCay and Acheson 1987; Bromley and Feeny 1992), many studies have uncritically assumed the existence of community-based environmental stewardship without challenging the notion that cooperation is always in

the interest of conservation or studying the direct link between social and ecological systems to support those claims (Berkes 1996; Ruttan 1998; Lu 2001; Pollnac and Johnson 2005;  Beitl 2011). As McCay and Acheson have pointed out, there has been a "tendency to romanticize human communities" for their imagined foresight and ability to overcome resource dilemmas (McCay and Acheson 1987: 10). Given these tendencies, it is important to understand property rights systems from multiple perspectives to design and implement conservation and management strategies for governing the commons (Ostrom 1990; Bromley and Feeny 1992; Hanna, Folke, and Mäler 1996; Ostrom *et al*. 1999). However, as Ribot and Peluso (2003) contend, a focus on property rights only offers a limited understanding of how benefits are derived from resources and suggest instead, a theory of access, in which structural social inequities are considered.

Ribot and Peluso (2003) argue that the concept of access differs from property rights in many ways. Property rights are only one mechanism for obtaining access. The authors define access as "the ability to benefit from things—including material objects, persons, institutions, and symbols" (Ribot and Peluso 2003: 153). Regarding access to resources, they argue that there are different powers involved that are subject to shift over time, based on one's position and power within a social relationship. Thus access is a *process* by which social relations and differentiation emerge from cooperation and conflict over resources in particular situations in which new legal frameworks potentially arise (Ribot and Peluso 2003: 160). Wagner and Davis (2004) illustrate the notion of access as a process in their discussion of the contemporary lobster fishery in northeastern Nova Scotia where individual fishers stick to their preferred spots occasionally acquiring access to other territories by branching out in the common grounds not regulated under

the traditional Berth system. Enclosure of the commons and the blocking of access is also described as a process by Murray and others, and of particular relevance to the burgeoning fisheries literature concerned with limited entry, catch-share programs, and individual transferable quota systems (Murray *et al*. 2010). Similarly, access is also highly relevant to the study of mangrove concessions in Ecuador managed by the communities as common property regimes where the exclusion of outsiders is enforced.

Few studies have examined common property institutions as political agents in their own right, that maintain power, authority, and control over territory and resources (Reddy 2002). The political ecology literature has been concerned with ideational and material struggles over resources and the role of power, discourse, policy, and science in shaping the outcomes of those struggles (Wolf 1972; Blaikie and Brookfield 1987; Bryant 1992; Greenberg and Park 1994; Zerner 2000; Stott and Sullivan 2000; Peluso and Watts 2001; Forsyth 2003; Peet and Watts 2004; Paulson and Gezon 2005; Biersack and Greenberg 2006). Armitage (2002) has used the approach to study mangrove conservation in Indonesia, suggesting that the policy narrative does not always match its implementation, calling for a need to monitor processes at various levels. Several scholars have used political ecology to analyze linkages between global and local processes in the study of the relationship between shrimp farming, mangroves, and local communities (Stonich 1995; Cruz-Torres 2000; Stonich and Bailey 2000; Martinez-Alier 2001; Stonich and Vandergeest 2001). The goal of this article is to evaluate how coastal policies shifted from an implicit preference for shrimp industry development to one focused on sustainable development with greater participation by ancestral coastal communities, and how those policy shifts have changed the nature of property rights, the

distribution of resources, and access among artisanal fishers dependent upon mangrove fisheries in Ecuador. A political ecology lens is appropriate for studying this process since property rights, by definition, are a set of social relations, which are cooperative, conflictive, hierarchical, divisive, power-laden, political, and constantly in flux. Using the framework for studying access proposed by Ribot and Peluso (2003), I will demonstrate in the following sections the ways in which social inequities and shifting access may be an important underlying factor contributing to the tragedy of enclosures in the Ecuadorian mangrove cockle fishery.

Shrimp and Shifting Access in the Ecuadorian Mangrove Fishery Commons

Mangroves in Ecuador have played an important role in the development of communities throughout history. Around the world, mangroves traditionally supply a variety of goods, including fish, mollusks, crustaceans, timber, charcoal, construction materials, medicinal goods, tannin, honey, incense, thatch, fuel wood, paper, and dyes for cloth (Snedaker 1986; Kovacs 1998; Ronnback 1999; Acharya 2002; Glaser 2003; Walters *et al*. 2008). In Ecuador, mangroves have not only traditionally been a source of fish, mollusks and crustaceans, but the wood has also provided charcoal, fuel wood, and construction materials for boats, homes, bridges, piers, and traditional fishing gear and traps (Mera Orcés 1999; CLIRSEN-PMRC 2007). In addition to the direct uses described above, mangroves provide numerous environmental services such as nutrient cycling, erosion control, sediment trapping, groundwater re-charge, water purification, storm surge/tsunami protection, carbon sequestration, micro-climate stabilization, biodiversity support, and habitat/ nursery service for commercial, recreational, and subsistence fisheries (Ronnback 1999; Upadhyay, Ranjan, and Singh 2002; Barbier

2003; Brander, Florax, and Vermaat 2006) . There are four prominent mangrove tree genera in Ecuador: *Rhizophora, Avicennia, Conocarpus, and Laguncularia,* whose protection has been mandated since 1985 (CLIRSEN-PMRC 2007). Prior to the development of the shrimp industry, mangrove areas were enjoyed by tens of thousands artisanal fishers as a public good.

Traditionally, mangrove cockles are harvested from the roots of mangrove trees for subsistence and domestic markets by women and children in the province of Esmeraldas and by men and young boys throughout the rest of the country. Presently, shells gathered in El Oro Province (Figure 1) are destined for export to Peru resulting in higher earnings for the collectors in El Oro ($12-20 per 100 shells) than in Esmeraldas ($6-12 per hundred shells). Prices are subjectively determined by the "quality" of the catch (larger shells and catches with a greater proportion of A. tuberculosa are sold for a higher price also depending on demand and seasonality). Prices are sometimes intensely negotiated between the collector and the buyer depending on their relationship to one another.[26]

[26] Many cockle collectors consistently sell their shells to the same person, either a relative or close friend. Others may alternate their sale of shells between different buyers opportunistically taking the best offer.

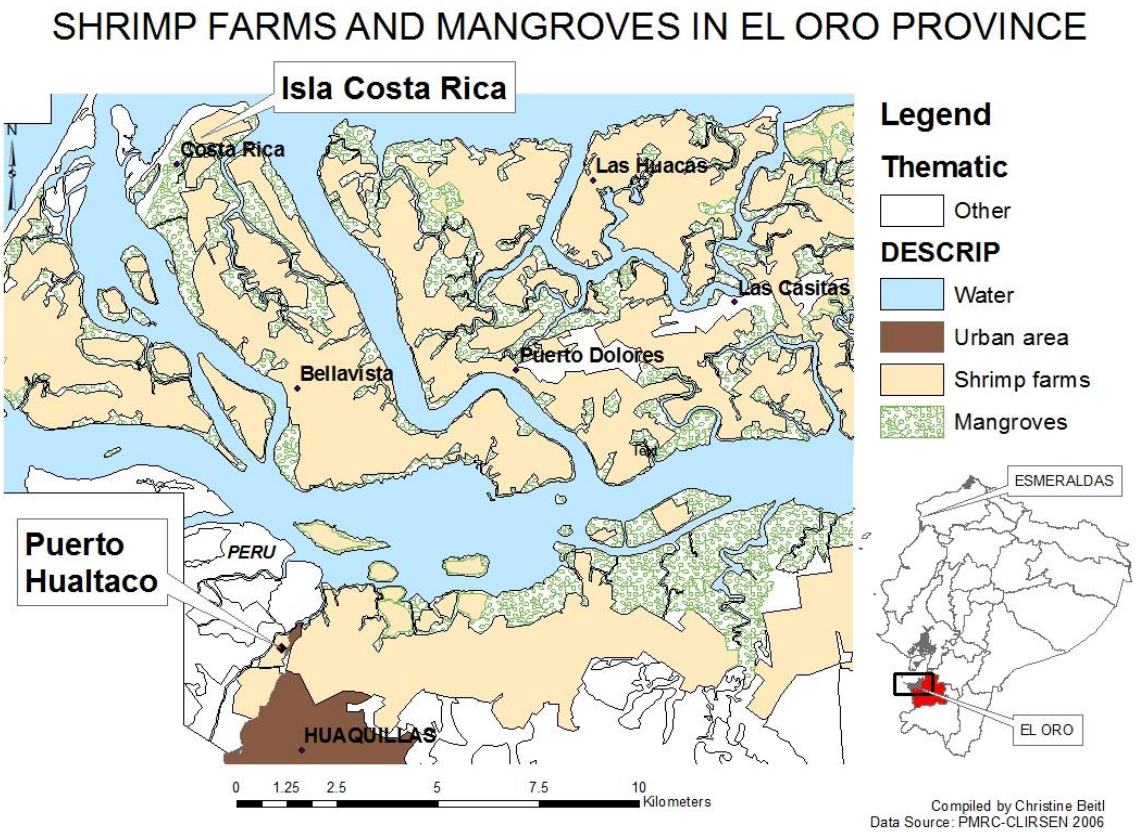


Figure 6.1: Shrimp farming and mangroves in the two study areas, Isla Costa Rica and Puerto Hualtaco in El Oro.

The first records of the cockle fishery's commercialization date back to the 1970s in a census conducted by the Instituto Nacional de Pesca (INP 1971). In the last 10 years, studies have begun to show declining catch and shell sizes in Ecuador (Elao and Guevara 2006; Mora and Moreno 2009; Mora, Moreno, and Jurado 2009) and throughout their range from Mexico to Peru (MacKenzie 2001). Under the recommendations of the Instituto Nacional de Pesca (INP), the Subsecretaría de Recursos Pesqueros (SRP) established the first measures to regulate the fishery in 2001 by implementing a closed season and permanent prohibition on the capture of cockles smaller than 45mm in length. In the communities that have been granted mangrove concessions, local rules of fishery management have been implemented for sustainable harvest of mangrove resources

(Ocampo-Thomason 2006; Bravo 2007; Coello, Vinueza Burgos, and Alemán 2008; Ecobiotec 2009). Fundación de Defensa Ecológica (FUNDECOL) and Coordinadora Nacional para la Defensa del Ecosistema Manglar (C-CONDEM), two environmental organizations for the defense of mangroves and livelihoods, have attributed the recent decline of the fishery to predatory capitalism practiced by the shrimp industry in Ecuador.

Shrimp aquaculture in Ecuador began as early as 1966 with rudimentary forms of culturing shrimp in tidal pools, taking advantage of the natural hydrologic processes and tidal fluctuations, and subsequently grew in response to international demand and the profitability of the industry (CLIRSEN-PMRC 2007). Since then, investments in technology, knowledge and infrastructure allowed the industry to expand into salt flats, upland brush areas (*matorral*), and agricultural/ pasture lands (*agropecuaria*) before "indiscriminately" encroaching on mangrove habitat (CLIRSEN-PMRC 2007: 3). This resulted in widespread environmental degradation and social conflict (Bailey 1988; Southgate and Whitaker 1994; Ocampo-Thomason 2006; C-CONDEM 2007; CLIRSEN-PMRC 2007), eventually raising concerns about the sustainability of the industry itself since shrimp depend on mangroves for a portion of their life-cycle (Parks and Bonifaz 1994).

By the mid-1980s, shrimp farms were expanding throughout the Archipiélago Jambelí in the province of El Oro and the Muisne-Cojimíes estuary in Esmeraldas. On a national level, 26.5% of mangroves have been converted into shrimp farms since 1985, with some estuaries deforested from 74.6% (Muisne) up to 90.2% (Chone) (Bravo 2007). Between 1969 and 1995, the Archipiélago Jambelí in the province of El Oro had lost

almost half of the original mangrove cover (Bravo 2006). Often compared to "gold rush" fever in other parts of the developing world (Cruz-Torres 2000; Jermyn 2000), the shrimp industry in Ecuador expanded rapidly in both geographical extent and political power, disrupting environmental services and displacing artisanal fishers (Figure 6.2) while producing one of the nation's top exports along with bananas and oil. Artisanal fishers with little political power or and economic resources could do very little but to stand by and watch their fishing grounds be bulldozed away. In this research, some informants regretfully admitted to me in interviews that they were part of the destruction process. In the early years of development, many artisanal fishers and shell collectors in Muisne took employment with shrimp companies to help in the construction of shrimp ponds without realizing the potential consequences of mangrove deforestation for their own livelihoods. Promoted by national governments around the world and supported by international banks and lending agencies, usually only the local elite and outsiders have had access to the credit, knowledge, and technology needed for the development of a shrimp farm, further exacerbating structural inequalities of wealth and power (Bailey 1988; Cruz-Torres 2000; Martinez-Alier 2001).

As shrimp mariculture rapidly spread in coastal zones throughout the world, the Ecuadorian shrimp industry has been considered one of the most successful cases for its increase in production and foreign exchange earnings over a relatively short period of time, ultimately surpassing the trawl industry (Bailey 1988). However, the growth of shrimp ponds from 89,368 ha in 1984 to 178,071 ha in 1995 just before the industry crashed in 1999 corresponds with the decrease in mangrove cover from 182,157 ha in

1984 to 146,938 ha in 1995 (CLIRSEN-PMRC 2007).[27] Despite the social and ecological consequences associated with mangrove deforestation and shrimp aquaculture documented in the literature, Ecuador is also unique for its progressive policies toward coastal management and the institutions dedicated to the implementation of integrated coastal management (Robadue 1995; Olsen, Ochoa, and Robadue 2003). While there has been some critique (Guest 1999), the Programa de Manejo de Recursos Costeros (PMRC, or coastal management plan) as been an important institution behind the design and implementation of policies related to conservation and development in coastal communities. Policies have shifted from a focus on shrimp farming development to sustainable development with community participation. The progressive policies on coastal management reflect broader trends in Ecuador which became the first country in the world to recognize the rights of nature in its constitution by 2008 (Mychalejko 2008; Acosta and Martinez 2009). It is within this context I examine the way in which mangroves have been "appropriated" under different property regimes that have denied access to formerly public goods, potentially undermining the sustainability of mangrove fisheries.

[27] The figures for 1999 are not reported here because of possible technical errors in measurement associated with the acquisition of additional aerial photos that increased the extent of the study area (for an explanation, see CLIRSEN-PMRC 2007: 29). Such figures showing a significant increase in mangrove cover between 1995 and 1999 during the height of the shrimp industry's production and success are questionable.

Figure 6.2: a) A cockle collector from Isla Costa Rica, El Oro with his total catch (left). b) A small-scale family shrimp farm in Muisne, Esmeraldas (right). While shrimp farms are designed to scale up production for surplus and export, the products from natural mangroves are estimated by FUNDECOL and C-CONDEM to support ten times the number of families compared to a small-scale shrimp farm. *All photos by author unless noted otherwise.

Methods for Studying Shifting Access within Ecuadorian Mangrove Commons

My argument draws on field research from January 2009 to December 2010 and during the summers of 2006 and 2008. I carried out exploratory interviews and observations in thirteen sites in two provinces (eight sites in El Oro Province and five sites in Esmeraldas Province), before selecting four sites to collect catch-per-unit-effort (CPUE) data and administer semi-structured questionnaires for cockle collectors: Isla Costa Rica and Hualtaco in the province of El Oro and Muisne and Las Manchas in the province of Esmeraldas.[28] All of the research sites in Esmeraldas and El Oro were

[28] Sites for exploratory interviews and observations in El Oro included the communities of Isla Costa Rica, Las Huacas, Bellavista, Casitas, and Pongalillo and the ports of Hualtaco, Bolivar, and Jeli. Sites visited in Esmeraldas included Muisne, Las Manchas, Bunche, San Jose de Chamanga, and San Lorenzo. I would like to express my gratitude to several individuals at five institutions for helping to orient me to different sites, introducing me to key informants, and in some cases, assisting with travel: Elba Mora and Juan Moreno at Instituto Nacional de Pesca, Adolfo Cruz and Miguel Cruz from Asociacion de Mariscadores,

heavily affected by mangrove deforestation and shrimp farming until the late 1990s when the white spot virus hit the industry. The focus of this analysis is in the two El Oro sites (Figure 6.1) where "*custodias* have been spreading like a fever now that everyone is asking for a concession" (Mora, personal communication).

Since 2003, the Muisne-Cojimíes estuarine system in the province of Esmeraldas has been protected by the Refugio de Vida Silvestre under the management and vigilance of the national park service and FUNDECOL, a grassroots environmental organization working in Muisne since 1989. In contrast, many mangrove areas in the province of El Oro have been protected by *custodias,* or agreements for the sustainable use and stewardship of mangroves. As of July 2011, the Subsecretaría de Gestión Marina y Costera authorized sixteen mangrove concessions in El Oro, amounting to 4,002 hectares of community protected mangroves. Isla Costa Rica, one of the study sites for this research, was one of the first communities in the country to receive a *custodia* in the year 2000. Many cockle collectors living in the city of Huaquillas/ Puerto Hualtaco are originally from the communities of the archipelago but have lost their ancestral rights to the *custodias* in their native communities for having migrated out. Several local associations in Hualtaco have asked the government for a concession, but at the time of this research, only two had been granted to Isla Costa Rica and Las Huacas (see Figure 6.1). The perceptions by members of local associations and other cockle collectors that total catches and shell sizes are larger in the *custodias* have been confirmed by this research (Beitl and Cruz 2010; Beitl 2011).

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Pescadores Artesanales y Afines "Costa Rica", Rafael Elao at Ecocostas, Wellington Angulo Banega and Frank Navarrete from FUNDECOL, and Bolivar Gamboa at the the Ministerio de Ambiente office in Muisne.

In Isla Costa Rica, I worked closely with the president of the Asociación Isla Costa Rica, Don Adolfo Cruz, who played an instrumental role in helping me to coordinate research activities and motivate the participation of other cockle collectors on the island. In Muisne and Las Manchas, my key informant and guide was a recent high school graduate, Adrian Vargas, son of a local fisherman and merchant who transports cockles and other mangrove products to neighboring communities. Adrian's mother is a housewife and former member of a now inactive local association of female cockle collectors. In addition to observations, mapping exercises, oral histories, and collection of catch-per-unit-effort (CPUE) data, I conducted interviews with 153 cockle collectors, fishers, women, and community leaders. The questionnaire for cockle collectors was divided into five sections: 1) informed consent; 2) information about cockles, including CPUE, shell size measurements, description of the site of extraction and means of transport; 3) perceptions of change in mangroves and the fishery; 5) participation in civil society activities, social movements, and other forms of collective action. I asked cockle collectors about whether they ever had a conflict with a shrimp farmer or another cockle collector and whether they believed that shrimp farming and artisanal fishing were compatible. In El Oro where *custodias* are present, I asked informants for their general opinion about effectiveness and whether they felt people respected the property lines. To evaluate the impacts of *custodias* on social relations among cockle collectors, I coded the answers of the interview questions and conducted a two-way cross-tabulation to test for significant differences in responses between the two provinces using the Fisher's exact test. Finally, I conducted focus groups for informants and local associations in all four

sites to present the preliminary results of my study and discuss issues of overexploitation and territoriality within the cockle fishery.

To gain a broader understanding of the evolution of coastal management policy and recent social-ecological changes in the last four decades, I consulted a number of policy reports, laws, presidential decrees, ministerial agreements, and scientific studies by NGOs, research institutions, and scholarly articles. I interviewed government officials, merchants of mangrove products, shrimp farmers, activists, and scientists from different NGOs, research institutes, local cooperatives and associations, and various government agencies concerned with mangroves, artisanal fisheries, and/or aquaculture.[29] In the interviews, I enquired about the history of conflict between shrimp and mangroves and about the effectiveness of *custodias*. In addition to these methods, I acquired much understanding about context from unplanned, informal discussions, participant observation, and focus groups with local fishing associations in Muisne and Puerto Hualtaco.

## Shifting Policy and Local Impacts in the Ecuadorian Mangrove Commons

### Conflict in the Commons

As discussed in previous sections, shrimp aquaculture encroached on highly productive mangrove ecosystems throughout the 1980s and 1990s due to weak enforcement of policies protecting mangroves from destruction. In both provinces, about

[29] I owe my gratitude to several institutions for their collaboration: Instituto Nacional de Pesca, Subsecretaría de Gestion Marina y Costera, Ministerio de Ambiente, Subsecretaría de Recursos Pesqueros, Subsecretaría de Acuacultura, Ecocostas, C-CONDEM, FUNDECOL, Arcoiris, Ecobiotec, CLIRSEN, Escuela Superior Politécnica del Litoral, Universidad Técnica de Machala, Junta Parroquial de Isla Costa Rica, Alcaldaria de Muisne, Cultivadores de Especies Bioacuáticas de la Provincia de Esmeraldas (ACEBAE), Jatun Sacha – Congal, Federación de Pescadores Artesanales Frontera Sur, Federación de Usuarios Ancestrales del Ecosistema Manglar, and several local associations in El Oro and Esmeraldas, particularly Asociación Isla Costa Rica.

half of my informants reported having had a conflict with a shrimp farmer (Table 6.1).[30] In many cases, they spoke on behalf of other "ancestral users" in solidarity with the group, expressing that they personally had not experienced a conflict, but their *compañeros* had. Most personal conflicts involved a verbal argument with the guard involving accusations of theft or trespassing. Occasionally, guards had been known to fire shots, and in a worst-case scenario, someone had been hurt or killed. However, a few informants pointed out that the guards are not the problem; rather it is the guard dogs that do not recognize the difference between a legitimate cockle collector and a thief (see Figure 6.3). One shrimp farmer from Muisne suggested that the dogs are a way to avoid conflict, because if the dogs do not deter the collector, then a violent confrontation would be sure to break out.

Many informants pointed out that direct and violent confrontation between artisanal fishers and shrimp farmers was mostly a problem of the past. In the early years of shrimp farm expansion, local communities formed alliances with environmental activists to destroy the walls and dikes of the shrimp ponds or threaten the staff with machetes. Today conflicts with shrimp farmers are less common since many cockle collectors have made agreements or asked for special permission to work on the pond walls. In Puerto Hualtaco, new policies require cockle collectors to carry a government-issued ID card identifying them as an artisanal fisher, which they are occasionally asked to present to the shrimp farm guards, alleviating some of the tension.

[30] See Beitl (2011) for differences between Isla Costa Rica and Puerto Hualtaco in the province of El Oro.

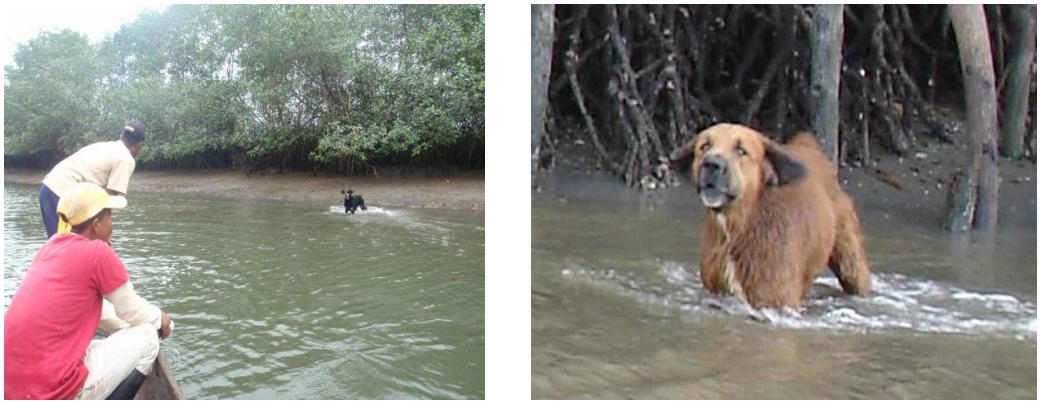

Figure 6.3: "*Perros bravos*" guard access to shrimp farms and deter cockle collectors and other artisanal fishers from getting too close and harvesting shells from the walls of a shrimp farm without special permission from the owner or guards on duty.

Table 6.1: Informant responses to interview questions in El Oro and Esmeraldas (n=153).

| | **EL ORO** | | **ESMERALDAS** | | **Two-way cross-tabulation measures of association** | |
|---|---|---|---|---|---|---|
| | Percent that agree | N | Percent that agree | N | Chi square | *p*-value |
| **Shrimp farming is compatible with artisanal fishing** | 47% | 64 | 30% | 43 | 2.964 | 0.064 |
| **Conflict with shrimp farmer** | 55% | 71 | 52% | 52 | 0.109 | 0.441 |
| **Conflict with another cockle collector** | 49% | 71 | 12% | 52 | 19.256 | 0.000 |
| **Gathering grounds lost** | 96% | 72 | 84% | 49 | 5.217 | 0.049 |
| **Gathering grounds lost to shrimp farms** | 19% | 70 | 41% | 44 | 6.809 | 0.016 |
| **Gathering grounds lost to *custodias*** | 63% | 70 | 5% | 44 | 38.168 | 0.000 |

In both provinces, informants generally agreed that they have lost their gathering grounds, but their explanations for lost gathering grounds differed depending on the province (Figure 6.4). In Muisne, Esmeraldas where there are no *custodias*, collectors mostly attributed the loss of gathering grounds to shrimp farms.[31] By contrast, in El Oro, particularly in Puerto Hualtaco, most informants attributed the loss of gathering grounds to enclosure by *custodias*.

Enclosure and Exclusion by Shrimp Farms in the Commons

The "expropriation" of coastal resources has directly affected livelihoods and some people's ability to earn a living (Bailey 1988). According to FUNDECOL and C-CONDEM, a healthy mangrove system supports up to ten families for every one family a shrimp farm supports. While intensive production of shrimp greatly exceeds the production of cockles (see Figure 6.2), most of it is for international export and very little remains for local and regional consumption. Many informants interviewed in this study were too young to remember the days that mangroves were bulldozed away and gathering grounds began to disappear in the 1980s, but had heard the stories from their parents. Other informants related their own observations of declining catches to pollution and effluents released from the ponds on a daily basis and the alleged illegal chemicals used to "clean" the pond of fungus and pests every three months after a harvest.

[31] The communities Las Manchas and Ostional are known by collectors in Muisne for their informal common property arrangements in which communities control access without holding a legal title or concession.

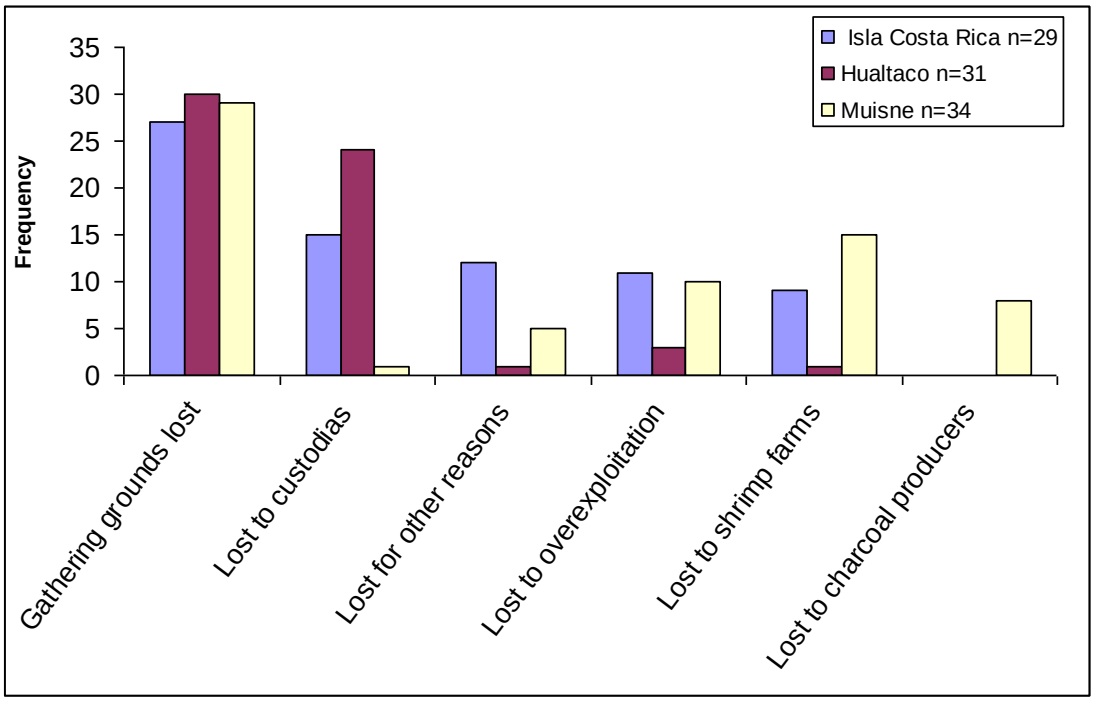


Figure 6.4: Local explanations for the loss of cockle gathering grounds by field site (n=94). While there is general consensus among cockle collectors that gathering grounds have been lost, a chi-square test reveals significant differences between study areas in explanations for the loss of gathering grounds at the 0.05 level.

Another critique of the shrimp industry has been its failure to provide local economic benefits. Many of my informants commented that shrimp farmers often bring in their employees from outside, very rarely offering full time employment to locals.[32] These findings are similar to observations made by Ocampo-Thomason (2006) in twelve communities of the Cayapas-Santiago-Mataje Rivers in Esmeraldas where shrimp farms only provided about 0.6% of local employment while 85% of households depended on mangrove fisheries. The failure of the industry to make a local economic impact was further confirmed in an interview with a shrimp farmer in Muisne who admitted to not

[32] These findings are not quantified since I realized later on in the research that different informants had different interpretations about what the question meant. When asked if he/she had ever worked on a shrimp pond, those informants who understood fulltime employment answered "no" even if they had worked during several harvests as wage laborers.

hiring locals from the immediate vicinity for permanent positions as guards or managers for fear that they will encourage their local friends to steal. On the other hand, many of my informants in both provinces claimed that they were not interested in employment on shrimp farms. Some informants complained that the jobs were exploitative (many hours and low wages) and seasonal. Others commented they never had the chance because they were not "invited" to work during the harvest. Some informants in Isla Costa Rica were not interested in those jobs because they consider themselves fishermen, not "peons."

While local employment on shrimp farms tends to be seasonal and temporary, some people in rural communities benefited from profitable work in the collection of wild post larval shrimp (PLS) to stock the ponds during the boom years (Parks and Bonifaz 1994; Guest 2000) until the PLS fishery was closed for concerns about overexploitation of seed in 1999. Other sectors in packing, processing, and transportation flourished throughout the late 1980s and 1990s, mobilizing the migration of people to rural fishing villages and urban centers where the industry thrived. Places like Muisne urbanized once again after a hiatus from the boom-bust legacy of the banana industry during the 1960s. As urban centers, Muisne and Huaquillas/ Hualtaco benefited from the thriving shrimp industry until 1999 when the white spot virus devastated the industry, closing hatcheries, processing and packing plants, and halting infrastructural development. Many people displaced by the crash of the shrimp industry in 1999 had no other choice in a precarious economy but to take up artisanal fishing until other employment became available. Many of them are still fishing and collecting cockles to this day. Between the degraded mangrove habitats and increased number of fishers, artisanal fisheries like that of the mangrove cockle, began to decline.

Changing Policy and Enclosure by *Custodia* in the Commons

Within the context of conflict between shrimp farming and the artisanal fishery sector, the Programa de Manejo de Recursos Costeros (PMRC) was established in the 1980s under the Office of the President of the Republic of Ecuador. During the first phase from 1986-2004, with financial assistance from USAID and Inter-American Development Bank and technical assistance from the University of Rhode Island Coastal Resource Center, its mission was to "Improve the quality of life for communities that depend on coastal and marine resources and increase the contribution of those resources for the wellbeing of the national economy while maintaining biological diversity and the productivity of coastal-marine ecosystems" (Herrera Ximénez and Molina Bravo 2008).[33] Recognizing the problems of mangrove degradation, decline in artisanal fisheries, inappropriate development, and a decline in water quality, many of their early efforts were focused on how to make shrimp aquaculture more sustainable (Odum and Arding 1991; Robadue 1995; Bordero and Retamales 2003; Macintosh and Ashton 2004). While the impacts of PMRC projects were not felt in many communities (Guest 1999), my informants in Muisne and Las Manchas remembered PMRC projects in positive light.

As the shrimp industry crashed in 1999 due to white spot virus, the idea to create *custodias* was born in the community of Bunche just outside Muisne during a conversation between PMRC biologists and an association of women cockle collectors who wondered why shrimp farmers were able to get concessions while mangroves remained an open-access public good for everyone else (Bravo, personal

[33] All translations from Spanish are my own.

communication). Interestingly, neither Bunche nor any of the communities around Muisne have a government-granted *custodia* today. The majority are located throughout Archipiélago Jambelí in the province of El Oro and in the northern part of Esmeraldas in the communities around San Lorenzo that form part of the Mataje Cayapas Reserve.

In the second phase of the PMRC (2005-2009), with several *custodias* already granted to communities in El Oro and northern Esmeraldas, the effort toward decentralization became more clear in its mission to improve and expand "integrated coastal management by supporting progressive transfer of management to the local level and contributing to sustainable use of coastal resources and improvement in the quality of life within coastal communities" (Herrera Ximénez and Molina Bravo 2008). Integrated coastal management was more actively pursued with participation of communities, as well as proposals to improve community wellbeing through investment and diffusion of information about coastal resources. Several management plans for different *custodias* were drafted (Bravo 2006, 2006, 2006, 2007), as well as a set of criteria by which communities qualify for a concession (Bravo 2007). Management areas expanded in their geographical range before the program was absorbed into the Ministry of Environment's Subsecretaría de Gestión de Marina y Costera in 2008, a government agency responsible for all laws pertaining to oceans and coasts, decentralization, management, and conservation of all natural resources within the coastal zone (Herrera Ximénez and Molina Bravo 2008).

Communities interested in obtaining a *custodia* were required to organize into groups or be "organized ancestral communities" capable of providing maps, a list of members, a management plan detailing sustainable use of mangrove resources, a copy of

the association's agreement, names of the officers, and two-year agreement with an external institution for receiving technical assistance (Bravo 2007). While many government officials interviewed in this research were unclear about the meaning of the term "ancestral" and the criteria by which ancestral is defined, the 41 concessions currently operating today have been granted to local civil society organizations, fishing cooperatives and associations formally recognized by a State agency. Activities considered "sustainable" in the management plans include controlled selective logging for charcoal production, conservation, education, research, reforestation, tourism, artisanal fishing, and culturing of a variety of fish, mollusks, and crustaceans (Bravo 2007).

Since 2000, Isla Costa Rica's *custodia* has enabled them to achieve the restoration of several mangrove areas, the recuperation of cockles and crabs, and the strengthening of local organization by patrolling and controlling access to gathering grounds (Bravo 2006). In addition to improved catch and shell sizes due to strict management of cockle gathering grounds by rotation, periodic closure, and exclusion of outsiders, the *custodias* have generated a sense of pride within the community historically marginalized by their isolation and lack of access to education, employment, and infrastructural development (Beitl 2011). However on a broader scale, the very *custodias* designed to defend artisanal fishers from the loss of mangroves are becoming a source of tension and conflict between members of associations and non-affiliated cockle collectors who are increasingly losing their ground in El Oro Province (Figure 6.5).


Figure 6.5: a) private shrimp farm prohibiting access by unauthorized persons (left) b) two association members posting their sign delineating the boundaries of their *custodia* (right).

In a mangrove landscape carved out by four decades of shrimp aquaculture development, there have been concerns about overexploitation in the cockle fishery. While activists were quick to blame the shrimp industry, many cockle collectors throughout the country generally attributed the decline of the fishery to overexploitation, increased competition, lack of control, lack of other employment opportunities, and too many "outsiders" without the local ecological knowledge to harvest sustainably. In my interviews cockle collectors expressed concern than too many people take small shells without allowing enough time for cockles to grow and reproduce. In Muisne, in particular, many cockle collectors complained about the entry of drug-addicted youth who typically collected shells of all sizes in exchange for drugs to satisfy their fix. When further probed to comment on the situation of mangroves in general, several informants in both provinces recognized the shrimp industry as the culprit. In line with the activists,

they acknowledged that shrimp ponds were responsible for the loss of many gathering grounds and the release of effluents into the estuary, an opinion more strongly held in Muisne than in the two El Oro sites. In El Oro, where many *custodias* have been granted to local associations, cockle collectors expressed concern that they were losing their gathering grounds to other *compañeros* from local associations and other communities that in some cases violently defended their *custodias* from encroachment and trespassing by outsiders.

As this case study has demonstrated, the *custodias* were the primary explanation for the loss of gathering grounds in the province of El Oro (see Figure 6.4). The problem was most clear in the case of Las Huacas, a community in the Archipelago Jambelí infamously known in both Isla Costa Rica and Puerto Hualtaco as a "violent community" feared for their fierce defense of their *custodias.* Several informants commented that the men from Las Huacas have been known to beat trespassers, confiscate catches, and steal personal belongings for years prior to obtaining their legal concession. As one man in Hualtaco said in an interview with me, "I prefer to get (only) 50 cockles than to suffer their abuse" referring to the men in Las Huacas. Other informants commented about the *custodias* in general, "we have lost our gathering grounds because the people who have concessions have made themselves owners." Another man bitterly stated, "It's all the fault of the *custodias* that we cockle collectors are now fighting amongst ourselves." Another man argued, "The *custodias* keep us from working—I do not agree with them." These opinions were further expressed in response to the question about whether they believed everyone has the right to work in mangroves: "We are all Ecuadorians and we all have the right to work in the mangroves, not only those *sabidos,*" he stated implying

that members of the associations were "sneaky" and corrupt.[34] He continued, "The greed…you have to be a *socio* (member of an association) to work. I don't agree with any institution."

Evidence for the rivalry between independent cockle collectors and members of associations was reinforced by my focus groups in Hualtaco where none of the independent collectors showed up despite personal invitations. In their absence, there was a collective tirade against them by *socios* accusing them of being uncooperative freeloaders single-handedly responsible for the decline of the fishery. Many *socios* argued that non-affiliated cockle collectors were the ones who take all the small shells and that all mangroves should be put in community concessions to alleviate these problems of scarcity. They further asserted that only *socios* should have the right to obtain concessions because they are generally the ones that participate in workshops and invest their time and effort to learn about problems in the fishery while independent collectors do not. Not surprisingly, the incidence of conflict between *compañeros* was significantly higher in the province of El Oro than in the communities around Muisne where there are no official *custodias* (Table 6.1).

More neutral opinions came from some of the individual interviews with *socios.* While some independent collectors expressed a lack of trust in local associations and suspicions that members of the board were all corrupt, many cockle collectors (including *socios*) expressed that they simply did not agree with the *custodias* because they have caused so much conflict. As a 45 year-old member of one association without a *custodia* commented:

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[34] *Sabidos* refers to people who are "clever" and knowledgeable in a sneaky or corrupt manner.

> I don't agree with the *custodias* because they don't let us in. We are all Ecuadorians and we have the right, why should we be divided if we are all Ecuadorians? They are so few *socios* and they have so many areas. It's not fair.

As another 25 year-old member of an association without a *custodia* of their own put it, "the *custodias* should protect mangroves against deforestation, but they shouldn't prevent people from working." The general sentiment shared by almost everyone was that everyone should have the right to work in the mangroves, but the frequency of this response was significantly higher in Hualtaco where 97% believe that mangroves are a public good and benefit to be enjoyed universally (Beitl 2011). Some suggested that rights to mangroves should be granted only to those who fish "responsibly" without destroying the mangroves. As one boy from Isla Costa Rica put it, "We all have to eat," recognizing at the young age of 14 the intricate connection between environment, economics, and subsistence.

Access, Enclosure, and Political Ecology of the Mangrove Commons

Following Ribot and Peluso's (2003) steps used for analyzing access to resources, in this section I discuss the power relations and mechanisms of access of the following three groups within the context of policy changes regarding mangroves: 1) shrimp farmers; 2) *socios,* all cockle collectors who are members of local associations with or without *custodias* of their own; 3) independent, non-affiliated cockle collectors. In addition to rights-based law (sanctioned by custom, law, and convention) and illegal access (theft or trespassing), Ribot and Peluso argue that access also manifests in ways that are structural and relational, which can influence who benefits from resources. Structural and relational forms of access are established by cultural and political-economic constraints imposed by technology, capital, markets, labor, knowledge,

authority, identities, and social relations. In this case study examining the effects of shifting policies and their effects on property rights and access in Ecuadorian mangroves, the *benefit* under study is the mangrove system and the fishery resources it encompasses. The shrimp farmer has enjoyed the productivity of his shrimp ponds while the artisanal fisher has enjoyed the productivity of a healthy mangrove system in which benefits are derived from multiple fisheries and other direct uses. Over the last several decades, mechanisms of access and power relations have shifted in response to changing policies affecting the competition between shrimp farmers and cockle collectors over mangrove areas for the benefit of their respective livelihoods.

Of all three groups, shrimp farmers have enjoyed the most power and benefits in the process of appropriating mangroves. This is best reflected by CLIRSEN's statistics in 1995 showing the total coverage of shrimp farms nation-wide exceeded the total coverage of mangroves by over 30,000 hectares (CLIRSEN-PMRC 2007). Shrimp farmers have exercised their political and economic power, gaining and maintaining access to mangroves based on their technology, financial capital, friendship with authorities, education, and through it all, they have been highly organized. Most importantly, they have enjoyed access to large international markets for mangrove products, particularly farm-raised shrimp, which has taken precedent over national demand for cockles and wild-caught shrimp collected by artisanal fishers. However, as also argued by many activists, many shrimp farmers originally acquired access to mangroves by illegal means.

The Presidential Decree 1391 is designed to regulate the shrimp industry and recuperate several thousands of hectares lost to shrimp farming after decades of

haphazard growth and expansion.[35] According to C-CONDEM and others against the shrimp industry, this new decree is unjust. They argue that shrimp farmers have gained illegal access under all circumstances by operating though coercion or bribes that enticed government officials to turn a blind eye wherever mangroves were being cleared for the construction of shrimp ponds. On the other hand, many shrimp farmers were able to gain access to mangrove areas through a complicated, bureaucratic process due to the heterogeneous nature of the coastal zone and its conflicting jurisdictions.[36] According to the Supreme Decree 2939-B in 1978, the exploitation of mangroves for shrimp farming was prohibited, but other uses were permitted (Pérez and Robadue 1989). One of my informants suggested that charcoal producers who had legitimate "ancestral" logging rights may have been encouraged by shrimp farmers to clear more areas than they needed for charcoal in order for shrimp farmers to pass inspections by government leasing agencies. Other farmers may have legitimately obtained a lease or title to upland areas and illegally expanded later into adjacent mangrove areas. Others had purchased shrimp farms that had unlawfully encroached mangrove areas under different ownership. While Decree 1391 represents the ways in which shrimp farmers' political power is declining in the face of changing coastal policies, those few shrimp farmers I interviewed in Muisne are in favor since they recognize the benefit of a healthy mangrove system for shrimp aquaculture itself. The fate of the expected recuperation of mangrove areas under the Decree 1391 has yet to be determined, but it is likely that many areas will be entrusted to local associations for mangrove reforestation and the establishment of new

[35] Passed in October of 2008, March 31, 2010 was the last day for shrimp farmers to submit their application including a plan for the reforestation of a certain percentage of their farm in order to legalize their occupation of mangrove areas.
[36] See Pérez and Robadue (1989) for a description of the process.

*custodias*. This is in line with the present goal of the Subsecretaría de Gestión de Marina y Costera, which is to expand efforts to conserve mangroves by augmenting the area of *custodias* from 37,818 to 47,000 hectares for community-based conservation (Rosero Moya and Santillan Salas 2011).

Cockle collectors who are members of local fishing associations have been empowered by the policy changes and the process of receiving a *custodia*, a form of access acquired by rights-based law. Their mechanisms for gaining and maintaining access have been facilitated by policy changes which also have enabled them to strengthen their political power through social networking, cross-scale institutional collaborations, and on the basis of their identity as "ancestral users." For example, based on their social relations, their identity as "ancestral users," and access to the proper government authorities through their participation in civil society, the Association in Isla Costa Rica was able to secure a concession of 519.79 hectares in the year 2000. In 2005, when a local shrimp farmer attempted to clear mangroves to illegally expand his operation, the community concession allowed *socios* from Isla Costa Rica to defend their property rights, uphold the law, and continue deriving benefits from mangrove fisheries for their community. Along with the legal backing has come a strong sense of empowerment which has further encouraged local participation in government activities as *socios* are beginning to feel more valued and less intimidated by government authorities and other outsiders. As their local organizations built their social and political capital through gaining access to authorities, they have effectively defended mangroves from further destruction and established management plans that promote sustainable

fishing within the boundaries of the *custodia* at the expense of excluding independent cockle collectors (Beitl 2011).

Independent cockle collectors have had little or no political and economic power to gain, control, or maintain access to the mangrove cockle fishery in Ecuador. Since they have been excluded from the political process, their access to gathering grounds has been significantly reduced as more public areas are enclosed by *custodias.* Those who are not displaced by problems of overexploitation in the remaining open-access areas may gain and maintain access by a special category of illegal means, what Ribot and Peluso refer to as "rights-denied access." Cockle collectors who have trespassed to collect in the *custodias* or near shrimp ponds, either to steal shrimp directly from the ponds or to simply collect shells from the mangrove fringes surrounding shrimp ponds have also gained access by illegal means. Without any institutional support, and because of their lack of interest in joining any institution, independent cockle collectors are likely to disappear into alternative livelihoods, as collecting cockles becomes less profitable or dangerous for the prospect of violent confrontation with shrimp farmers or associations defending their *custodia.*

## Conclusion

The political ecology approach employed in this study has illustrated the ways in which the shifting nature of access within the mangrove commons has corresponded with policy change and contributed to problems of conflict, overfishing, and a tragedy of common property rights. The appropriation of mangroves by way of shrimp farming or community-based concession has resulted in an unequal flow of benefits. As a common property arrangement, *custodias* are collectively owned by an identifiable group of

individuals (Satria, Matsuda, and Sano 2006), which, very much like shrimp farms, are a form of private property. While *custodias* were designed to overcome the problem of the commons, like shrimp farms, they have also subtracted from the welfare of the other users and have occasionally resulted in illegal trespassing or theft, further epitomizing the problem of the commons (Buck 1998; Ostrom *et al*. 1999) and illustrating the contradictions of the term "common property" for its ability to *include* and *exclude* simultaneously (O'Flaherty 2003). As an ecological consequence, shells collected outside of the managed areas of the *custodias* tend to be fewer and smaller in size, suggesting that the common property arrangements have simply deflected the problem of overexploitation to open-access areas where independent collectors compete for increasingly scarce resources (Beitl 2011). A political ecology of the commons addresses the changing nature of access and structural inequities depending on the political agents in power (Ribot and Peluso 2003) and the ways in which common property institutions themselves may function as political agents in their own right (Reddy 2002). These considerations may also be relevant to other community-managed marine areas in other parts of the world (Gallardo Fernandez and Friman 2011).

The case of the mangrove cockle fishery further demonstrates that overfishing appears to be related to a long legacy of habitat fragmentation by the shrimp industry and subsequent enclosures of remaining mangrove forest fragments by *custodias* ultimately giving rise to new social tensions. This study contributes to understanding about the ways in which material struggles over resources and structural inequity can also manifest politically in collective actions and common property solutions to landscape degradation with significant implications for ecological outcomes. Considering questions of shifting

access and the tragedy of enclosures, it is necessary to ask whether the policy changes in Ecuador are effectively moving in the direction toward sustainability, participation, and integrated coastal management. It is expected that the new policies will contribute to mangrove recovery in some areas, but questions still remain about how new areas will be divided and who will benefit from access to them. As more *custodias* are established in the near future, independent fishers will continue to be displaced by overexploitation within open-access areas and forced to make a choice between engaging in illegal access or leaving the fishery all together.

On the other hand, the establishment of *custodias* on the Ecuadorian coast has great potential to contribute to the sustainable development of mangrove fisheries, and policy makers must consider the needs of non-associated independent fishers to facilitate their access and evade a tragedy of enclosures. Some government officials have argued for a need to mandate the participation by all cockle collectors in local associations. Before such policies are considered, further research should seek to alleviate the growing tensions by verifying claims made by association members and certain government officials that independent cockle collectors actually harvest in an unsustainable manner (Beitl 2012). Furthermore, incorporating independent cockle collectors who are distrustful of institutions presents the danger of coercive collective action and the creation of citizenship by government according to its own ideology about ‘the common good'. Foucault (1991: 94-95) contends this is "essentially obedience to the law" by citizens in order for the government to maintain its "principality" or power in a Machiavellian sense. Such authoritarian forms of governance under the guise of "progressive sustainable development" that ignore the role of local knowledge,

heterogeneity, and individual rights to self-determination are likely to backfire (Scott 1998).

One final concern raised by Ribot and Peluso (2003) is that when policies shift toward greater citizen participation and decentralization, they sometimes fail to allocate property rights to local people, resulting in ambiguity over access. This has not been the case in the Ecuadorian cockle fishery. Local associations did indeed receive very clear rights to their new mangrove concessions, but they did so at the expense of further marginalizing independent cockle collectors with significant implications for the sustainability of the fishery. If coastal policy in Ecuador is to truly move in the direction of conservation-oriented and "participatory" policies then it should first address issues of equity and access.

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# CHAPTER 7

# CONCLUSIONS: COMMONS THEORY BEYOND COLLECTIVE ACTION

For the last decade, researchers studying the commons have recognized the limitations of institutional approaches and common property theory, calling for the scaling up of local lessons (Berkes 2005; Ostrom et al. 1999); the linking of social and ecological systems (Anderies, Janssen, and Ostrom 2004; Pollnac and Johnson 2005); the incorporation of theoretical and methodological insights from geography (Giordano 2003) and human behavioral ecology (Aswani 2005; Lu 2001; Ruttan 1998); and a re-conceptualization of the commons as embedded systems situated in larger political, social, economic, and ecological contexts (Campbell 2007; McCay 2002; Wagner and Talakai 2007; McCay and Acheson 1987). In this ethnographic study of the mangrove cockle fishery in coastal Ecuador, I have examined the intricate relationship between individuals, institutions, and the environment in two distinct resource systems, the cockle fishery and its mangrove habitat. In this chapter, I summarize the major findings and their significance. I demonstrate how a more broadly-conceived definition of the commons problem addresses many of the gaps in commons research and further contributes to the development of frameworks for research about sustainability and the political ecology of the commons. I conclude this chapter with a discussion of the limitations of this research and suggest pathways for future investigation.

The Creation and Consequences of Collective Action Institutions

The classic solution often prescribed to the problem of the commons in the literature has been the creation of institutions for collective action and the establishment of property rights. Following Ruttan's (2008) distinction between two ways of measuring success, I hypothesized that collective action and common property arrangements would have positive effects on common pool resources. In Chapter 4, I use the first distinction, *collective goods provisioning*, or assessment of the quality of the resource base; and in Chapter 5, I use the second measure of success, *collective action*, or the degree to which individuals contribute or comply with rules and contribute their personal time or resources to a collectively defined goal (Ruttan 2008).

To test the hypotheses, I developed measures of sustainable fishing behavior and collective action that were appropriate to the ethnographic context of the mangrove cockle fishery in Ecuador. First, I developed a typology of management regimes to test their effects on shell and catch sizes (Chapter 4). Then, I coded responses to open-ended and semi-structured questions from the interviews with *concheros* to create measures of collective action (Chapter 5). Finally, drawing on the idea that smaller shell and catch sizes indicate harvesting pressures (Flores and Licandeo 2010), I developed proxies for sustainable fishing behavior (or "responsible fishing," as defined locally) by calculating the mean shell length (by individual catch and by management regime), the proportion of a catch with shells below the allowable size for commercialization, and the total catch per individual unit of effort (CPUE). These measures were designed to function in multiple contexts, across study areas, and under a variety of institutional arrangements to capture the complex interactions between institutions, individuals, and the environment. My

attention to the ethnographic context under which civil society organizations began to flourish on the coast helps further explain the efficacy of collective action in environmental governance.

The major finding about management regimes and common property rights in Chapter 4 is that *custodias* in Isla Costa Rica are associated with higher catch and shell sizes, despite the highest levels of fishing effort compared to all other gathering grounds around the community, as shown in Chapter 3. However, the institutional-level analysis used in Chapter 4 to measure the success of *collective goods provisioning* does not reveal whether individuals are obeying the rules-in-use or if some other environmental factors are at play. Thus, while common property arrangements may appear to promote a more sustainable harvest of fishery resources, the institutional-level analysis fails to capture individual differentiation and whether people refrain from their presumed tendency to maximize resource use. This question was addressed in Chapter 5, which uses individuals as the unit of analysis and shows that environmental factors beyond a fisher's membership in institutions more adequately explain variations in shell size. Thus, at the level of the fishery, environmental conditions of each gathering ground may serve as an ecological constraint over an individual's ability to harvest shells in a sustainable manner, regardless of his/her participation in collective action institutions. In this way, *custodias* provide a healthy habitat which allows *concheros* to harvest sustainably.

In testing the effects of institutional membership on behavior toward resources, I gained further insight about the nature of the commons problem, which addresses a significant gap in the literature concerning attention to resource characteristics and individual differentiation within and across groups (Agrawal 2001). I framed the analysis

around two distinct forms of collective action highlighted in the literature: *contribution* and *subtractability* problems. Members of associations contribute to collective action (i.e. mangrove reforestation projects, workshops, political demonstrations for the defense of mangroves) for multiple reasons: 1) for their obligations as *socios;* 2) to uphold their reputations as collaborative, dependable, and trustworthy; 3) for their fear of sanction for not following rules or group agreements; 4) for their access to the flow of information about events and encouragement by their peers to "collaborate" or participate; and 5) for their pride as members of associations and ancestral users of mangroves. However, the *subtractability* problem that characterizes the fishery is more difficult to overcome. In the fishery commons, *concheros* can conceal their non-cooperation, which may only be witnessed by a few loyal *compañeros,* friends, or family members. These findings emphasize the importance of resource characteristics and group characteristics, which has received less attention in the common property literature (Agrawal 2001).

The ambiguous effects of collective action on the environment can also be interpreted in light of the differential nature of the social histories of resources: differential power relations associated with their depletion and different narratives explaining their decline, the actors responsible, and whether people are unified in their perceptions about who should be held accountable. Artisanal fishers are generally united in their belief that shrimp farms are responsible for the depletion of mangroves, but largely divided in their perceptions about who is responsible for the decline of the fishery. Such divisions may have contributed to weak institutions in places like Muisne, along with issues of trust, which I have identified in Chapter 5. In El Oro, independent cockle collectors are also distrustful of fishing associations and prefer not to participate.

Weak local institutions, economic heterogeneity, lack of trust, and exclusion have long been considered barriers to collective action and the sustainable governance of environmental resources (Jones 2004; Ostrom 1990; Beard 2007). This point further draws attention to the role of context and the ways in which the relationship between collective action and the environment is not unidirectional; rather it is based on multiple levels of feedback between social and ecological systems. Understanding the context for the effects of collective action and institutions on the environment helps explain their efficacy in sustainable governance.

On the other hand, local fishing cooperatives and associations provide an institutional base to facilitate cross-scale collective actions among multiple actors (government, shrimp farmers, and artisanal fishers) to collaborate for a common goal of conserving and restoring mangrove forests on the coast. Civil society institutions have contributed to local empowerment, a sense of pride, and participation, especially in small communities and among members of associations. Local institutions can be further strengthened by cross-scale interaction (Berkes 2002). New coastal policies favoring mangrove conservation in Ecuador represent new ways of valuing common pool resources for greater society and a step toward implementing integrated coastal management (Olsen, Ochoa, and Robadue 2003; Robadue 1995).

Redefining the Commons Problem: Towards a Political Ecology of the Commons

I gained further insight about the importance of resource characteristics for defining and overcoming the commons problem in my examination of the ethnographic context. Each of these two resource systems, mangroves and the cockle fishery, have different causes of their decline and a different set of challenges facing their

sustainability. For the fishery, in which users generally have equal access, the commons problem is best characterized as a *subtractability* problem. In contrast, the problem of the commons in mangrove systems reflects more of a *valuation* problem, in which actors with the most political and economic power have widely converted them for shrimp aquaculture, privileging shrimp exports over livelihoods based on mangrove-associated products (Martinez-Alier 2001).

The recent policy changes concerning mangrove conservation, the ancestral rights, and *custodias* represent new ways in which mangroves are valued with implications for the empowerment of disenfranchised artisanal fishers. However, *custodias* have added a new layer to the commons problem in the fishery—the question of access and the creation of a new hierarchy of artisanal fishers. New tensions between members of associations who have access to a larger extent of mangrove areas than independent cockle collectors may potentially undermine the sustainability of the fishery in the future. These findings have particular relevance for the development of a political ecology of the commons.

Ecuador is one of many countries moving in the direction toward the creation of innovative policies that are more participatory and rights-based oriented for artisanal fishers. As with every good intention, aiming for greater participation and a "greater good" is no small feat. In Chapter 6, I use a political ecology approach to explore the ways in which common property institutions may function as political agents (Reddy 2002) with the power to include and exclude simultaneously (O'Flaherty 2003). Using Ribot and Peluso's (2003) theory of access to develop a "political ecology of the commons," this chapter demonstrates one of the multiple ways that common property and

political ecology are well-positioned to complement each other's theoretical perspectives, as also argued by Campbell (2007).

Much of this research has shown that *custodias* offer much potential for participatory community-based conservation, empowerment, and habitat rehabilitation. It is possible that the productivity of the cockle fishery will be improved by the pockets of community-based conservation with benefits that extend beyond the boundaries of protected areas through ecological connectivity. However, local associations will continue to face the challenge of fostering solidarity and trust. Policy makers will continue to face the challenge of social inclusion and exclusion. These findings have particular relevance for the literature on decentralization and community-based natural resource management in Latin America where the needs of local communities and ancestral rights to resources are increasingly recognized by national governments and incorporated into land tenure policies (Velez 2011), forest management (Gibson, McKean, and Ostrom 2000; Velásquez Runk 2009), and marine protected areas (Gallardo Fernandez and Friman 2011).

Open Access and the Free-for-All Fishery?

Finally, this research has explored other forms of social organization that contribute to sustainable use of common pool resources. Building on the notion of the commons as an embedded system, I explore how customary norms in fishing contribute to sustainability in Chapter 3. The first major finding of this research—that open-access situations do not always result in a tragedy as previously presumed—contributes to commons theory, the anthropology of fishing, and coastal ethnography. Since much of commons theory developed around critiques of Garrett Hardin's (1968) tragedy, there has

been an overemphasis on institutions that hypothetically provide the appropriate conditions for individuals to engage in collective action to overcome resource dilemmas. Researchers working in the South Pacific on customary marine tenure (CMT) have pointed out that these institutional perspectives have not been adequate to describe the situated and fluid relationships between culture, kinship, and resources (Wagner and Talakai 2007). Other scholars have been critical of the tendency of both scholars of CMT and common property to romanticize traditional institutions without critically assessing group motivations for cooperation and whether they are beneficial for resources or if conservation is an epiphenomenal outcome (Pollnac and Johnson 2005; Ruttan 1998). By examining the cultural aspects of the fishing effort over time and space on a micro-scale in Chapter 3, I found that even in the absence of institutions, open-access, free-for-all situations are governed by social relationships that result in a relatively reliable returns for fishers over time. Such findings are important contributions to the commons literature that often exalts the role of property rights since all kinds of property arrangements may be susceptible to open-access conditions, depending on the degree to which rules are enforced and access is controlled.

Chapter 3 also demonstrates that while individuals have preferences for certain gathering grounds resembling a form of territoriality, it is not the same as territoriality described in the fisheries literature, in which fishing grounds are actively defended through rivalry (Acheson 1987) or secrecy (Durrenberger and Palsson 1987). Instead, it is often based on mutual respect that results in large aggregations of most individuals in some areas (usually the more productive gathering grounds). The chapter further suggests that individual preferences are not necessarily determined by resource abundance or

patchiness alone, as shown in the behavioral ecology literature (Sosis 2002). Instead, certain individuals habitually harvest areas considered less productive in the same way that the majority habitually harvest their preferred spots. Thus, decisions about where to fish are often shaped by cultural norms, customs, habits, friendships, tradition, organization of labor, ecological knowledge, access, and mutual respect among cockle collectors who share fishing space. These findings contribute to burgeoning scholarly interest in the environmental sustainability of open-access situations (Moritz et al. 2010) and the way fishing space is socially produced with implications for marine resource management (St. Martin 2004; Begossi 1995).

Policy Implications

This research has several policy implications. Much of this research was carried out with assistance from several individuals at multiple Ecuadorian institutions, in particular, the Instituto Nacional de Pesca, which is a public research institution dedicated to the investigation and monitoring of Ecuador's fisheries. While my research collaborators may draw their own conclusions, I highlight three key points that they may wish to consider when making policy recommendations to regulatory agencies like the Subsecretaria de Recursos Pesqueros.

First, consideration of the socio-economic context should be taken into account when making recommendations about fishery closures. Closure periods are often effective, as shown in the mangrove crab fishery (Solano and Moreno 2009). However, it is important to understand what kinds of opportunities would be available to *concheros* should they reinstate the closure period of the cockle fishery from February to March. I recommend the development of a research group led by a social scientist to study how

artisanal fishers respond to socio-economic and environmental change through livelihood switching across multiple areas and fisheries. Broader understanding of the fishing effort over larger spatial and temporal scales will help them design appropriate recommendations for policies and a more effective regulatory environment.

Second, this research has shown the importance of government support in a comparison of study areas in the provinces of El Oro and Esmeraldas. In Esmeraldas, there are fewer interactions between local civil society organizations and government agencies and many local associations do not have access to the same kinds of assistance as in the south. In contrast, a vibrant civil society sector in the province of El Oro may be one of the reasons explaining why *concheros* in the south generally enjoy a higher standard of living and greater access to government support. This finding may encourage the central government to engage in more outreach in the fishing communities in Esmeraldas to promote a more thriving fishery sector and better serve Ecuador's citizens in remote areas.

Finally, an ecological assessment of the *custodias* on larger spatial and temporal scales is needed. Such research should be multi-disciplinary, involving biologists, ecologists, economists, anthropologists, and geographers. Ecuador represents a unique opportunity to study these forms of co-management. The lessons that could be learned from such research have much to contribute to coastal and fishery management throughout the world.

Beyond Conventional Collective Action in the Commons: A Future Research Agenda

Overall, this research not only sheds light on the causes of fishery and mangrove landscape degradation on the Ecuadorian coast, but also assesses the role of different

actors, management strategies, and other aspects of human organization that have emerged in response, and the ways in which they may contribute to resource sustainability at different levels and on various scales. Like much of the research on sustainability, some limitations of this research have been associated with the tradeoffs of combining social and ecological data and giving greater weight to the social processes that affect the fate of resource systems. Many of the environmental outcomes examined here have been attributed narrowly to social processes, since the influence of other environmental factors like climate change were beyond the scope of this research. To further address subtractability, exclusion, and valuation problems and advance commons theory, there is a need to develop interdisciplinary research agendas for more robust analysis of the interaction between biological and social variables within their larger environmental context.

One possible future direction might follow the lead of David Bray and others who examined the effects of collective action institutions on landscape change over time in the Yucatan Peninsula in Mexico using GIS technologies (Bray et al. 2004; Bray et al. 2003). With the new policies advocating community-based conservation through the anticipated expansion of *custodias*, Ecuador would provide an ideal location to replicate similar methods examining the relationships between institutional change and coastal mangrove forests. For example, differential participation in activism defending mangrove resources should be further explored along with other forms of agency that may have reversed trends of deforestation to reforestation on the Ecuadorian coast. Such approaches not only have particular relevance for the literature on political ecology and social justice in relation to environmental change, but would also provide critical tools for coastal and

fishery managers. However, an analysis of broader-scale landscape-level processes would not be complete without ground-level local research by ecologists, anthropologists, and other scientists to evaluate forest quality as well as the quality of life in coastal communities. Such an endeavor might entail mapping the social and biophysical landscape with attention to the finer resolution of the local level to visualize cultural and ecological processes often obscured in landscape ecology and landscape anthropology (Velásquez Runk et al. 2010).

Another possible future direction for this research would build on the advances made by decades of experimental research on collective action and cooperation. Future research should aim to bring together econometrics, ethnographic, and environmental research to advance theories about why collective action occurs in some cases and how it can overcome the problem of the commons. The goal of such research would move beyond hypothetical scenarios often used to measure cooperation in many experimental designs to study the direct impact of cooperation on environmental outcomes. For example, Rustagi *et al.* (2010) first measured the propensity of individuals to cooperate in various communities, later linking the results to outcomes of commons management in a quantitative inter-community comparison. The incorporation of a more qualitative, in-depth ethnographic analysis would significantly complement their approach for more critical understanding of the relationship between cooperation and the environment. Such initiatives would potentially allow for predictions, projections, and the development of scenarios for planning and resource management. Such research is well-situated to advance theoretical understanding about resilience, vulnerability, and nature-society

interactions at multiple levels linking individuals, institutions, and the environment (Gunderson and Holling 2002; Berkes, Colding, and Folke 2003; Adger 2003).

Despite the rich history of social movements and grassroots resistance to global processes contributing to environmental degradation in Ecuador, this dissertation has paid scant attention to discursive frameworks and the ways in which they shape local participation, conservation policy, and environmental outcomes (Biersack and Greenberg 2006; Escobar 1998, 1992; Escobar and Paulson 2005; Brosius 1999; Brosius 1999). This is particularly important for scholars of Latin American studies where questions of development, resource management, conservation, resource rights, and claims to territory are intricately tied to social movements, democratization, social justice, identity, and cultural revitalization (Rhoades 2006; Bebbington 1993; Stevens and De Lacy 1997; Escobar 1998; Wilshusen 2003; Van Cott 1994; Martinez-Alier 1991; Velásquez Runk 2009; Escobar and Paulson 2005). However, this dissertation provides a good foundation for further ethnographic investigation of social movements in coastal Ecuador or other parts of Latin America. Bridging conventional materialist theories of collective action in the study of social movements (Tilly and Tilly 1981; Feeny 1983) with ideational concerns associated with new social movements (Peet and Watts 2004) and collective identities (Escobar and Paulson 2005) would further advance understanding about the relationship between social processes and environmental change on the Ecuadorian coast. One possible future direction is to delve more deeply into questions about increasing mistrust of local institutions by *concheros* in places like Muisne. Such research would contribute to more nuanced understanding about environmental justice movements (Martinez-Alier 2002) by illustrating the ways in which certain actors and interests may

have been privileged in the discourse used by activists while individuals in most need of empowerment, social justice, and support have been further disenfranchised in the process (Brosius 1999).

Finally, environmental change in coastal and marine systems is occurring at unprecedented rates. Not all of environmental change is a consequence of human action, but all humans will undeniably experience its impact to varying degrees, responding and adapting at individual, household, and/ or community levels. As different kinds of commons are increasingly under pressure from population growth and unequal access associated with larger political economic structures, advancing understanding about the diverse forms of human organization around environmental resources is essential.

One important observation not systematically measured in Chapter 3 was the fluctuating nature of the fishing effort. It remains poorly understood whether people are responding to environmental variation (low returns and ecological constraints) or changes in the socio-economic context (opportunities). Human ecologists, particularly, behavioral ecologists interested in the intersection between culture, economic systems, and the environment, are well-positioned to address questions about environmental constraints that may or may not result in common pool resource sustainability, contributing to burgeoning interest in the application of evolutionary theories to contemporary problems (Tucker and Rende Taylor 2007; Tucker 2007; Heinen 1995; Heinen and Low 1992). Moreover, ethnographic understanding of household-level and group-level adaptations to environmental changes in coastal resources would also provide important insights about boom-bust cycles and resilience of many fisheries (Hamilton, Colocousis, and Johansen 2004; Finlayson and McCay 1998) and how people respond through migration, livelihood

switching, or community organizing (Hamilton, Colocousis, and Johansen 2004; Endter-Wada and Keenan 2005; Griffith, Pizzini, and Johnson 1992). This dissertation, along with ongoing research by the Instituto Nacional de Pesca in Ecuador, provides important baseline data and a strong foundation for future research on socio-economic and environmental change in other mangrove-associated fisheries in Ecuador. It also represents a step toward understanding the complex causes and consequences of environmental change and the establishment of new frameworks for the study of sustainability and environmental governance.

Moving beyond conventional approaches to studying collective action in the commons can be replicated in the study of all kinds of environmental resources shared by multiple users (e.g. forests, grasslands, water, the atmosphere, or public parks). The interdisciplinary approaches suggested here would contribute to nascent research agendas concerning the human dimensions of environmental change (National Research Council 1999) and sustainability science more generally (Kates et al. 2001). A more holistic definition of the common problem and a strong theoretical orientation in studying the multiple ways that humans interact with resources has many applications as the relationship between society and the environment becomes more precarious in the face of population growth, unequal distribution of resources, environmental degradation, overexploitation, and climate change. Such future directions have significant implications for policies that aim toward environmental sustainability, economic growth, and human well-being worldwide.

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APPENDIX A

SEMI-STRUCTURED QUESTIONNAIRE USED FOR COCKLE COLLECTORS

**II. CPUE Y INFORMACIÓN SOBRE LA CONCHA**

Fecha _____ Comunidad/barrio _____ Nombre _____ Edad ____ Sexo ___ Asociado _____
Sitio (E) _____ Conchal _____ custodia/AP? ____ Orilla?/ m dentro? ____ Clima _____
Desplazamiento hacia sitio: A pie ___ En canoa a remo ___ Canoa a motor ___ Otro _____ # concheros total ____ <1 ___

1. Donde esta acostumbrado conchar? Porque? _____
2. Quien le enseñó conchar allá? _____ Hace cuanto? _____ Muchos concheros? _____
3. Tiempo deja un sitio descansar? _____ donde aprendió? _____ describe suelo donde mejores conchas? _____
4. Que hace con pequeñas conchas? _____ porque? _____
5. Ud cree que todos los concheros dejan las pequeñas? (si no, porque las llevan?) _____
6. Alguna vez ha tenido un conflicto con un otro conchero (s)? _____ describe y # veces? _____
7. Conflicto con camaronero? ____ Describe y cuantas veces: _____

| No. | *Anadara tuberculosa* | | | | *Anadara similis* | | | |
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# Captura total _____ # horas _____ # muertas ____ #semillas/ombligos _____ # pequeñas/medianas dejó _____
# para corral ____ # pagó para viaje ____ # comer ____ # vender ____ Fecha de venta _____ $ precio/ciento _____

## III. DATOS DE BASE DEMOGRAFICO

**Nombre Comunidad/ Barrio** _____ **Fecha** _____

| | | | | |
|---|---|---|---|---|
| 1.**Nombre de Informante** | | | 2. Sexo | 3. Edad |
| 4. Cuantas veces la semana se realiza esta actividad? | 5.Dias/ semana | 6. Horas / día | 7. Desde cuando | 7a. Quien enseñó/empleo de papis? |
| 8.Otra actividad económica aparte de la extracción de la concha? | 8a. Pescador ____ Cangrejero ____ Camaronera ____ Agricultor ____ Jornalero agrícola ____ Quehaceres domésticos ____ Otro (explique) | | | |
| 12. **Asociación** | 9. Días/ semana | 10. Horas/día | 11. Desde cuando | |
| 13. Nivel de educación: | 14. Lugar de nacimiento | | 15. Años aquí | En la Costa |
| 16. ¿Ha salido alguna vez para trabajar? | 17. ¿Adonde? Otros lugares donde ha vivido y tiempo de estadía | | | 18. ¿Hace Cuanto? |
| 19. ¿Por qué ha salido a trabajar? | 20. ¿En que? (listado y tiempo)/y preferencia? | | | |

## IV. MANGLAR, PESCA ARTESANAL Y CAMBIOS SOCIO-AMBIENTALES

1) ¿Comparando con 10 años atrás, ahora: **CPUE**: mas__menos__igual__ **tamaño**: mas__menos__igual__? **¿Porque?**

2) ¿Ud se preocupa por la situación de la concha---que está en peligro de acabarse? ___¿porque? ____ ¿A que dedicaría ud?

3) ¿Hay sitios donde ud ya no puede conchar? _____ ¿desde cuando?_____ ¿porque?

4) ¿Ud cree que todos tienen derecho de usar el manglar o hay que prohibir el ingreso de algunos concheros o otra personas (carboneros, camaroneros, etc…)?

5) ¿Ud cree que hay beneficios de las custodias / áreas protegidas? _____ ¿porque?

6) ¿Y todos respectan las custodias? ____ ¿Por qué/ porque no?

7) ¿Cuál es lo que mas amenaza los manglares en el país?/ ¿Que problema hay en los manglares?

8) ¿Son compatibles la industria camaronera y la pesca artesanal? _____ ¿carboneros y pesca artesanal? _____

9) ¿En las últimas décadas, ud ha observado algunos cambios del clima? *mas calor/ frío, mas seco/ lluvia, cambio del suelo, todo lo mismo*

10) ¿Qué solución hay para el problema de la concha o de los manglares? Que opina - se necesita control de las autoridades o las comunidades/ asociaciones locales deben encargarse del problema/ no hay solución?

## V. ACCION COLECTIVA Y OTRAS ADAPTACIONES A LOS CAMBIOS

| **¿Ha participado en…? ¿Cual? Nombre del proyecto o un proyecto de quien?** | **Veces** | **Año** | **Porque? Incentivos? ¿Funcionó? ¿Había beneficio?** |
|---|---|---|---|
| * Reforestación de manglar? | | | |
| * Cria de conchas (comunitario) | | | |
| * Talleres sobre la concha o manglar | | | |
| * Minga (limpiar playa, comunidad) | | | |
| * Huerta comunitaria | | | |
| * Marcha política en defensa del manglar | | | |
| Propio huerto | | | |
| Propio Corral de conchas | | | |
| Recoger cangrejos | | | |
| Pescar en el estero | | | |
| Pescar en alta mar | | | |
| * Trabajar en una camaronera (pesca) | | | |

APPENDIX B

SEMI-STRUCTURED QUESTIONNAIRE USED FOR MEMBERS OF ASSOCIATIONS

**ENCUESTA PARA LOS SOCIOS Y LAS ASOCIACIONES**

1) **Nombre de la asociación:** _____
2) **Numero de socios actualmente:** _____
3) **Año de la fundacion:** _____
4) **Motivos por organizarse:** _____
5) **Desafios en organizarse:** _____
6) **Misión de la organización:** _____

_____

7) **Asistencia y apoyo external:** _____

_____

8) **Obligaciones de los socios:** _____
9) **Actividades:** _____

_____

10) **Logros como organización:** _____
11) **Fracasos o problemas como grupo:** _____
12) **Motivos por asociarse personalmente:** _____
13) **Si ya no es socio, porque se retiró:** _____
14) **Si ya no existe la organización, porque?** _____
15) **Otro comentarios:** _____

**GRACIAS POR SU COLABORACION!!!**

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