A CROSS-SECTIONAL ANALYSIS OF SOCIAL-ECOLOGICAL INDICATORS AND RESILIENCE ON THE ISLAND OF CHILOE, CHILE

by

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(Under the Direction of Elois Ann Berlin)

ABSTRACT

As aquaculture gains prominence as a major economic industry, and as wild-capture fisheries decline, coastal communities on Chiloé Island in southern Chile are facing inevitable social-ecological change. This research provides a cross-sectional, proxy-longitudinal study of indicators of resilience in a coastal community on Chiloé that is undergoing a transformation from small-scale fisheries to wage labor in aquaculture firms. Systematic data collection and analysis revealed that maintaining a high degree of specific resilience indicators is more likely to occur among fishermen who do not become aquaculture employees, and that even higher scores resulted from fishermen who became members of a small-scale, native species aquaculture cooperative. This information can serve as a model for sustainable development strategies and resilience in other coastal communities facing transformations due to changing ecological and economic factors.

INDEX WORDS: Resilience, Aquaculture, Fisheries, Common Pool Resources, Chile, Chiloé

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Chapter 1: Introduction

Figure 1.1. The harbor in Chonchi, Chiloé, displaying the dichotomy between industrial aquaculture and artesanal fishing.

This research examines the social-ecological impact of commercial aquaculture on a community on the island of Chiloé, in the X region of Chile. I lived for an 11-month period in the town of Chonchi (population 11,000), from which the majority of the data were collected, though for statistical purposes the data in part one of the study were supplemented by including the neighboring island of Lemuy, which is part of Chonchi's maritime jurisdiction. This research includes a detailed analysis of the transition taking

place from wild-capture fisheries to aquaculture, and an analysis of an applied adaptive strategy in fishing communities for social-ecological resilience and sustainability.

Aquaculture has gained prominence in the past 25 years as a worldwide industrial enterprise. Though its roots can be traced as far back as approximately 890 AD in Asia, the industrialization of the practice vigorously began to flourish in the 1960s, with a significant spike in the 1980s. Today, aquaculture is the world's fastest growing food producing sector. There are two distinct divisions within aquaculture production – household or cooperative small-scale operations and corporate, industrial mega producers, the latter of which is becoming the industry standard. The comparison can be made roughly to artesanal fishing vs. industrial fishing, where the former group is autonomous and extensive and the latter is multi-national and intensive. The communities most affected by this industrial shift tend to be fishing dependent communities that have been reliant on wild stocks for generations, since most aquaculture takes place in natural bodies of water alongside natural aquatic ecosystems.

The issues surrounding aquaculture are numerous and diverse. The history of governing marine resources has never been an easy process, and even now with the controlled environment of aquaculture, the difficulty has not dimished. As with wild capture fisheries, aquaculturehas to contend with the challenge of a large body of water where the characteristics vary from location to location, as well as the difficulty of being able to observe processes that create this variabiltiy from beyond the surface. From the social perspecitve, these processes, both on the production side and the ecological side, all have an effect on the local communities, particularly the people who have historically depended on these resources in their natural state throughout their history. Matters of

access to and regulation of common property, as well as concepts of environmental justice are all integral to the transition taking place on the island of Chiloé, though with effort, despite these hurdels, samll-scale enterprises are demonstrating resilience, proving that even with humans as a part of the model, systems are capable of renewal.

Thirty percent of the marine products consumed today come from aquaculture, totaling 39.4 million metric tons with a total value of US$52.5 billion worldwide (FAO 2005). At the same time, the world's wild stocks are in a steady decline, with estimates that only 10 percent of the natural capacity of large fish are left, mostly due to over-fishing (Myers and Worm 2003). However, demand for seafood continues to rise. Worldwide, consumption of seafood has increased from 27 pounds per capita in 1976 to 33.5 in 1996, and world populations continue to grow (FAO 2000).

With rapid growth and change in any socio-economic sector, concurrent socio-cultural changes occur. This is particularly true in areas where this shift supplants traditional lifeways, causing adaptations that may or may not be beneficial to the society as a whole (Britan and Denich 1976; Izac and Swift 1994). Goldshmidt suggests that often industrialization can cause the impetus for labor to become one of achieving wealth rather than making a living. Self-sufficiency changes to profit, usually based on the shift from diversification to single crop production, although this strategy then only benefits the few while quality of life becomes lowered for most. He also stresses that this shift from autonomous living to industrialized wage labor can seriously alter social institutions, as the divide between employer and employee supplants original social foundations (1949). This is one of the major changes taking place on Chiloé, where

adaptive strategies to this industrial shift is occurring at varying rates and styles, most of which are not necessarily resilient.

As the world's wild fisheries are declining, and demand for seafood rising, aquaculture is taking the place of wild-capture fisheries by means of the controlled production of this resource. While the continued supply of this important resource was the original intention of aquaculture, the real driving force behind the massive and rapid expansion is profit and centralized industrial production of food. Aquaculture is no different from agriculture, and suffers the same consequences of industrialization. It is widely accepted that small-scale production is more socially and economically sustainable (Thu and Durrenberger 1998). When this system is threatened by large-scale, exogynous, global processes, local structures and identity are altered during the struggle for access to resources (Wells 1996), which can have severe consequences for local communities unaccustomed to change.

In Chile, in particular, the marine ecosystem has proven to be a favorable environment for expansion in this field, at the regional, national, and international scale. Thus, areas in Chile where aquaculture is concentrated are in the process of socio-cultural change as many traditional fishing families are making the transition from autonomous entities to participants in structured regimes. Because employment opportunities for these families are extremely limited, and their skills base so specific, subsumption into the dominant economic paradigm becomes inevitable. The impact of aquaculture in southern Chile, where the majority of the firms exist, has been significant on both an ecological and a social scale (Ohlson 1996; Caniggia 1988). While some social institutions remain intact despite this regime change (Barrett et al. 2002), changes on various scales have

occurred in the coupled human-ecological system that is the Chiloé archipelago. Communities in this region are changing, mostly through subsumption into the dominant regime of aquaculture.

The first part of this study presents a quantitative analysis of the transition from the occupation of wild-capture fisherman to aquaculture employee in Chiloé. Based on a proxy-longitudinal model, I examine three impact indicators: environmental values, job satisfaction, and perceived well-being. This research endeavors to represent how these variables are affected by this occupational shift to aquaculture in a small, historic fishing community. Since many governments in countries that are encouraging aquaculture as a form of economic development believe that fishermen would make ideal aquaculture employees, or that aquaculture is an employment solution for displaced fishermen (see for example NOAA statement on aquaculture; El Llanquihue 2004), understanding the consequences of this transition is important for institutional success and sustainability in areas where aquaculture is supplanting wild-capture fisheries. The second portion of this study examines an adaptive strategy for resilience in the face of fishery loss and aquaculture advancement. Through a case study of the establishment of an aquaculture cooperative in a nearby community, I will explain how small-scale, locally managed aquaculture firms of an endemic mollusk species can be a model not only for resilience, but also for sustainable aquaculture, communities, ecosystems, and provide economic and nutritional security.

In chapter two I provide a narrative background of the study area of the archipelago of Chiloé, Chile. I discuss in detail the coastal geography of the islands, including the seascape in the archipelago as it relates to aquaculture. I proceed with what

is known of the early history, through attempts at Spanish colonization, in order to explain the convergence of cultures that formed the Chiloé of today. The Chilote culture is unique within Chile, and holds a certain mystique among Chileans. This includes a description of the physical geography, and an in-depth, diachronic account of Chiloé, with a focus particularly on fishing culture. I detail the phenomena of cooperation among the islanders in order to provide a socio-cultural background that plays a critical role in their capacity for resilience. Historic and contemporary lifestyle is discussed, as well as prominent Chilote folklore, which provides a view to better understand the Chilote connection to the sea, and perhaps why this study is ultimately significant to rural coastal development. Understanding the history and contemporary reality of life on Chiloé will provide for a better perspective on why an occupational shift is occurring, and particularly, by whom.

Chapter three is a description of Chilote fishing. I pay special attention to the history of fishing on the island, and its rise in popularity during the Pinochet regime. The two major technologies of artesanal fishing are described using data derived from ethnographic investigation. This chapter provides insight into the lives of fishermen and their families, their dependence on marine and coastal resources, and depicts an image of why a connection and access to marine resources be maintained.

Chapter four discusses the theoretical perspectives of common property resources and resilience that drive the questions inherent in this research. I present this section before the analysis and discussion because of its value to the conceptual nature of this work. Due to the diverse and complex nature of this study, the theoretical component is best understood when disbursed within its appropriate context. However, in this chapter I

bring into view the various characteristics of successful common property resources and their user groups, ending with their governance and recommendations. I pay careful attention to adaptive strategies for management, and ideal scenarios for success in keeping the commons open in a sustainable and equitable fashion.

After this mostly introductory portion of the paper, chapter five delivers explanatory information with regard to Chile's push in the direction of aquaculture. I begin with an overview of aquaculture in general, which progresses into some theoretical discussion over the importance of aquaculture as a development tool. The theme of development is paramount in this work. In this dissertation, I discuss aquaculture in terms of development, particularly in the final portion of the data analysis where cooperative mussel aquaculture is the apparent best-case solution for fishermen coping with disappearing fisheries. I define development and address the components that are directly related to this study, namely poverty, community, and sustainability. One of the two components of this research was to analyze the resilience capacity of a cooperative mussel aquaculture farm among former artesanal fishermen. It is my hope that this work will provide evidence of such an effort to be a form of resilience and sustainability for coastal communities undergoing significant occupational transformation.

Chapter six continues this discussion of development from the large-scale perspective of the Blue Revolution, which takes the specificity of this research onto a broader scale of inquiry. Here I discuss the elements of aquaculture on a worldwide scale, as well as its impact on Chiloé in particular. This chapter is a description of the green and blue "revolutions" and how they factor into development on a global scale. I define aquaculture, highlighting the various key species farmed in Chile (salmonids, algae, and

shellfish), including associated technologies and economic importance. The long yet rapid rise of aquaculture in Chile, including policy, legislation, and various other issues is detailed not only as background, but to acquaint the reader with its substantial rise in relative power. Aquaculture is not without its environmental concerns, which will be discussed, and the chapter will conclude with probable future directions of aquaculture in the region.

Chapter seven begins with outlining the objectives of the study and the observations that drove the subsequent questions. This is followed by a description of the project design, in which a dual-phase, qualitative/quantitative approach was taken. Here, I discuss the variables I measured and why I chose them as being adequate social indicators of resilience among fishermen making the transition to aquaculture employee in Chiloé. I then discuss the methods used to address the proposed questions, and the tools employed to analyze the data.

This eighth chapter provides the discussion of the data I collected and analyzed, and outlines the transformation taking place on the island through quantitative and qualitative interpretations. I re-examine the traditional Chiloé in order to emphasize the potential gravity of this shift. I discuss the adaptive qualities of the fishermen's mussel cooperative as explained through the theory of resilience, and provide potential impacts of this study and future direction.

Chapter 2: Study Area – Chiloé, Chile

The land is hilly, but not mountainous, and is covered by one great forest, except where a few green patches have been cleared round the thatched cottages. From a distance the view somewhat resembles that of Tierra del Fuego; but the woods, when seen nearer, are incomparably more beautiful. Many kinds of fine evergreen trees, and plants with a tropical character, here take the place of the gloomy beech of the southern shores. In winter the climate is detestable, and in summer it is only a little better. I should think there are few parts of the world, within the temperate regions, where so much rain falls. The winds are very boisterous, and the sky almost always clouded: to have a week of fine weather is something wonderful.

- Charles Darwin, Voyage of the Beagle, 1909

Figure 2.1. Map of the Chiloé archipelago

Cultural and Physical Geography of Chile

Chile is a long, narrow country in the southern hemisphere of South America, encompassing multiple ecoregions from the northern deserts considered the driest place on earth to the Antarctic. The entire country is coastal, bordering the Pacific Ocean and sheltered by the Andean mountain range, dividing it from Argentina. Chile has an unstable geological base, due to a major fault line that often produces earthquakes, some major, and also has more than thirty active volcanoes (Rector 2003). The ocean current named after the geographer Alexander Humboldt flows from south to north along Chile's coastline, bringing cool waters as far north as Ecuador, but technically runs as far as northern Peru. This current is essential to supplying and maintaining the abundance of marine organisms that have made Chile a major contributor on the international seafood and product market, and approximately 18-20% of the world's fish catch comes from the Humboldt Current Large Marine Ecosystem – HCLME (Alheit and Bernal 1993).

The HCLME is a Large Marine Ecosystem extending from the West Coast of South America from Northern Peru to Southern Chile. The cold, low saline waters flow south to north and can extend 1,000 kilometers offshore. This system is responsible for the high levels of marine biodiversity in the region, and is also considered the most productive marine ecosystem in the world, in addition to being the largest upwelling system. This upwelling brings cold, nutrient-rich water to the surface, allowing for significant growth and production of marine species, making this area one of the world's largest fisheries, producing approximately 18-20% of the catch. The species here are

mostly pelagic (sardines, anchovies, jack mackerel), and both Chile and Peru are highly dependent on these fisheries (Bernal et al. 1983).

Chile returned to democracy in 1980 with a constitution going into effect while still under the rule of the military dictator, Augusto Pinochet. In 1988 Pinochet lost a referendum that would have guaranteed him power to rule until 1997, and in 1990 the first democratic president, Patricio Aylwin, was elected (Rector 2003). Today, both the democracy and economy are stronger than most countries in Latin America, and dedicated democratic leaders have brought Chile economic and social stability through the implementation and improvement of economic indicators (Schurman 2001).

Chiloé

Figure 2.2. Fishermen leaving the harbor in Chonchi, Chiloé at sunrise.

The big island of Chiloé (from *Chilhue*, meaning land of the seagulls), as it is known, is the second largest island in South America, measuring 112 miles from north to south, 3,241 square miles, and is part of an island archipelago consisting of 30 smaller islands. Located 42.30°S and 73.50°W and 700 miles south of Chile's capital city of Santiago in the X region, Chiloé is separated by the Chacao channel and is accessible only by ferry. Chiloé has a population of 140,000, who are Spanish speaking, mostly Catholic, and mostly mestizo. The island has the highest concentration of indigenous people of any region in Chile called the Huilliche – *people of the sea* (Minnis et al. 2000),

who's population figures into the total of 140,000, though is not a significant portion with an estimated population of only a few thousand. It is also the poorest province in the country. Over 50 percent of its population is rural, and 23 percent of that population lives in poverty (Barrett, Caniggia, and Read 2002).

Much of the early history of Chiloé is unknown, and is primarily based on scholarly hypotheses. It is believed that the island was first inhabited by the nomadic indigenous people known as the Chonos, creators of the *dalca*, or small, canoe-like boat built by binding bent planks together. This tradition of artesenal boat building persists today, and Chilote boat building expertise is nationally recognized. The Chonos were expert navigators, and guided the Spanish through the archipelago's labyrinth of channels during the initial contact period of the Spanish, beginning in 1540.

Around this time, a division of the indigenous culture group from the north, the Mapuche, came to the island and mixed with the Chonos, becoming the Mapuche-Chono. In later years this group became known as the Huilliche, or southern Mapuche. Historically, the Huilliche lived as they and other native islanders, or Chilotes, do today – farming and fishing. Their homes were scattered along the coast, and they farmed potatoes and corn, and foraged for shellfish in the intertidal zone (Cárcamo 2002).

There is a long history of autonomy on the island through colonization to present day. First occupied by Europeans in 1567, the island was a remote colony of Spain for nearly three centuries. Despite its relatively large size, Chiloé had nothing to offer to the Spanish in terms of gold or silver, nor was it at an advantageous location for a military outpost. The few European colonists, along with the indigenous Huilliches, lived

traditionally through fishing, farming, and livestock-raising, creating an autonomous and stable community.

When Chile declared independence from Spain in 1818, and included Chiloé in its boundaries, the island's colonists asserted their allegiance to the crown, claiming that they would have more autonomy as a half-forgotten province of Spain (Cárcamo 2002). More than two thousand Chilotes fought on the side of the royalists during the independence wars on the mainland, and more still devoted themselves to defending their communities against the military forces sent by the newly-formed Chilean government, meant to conquer and annex the island. In 1820, Chilotes repelled an attack by the by the Scottish-Chilean naval officer Lord Thomas Cochrane; four years later they battled a Chilean squadron under the command of Admiral Ramón Freire. Even after their abandonment in 1825 by the Spanish Royal authorities sent to assist their pro-Spanish defense efforts, the islanders fought on for yet another year "for no other reason than to avoid annexation to Chile (Tangol 1972:78). In 1826 Chiloé was at last integrated into the new sovereign nation of Chile, though this did not change their way of life. Their life consisted of fishing, potato cultivation, and livestock raising, all still practiced today. Despite the fears of Chilotes, Chiloé was basically ignored by the Chilean government until its vast natural resource wealth was discovered in the 1970s under General Augusto Pinochet (Cárcamo 2002).

Today, those who claim indigenous heritage live predominantly on the west coast of the island. With no barrier islands, there is no sheltered water, as on the east coast, and the coast is open to the rough Pacific weather and constant winds. Because it is an unpromising target for development, the National Park of Chiloé was placed in Huilliche

territory. In 2002, the park boundaries were re-drawn as lands were granted back into indigenous possession.

Culture of Cooperation on Chiloé

Within the Chilote culture there is a long tradition of cooperation and sharing. Over the centuries, the Spanish and the Mapuche-Chono fused and produced a culture unique to Chile. Hierarchic class structure between the two groups was almost nonexistent because people were isolated, autonomous, and they all shared in the hardship of life on the island that demanded strategies for survival over hierarchic division of class (Velásquez 2003). This sense of equality, unusual in any colonial situation, has been preserved through today, though is threatened by the new class structure being brought to the island by the growing aquaculture industry. Before aquaculture, Chiloé was largely a one-class society, with few families possessing significantly more wealth than the majority of the population. With aquaculture, however, came immigrants from the city and international locations, who insisted on the improvement of infrastructure not only for their commercial operations but also to maintain a quality of life that was not yet available on Chiloé. This in turn brought a new class of laborers from elsewhere in Chile who were enticed there by the employment boom for construction and other semi-skilled labor (Personal communication and observation, Chiloé 2005-2006). Since this new hierarchic class structure is still relatively new, it is unclear what effect this is having on the native Chilote population, though it is evident that certain class related problems are beginning to arise. People complained of

crime, which historically has not been an issue on the island, and always blamed any problems on the *afuerinos* (outsiders).

I found the Chilote to be characteristically generous with both material and non-material goods, and Darwin called them "humble, quiet, and industrious" (1909). At first I had the impression that they are open, since people readily invite strangers for meals. However, opening up on a personal level is another matter. I found that their reluctance to talk and answer questions is not out of distrust necessarily, but is more of a cultural trait of shyness and humility. Making a breakthrough with Chilotes can be an arduous task, but once a connection has been made, one becomes readily accepted by neighbors and friends and feels like an accepted member of the community. Despite an overwhelming poverty, Chilotes are exceptionally generous, a trait that is historically embedded.

Cooperation over competition is generally difficult to explain and understand when associated with altruistic tendencies among human groups, especially those that have high numbers of participants (Axelrod 1984; Argyle 1991; Cox et al., 1999). Computer simulation by Cox et al. (1999) shows that cooperation in large groups can occur when specific conditions are present, particularly with regard to access to and necessity of food, labor, and information. It also indicates that "cooperation is rewarded with cooperation" (1999:373). It is also possible for indirect reciprocity to produce cooperation (Milinski et al. 2002), which is an element of the system on Chiloé, where reputation (indirect reciprocity), is as important as goods and services. This strategy has paid off in terms of survival on Chiloé, where living is challenging. Many subsistence activities require cooperation for success. Fishing on the west coast, for example, is

virtually impossible to do alone since the primary gear is the corral net that is stretched from poles about 40 feet apart along the beach into the ocean, where large waves rarely subside, shown in figure 2.3.

Figure 2.3. Example of method for harvesting fish on the island's west coast, without the nets.

On Chiloé, an important system of reciprocity akin to the Potlatch (cf. Fleisher 1981; Kan 1986), called the *minga*, is still practiced today, and has expanded to encompass contemporary needs and associations. Essentially, the *minga* is a formal system of direct and indirect reciprocity that allocates resources for the overall good of the community. It is typically used for labor-intensive activities, such as harvests, building construction, and net mending.

A contemporary *minga* can be initiated by any community member, who must in turn supply food and drink to the participants. Reciprocity, unlike the potlatch among the Kwakuitl where goods are exchanged, is most often in the form of labor and food. This cultural practice has diffused into the informal, quotidian life of the Chilote. Neighbors share their catch, harvest, and slaughter, and rarely is there a feeling of guilt in one household for having more than the next because they rarely do.

Pedro, a good friend and fisherman, would regularly save a portion of his daily catch to give to his non-fishing neighbors in exchange for both respect as a community member as well as the comfort of knowing that his generosity would be matched. Firewood, an essential survival item used for heat, cooking, and drying clothes, was routinely shared among households, and labor costs waived or extended in times of economic hardship. (The majority of fuel wood was hauled in from areas of the island inaccessible to most Chilotes who don't own cars or trucks necessary for making the trip to the remaining forests, in which case people dedicate themselves exclusively to providing fuel wood to their community, at a determined cost plus labor.) If someone needed help, in anything, a neighbor or family member was always available to assist. While this study was not based on understanding cooperation on Chiloé, establishing cooperation as a characteristic of the island's culture becomes important when discussing the cooperative efforts of fishermen in future chapters.

Chilote Social Structure

A marginal social structure emerged over the past century, with some historic families having held control over ports and natural resources, establishing themselves as a type of persisting aristocracy. Another type of hierarchical social system that does not fit into traditional Chiloé has recently emerged as a result of the growing aquaculture industry, producing what Fried referred to as "stratified" society (1967). In this type of societal structure, resources tend to be assigned to a group that is smaller than the overall population and are not redistributed, producing unequal distribution of natural resources, often necessary for survival (Fried 1967). In the case of Chiloé, individual access to marine resources is becoming limited through privatization of space by aquaculture firms. During a meeting with the artesanal fishermen held by the mayor of Chonchi, this issue was at the forefront of the conversation. There is only one dock in the small port of Chonchi, and with this area being a key entry and exit point for the aquaculture firms, competition for space is fierce. This, however, has come down to economics, since the city is considering allowing the firms to privatize the dock, which would displace the artesanal fishermen and literally destroy the practice.

The aquaculture industry provides jobs directly as well as indirectly through the labor force associated with infrastructural development. People come from other parts of mainland Chile to work as semi-skilled laborers in this sector, creating a new class of people economically similar to the native Chilotes but without the cultural characteristics of the islanders. Another, upper class has been developed that is a direct result of the salmon farming industry. These professionals are highly educated and typically from the

capital of Santiago. This in-migration began only 20 years ago, though it has been significant. These wealthy people have infrastructural demands that are being met, though at the same time marginalizing Chilotes as their poverty becomes more visible in contrast to the wealth of outsiders. Their traditional way of life is now threatened as certain issues of class, relative poverty, external values, and extended employment possibilities establish themselves. Some of the smaller islands in the archipelago, due to their isolation, still exemplify historic Chiloé, with resources such as electricity and plumbing still a rarity, and involvement in the market economy patchy. This is expected to change steadily, as the aquaculture industry expands to these yet unexploited resources.

Lifestyle on Chiloé

Most Chilotes (people from Chiloé) still live traditionally, with a farming plot adjacent to their home, and a wooden fishing boat, typically without a motor. To this day, they are still distinguishable from other Chileans, with their own dialect, music, and folklore. However, as the rich natural resource base has been discovered, dramatic socio-cultural and economic changes abound. The salmon aquaculture industry has brought in many transplants from mainland Chile, brining along with them income and mentalities that has contributed dramatically to the changing physical and cultural landscape. On the one hand, infrastructure is improving out of necessity for more efficient transportation of the product. Paved roads, DSL cables, commerce, and public services are widespread, mostly from revenue and demand created by the industry. On the other hand,

gentrification of the island is supplanting Chiloé's inherent cultural uniqueness, by marginalizing the native inhabitants through the creation of a nascent class structure and the appropriation of resources.

Chilotes live today as they have for decades, the difference being the spread of electricity, which of course brings television. Television satellites exist on most of the houses, providing Chilote fishermen with HBO and CNN. Even so, life is still very hard on the island for most Chilotes, and many people simply do not pay attention to world events because survival is a full-time occupation.

The single most important activity for Chilotes is keeping warm. It became my obsession as I realized that the rain and sleet were not going to disappear. Hours a day are spent chopping, hauling and gathering wood, to then make and maintain a fire in a 19th century wood-burning stove. Most people have a wood-fueled oven that acts as the central heat source, as well as a cooking stove, oven, and clothes dryer. The kitchen is the most important room in the house, mostly because it is usually the warmest. Before iron stoves, Chilotes had a *fogón*, or hollowed space in the center of the kitchen floor, which was all earth, with an open fire and large pot hanging over the flames. An open loft above usually held potatoes, seaweeds, mussels, and other stored food items that were naturally smoked through this system, allowing for indefinite storage. This style is not uncommon today on the smaller islands, or in community centers. An 85 year old woman told me that she was never able to acclimatize herself to a more modern kitchen, because she did not trust cooking when her nose did not stay cold.

The fishermen and many recent converts to the aquaculture industry still live a relatively traditional Chilote lifestyle. This is especially true on the smaller islands, since

commercial integration has been slow to reach them. The members of my sample group lived this way not because they were hanging on to the old lifeways out of a conscious desire to maintain traditional culture, but because they were poor, and this lifestyle is adapted to living more off the land than from income from wages. Being members of multi-generational Chilote families, they know how to survive with very little. Most surprising, however, is the fact that overall, the introduction of intensive aquaculture has not significantly changed the lifestyles of native Chilotes. This may have an impact as the industry grows, but since salaries have not significantly improved, standard of living is not going to change.

Chilote Folklore and Link to the Sea

Chiloé is unique within Chile, owing mostly to 200 years of near isolation during the colonial period (Rector 2003). One historian suggests that in order to understand Chiloé, one must also know its history, architecture, and the Chilote imagination (Cárcamo 2002) that pervades daily life. The island holds a certain mystique for Chileans, and is described as being magical, referred to "*la mágia de la isla"* – the magic of the island. There is a rich folklore unique to Chiloé, with mythological figures accounting for most of the phenomena on the island in the geologically active region. Depictions of these figures can be found everywhere on the island, in murals, wood carvings, statues, oral histories, and place names.

One native legend states that the island was formed by twin serpents, Cai cai-vilu and Ten tén-vilu. Cai cai, the evil serpent, rose from the sea in anger and flooded the

earth while Ten tén, the protector, was deep asleep in his mountain fortress. Cai cai's anger and torment was accentuated with the help of her friends thunder, fire and wind, which woke Ten tén with the sound of a little girl laughing. This in turn made her laugh, insulting Cai cai and friends, making them fall down the hill. Full of rage, they charged Ten tén with a force that shattered the earth into many islands, and after a battle between the two serpents, Cai cai fell to the bottom of the ocean and remains asleep to this day, while Ten tén is asleep in the mountain. They are still there, as evidenced through earthquakes when Cai cai has nightmares (Mansilla 1965). Their tale is also kept alive in place names and drawings throughout the island (figure 2.4).

Figure 2.4. Interpretation of Cai cai-vilu and Ten tén-vilu. Source: www.mitologiachilota.cl/monos/tenten.jpg

Though contemporary lifestyles have supplanted much of this folklore particularly among younger Chilotes, it does persist. During my interviews with fishermen, one popular figure would come up more often than not. People said the *Pincoya*, a mermaid, represents the beauty and the natural bounty of the island (see figure 2.5). When I asked fishermen where they saw the future of fishing in Chiloé, sometimes they said that it "*depende en la Pincoya"* (depends on the *Pincoya)*, and several people claimed to have seen her. The direction in which *la Pincoya* looks out to sea indicates where the fish can be found that coming year. She is also the savior of lost or threatened fishermen. If she is not able to save them, she is aided by her siblings in taking their bodies to the ghost ship, *el Caleuche*, where they become crew on this vessel of "eternal happiness" (Mansilla 1965:34).

Figure 2.5. Statue of *La Pincoya* at the harbor of Ancud, Chiloé. Stone or wood carvings of the various figures are ubiquitous on the island.

The mix between Catholic indoctrination and native mythology is complex and extensive, though historic resistance to Catholicism is clear. Only one person of 53 ever mentioned God as having a role in the future of the fishery. There is still a belief in a secret society of warlocks (*brjuos)*, who meet in caves and have the ability to fly with the power of a cloak made of skin taken from the breast of a virgin's corpse and its light is fueled by oil taken from the bodies of dead Christians (García Barria 1985, Mansilla 1965), clearly indicating an organization of native resistance to the Spanish. To become a warlock means ridding oneself of Christianity through a series of rituals, one of which is

a 40 night cleansing under a waterfall to rid all traces of baptism. These *brujos* have the power to cause fatigue, illness, hair loss, open doors, and cast an evil eye (Minnis 2000), and some people live in a subdued fear of strangers, as they might not be completely of this world. While people do not talk of the *brujos* as practicing these magical events, they do still refer to incidents with strangers with an element of skepticism and sometimes even fear.

I was often invited to Pedro's house for meals or just to visit with Erica, his wife, and son Pedrito, age seven. Erica and I became fast friends, as we were very close in age and personality. Pedrito called me *tía* (aunt), and was proud to have "the foreigner" be so close to his family. During one visit, Erica's great aunt was visiting from Lemuy, where Erica grew up. They began telling some stories of strange events that had happened to them there, and it piqued my interested to learn more about how pervasive these sentiments were among more people. Learning this, the great aunt invited me to Lemuy where she promised to get some friends together to share their stories. Over lemon verbena tea we had foraged for earlier around the house, after a lunch a recently slaughtered pig in the house of a great aunt of a good friend, several older women told tales of the magic of their islands. They all claimed to have seen both *la Pincoya* and *el Caleuche* on multiple occasions, and some recounted instances of *la Voladora*, (a woman contracted by *los brujos* to fly long distances around the island bringing messages back and forth) flying into open windows at night.

Another told about when a *brujo* tested her and her father on their way to town by playing games on them to see if they would succumb to his magic. She said that as they were walking on the dirt road, a man dressed in a tattered cloak appeared behind them.

He asked where they were going, and when they replied “town”, he asked if he might accompany them. They did not understand why he would want to do this, and being wary of strangers, said no. The man then left the road and headed toward the hills. Later, he appeared again in front of them on the path and asked again if he could go with them. Since this spooked the father and daughter, they said yes, realizing that this was a test by a *brujo*. He walked with them in silence, and from the moment he joined them, the call of the cucau, a small bird more often heard than seen, was heard all around. This bird is also important in Chilote mythology, and hearing it on one’s left means danger ahead, and on the right that all is well on the journey. The pair could not discern where the calls were coming from since they appeared to be coming from multiple directions and from many birds. They were uncertain what to do, but knew full well that this was a *brjuo*. They ultimately decided to continue to town, and when this decision was made, the man in the cloak went off into the hills again, and at that moment, the birds stopped calling.

Despite being colonized by the Spanish and Jesuits, this belief system has remained intact and on the surface of daily life, which is what makes Chiloé unique within Chile. This maintenance of indigenous spirituality after colonization is not unique to Chile. The Seri of Sonora, Mexico were quite adept at keeping their traditions alive, even when forced into missions by the Spanish (Burkhalter 1976; Felger and Moser 1985). Spiro explains the ability to function in a two-religion society may be due in part to a “conceptual syncretism” of the two religions, where underlying properties of each are amenable to fusion **(**1996:264**)**. In the case of Catholicism and Chilote spirituality, supernaturalism is a component of each, which allowed for a combination of both to produce contemporary Chilote spirituality.

Consistent with the characteristic self-sufficiency of Chilotes, pharmacological use of plants is still very common. The use of plants as medicinals arose out of necessity, and has persisted due to isolation and poverty. The *Machi*, is a shaman-like medicine person (typically a woman), that is still quite common, and who's services are not confined to the rural poor. Though real in the human and physical sense, the *Machi* is also said to be the shaman of the *brjuos*, in which case, it is then a male.

It is often difficult to discern reality from mythology, whether from oral accounts or text, as discussion in either form is always in the present tense and matter of fact, leaving interpretation of validity up to the listener or reader. The *Machi* is often asked to attend crop plantings to ceremoniously apply herbs for a profitable harvest. She also acts as a mediator between humans and spirits, and performs ceremonial healings. Most people I met turned first to plants over contemporary medicine, since they were abundant and free. Almost all plants with pharmacological value in Chiloé are easily found, and knowledge of them ubiquitous. I was often brought branches of mint, lemon verbena, eucalyptus, and tea concoctions for minor ills, and no home was without drying branches of these herbs in the windows.

The inhabitants of Chiloé, by virtue of their geography, were and are still obligated to communicate through the use of boats. Roads, especially paved ones, are a relatively recent phenomenon on the island. The main road that transects the island along the coast from top to bottom was only put up in 1960 after the famous earthquake that caused significant damage, mostly in the north. This earthquake and subsequent tsunami was the largest earthquake (magnitude 9.5) of the 20th century, with the majority of the damage occurring on the island. The 25-meter tsunami waves killed at least two hundred

people, sinking all boats, and flooded half a kilometer of coastal lands (UNESCO 2005). Though a significant environmental disaster, the event did not cause a dramatic change in lifestyle in the long-term, as boats, homes, and lifeways were rebuilt, thanks in part to generous donations by the US Government under the Kennedy Administration. This earthquake was felt all around the Pacific, causing extensive damage to the U.S. island of Hilo, Hawaii, 6,200 miles from the epicenter (NGDC 2005).

Chiloé has two sides, one surrounded by the other, smaller islands in the archipelago, and one open to the Pacific ocean. The inside passage tends to be more populated than the exposed side, which is home to a national park and repatriated indigenous lands. Though not exclusive owners of the land until recently, the Huilliche have been the permanent residents of this side of the island throughout their history, meaning that they were never displaced. They can attribute this good fortune, unlike the Mapuche further north on the mainland, to the lack of resources and a challenging geologic zone. The interior sea on the west coast is a navigational challenge, with a tidal range of up to 23 feet, compared to eight feet on the Pacific side (Minnis et al. 2000). This extreme tidal range, however, lends to an amenable environment for gathering shellfish, fish, and seaweed in the inter-tidal zone. This practice is as much a subsistence activity as it is social. Multiple families can be seen during low tide, gathering mollusks and seaweed, used to supplement their diet. Packaged food on the island, like most resources (e.g., electricity and gas) is extremely expensive because of the added costs of transporting these commodities to the island via ferry or cables.

Once an important port for the exportation of cypress, Chonchi is now the center of aquaculture on the island, with 17 salmon firms and 60 mussel aquaculture

concessions operating in the marine jurisdiction of the town of 11,000 people. There are five salmon and 11 mussel farms on Lemuy. There is also a disappearing artesanal fishing sector, with only 11 registered boats and 30 registered union members (Chonchi Harbor Master, Chilean Navy statistics), that make this region ideal for understanding the transition away from wild-capture fisheries to the aquaculture sector.

Chapter 3: Chilote Fishing

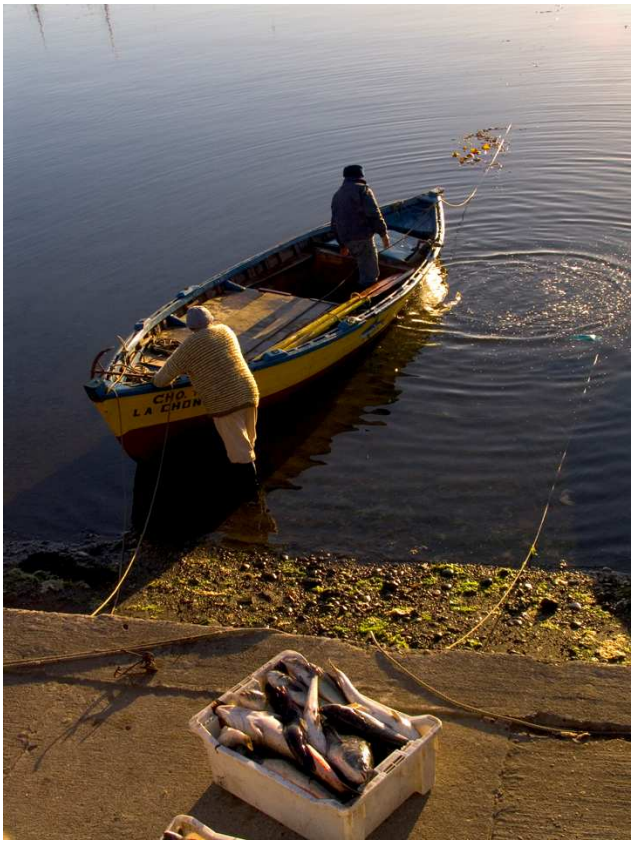

Figure 3.1. Fishermen in Chonchi with a typical *bote*, using oars and sometimes an outboard motor. Here they have arrived with their daily catch to sell to either a buyer at the dock or at the local market in town. However, this small amount is most likely destined for personal consumption.

Chile is a country with approximately 78,563 kilometers of coastline, with 82 percent of its population living within 100 kilometers of the coast (WRI Earthtrends 2003). In South America, it is second to Peru for wild-capture fisheries, producing half the yield, with indications toward a decline in the industry (FAO 2004). On the other

hand, aquaculture production in Chile has experienced rapid and significant growth, increasing by 1,360 percent since its inception in 1980 (World Resources Institute 2005). The majority of the fisheries are small-scale artesanal, with about 45,700 people employed in the industry out of a total of 50,873, and a 20 percent share in the total exports of fish products including aquaculture (FAO 2005). However, sharp declines in fin-fish populations have led to dramatic consequences in this sector of the population, forcing employment elsewhere as the sea's resources disappear.

Fishing as an industry in Chiloé arose with the advent of a market economy on the island. Prior to that, fishing was another means of subsistence - an addition to farmed and gathered food. Navigational skills were and are paramount, especially for those living on the smaller islands in the archipelago. There is still a system of trade between the smaller islands, and farmers bring their harvest to the port cities on the larger islands to sell, often making the crossing in a motor-less rowboat, returning with items only found on the big island. Today, fishing on the island can be categorized by those who work for large national and international industries and those who fish as part of household economies, either a boat owner, fisherman, or crew. The latter group are referred to as *artesanal*, meaning small-scale and near-shore. This group, unlike many people in the industrial sector, exemplify Chilote culture, and are primarily multi-generational residents of the island archipelago. They are also symbols of the island's character. According to residents, they epitomize the island's characteristics of pride, autonomy, and tradition.

Fishing in Chiloé has long been an important sector in the island's economy, even in an informal context. Most of the fishing in the region was for local consumption, with the majority of the fishermen operating independently. Due to this lack of market

integration, Chilotes have suffered far less than their mainland counterparts in terms of international market fluctuations. In the 1970s however, Pinochet's policy of privatization, industry deregulation, and export oriented resource extraction began to change this subsistence based, autonomous system (Schurman and Sheehan 1992). Pinochet's strategy was to promote private business for economic growth by subsidizing and deregulating large-scale commercial operations. The resulting large-scale extraction came easily, particularly affecting Chiloé's marine resources (Lomnitz and Melnick 2000).

Large fishing companies began to arrive on the island in the late 1970s, exploiting both fin-fish and shellfish for Chile's new export markets in Europe, North America, and Asia. At this time, processing plants grew from two in 1976 to more than 50 in 1996 (Schurman and Sheehan 1992). Many Chilotes moved from their subsistence farms to the coastal towns to work for the new corporate fisheries as unskilled laborers, thus becoming economically dependent on external forces. This marked a shift from a small-scale subsistence-based, localized economy of fishing, farming, and livestock raising, to induction into the corporate global economy of large-scale harvesting and packaging of marine products. What was once a common property resource, used and managed by local populations, became privatized and controlled.

Despite the declines in registered landings, Chile is still one of the top five fishing countries in the world (FAO 2005). The two major species of fin-fish traditionally used by Chilean near-shore fishermen are Chilean jack mackerel (*Trachurus murphyi*) and anchoveta (*Engraulis ringens*). The population of the former was reduced as a result of over-fishing in the mid 1990s, while the latter was affected by climatic changes due to el

Niño. For example, landings in this sector decreased approximately 47.9 percent compared to the mean of the period between the years 1994-1997 (FAO 2005). At the same time, aquaculture has risen in the country to account for nearly half (46.5%) of the total exported fish products.

It is difficult to assume that artesanal fishermen are to blame for the decline in stocks. Historically, when their boats had no motors, and were only about eight feet long, their efforts were marginal. They have changed little today, with the exception of the addition of outboard motors. The decline is most likely due to the industrial fleet, which fished for the same species, though at the mouth of the archipelago, thus inhibiting migration into the bays, to which the artesanal fishermen are confined. The fishermen today, specifically, those who fish for near shore fin-fish, use the same boats and technology as they have for years. The motor only allows them to use less effort, not necessarily to go farther off shore because the weather is prohibitive to a boat that size, regardless of technology. These people are at the largest economic disadvantage, and are having a difficult time making a living by fishing this way. In Chonchi, there were nine of these boats left, and most never left the harbor. Those that did went mostly as a supplemental activity, as few of the fishermen worked exclusively in fisheries anymore. The few hold-outs who worked exclusively as fishermen were supplemented by their wives who were employed primarily in the service sector. The conditions of the artesanal fisheries on Chiloé are challenging, and present a vicious circle of events from which most can never escape. Even though fishermen cooperate and help one another, this is not enough when a motor dies and there is no money to replace it, or when red tide closes the mollusk fishery for months at a time, when catches decline because of industrial fishing,

or when farmed products are preferred to wild catches for issues such as uniformity and traceability.

There is another category of fisherman, however, that is still managing to scrape out a living in this line of work, though those days are numbered. These are the *busos* or divers, who have more complex technology and larger boats (see figure 3.2). They are still in the category of artesanal fishermen, with boat size restrictions and different catch limits than that of the industrial fleet. They are also near-shore, though as stocks have been depleted, they have been venturing farther and farther away from their homes in order to find their catch. Their boats are not open dingy type vessels like the fin-fish fishing boats, but rather have an open end and an enclosed bridge and below-deck galley and bunk room. These fishermen dive for their catch, rather than use hooks, lines, and nets. They wear inch-thick neoprene wet suits, attach a 40 meter hose to a mask, and have a first mate pump and watch the propane generated oxygen tank fixed on the back of the vessel. This practice of diving for marine resources goes back generations, and divers historically used sea lion fat for insulation. Divers are restricted to a depth of 20 meters, although many are diving deeper for the same reason that they must increase their distance from home.

Figure 3.2. *Buso* or diver boats lined up for inspection at the dock in Chonchi. As the inspector went down the line, certain required pieces of technology were hurriedly yet secretly passed from boat to boat to make sure everyone passed.

The *buso's* catch consists of mussels, clams, sea urchin, crab, seaweed, and some conger eel. There are seasonal regulations and catch limits for these species, though according to my observation, most seemed to be an all year commodity if there was a buyer. Despite having a short harvest season, the sea urchin (*erizo*) is the most lucrative marine resource, due to an export market to Japan. The mussel and clam fisheries are in a great amount of distress, not in terms of availability but owing to competition with aquaculture products that are more uniform and are traceable, as well as increasing bouts of disease such as red tide and other bacterial contaminants, most notably *Vibrio parahaemolyticus*. Farmed species are not immune to such pathogens, but with more

frequent water and product testing and traceability standards, success in the national and international market is more likely to fall on these products over several hundred kilos of a random mix of wild stock, which is what the *buso* regularly brings to the buyers.

The life of the artesanal fisherman is not great in contemporary Chiloé. There are very few left who work exclusively in this craft, though these are tenaciously hanging on. Understandably, they do not want to change their line of work that has been a part of their history and culture for generations. The issue for these men is that their method of livelihood is in peril because of natural and anthropogenic forces that have made finding their prey more difficult and more dangerous. Their income is uncertain, and appears to be on the decline as their product is becoming less and less competitive. Many live in poverty, and struggle to make life work. Those who do not supplement their work with other employment have wives or other family members who help the family economically. The fishermen in Chonchi and Lemuy provided the same story each time I spoke with them, which is unfortunately the tale being told among fishermen worldwide. Understandably, their plight is not unique. During an interview with Raúl (Personal communication, Chonchi 2004), a multi-generational fisherman from Chonchi, I recorded the following statement that serves as a generalization for the others:

> *No one wants to be a fisherman anymore. It is very sacrificial work. I certainly don't want my son to be a fisherman. Every year it gets worse, the sea is getting worse, and our fish are disappearing. Today, I got 300 kilos of sea urchin. Five years ago we were getting 800 kilos a day. The price has only gone up ten pesos in ten years, from 190 to 200 pesos per kilo. We have to go farther away, sometimes travel all night, just to get the same amount of product that we used to, and that means we work more hours. It is more dangerous, because we have to go so far, where the sea is more dangerous, and we have to dive deeper there too. I'm going to buy a cow.*

There are approximately 10,000 artesanal fishermen on the island, which is around eight percent of the total current population (INE 2003). These people have recently been experiencing restrictions that are negatively altering their fishing rights and affecting their way of life. These restrictions have been both direct – through legal measures passed by the state, and indirect – caused by environmental degradation that has resulted from over-harvesting of ocean resources by industrial barges, as well as pollution and waste generated by salmon farms. With regard to legislative effects, a series of measures were passed in order to promote free-market activity. In 1991, these measures were consolidated into a national fisheries law, *Ley General de Pesca y Acuicultura*. This network of laws surrounding marine resources favored, overall, industrial activity, though limits were placed on both sectors of the fishing fleet. Additionally, the *Ley General* designated the ocean surrounding Chiloé from five miles offshore for use exclusively by industrial fleets. Artesanal fishermen were given exclusive use rights to the area from shore out to five miles. While the artesanal fishermen rarely, if ever, violate their maritime allocation out of a physical inability to access more open waters due to their small boat size, the industrial fleet often does violate the law to harvest in near-shore waters.

As viewed by fishing companies and the Chilean government, these measures were a success. Between 1985 and 1996, industries in Chile's fishing sector grew by an average of 127 percent (Schurman 2001), and after a sharp decline in landings from 1994-1996, the industry has held steady (see figure 3.3). Exports accounted for 12 percent of the nation's export earnings in the mid-1990s, and the presence of large domestic and foreign fishing companies in Chiloé rose from 25 to over 100 (FAO 2005;

Schurman 2003). However, artesanal fishermen feel differently about the matter. There is a disproportionate allocation of harvest quota. For example, in the case of *merluza* (hake), a major fishery in southern Chile, the artesanal fleet is allocated 20 percent of the total quota, with the remaining 80 percent going to the industrial sector. This ratio, however, does not correspond to the numbers of fishermen harvesting this species; there are three times more artesanal fishermen harvesting *merluza* than industry workers (SERNAP 2005).

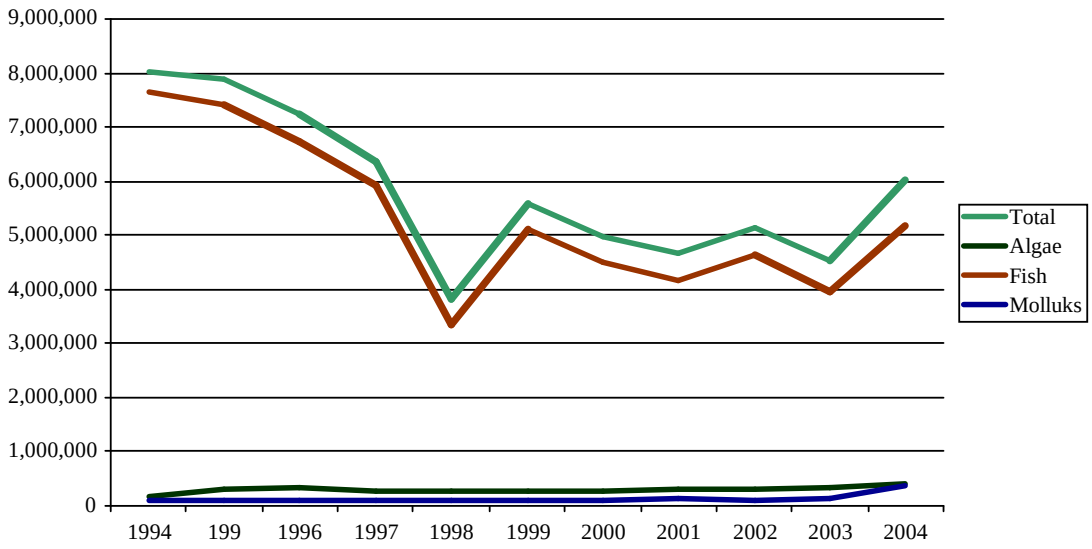

Figure 3.3. Chile's wild-capture Landings by Species (in tons) 1994-2004. Data source: Anuario Estadístico, Sernapesca.

Most Chilote artesanal fishermen are wary of the government and corporate fishing industries. They feel as though they are targeted as a sector by higher powers, and that their rights are continually diminished to make way for economic potential, which is generally in the form of corporate industry. Like most small-scale fishermen on a global

scale, complaints of this nature are not unique to Chiloé or even Chile. Especially in the absence of formal institutions and economic power, marginalization of this group is going to occur (Ostrom 1990). There are formal labor unions among artesanal fishermen in Chile. Their power differs significantly depending on the location, even on the island of Chiloé. On Chiloé, each town has its own union, with established by-laws and membership requirements, and are registered with the regional department of labor. Some of these unions do indeed have power to a certain extent. In the northern island city of Ancud, fishermen there have managed to redesign harvest areas along with state policy-makers for a more equitable distribution of space between them and the industrial fleet. The unions in smaller towns, however, continue to struggle for a voice, and many, as is the case in Chonchi, have given-up hope out of frustration.

Fishermen in Chonchi are at a particular disadvantage due to the geography of their town. Its location has proven favorable for salmon and mussel farms due to efficient currents and water depth, as well as shelter from strong winds, all of which lend to success in aquaculture. There is only one port in the town, and it is shared by artesanal fishermen and the larger vessels belonging to the farms that ferry smolt, feed, salmon, and people to and from the farms. At a meeting held by the mayor with the artesanal fishermen in March, 2005, it was mentioned that the port was to be privatized, with ownership given to the farms for docking rights. Currently the dock is open-access to fishermen with no associated fees. The fishermen felt this was a final blow to their industry, but with no established sea tenure, nor significant economic contribution to the town, there is almost nothing they can do to protect themselves against this redistribution and privatization of common property.

There is much contention between fishermen and the aquaculture firms all over the island. The fishermen are extremely suspicious of the government and the corporations, and usually for good reason. Most are very much aware of some detail of inequality in the system. For example, the predecessor to the current *Subsecretario de Pesca* (Secretary of Fisheries – the highest national office responsible for overseeing the regulation of fishing activities) was for many years president of the Association of Salmon and Trout Producers of Chile, a pro-industry lobby group. In fact, *Subsecretario* Daniel Albarrán was pressured to resign from his national appointment in August 2001 for allegedly receiving bribes from the salmon exporting company Aguas Claras (Aquanoticias 2002; Ecoceanos 2002).

Acts of defiance against the aquaculture firms are not uncommon. Fishermen have routinely broken salmon nets, not as an act of vandalism as much as it is to temporarily increase the quantity of high market value species. Open-ocean salmon fishing is currently prohibited, though when asked most fishermen could not give me a straight answer about its legality. Even though research shows that allowing a wild-capture salmon fishery would solve many environmental problems associated with the escapees (Soto et al. 2001), it has yet to be legalized, most likely because it might provoke more destruction and encourage rivalries.

The salmon farms are now the most highly contested maritime issue on Chiloé. The fishermen claim that they are responsible for almost all of their problems, including environmental degradation and their declining economic status. At the same time, however, people I spoke with in Chonchi say that the salmon farms are positive in that "at least they are here, offering employment. Before, the men used to just stand around on

the corner, doing nothing. Now, even though we are still poor, at least we have work" (Personal Communication Chonchi 2004).

The fishermen here know that their days are numbered, but given the only other option for them as unskilled, uneducated individuals is to work as an employee in the aquaculture farms, some still cling tenaciously to the lifestyle and heritage that drew them to the business in the first place. There are many though who have acquiesced to financial stress, and have gone to work for the firms. Some do it seasonally, while others have gone to work full time. The effects of this transition will be discussed in detail over the next several chapters. The following chapter will address the theoretical concept of common property resources in terms of changing access rights and their management in Chiloé.

Chapter 4: Common Property Resource Theory Contextualized in the Case of Fisheries and Aquaculture On Chiloé

This project weighs heavily on many of the ideas derived from discussions of common property resource theory and practice. A common property resource perspective explores the relationship between human society and natural resource use. As resource use changes, so do the corresponding social institutions that emerged to regulate their use. This research explores human responses to politicized nature on an individual level. I discuss in this chapter how a “bottom-up”, participatory, and adaptive approach to management and use of resources is a preferred strategy for sustainability and resilience. Perhaps the most important criteria of success is a high degree of participation and ownership, characteristics that do not degrade quality of life, as described in chapter seven through the three resilience indicators surveyed in this study.

Common Property Resource Management and Steps to a Focus on Resilience

The study of institutional approaches to natural resource use largely arose from discussions of the management of common property resources (CPRs). While often taken to refer specifically to resources under collective tenure, strictly speaking, the term common property resource refers to specific characteristics of a resource rather than the property rights involved (Ostrom 1990; Ostrom et al 1999). CPRs are natural and anthropogenic resources in which "the exclusion of beneficiaries through physical and

institutional means is especially costly and exploitation by one user reduces resource availability for others" (Ostrom, et al. 1999: 2). In such a system, as all appropriators are dependent upon the resource and jointly affected by each other's actions, they therefore must develop coordinated strategies that, by constraining the options available to the individual resource user maximizes the collective returns from the CPR and ensures its continued survival (Ostrom 1990).

CPR scholars (e.g., Ostrom, 1990; Ostrom et al. 1994; Cortner et al. 1998; Agrawal 1999; 2000; McCay 2002) outline a methodology for an institutional analysis of common property resources. It is first important, they argue, to understand the characteristics of the resource itself, including its level of predictability over time. The second step involves ascertaining key attributes about the resource users, including their number and time horizons and whether they have pre-existing norms of behavior from collective action in other arenas outside the CPR. The final step in an institutional analysis of a CPR is to examine the rules that have been devised and the ways through which cooperation with these rules is monitored and enforced.

Building upon this methodology, scholars have offered explanations of how and to what degree of success user groups are able to counter the numerous obstacles facing collective management of the CPR. These problems include limited information, free riding behavior and monitoring individual compliance with the rules (Ostrom 1990; Ostrom et al. 1994). CPR institutions will not be uniformly successful in meeting such problems. Consequently, much research in institutional theory addresses the question of CPR regime robustness - that is, what characteristics of common property resources and of user groups facilitate the development of effective collective management schemes?

While no consensus has yet developed as to the prerequisites for sustainable CPR management (Agrawal and Gibson 2001), several recurrent themes have emerged.

Success in Common Property Resource Management

Several resource characteristics have been found to influence the effectiveness of common property institutions. Common property institutions are most effective when applied to resource systems in which the dependability and value of production per unit is low and when a large area is required for efficient use (Ostrom 1990). In the case of marine resources, effective self-organization is most likely to occur when the resource is starting to deteriorate but has not yet done so substantially (Ostrom 1997). With the transition occurring among small-scale fishermen on Chiloé due to lack of and restriction to resources, I observed that this emergence of self-organization[1] is occurring. In chapter seven I discuss this process through the analysis of a cooperative mussel aquaculture firm organized among a fishermen's union on Chiloé. This case is a non-theoretical example of this process of organization and institutional formation with a view toward social-ecological sustainability. Furthermore, clearly defined boundaries are often required in order to effectively exclude non-members from appropriating part of the resource (Ostrom 1990; 1997). This characteristic is certainly in place with aquaculture cooperatives where space is delineated by visible boundaries. Other important characteristics of the system include the size, measurability and carrying capacity of the resource as well as technologies employed to harvest it. Overall, small-scale cooperatives

[1] Self-organization is one of the three key elements of resilience.

adhere to these defined characteristics for successful common property resource institutional formation and longevity.

CPR User Groups and Characteristics of Success

Much more attention has been dedicated to the role of group characteristics in shaping the effectiveness of a CPR management strategy (Ostrom 1990, Ostrom et al. 1993; Cardoso 2002). Much debate has centered on the role of group size in creating effective CPR institutions. Olson (1965) argued that smaller group size best facilitates the collective action required for successfully governing a CPR. Ostrom, (1999) agrees, stating that relatively homogenous and small groups up to 300 members tend to be most robust. In the case of large groups, nested governance systems that are compatible at all levels tend to be required (Ostrom 1990; Cardoso, 2002: 29). In a study of lobster resources in Maine, Acheson (1989) revealed the complex regulatory system designed by Maine lobstermen to ensure resource and economic sustainability. They, like many other small-scale communities reliant on common property resources, devised a system for sustainable resource management based on group imposed quotas, technology restrictions, monitoring and regulation, and a code of secrecy. Though this user group fell under the umbrella of government policy, it was their informal institutionalized system that actually kept the resource sustained and the economic desirability high. External control is effective in some settings, but not often better, nor more sustainable, than control by those directly affected in small-scale systems (Ostrom and Schalger 1996).

It is unclear in most cases, however, whether the rules and institutions with regard to resource use were derived through deliberate actions on the part of the community of users, or if they arose simply as mechanisms to ensure sustainable resources without regard to formalized structure. Regardless, scholars recognize that these regimes are often more functional and sustainable than government plans, since they benefit from years of interaction and experience with the resource and ecosystem in general (Agrawal and Gibson 2001; Berkes 1985; Durrenberger and Palsson 1986; Carrier 1987). This fact makes the case for keeping common property regimes in place, especially in small-scale user groups, difficult to appeal to government agencies that assume without scientific and external regulations, resources would be overexploited and depleted. While cultural homogeneity has not been clearly proven to be a requisite for effective CPR institutions, the presence of shared norms of behavior regarding the resource itself is important (Ostrom 1997). These shared norms also must extend to a common understanding of the nature of the resource and the necessity of protecting it. Collective norms are most likely to occur when a group shares a past and expects to share a future, making social standing in the community an important asset. The expectations of a shared future in turn are built in contexts of frequent interaction (Poteete and Ostrom 2002). If norms are shared within a user group, greater trust will usually exist and an individual will be subject to social censure for taking actions that violate them. Furthermore, actions contrary to group norms may not even be considered among the range of possible strategies (Ostrom 1990).

CPR Management Regimes

The effective governance of a CPR is contingent upon effective communication between resource users, the group's ability to monitor and enforce rules, and to resolve conflicts when they arise (Ostrom 1990; McKean 1992; Agrawal 2002). In smaller groups, monitoring and rule enforcement can be conducted informally through social pressure. On Chiloé, it was clear that this was the case, but only among owners or individuals of the same occupation. In other words, fishermen would regulate use as much as they would regulate their ability to get away with breaking the rules. People would often steal mussels from unknown farms, but when they had their own farm, regulation was quite possibly the most important factor in its management. In larger groups, more formalized systems of monitoring and rule enforcement may be required (Ostrom 1990), as evidenced by the sentry at the door of all salmon aquaculture buildings, and the armed individuals guarding the pens 24 hours a day. Absent some collective mechanism of monitoring and enforcement, usually through ownership or shared identity, the system may break down as each individual may find that, on an individual basis, the social costs of monitoring and reprimanding a neighbor are higher than the benefits (Cardoso 2002). In such cases, if monitoring is referred to distant government agencies, the cost of rule-enforcement increases while effectiveness generally decreases (Agrawal and Gibson 2001).

On Chiloé, as in other instances, the relationship of the local CPR user group with governance systems operating at other scales is fundamental for effective management.

The most robust management regimes will be compatible at multiple levels, e.g. between community associations and federal agencies (Ostrom 1990). Through the formation of small-scale mussel grower associations, these groups have a voice and therefore a means of communication with multi-level government agencies. Furthermore, this system is effective in social contexts based primarily upon horizontal as opposed to vertical power relations. The absence of a rigid vertical power hierarchy and the consequent autonomy of this user group to make decisions without countermanding by external authorities is considered crucial to the creation of effective CPR institutions (Ostrom 1997; Poteete and Ostrom 2002).

There have been a plethora of studies focused on the characteristics needed for successful CPR governance (Berkes 1985, 2002; Ostrom 1996; Agrawal 1999; Hanna 2000; Dietz et al. 2002, among many others) but what has not been researched is what happens to successful CPR structures as the human/nature relationship changes (Agrawal 2003). Fishermen on Chiloé are not unique among fishermen world-wide when it comes to changing resource availability and access. As access rights are diminished, and people turn to alternative economic activities, a ripple effect occurs throughout the community as social structures, informal rules, and hierarchies falter and collapse.

It is critical that research be initiated to better understand the ecological properties characteristic of coastal ecosystems, and become more fluent in the intricacies of human cultural, ecological, and economic behaviors that impact coastal and marine resources. It is therefore necessary to examine how human population needs will continue to impact coastal ecosystems at the species and systemic levels. Thus, it may become possible to redefine our relationships with coastal systems and seek more sustainable management

approaches, through an adaptive cultural, biological, and economic approach. Cooperative mussel aquaculture in Chiloé may be a step in this direction, and could potentially serve as a model for the equitable governance and use of CPRs through system renewal and sustainable social-ecological systems.

Adaptive Management

Characteristic of most natural resource management is a bottom-up methodological approach from the smallest-scale land user to national or international level political-economic structures, or what Vayda (1983) terms "progressive contextualization". In such a perspective, the resource user is the central agent whose relation to the natural world must be seen in historical, political and economic contexts (Blaikie and Brookfield 1987; Zimmerer 2000). In the case of marine resources, progressive contextualization as a technique would allow managers to focus on spatially and temporally specific variables and act accordingly. The newest incarnation of this method is adaptive management, which though gaining momentum, has yet to be implemented in large-scale systems.

Adaptive Management appears to be a solution to sustainable and functional resource management and system resilience. This strategy has emerged as a coping mechanism for system unpredictability, introduced nearly 25 years ago (Holling 1978; Walters 1986; Dryzek 1987; Lee 1993). Adaptive management requires more time and input than traditional, standardized forms, including the application of alternatives and subsequent interpretation of their effects (Zedler 2003; Christensen et al. 1996). It is a

dynamic approach that requires action and reaction to change and surprise (Lessard 1998).

Social-ecological systems are inherently adaptive, however, which can be used as a benchmark for nascent management practices. The theory of Panarchy, or nested adaptive cycles, suggests that there are multiple levels within a system that cooperate for functionality. When this communication is disturbed, sustainability is weakened (Holling 2001; Gunderson and Holling 2002). It is the testing of approaches that Holling (2001) calls the “adaptive cycle”, which relies on “wealth, controllability, and adaptive capacity” (Holling 2001: 394) that shape institutional response to human ecosystems. A formal process of adaptive management will be required for successful natural resource management, as well as to implement successful ecosystem management.

Chapter 5: Chile's Rationale for Aquaculture

Aquaculture: An Overview

Aquaculture is the controlled cultivation of natural aquatic species, such as fish, mollusks, crustaceans, and plants. Aquaculture may take place in oceans, rivers, lakes, ponds, and man-made terrestrial tanks. By farming, it is implied that aquaculture is the deliberate and controlled production of such organisms, from simply stocking a species to feeding and maintaining their health. In this definition supplied by the Organization for Economic Co-operation and Development, it is also specified that aquaculture also implies a degree of ownership. This is distinct from stocked fish that are open-access common property, which are considered fisheries (OECD 1989). Thirty percent of the marine products consumed today come from aquaculture, and it is currently the world's fastest growing food producing sector (FAO 2005).

Asia is the world leader in aquaculture production, due to its historical foundation in the process dating to circa 889-904 AD. The first known records of aquaculture are from China, where carp was farmed in flooded rice fields. This system took advantage of excess water while at the same time fertilizing the earth and clearing the land of weeds. Latin America has experienced a sharp rise in aquaculture production, with an average growth rate of 18 percent per year during the 1990s. The market is expanding most rapidly in North America, growing by approximately 13 percent per year in recent years

(FAO 2005). Aquaculture clearly is a world-wide phenomenon, with a diversity of scale and levels of market integration. People in some countries practice aquaculture at a subsistence level, while other countries are internationally engaged in an industrialized process of fish production and export.

Aquaculture, as relatively new on the industrial scale, is still in a process of adaptation. There are some concerns that the cultivation of certain species at certain scales is ecologically harmful. Although the cultivation of marine products is in a controlled environment, there are cases of escapes, contamination, and spread of disease, all potentially harming the natural ecosystem in the surrounding area. Studies in Chile have shown escaped salmonids, a carnivorous species, colonizing their non-native environment after escapes occur, resulting in resource competition and potentially altering local ecosystemic processes (Soto et. al, 2001; 2004). Shrimp production in much of Asia has resulted in the deforestation of mangroves and wetlands in order to create space for shrimp ponds (FAO 2005). The cultivation of carnivorous fish depends on the extraction of other fin-fish that are converted to meal for fish food. In some parts of the world, this has meant depleted stocks for local fishermen who still depend on these species for a supplement to their diet, and for income. It has recently been recommended that endemic herbivorous or filter feeders be farmed as opposed to non-native carnivorous species in order to avoid some of these potential perturbations (NOAA 2005). Another suggested solution is to farm exclusively in terrestrial, man-made tanks where all stages of production could be managed, including the disposal of waste.

Aquaculture is a field that has experienced rapid growth and expansion since the 1980s on a global scale, while most wild-capture fisheries are in a decline. International

development agencies and state and local governments herald aquaculture as a means of economic development, diversification of resources, and food security. Some scientists argue that it can be a strategy for taking the pressure off of wild fish stocks in order for them to recover. Seafood accounts for 16 percent of all animal protein in the human diet, making it our most important single source of high-quality protein (WHO 2005).

The primary increase in aquaculture products has occurred in Low Income Food Deficit Countries (LIFDCs), further establishing the practice as an indispensable nutritional and economic resource (FAO 2005). Many countries, including the United States, have encouraged aquaculture research and development as a means to meet the growing demand for seafood products in the face of a significant decline in wild populations (NOAA 2005). When environmental and social needs are met, aquaculture can alleviate poverty and hunger, and generate employment. Commercial aquaculture has the additional benefit of stimulating local and national economies.

The future of aquaculture depends on cooperation between stakeholders, including regulatory agencies, universities, scientists, and fishermen in order to achieve responsible and sustainable aquaculture operations. Improving technology and research and development into species diversification can promote a sustainable future of marine resource consumption, and may benefit a wider range of consumers. The diverse ecological, socio-cultural, and political interests involved make this a challenge, though one that has the potential to be met. Global cooperation is paramount for the diffusion of successful information and technology to establish and maintain sustainable practices. Under the right conditions, aquaculture has the potential to meet demand for this

important resource, while at the same time establishing socio-ecological improvements that will benefit these systems on a global scale.

Aquaculture in Chile has been on a path of rapid and intensive expansion since the early 1980s. One reason the Chilean government would support such industrial moves is to gain foreign exchange in order to pay foreign debt and loans. At the inception of Pinochet's military regime in 1973, structural readjustment programs were initiated to deal with the failing economy, funded by the World Bank and the International Monetary Fund (IMF). The basic elements of the reforms were liberalization of trade and privatization, beginning with the initiatives of returning land and industries to their original owners; the privatization of public enterprises and banks; reducing import duties; reduced public spending and tax reform; and the stabilization of domestic prices through a fixed exchange rate. The reforms were long and costly, lasting 20 years, and including two major recessions. Since 1985, the economy has stabilized and grown after multiple failures and reforms. New structural adjustments were implemented, and a debt conversion program was initiated with the aid of the IMF and the World Bank, reducing Chile's external debt by $10 billion between 1985 and 1990 (Venezian and Muchnik 2002). While these strategies were not necessarily perfect by any means, Chile is now in a place of relative economic stability and comfort, aided by an increased GDP from aquaculture, Chile's third largest export after copper and timber.

Aquaculture as a Tool for Rural Development and Social-Ecological Resilience

One of the prevailing themes in aquaculture has been its potential to aid in the economic development of developing countries. Many traditional strategies proposed by development agencies have been disasters, primarily due to incongruity between the agencies and their target populations, especially with regard to socio-cultural issues. Often, embedded cultural traits are ignored, therefore rendering the development strategy impossible when the elements involved to not make sense to the intended population.

Perhaps one of the reasons for success in this case in Chiloé has been the "hands-off" approach by the agencies in charge, which in turn has provided a significant degree of ownership, not only in economic terms but also by allowing social and cultural structures to remain intact. The idea of this study was to explore the changes that occur during the shift in occupation when a fisherman becomes an employee of an aquaculture firm. Fortuitously, I was also able to measure an alternative to corporate employment in the form of a cooperative, which ultimately proved to be a preferred strategy for development and sustainability in coastal communities in Chiloé where artesanal fishing has all but disappeared.

Development

> de-vel-op-ment *n* (1756) **1**: the act, process, or result of developing **2:** the state of being developed **3:** a developed tract of land; *esp*: one that has houses built thereon. (Webster's 1983)

According to this definition, even the dictionary has an ambiguous interpretation of the term. Naturally, the word takes on different meanings when applied to various contexts, though given its less than concrete origins, is open to a plethora of uses even within a dominating theme. This subjectivity affords many allowances to organizations that claim "development" as a prevailing theme to their existence. For example, the World Bank lists the following as "topics in development":

> Agricultural and rural development, AIDS, anti corruption, debt relief, education and training, energy, environment, evaluation monitoring, financial sector, gender, globalization, governance and public sector reform, health, nutrition and population, information and communication, infrastructure, knowledge sharing, law and justice, macroeconomics and growth, mining, participation, policies, poverty, private sector development, social development, social protection and labor, sustainable development, trade, transport, urban development, water resources management, water supply and sanitation (http://www.worldbank.org/html/extdr/thematic.htm – 12/8/02).

There are also several standard definitions of development, most of which would be improbable if they were to be attempted and implemented by most development organizations. These consist of development as economic growth, distributional equity, structural change, democratization, and mass participation and modernization. The economic growth model seems to be the most pervasive, wherein growth is marked by an annual increase in a country's GDP, though does not necessarily improve standards of living for the majority. The model of distributional equity is the most fair, and emphasizes colonialism as the cause of inequality, though has not achieved a framework to make it work. Structural change is geared toward a shift from agrarian production to manufacturing and services, stating the market should be the force that allocates resources, not the government. Democratization and mass participation sees structural transformation through adjustment programs and political involvement as the key, and

modernization is a structural and attitudinal adjustment, achieving a more Westernized structure (Logan 2002).

While there is no singular definition of development, and the context differs according to whether economics or social indicators are the pervading factors, the accepted standard for development institutions is structural adjustment to increase employment in order to alleviate poverty and increase literacy, education, health, housing, and other basic needs. Recently, quality of life indicators have been included in development definitions and go beyond meeting basic needs to include "self-esteem" and "freedom from servitude" (Todaro 2002). However, multi-national corporations and development institutions that assume responsibility for the management of resources in developing nations have an alternative self-interested ideology. With this expression constituting the definition of development and management, the moral and ethical obligation of development disappears and economic gain becomes pervasive. If we add Marx's point of view that resources are not independent of the users (Plattner 1989: 381), investigation and discourse surrounding issues of development become complicated, since the imperative to incorporate human dimensions is paramount to the successful and viable implementation of strategies. Institutions have yet to acknowledge this most basic factor however in the conceptualization of their development schemes.

There are some organizations, specifically, NGOs that believe altruistically in equitable development. This appears to be an emergent notion based on the inequality, objectification and exploitation of nations and peoples that are powerless in the face of economic greed. Local management of resources in developing nations has only recently become a topic of consideration in the backlash against foreign economic control and the

inability of their strategies for growth to be successful in terms of development as a means to support social indicators. This approach corresponds with the neo-Marxist development as distributional equity definition that is concerned with equitable distribution of income and social amenities (Logan 2002).

Among Marx's modes of production, the "tributary mode" is of most consequence when discussing internal control in development (Wolf 1982). This mode is explained as workers having "direct access to the means of production, but their activities are directed through political domination" (Plattner 1989: 385). In a World Bank development strategy in Somalia, for example, banana production is taken out of the hands of local participants, and regulated through foreign investment, keeping capital out of Somalia instead of diffusing it inside the country, contrary to the original plan devised by the development institution. The only beneficiaries of foreign capital investment then are external markets and the political elite, epitomizing the ineffectiveness of "top-down" strategies for growth (Samatar 1993).

These are, of course, negative interpretations and examples of what development means to organizations concerned with development. However, given the significant body of literature and empirical evidence leading to these conclusions, pessimism in terms of development strategies in Less Developed Countries (LDCs) is not unfounded. In order for equitable development and growth to occur, economics would need to be second to social indicators, and that is not generally found in human nature.

Poverty

The aquaculture cooperative project in Chiloé can serve as a model of development and poverty alleviation through the focus on the implementation of mussel farming as a means for economic independence and the subsequent rise of social indicators (basic needs). This model has involved local participation from its inception, and has focused on education as a means to increase independence, maintain a positive attitude toward the community, and to produce functional knowledge and skills and a scientific approach to the natural environment. This model also addresses the issue of sustaining basic food needs, which in some instances in aquaculture development strategies has been ignored in the face of economic gain (see Pollnac and Weeks 1992). Perhaps most importantly this model has been successful as a development alternative in Chiloé because of the similarity of the activity to historic activities of agriculture. While community participation has been demonstrated repeatedly as a factor for success (Berkes 1986,1987; McCay and Jentoft 1996; Fischer 2000; Russell and Harshbarger 2003), the continuation and maintenance of traditional skills and knowledge may be even more important for success (Pomeroy 1992).

Community-based programs suggest a higher level of sustainability and productivity than detached government or private management institutions. Central to this theme is the notion that community participation empowers local people through the development process and reduces dependency (Twyman 2000). Looking at the “bottom-up” versus “top-down” growth strategies, Western notions of development do not always coincide with the best interest of the people nor of the resources (Zimmerer 2000). It is

therefore critical to work with local communities from within on a participatory scale in order for development strategies to be viable and to encourage endogenous growth.

Sustainable Development

Sustainable development has emerged as a theme as a reaction to the exclusion of environmental concerns in favor of exclusively addressing social issues. The Green Revolution serves as an excellent example of the process of ignoring "green" issues in terms of paying attention to environmental factors that would contribute to the overall efficacy of the projects for longevity and continuity. This is especially important when dealing with both economics and food resources, particularly among the poor, who generally tend to overexploit resources and who are often denied access to these limited resources (Pollnac and Weeks 1992).

Sustainability is a very difficult concept to define, which is why it is such an interesting topic to explore on both an academic and applied level. The term is most easily conceptualized when understood as a strategy, as well as one that encompasses not just natural resources (common property), but communities and institutions that depend on them as well. The degree to which people and organizations can agree with the conceptual and operational issues surrounding sustainability will determine its functionality.

The most widely used definition of sustainability is the statement that resources should be used in a manner that will assure that they exist in either their present form, or better, for future generations. With the pressure on most natural resources by a growing

global population and globalized economy, this becomes increasingly more difficult. At issue is not then to stop resource use, but rather how to increase resource use within a strategy that allows for extraction and consumption without over-exploitation. That said, sustainability lies in the institutional structures that manage the resources, from the very basic grass-roots level up through national and international organizations (Ostrom and Schlager 1996; Cortner et al. 1998; Agrawal 2002; Berkes 2002). Sustainability thus relies on communication and cooperation at various levels of organization among both user and management groups. In some over-exploited systems, sustainability also depends on system resilience first in order for system renewal to occur, and sustainability to begin. Fisheries management provides an excellent example of the process.

Throughout history, most extractable resources have been managed within a common property framework (Hanna 2000; McCay 2002). However, resources in an open access scenario, such as fisheries in the high seas, have been overexploited in recent history, mostly due to population increases and more efficient technology. It is this system that has led governments to assume control, citing environmental and economic problems that in the opinion of government officials and some resource scientists, could only be solved through this type of external intervention. The problem with this perception is that most common property resources do in fact have systems in place to self-regulate, though they are often difficult to understand and incorporate into management schemes (Ostrom 1987; McCay 2002).

This trend of external, state control is transitioning, however, as many governments have recently turned to common property systems within local communities to promote local involvement in resource management in order to decentralize the

government's role in this regard, and as a mechanism for economic and social sustainability (Berkes 1986; Agrawal and Gibson 2001; Agrawal 2003). This is also a shift that recognizes the fact that local users have the greatest stake in the resources. The problem with this reintegration of local structures into government policy is that each case has to be considered on an individual basis. Common property regimes for different resources differ widely according to cultural and environmental characteristics, making generalizations impractical and virtually impossible. While there are some overriding characteristics for most regimes, the context under which each arose is critical to consider for functionality (Ostrom 1990). In other words, the contextual fit between these formal and informal institutions is paramount in order to make a system work. It is therefore important to know how people relate and respond to common property resources, which requires understanding their situations and how institutions have been specified within those historical, ecological and cultural situations.

Sustainability is clearly complex. It relies on human factors that are successfully integrated to produce functional cooperative efforts in resource use. The world's resources depend on these efforts and will require increasing global participation as the impact of resource use and exploitation is felt on a global level. While this does present a challenge, it can be achieved, as demonstrated in the Maine lobster fishery. Sustainability is possible, but depends on the ability of institutions and individuals to cooperate and adapt to the constantly changing interconnected global environment of today's world.

Rural Development and Community

The concept of community-based participation in natural resource management is one that thus far appears to be better in theory than in practice. As a concept, local participation is viewed as a development tool for curtailing dependency, creating self-sufficient economies, as well as creating certain socio-economic gains between the "community" and policy implementers. In actuality this strategy may be more one of superficial concern for those who have historically depended on the resource in question, and a means toward the goals of the implementing agency.

Much of contemporary community-based participation is due in part to lessons learned by instances such as the Green Revolution. While much of the Green Revolution's actions were regarded as successful economically, e.g., spurring multi-dimensional commercial and industrial demand from new crop implementation, they were in fact at times relatively harmful to the local communities. The most critical concept in this type of management or regional development is to understand the community and its relationship to the resource. This relationship includes, but is not limited to, socio-cultural connections to the resource, political orientations, economic structures and the diversity of the local environment. From this standpoint, as Twyman points out, standardized models for community-based management can not be used unless critical attention is paid to the above criterion without serious consequences to the outcome (2000:329).

Community

As a result of the complexity of implementing strategic and viable community-participation management plans, few tend to succeed. The factors involved are diverse and many, as are the intentions of both parties intended to collaborate. A number of studies have been done on the issue of co-management / participatory management, though it remains fundamentally a theoretical concept (Pinkerton 1987; Levieil and Orlove 1990; Western and Wright 1994; Agrawal and Gibson 2001). Often the measure of success is manipulated or determined according to the desired outcome of the implementers (Twyman 2000). As a tool for development, this model has potential for creating equitable systems of sustainable resource management and economic sustainability. However, it will require that each side of the equation understand all the variables involved and work toward serving the interests and desired outcomes of both parties.

These development strategies are the most recent trend in development, and governments are often pressured by international conventions and aid agreements to adopt them. The problem that arises from this is that mistakes are made, attention to factors with regard to the resource are not considered, and the best interest of the local community is ignored. Additionally, the strategies are not always adaptable in certain environmental contexts. External forces for demand of the resource, that also act as supplier, tend to weaken local management systems to such extremes that defeat and collapse are the outcome (Tough 1999). This growing loss of control over the resources

generally leads to political and economic dependence of local groups on the larger market economy, leading, once again, to the state that initiated the process.

In the late eighteenth century social Darwinism and Malthusian economics pervaded discourse as pertaining to the issue of poverty alleviation. As time progressed, however, social figures such as Marx began to change this outlook and contributed to the modernization approach of the 1960s. Radical development theories of the 1970s contradicted the modernization approach and conceptualized dependency and world system theory that carried the theme of participation, or local access to and control of the resources after so-called development strategies have been implemented. The 1980s brought a new dimension to development strategies, as economic and environmental consciousness emerged in the form of “sustainability”.

Chapter 6: The Blue Revolution

The Revolution That Started it All

The Green Revolution (GR) of the 1960s and 1970s was an overhaul of a self-sufficient system. The typical farm prior to the GR relied on small-scale practices and non-chemical fertilizers. They supplied their own seed and controlled disease and pests through cropping strategies (Sen 1982; Pottier 1999). The institutions in charge of administering the development projects within this framework ended such practices in favor of optimizing land use for improved yields, while at the same time genetically modifying seed for the same purpose with the end goal of ending poverty and world hunger. Seed then, had to be purchased, as did fertilizer and technologically and chemically sophisticated methods of pest control, thus institutionalizing dependence on formalized networks in order to be supplied with once basic and free commodities (Pottier 1999).

It is not a secret that this attempt at agricultural improvement was a failure, not in terms of increased production, but in terms of social-ecological sustainability. What was meant as a quick fix to poverty and hunger failed because it did not address the underlying economic, political and social institutions that had developed over years of culturally specific processes. Poverty was not alleviated in many areas because not everyone had access to the required technology needed to produce these hybrid crops.

Despite significant food production growth, many people still suffer from hunger since they can not afford to purchase the food that they may help grow. For example, in South America per capita food resources increased by approximately eight percent, though the percentage of those living in poverty as defined as being hungry rose by 19 percent (Food First 2000). Unfortunately, in Chile, this process appears to be repeating itself off land but in the sea, as the new Blue Revolution takes hold.

The Blue Revolution

The "Blue Revolution" is the term now used to describe the aquaculture boom of the past 20 years. The term is derived from the similarity of aquaculture efforts to the "Green Revolution" of the 1960s. Many of the ideological concepts correspond from one "revolution" to the next, though while in both cases may appear, and sometimes are positive, have their shortcomings as well.

The Blue Revolution is thought to provide the same service by the same organizations. Organizations such as The World Bank and the FAO discuss aquaculture as a development tool without much regard to the lessons learned from its predecessor. By 1985, such development organizations and aid agencies directed $200 million per year into aquaculture projects (Boychuck 1992). Undeniably, when presented with a strategy for both economic stability and food security with little overhead in some cases, aquaculture would seem to be an obvious solution to some of these problems in the world. Sometimes, it does work out to have a positive effect, but in the end, as with all

development schemes, there are problems, some of which could have been avoided, and some that will in the future as the nascent industry adapts to unforeseen perturbations.

Aquaculture in its developmental stages was much like traditional agriculture, involving little to no technology. This practice, since its invention in China many thousands of years ago, has persisted to present day. According to the FAO, 80 percent of the fish produced by aquaculture are herbivorous or omnivorous, and are meant for local consumption. The most important trait of this practice is that their production is done in low-intensity systems, meaning that they are usually raised in fresh water ponds without human technological intervention. Low-intensity systems work. They are marginally invasive to an ecosystem, they provide nutritional support and alleviate poverty in many countries around the world. This is the strategy that should be followed, and to an extent, it is. The issue, however, is that sometimes greed with regard to scale and even economics comes into play, and governments and development agencies manipulate proven strategies for higher profits and yields. The larger the scale, however, the more susceptible these operations are to collapse due to disease and parasites. Some industries have suffered such blights, and have never been able to recover.

The massive investment by agencies attempting to alleviate poverty and hunger on a large-scale, and quickly, necessitated particular spatial allowances that weren't necessarily already in place. For example, shrimp farming efforts led to the destruction of mangrove forests in countries such as the Philippines, Thailand, and Ecuador to make room for shrimp ponds. Not only are these farms responsible for deforestation, but they produce pollutants that contribute to the destruction of native shrimp fisheries. Most important in this dialog is the fact that a once sustainable, small-scale practice has been

seized by corporate interests. In Ecuador, Coca-Cola and General Foods are major investors in shrimp farms, which becomes an issue of privatization of common property, i.e., the mangrove forests, that provide other invaluable ecosystem services such as breeding ground for wild species and erosion control. Carnivorous fish production such as salmon is equally as destructive, but due to the immense technological investment required, this practice is generally supported by the state. This strategy for development simply does not make sense from an economic and feasibility standpoint. However, aquaculture such as salmon farming is an indication of the commercialization of an industry that was originally meant to supply food on a non-industrial, local scale. The product now has a tendency not to feed the hungry, but to create profits for international corporations through export to elite markets such as the United States, Europe, and Japan.

It is now common knowledge that the world's wild fish stocks are in a decline (see NOAA, PEW, FAO). The Japanese were the first to recognize this, probably because of their national reliance on seafood, and their expulsion from international fishing territories after the introduction of the Exclusive Economic Zones came into effect in 1982 (UN Law of the Sea V:55). Nearly one hundred years ago, they began to develop what is now the world's largest aquaculture industry (FAO 2004). This explosive growth comes at some costs, however, as their waters become increasingly contaminated, and other countries follow suit. An article in the Economist claimed that this was all "cause for optimism", that as the Green Revolution was a success in increasing crop production and pest control with the use of pesticides, the Blue Revolution will have the same effect (The Economist 2003). This is true, but it should not be viewed as optimistic. These so called technological advances in both revolutions, while having led to higher production

yields, have caused irreparable harm to natural ecosystems through the widespread use of these pesticides, antibiotics, and other control mechanisms used to generate a high yield of a living species in an unnatural environment.

Socio-Cultural Effect of Aquaculture

Commercialization of common property resources has long been known to have adverse effects on local peoples, and often creates dependency on external structures or institutions (Gunder-Frank 1967; Jorgenson 1989; Greenberg 1998). In the process, local people dependent on natural resources generally become less self-sufficient and more dependent, while simultaneously land and/or water becomes less accessible and more privatized (Berkes 1985; Pottier 1999). Much of the literature with regard to commercialization of resources is land-based, due to the fact that agriculture has been around significantly longer than aquaculture. The two practices are dramatically similar, however, even with respect to the alteration of land/seascape through the development and allocation of plots. Therefore, much of the examples cited herein belong to land-based activities, though due to the parallel function of both, discussing aquaculture interchangeably with agriculture is justified.

As with the Green Revolution, the Blue successor faces the additional similarity of creating, by default and economic drive, an even more substantial economic divide than has existed prior to its inception. Leaving the subsistence realm and delving into an international market economy tends to focus on output, usually using foreign investors to aid in start-up. This in turn funnels capital out of the country, and the local people are left

with less than they started with. In aquaculture, local resources are often used to produce feed and create space, the environment is contaminated and often destroyed, and the local communities once dependent on these resources therefore suffer economically from an inability to sustain their livelihood in historically traditional ways.

The case in Chile is slightly different from the "revolutionary" definition described here in that aquaculture was not introduced there as a development tool, unlike countries such as India, Thailand, and Ecuador. Aquaculture came to Chile when their natural resource base and amenable marine ecosystems were discovered. International corporations combined forces with the Chilean government to establish large-scale aquaculture in the region, primarily destined for the export market. Aquaculture there was never meant to ease the food production burden, since there never has been a shortage that demanded such schemes.

The difference in this particular situation stops here, however, as commodification on this scale had led to increased poverty and increased dependence on external institutions as a result of loss of marine access and other factors leading to the decline of marine resources, yet directly or indirectly related to the large-scale aquaculture industry. The struggles of small-scale aquaculture operators have been discussed in previous chapters, as have the issues facing small-scale fishermen. The issue at hand therefore becomes one of access rights to common property and equitable and sustainable allocation of resources, space, and technology.

Aquaculture continues to be considered a part of fisheries, despite being an independent sector, more akin to agriculture (Pillay 1994), due only to its association with marine resources. This is why many agencies charged with the management of such

species have decided that this would be an appropriate transition for people dependent on wild-capture fisheries who are faced with an economic and social crisis due to the decline and/or closure of their fisheries. In the United States, the National Oceanic and Atmospheric Administration (NOAA), the agency that houses NOAA Fisheries and regulates federal fisheries, has suggested this strategy (NOAA 2005), as well as regional governments in Chile, where a similar situation is at hand (El Llanquihue 2004). While superficially this appears to be an excellent solution in the face of degraded wild-capture fisheries, there are inherent and fundamental differences between the two practices that may make this far from ideal.

Keeping people connected to the sea, where their knowledge and skills base and a feeling of competency and ownership can continue is of paramount importance (Pollnac and Poggie 1988; Diener 1997). The direction of this plan, then, should be carefully considered. When fishermen become employees of large firms, such as the situation in Chile, much of this is in fact lost. A better solution is to provide them with the same basic autonomy that is basic to fishermen's characteristics, by forming small-scale aquaculture operations where the same degree of ownership and knowledge are maintained.

The Aquaculture Revolution on Chiloé

During the past decade, aquaculture has developed significantly in Chile, though it has been an active industry in the region since the early 1980s. Aquaculture is generally perceived to be a profitable activity, economically and socially, and has thus established itself as an industry destined for expansion. As a result, however, dramatic social change

has occurred since the inception and rapid expansion of aquaculture in Chile, most notably in traditional fishing communities along the southern coast and Chiloé island. Therefore, the future of aquaculture in the region will be highly dependent upon the resilience of the economic and social institutions that are now dependent on the industry.

Aesthetically, aquaculture has changed the seascape of the Chiloé archipelago as much as agriculture has on land, though on a much faster scale, as depicted in figure 6.1. It appears, when looking onto the bays from land, as though the plots of farmland have slid off into the water, as the squared-off individual concessions give the look of crops in the water. Navigation of larger vessels has become more difficult since the sea is now cordoned off by private property. The shoreline is littered with plastic and foam pieces that have been broken off of the floats that suspend mussel chains. The salmon companies employ armed guards to deter theft and net breakage, while the smaller farms have their own means of theft and vandalism deterrence, usually a 24-hour watchman. Unguarded, a concession is quite likely to be robbed, not so much out of desperation for the product, but more out of spite and a feeling of vengeance by local residents. Granted, if there is no threat of an armed guard, taking a chain full of mussels is a lot easier than spending several hours underwater looking for them.

Figure 6.1. View of the Chiloé seascape near Quellón on the southern part of the island. This photo is representative of many parts of the archipelago, where both mussel and salmon chains and pens are taking up more and more of the space.

There are some aquaculture activities in the world that are destined to be an aid in socio-economic development among the rural poor (Drewes 1986; Pollnac 1982; Pollnace and Weeks 1992), but in Chile, because it started 25 years ago on a large-scale operational level, it is driven by economics for the most part. Unfortunately, the primary aquaculture product in Chile is an elite product destined for only a small percentage of the world's population. This is problematic for several reasons. First, what might be a widely available protein source is now an elite consumer item. These are salmonids in Chile, and shrimp in Ecuador, Thailand, and India. Much of the new research and

development worldwide is still focused on these high-end consumer products, mostly exported to Europe, the United States, and Japan. Mussel aquaculture in Chile is a large exception to this rule. Second, the technological overhead for farming many species, especially carnivorous fish, is so immense that only corporations can afford to run their production, and in the case of Chile, these corporations are mostly foreign-owned. Third, the corporations rely on local labor and return little to the local economy. In short, they are depleting the local environment and limiting access to resources, while channelling capital away from its source.

The majority of the aquaculture firms on Chiloé are salmon producers (*Oncorhynchus mykiss, Oncorhynchus kisutch* and *Salmo salar),* followed by mollusks (three species of Mytilids - *Mytilus chilensis, Choromytilus chorus* and *Aulacomya ater*) and oysters (*Tiostrea chilensis* and *Crassostrea gigas*) and the scallop *Argopecten purpuratus*. The agarophytic seaweed *Gracilaria chilensis* is currently the only cultivated species of sea algae in Chile (Buschmann et al., 2000).

Development of Primary Aquaculture Species in Chile

Table 6.1. Aquaculture Harvests by Farmed Species, in tons. Data source: Directive of Fisheries and Aquaculture, The Undersecretary of Fisheries, 2003.

Species	1996	1997	1998	1999	2000	2001	2002
Selly weed (pellilo)	105,212	102,767	68.368	31.278	33.471	65.538	14.597
Red abalone	8	1	1	48	66	73	60
Giant mussel	199	188	32	566	295	506	1,078
Chilean mussel	6,064	8,635	11,911	16,203	23,477	34,648	41,648
Blue mussel	298	261	353	477	224	292	330
Peruvian scallop	9,779	11,482	16,474	20,668	19,018	18,534	14,460
Chilean oyster	526	328	247	291	200	229	294
Pacific oyster	1,776	3,203	4,076	5,441	5,641	7,089	3,728
Turbot	168	278	426	333	259	303	217
Atlantic salmon	77,327	96,675	107,066	103,242	166,897	253,850	248,407
Coho or Silver salmon	66,988	73,408	76,954	76,324	93,419	136,870	94,927
Chinook or King salmon	341	738	108	208	2,524	3,807	2,248
Rainbow trout	54,429	77,110	75,108	50,414	79,556	109,895	105,410
Total	**323,115**	**375,074**	**361,412**	**305,493**	**425,057**	**631,634**	**527,404**

Salmonids

In 1905, the Chilean government began to show a strong interest in the subject of aquaculture based on the practice that had begun in the northern hemisphere to compliment decline wild salmon stocks. The Chilean initiative brought a small amount of Atlantic salmon (*Salmo salar*) and rainbow trout (*Oncorhynchus mykiss*) eggs to Chile via a purchase in Hamburg, Germany. The eggs were priority shipped to Buenos Aires, then by train to Mendoza, and then carried over the Andes by mule to their destination of Los Angeles in Region VIII on a fish farm on the Blanco River built in 1904. This farm had the success of producing the first farmed salmonids in the country. This marked the inception of farming trout in propertys to stock rivers and lakes that by 1914 became the center of development for sport fishing in Chile. By 1930, 114 thousand sockeye salmon eggs and 225 thousand coho salmon eggs had been imported from the United States, but due to lack of technology and environmental expertise, the majority of these stocks failed. The state then began to solicit and rely heavily on external expert advice, most notably consultants from North America, specifically the Canadian firm Hartfield International, who were responsible for providing scientific expertise under the Ministry of Agriculture, which would later become Sernapesca, the National Fisheries Service. This promoted government interest in training nationals in areas related to aquaculture. University programs were created in marine biology, oceanography, fisheries engineering, as well as the establishment of agencies for research in aquaculture, like the Instituto de Fomento Pesquero (IFOP). This institution, founded in the mid 1960s, was supported by the Chilean government and the Food and Agriculture Organization (FAO)

of the United Nations. This organization was instrumental in establishing the foundation of Chilean aquaculture, not just for salmon, but for shellfish as well (Vergara 2003).

Salmonids are not native to Chile. Salmonids are fishes of the Family Salmonidae, which includes 66 diadromous species native to the northern hemisphere (Fishbase 2005). They were introduced in Chile and the southern hemisphere in the late nineteenth century through deliberate importation and release into rivers and lakes for use as a sport-fishing attraction. During the latter part of the twentieth century, interest arose in the production of these species for direct consumption. The technology for salmon farming was at this time being developed in the United States and Norway, and was imported into Chile along with the eggs, marking the inception of an industrial explosion on the sea.

The 1970s saw, under the dictatorship of Augusto Pinochet, an aggressive plan of privatization, industry-deregulation, and export-oriented resource extraction. The general strategy of this regime was to promote private business as the motor for economic growth by subsidizing and deregulating large-scale commercial operations, opening the door for resource over-exploitation by allowing almost unregulated use of the southern fjords and estuaries. These changes were significant for the Chilotes, who had never been a part of the national or international market. Commercial fishing fleets began to arrive, and many Chilotes found work as processors aboard the ships, dramatically changing their way of life forever. The second wave of change took place in the early 1980s with the introduction of corporate aquaculture in the region (Lomnitz and Melnick 2000). Currently, 64 percent of all salmon production companies in the country are Chilean property (Vergara 2003), distributed among Chile (62%), Norway (16%), Holland (12%), Japan (5%), Spain (4%), and Canada (1%) (SalmonChile 2002).

The beginning of the 1980s marked the inception of salmon farming in Chile as a large-scale commercial industry (Barton 1997), spearheaded by funds from Pinochet's dictatorship and the U.S.-based ITT Corporation (Paley and Dubois 2006). The effort, from the beginning, was aimed at reaching the international market, thus differentiating the process from aquaculture in the development sense. The state was involved from the onset, creating the Regional Planning Service in Regions X and XI, which together with the Office of the Undersecretary of Fisheries developed and financed feasibility projects to farm salmon with foreign technical and financial aid. Technology during this time was nascent, and most companies had to construct their own equipment and infrastructure, including pens, platforms, nets, and moorings. The first floating structures, for example, were wooden net pens constructed by local carpenters, under the guidance of a technician and based on photographs (Caniggia 1997).

In 1981, salmon production had reached 80 tons. Investigation into the research and implementation of new technology was rampant, as was the creation and exploitation of new sea farm sites. The final state initiative to introduce salmon in Chile was through the Office of the Undersecretary of Fisheries and the Canadian International Development Agency (CIDA), implemented by a Canadian consulting firm aimed at the evaluation of water resources to farm salmon in Chile's southern regions (Vergara 2003).

In 1984, the Norwegians came to Chile to expand their market. Their rationale was that it would be more cost efficient to supply other countries in South America with salmon farmed in Chile as opposed to Europe, due to cheaper labor and cheaper exporting costs. The real expansion began in 1986, and continues to rise. This same year, the Association of the Salmon Industry in Chile, or SalmonChile, was established. The

association includes 17 companies, and is driven by the idea of establishing standards for quality, and to promote Chilean salmon internationally. The very next year, the first salmon were exported to the United States, brought from Chiloé on boats in wood boxes with ice. They were processed at the plant, packed in Styrofoam and ice, and sent to the airport for direct export (Vergara 2003). In 1990, the industry began developing salmon reproduction in Chile, producing the first generation of coho salmon eggs, initiating scientific advancement in the country, and establishing internal research and development. By 1985 Chile joined the group of top salmon and trout producing countries. The beginning of the 1990s marked a milestone in Chilean salmon farming, when the first generation of coho salmon eggs were obtained nationally (Sernapesca 2004). At this point, Chile became independent from the supply market and was able to experience explosive growth on an international market scale, with farmed salmon accounting for 63% of all fish exported from Chile (Paley and Dubois 2006).

Algae

Commercial production of algae in Chile dates back to 1968, with the farming of pelillo (*Gracilaria chilensis*). The first private, commercial farm established operations in Region III in 1976, and in 1982, pelillo was farmed with the objective of providing it to the agar-agar industry, which uses it as raw material in processing (Vergara 2003). Agar-agar is an additive used as a stabilizing agent and thickener in products such as ice cream, canned soup, and soy-based “meat” products. In non-food items, it is used as a binder in cloth and paper manufacturing, in dentistry, and cosmetics. Carrageen and alginates,

other commercial derivatives of seaweed, have also increased demand for seaweed, and the value of exported algae is on the rise.

This industry has also been tightly interwoven with artesanal harvesters. In the 1980s, Chile was undergoing an economic crisis (Rector 2003). As a result, many people, not just fishermen, began harvesting pelillo, mostly in Region X because of its ease of extraction, abundance, and economic value. Pelillo is easy to harvest, since it is found on the beach at low tide. In a rowboat, pelillo can be harvested near-shore with a diver. The uncomplicated procedure of pelillo harvesting and subsequent explosion of harvesters caused there to be a collapse of the natural population in the mid 1980s, leading to an indefinite ban on harvests (Silva 1987), which was lifted, incidentally, in 1995. Because of its increasing economic importance on the international market, significant research in the area of algae farming was carried out in the 1990s, and an improvement in the quality and quantity of algae biomass was established. A Chilean company, Algamar, is now the world's leader in algae production. Luga, in its black and red forms (*Sarcothalia crispata* and *Gigartina skottebergii*) is an artesanally harvested algae that has evolved into the realm of aquaculture. This new species production became established due to initiatives that promoted the diversification of use, mostly by-products associated with the carrageen industry.

At the beginning of the century, Chile was farming 21 species of marketable algae, with the majority of the 382 farms now located in Region X, producing 46,388 tons in 2004. Wild harvest landings are still significantly higher than cultivated algae, totaling 410,850 tons in the same year (Anuario Estadístico 2005). The relative ease of farming algae presents an opportunity for small-level operations or groups with low-level

initial capital to exploit the industry. The most productive pelillo farm, for example, was a started by approximately 600 fishermen who have organized a cooperative and an association, growing and marketing algae produced on over 100 hectares of marine concessions in Region VIII (Silva 1987).

Shellfish

The most predominantly farmed species in this category are mussels, followed by oysters and scallops. Mussel farming is one of the oldest aquaculture activities in Chile, beginning experimentally in 1943 in the southern portion of Chiloé Island. The government established the first mollusk farming operations on rafts and long lines in other areas of Region X in 1967, using French and Spanish technology. This effort was the first state operated aquaculture, and was run by the Institute of Fisheries Promotion (IFOP) and the Division of Fishing and Hunting, under the department of agriculture (SAG) (Aquanoticias 2002).

Until the early 1990s, this original system did not change, and was managed on an almost exclusive small-scale basis, as it was since its inception at this scale in the 1960s. Despite the participation of the Universidad Austral de Chile with the goal of motivating the private sector in to this activity, the advances were still marginal. This sector remained a secondary and small-scale activity until the early 1980s, when larger firms began the effort in earnest in terms of both national and international distribution. It was not until around this time that the native species of *Mytilus chilensis* (el chorito) was farmed, and this only because demand was rising and wild stocks were depleting. The

first species farmed (*Aulacomya atra*) was also a native species, though much less ubiquitous and with a longer maturation period (Revista Mitilicultura 2005). Today, choritos represent 98 percent of farmed mussel production in Chile (Sernapesca 2005, Aquanoticias 2002). Unlike the salmon farms, mussel aquaculture is still dispersed, probably due to its humble origins. Dispersion in this case means that in the majority of the cases, seed farms, species cultivation sites, processing plants, and exporters are usually separate entities, neither functioning as a whole nor as a single corporation. The vast majority of firms are small-scale, producing a maximum of 2,000 tons of primary product.

Oysters have also entered the market recently, though still only around three thousand tons are produced a year (Vergara 2003). Compared with France's 100 thousand tons per year (FAO 2005), this hardly seems worth mentioning, but it is growing, along with scallops in the northern regions. Oysters are still a domestically marketed product due to extreme competition with Pacific oysters produced elsewhere that have a higher international market value. The shellfish market in Chile is now focused on abalone as a high-end product, and it is the newest species to enter Chilean aquaculture. Technology and marketing of this species are still in the initial stages, though it looks to be a promising enterprise due to market demand.

Naturally, foreign interest in Chilean aquaculture has risen in the past decade, and Spanish companies came in during the latter part of the 20th century with comprehensive processing plants for mussels, thus establishing an important industrial purchasing power. This change from an artesanal practice to an industrial scale was massive and fast, bringing with it an explosion of mussel aquaculture centers and subsequent growth (see

figure 6.2). This rapid change by industrialization is not uncommon, as documented by Durrenberger in the history of Alabama's seafood processing (1992). Spain is still today the primary market for the Chilean mussel industry, worth $32 million in 2004, double the amount from the year before (El Llanquihue 2004), with 70 percent of the production slated for export. Worldwide, farmed mussels account for 71 percent of the total, while wild harvests represent only 21 percent (Aquanoticias 2002). The growth of mussel farms in the region has been phenomenal, and shows no signs of slowing down. In 2001, 263 new proposals were submitted, approximately half of which were set-up around Castro, the capital city of Chiloé.

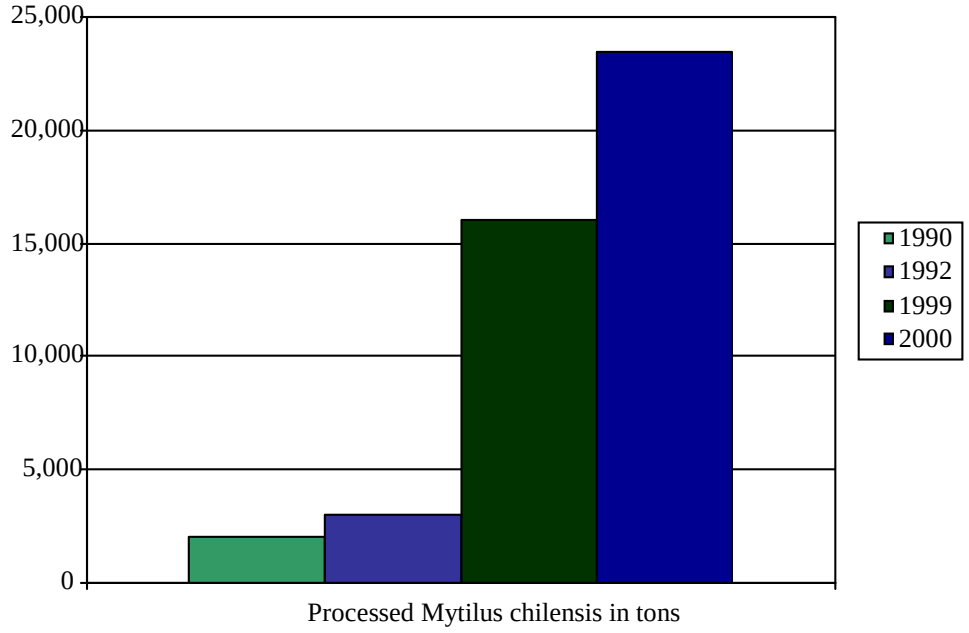

Figure 6.2. Chile's mussel aquaculture production in tons 1990-2000. Data source: Anuario Estadístico, Sernapesca.

As a product that is easily farmed, there is much worldwide competition in the production and marketing of mussels. The Chilean mussel industry faces some strong adversaries on the international market, such as distance, and an increasing occurrence of red tide. However, the most common species farmed (*Mytilus chilensis*), is favored in some markets, keeping it relatively strong. Today, mussels are farmed using the French long line system with a float, usually styrofoam or plastic, on top. Again, due to water quality and geographical conditions, this industry is also concentrated in Region X, specifically within the Chiloé archipelago, where about two thirds of the production exists. Currently, there are 391 mussel production sites in this region, and 570 new applications for production sites during 2001 (Sernapesca 2003).

The mussel industry's burgeoning popularity has inspired more cooperation than usual out of necessity for dealing with the high costs of monitoring and marketing. The Association of Mollusk Farmers of Chiloé is an excellent example. The association consists of 40 firms of all sizes, but non-corporate and mostly family owned. The association has been in existence for 17 years, with the initial objective of establishing a group to create a nexus between the members and the government. There were 11 producers in the beginning, and they were all family firms that cooperated together for a voice in legislation and to facilitate marketing. Unfortunately, according to these associates, the industrial sector quickly discovered that mussel farming was a good and simple resource, creating more competition for the family farm and marginalizing them once again.

According to some mussel farming associates, law enforcement of the mostly environmental laws put into place in 1986 were not actually enforced until recent years.

To them, enforcement of environmental laws, in addition to ensuring a more reliable product and practice, means high costs to the producers. In order to export their product, they must be accredited, which is becoming more of a criterion for the domestic market as well. Accreditation is very expensive, and therefore, most of the small firms are not accredited. Cooperation, it seems, is the only way for these firms to compete in the growing market, though they have not yet reached the stage of the industrial firms, where all services are housed together, from seed to processing to export. Therefore, they are forced to go through middle-men for most of these services, which in turn raises the prices. For these small firms, the production costs amount to 60 pesos a kilo, and their net gain per kilo is 40 pesos. Their profit, then, is 20 pesos, or approximately $.37 per kilo of final product. Clearly, cooperation would be an advantage in this situation. However, based on conversations with members of the association, as with fishermen, personality is often said to be the deterring factor for cooperation. While this is what they say, there are most likely other reasons for the lack of cooperating to create these services, though they are unclear. History shows that fishermen are not actually too independent to self-organize, as the folk model would indicate, but that in case the case of the U.S. in the 1930s, their unions were redefined as firms in order for the government to fix prices (Durrenberger 1996). This is changing, though, as some organizations are promoting cooperation in terms of technological advancements for issues such as these, and other, more pressing issues, like traceability. Survival of the family firms is becoming more and more reliant on the ability to cooperate, and attitudes are changing in an effort to remain competitive. The benefits of being a member of the association are much like those of a cooperative, though the members don’t see it as such, since they do not share production

duties cooperatively. Like a cooperative, however, by joining forces at this administrative level they are given institutional power and a voice that they otherwise would not.

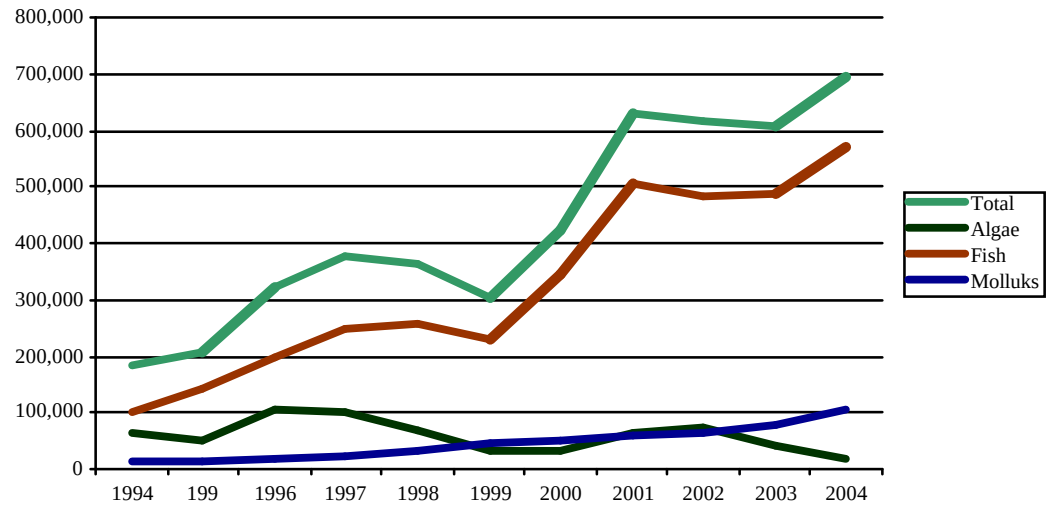

Figure 6.3. Chile's aquaculture firm harvest by species (in tons) 1994-2004. Data source: Anuario Estadístico, Sernapesca.

Associated Ecological Issues

Southern Chile's ocean temperatures and coastal geography provide an ideal environment for aquaculture, and in particular, salmon farming. These favorable conditions, coupled with the availability of cheap labor in Chiloé and other rural areas in the region, have led to extreme and rapid expansion of the industry (see figure 6.3) This rapid expansion, initially fueled by economics rather than sustainability, has created some problems that have yet to be resolved. Due to the nature of the industry, environmental issues are inextricably linked with aquaculture. There are many critics of the industry, even though it is strongly backed by the government and some development agencies. The popular criticism is that salmon farming is environmentally destructive, and it is

when carried out at the current scale and level of intensity. There have been few studies to date regarding the effects of large-scale mollusk farming, though it is generally thought to have less of a negative impact than salmon.

When salmon are caged at unnaturally high densities, they become more vulnerable to disease, which in turn requires the use of antibiotics, potentially affecting other species and humans through consumption (Cabello 2004). Disease can also be spread to wild species, and some reports indicate the transmission of sea lice from farmed to wild salmon, which can lower fitness and even lead to death (Krkosek 2005). Studies also show that farmed Atlantic salmon (*Salmo salar*, the salmonid species preferred in aquaculture) has significantly higher levels of contaminants than wild salmon, potentially posing a human health risk at specific rates of consumption (Hites et al. 2004; Jacobs et al. 2002).

A more historically documented issue is the destruction of the ocean benthos in the sea column beneath salmon farms. Antibiotics, disinfectants, food, and salmon waste accumulate, resulting in hypoxia, meaning an oxygen depleted “dead zone”. This can cause devastating consequences to benthic species and even the surrounding ecosystem (Chou 2004). A typical farm holds several pens, usually occupying a total area of 10 hectares. There are more than 1,000 farms in the waters surrounding Chiloé, meaning there could be approximately 10,000 hectares of damaged ocean floor, that, according to a study at the Universidad de Chile, can take up to 135 years to return to normal ecological conditions (Sandoval 2002). However, research into the environmental effects of salmon farming is still nascent, and much more is needed in order to provide definitive

evidence of contamination on a scale larger than directly beneath the pens (Soto and Norambuena 2004).

Though it is mostly speculative, some environmental groups, based on scientific studies carried out through their own funding, suggest that red tide – *marea roja* - may also be caused and/or increased by salmon farming (Oceana Chile 2005). There is no question that algae blooms directly below salmon pens are a result of increased nitrogen loads from salmon feces and non-consumed food pellets (Ruiz et al. 2001). These blooms however do not necessarily equate to red tide, or more correctly, harmful algal blooms (HABs). HABs can be caused by different species, of which most commonly found in Chile is the dynoflagellate *Alexandruim catenella*. When a bloom occurs and is processed through the feeding mechanism of bivalves, it can be toxic to humans well before the fish kill levels are reached through the consumption of dynoflagellate populations accumulated in bivalves. This is a specifically important issue on Chiloé, where bivalve aquaculture in an important and growing industry, not to mention its importance as a foraged subsistence supplement. This problem seems to be increasing in frequency on Chiloé, causing some panic in the mollusk aquaculture industry, as well as local populations that depend on the resource for income as a foraged species and a nutritional supplement. In 2002, three people on Chiloé died from eating contaminated shellfish, and many people lost their jobs after closures in the industry occurred. There were closures across the board in Chiloé's coastal waters from 80 days to nine months, causing the area to be declared a disaster zone (IAEA 2004). This has had, and will continue to have, severe and dramatic consequences for the people of Chiloé and to the nation if the problem is not controlled in the future.

Facing this potentially disastrous situation, the mussel production industry in Chile is attempting proactive solutions to this problem. Water quality and product toxicity monitoring is permanent and dispersed in the X Region, funded by Sernapesca, the Chilean National Fisheries Service, and the National Health Ministry. While this monitoring is critical to the industry, it still does not decrease the growing negative association with Chilean mussels resulting not from an epidemic of infected people, but from the fear of consuming the product in the first place because of the widely publicized outbreaks of HABs. Having a system in place that eliminates the risk of consuming infected toxic shellfish is the only solution to maintaining this burgeoning industry, and one that Chile is working hard to deliver. The export market is more closely monitored than the national market, though certification is still voluntary. Without certification of the product, however, producers are not able to export. The certification process is a basic water quality test that takes place every 15 days, or more when an alert has been posted.

This certification process is the financial responsibility of the producers, and not the state. These tests can be rather costly when the cost of the boat, captain, and water quality expert are all factored in. This can prove to be the hindrance that keeps small-scale operators out of business. One solution, already in effect in some areas, is to form a collective of neighboring small farms. If their areas of operation are close enough together, the water test can apply to the four or five farms, thus cutting the cost to a more manageable amount. This strategy, however, requires an amount of cooperation that is not easy to achieve between strangers, and is therefore not common practice among the newer mussel farms.

The salmon also escape. As mentioned earlier, this is due to various forces, including weather, marine mammals, and humans. In the past ten years, one million non-native Atlantic salmon have escaped from fish farms and established themselves in streams in the Northwest United States alone (The Economist 2003). It is unclear how many have escaped in Chile, though since salmonids are a non-native species, they have the potential to seriously disrupt southern Chile's marine biodiversity and ecosystemic structure when released into the wild. Salmon are carnivorous, and in this region they tend to prey on species with a high economic value, especially for artesanal fishermen, such as merluza (*Merluccius gayi gayi*) and róbalo (*Eleginops maclovinus*). It is estimated that nearly one million of these salmon escape annually, and that the rate of escape is 1.5% of the total produced in Chile (Ecoceanos News 2003). Many Chilote fishermen attribute the decline in near-shore fin-fish to the salmon farms, usually, however, from a more indirect causality such as contamination. Studies are currently underway to assess salmon's ability to colonize natural environments (cf. Fleming et al. 1996), and to assess the practicality of allowing a capture fishery in order to curtail their potential naturalization (Soto et al. 2001).

New regulation is constantly in the works as this critical industry works its way through an adaptive process and finds itself in the midst of major ecological controversy. If the Chilean, and other governments involved in this industry want to see it continue, they will have to appease environmentalists and consumers who are increasingly more concerned with the viability of the product. 2001 saw regulations that specified distance between farms, meaning that one mussel farm to the next had to have 200 meters of separation, and a mussel and salmon farm had to be separated by 400 meters. The water

column has to be tested on a monthly basis, pen rotation must regularly occur, and certification is necessary if the product is destined for export. Interestingly, having the mussels mixed in with the salmon farms is bringing the issue of polyculture into play, even if circumstantial. There have been no studies of the effects of mussels on salmon farms on this level, though as filter feeders, their potential contribution to cleaning waste from their neighbors is probably more than negligible. As a marketing strategy, too, their proximity to salmon farms aids in their marketability. Salmon feed, spiked with a colorant to turn their flesh pink (as is natural in wild species due to the intake of krill) drifts to the mussel chains and has a similar effect on them, making their flesh a darker, salmon colored hue. Oddly, this is preferred on the international market even though it is unnatural for most mussels to be this color, since it is impossible for them to eat the krill (euphasiid shrimp) that give carnivorous salmon their pink color (Personal communication. Chonchi 2004).

Commercial Aquaculture Regulation in Chile

Commercial aquaculture in Chile began under what is known as “the old fisheries legislation”, comprised of Decree by Legal Force (DFL) No. 5 of 1983, which was a revision of DFL No. 34 of 1931, a piece of legislation that oversaw the fishing industry and all of its derivatives. The governmental decision that served as the landmark for today’s institutional structure, and the generation of new regulations, was the transfer of responsibility for all national fisheries activities from the Ministry of Agriculture to the Ministry of Economics, Development and Reconstruction. This institutional change was

the catalyst for the creation of the Office of the Undersecretary of Fisheries in 1976 and the National Fisheries Service in 1978 (Sernapesca 2003). The former is the organization in charge of proposing and promoting policies and sector regulations, and the latter is responsible for their execution and enforcement.

Nevertheless, it was not until 1991 when the *Ley General de Pesca y Acuicultura* (General Law of Fishing and Aquaculture - LGPA) took effect that the granting of aquaculture concessions – including all other maritime permits – was realized on behalf of the Ministry of National Defense, via DFL No. 340 of 1960 and Decree No. 660 of 1988. Along with the LGPA came concepts that were not specified in the previous regulations; for example, that the type of permit required for an aquaculture operation depended upon the location of the activity and the characteristics of the watershed to be used. Thus different types of aquaculture permits arose, concessions, authorizations, and other permits pertaining to private lands (article 24 of the Regulation of Aquaculture Concessions and Authorizations). In contrast with the other types of marine concessions, still pertaining to the older and more restrictive law, the new aquaculture concessions and authorizations are granted validity for unlimited lengths of time and can be sold, rented, or transferred. Disputes amongst marine concession applicants may occur regarding these differences or rights for public space usage (Sernapesca 2003; Vergara 2003). This change has been extremely relevant, however, since it has implied new specifications regarding the use of territorial space, as well as environmental and sanitation measures (Aquanoticias 2002).

In Chile, the rapid rise of aquaculture outpaced the establishment of legal institutions and regulations. In an effort to promote economic gain, infrastructure and

technology was advanced well before regulatory efforts were implemented. The principle regulating agency for aquaculture was not established until 1991, when the General Law off Fishing and Aquaculture (LGPA) was written. This regulation introduced important changes to the aquaculture sector, most notably the ability for permission to attain transitory occupation permits, while also annulling the payments required for specific occupation licenses for small aquaculture initiatives. This falls within Title Five of the LGPA document, which organizes authoritative bodies, and delegates responsibility with regard to the regulation of all sectors of aquaculture. The proper authorities within the State regulatory institutions must review any activity related to the cultivation of hydrobiological resources, from the granting of permission to the development of its operation. These institutions include, but are not limited to: the Office of the Undersecretary of the Navy, the Office of the Undersecretary of Fisheries, the National Fisheries Service (Sernapesca), the Hydrographic and Oceanographic Service of the Navy, the Merchant Marine and Maritime Territory Authority, the General Water Authority, the National Borders and Frontiers Authority, the National Commission for the Environment (Conama), and the General Treasury of the Republic (Vergara 2003).

Enforcement can take many forms, depending on the scale of the aquaculture operation. Theft and vandalism is a fairly common problem. I often encountered people who had access to boats with two or three mussel chains, for example. The smaller mussel farms must employ a guardsman to monitor the concession day and night. This can be a family or cooperative member, or someone well known to the owner who often lives and works on the property. The larger salmon farms have a standardized system of enforcement, often with armed guards, though the guns are for the sea lions that often

break nets in order to feed on escaped salmon. The Police Force of Chile is also included within the range of controls established by the National Fisheries Service and the Merchant Marine and Maritime Territory Authority to oversee regulatory compliance.

A notable limitation within the current legal framework is its focus on regulating production activities, without much regard to other realms such as experimental or educational practices. To this end, the National Policy for Aquaculture (PNA) emerged as a new universal regulatory agency that will oversee all scales of operation in this sector. This organization is also charged with the promotion of growth in the aquaculture sector, though the new principles laid out in August, 2003 by President Ricardo Lagos are specifically geared toward sustainable development and equal opportunity.

Authorized Areas for the Practice of Aquaculture (AAA)

Chile is at a geographical advantage with regard to aquaculture, owing to its environmental conditions that are suitable to a variety of aquaculture activities. This however poses a conflict between other users competing for access and use of the coastal border, specifically fishermen. There has been some legislation to this effect, though it appears to still favor large-scale aquaculture operations over all else. The legislation, Article 86 of the LGPA established that areas of ocean beaches; public beach lands; areas of water; seafloor and rock in and around bays; and rivers and lakes that are navigable by vessels of over 100 tons; which have been classified as Authorized Areas for the Practice of Aquaculture (AAA) by one or more supreme decrees issued by the Ministry of National Defense, may be granted aquaculture concessions in those areas (Vergara 2003).

The clear intention of this article was to facilitate the process of assigning spaces, which was done case by case, with respect to the older regulation. On the other hand, with regard to non-navigable rivers, aquaculture concessions can be granted only for segments that are affected by tides and with respect to the properties or sectors specified. The Official Listing of Navigable Lakes and the Official Listing of Navigable Rivers were established in 1998 by supreme decree, both pertaining to vessels over 100 registered gross tons (RGT). For the rivers and lakes not included in the list, the Office of the Undersecretary of Fisheries must authorize the development of any aquaculture activity. Exceptions to this rule are those activities developed within closed bodies of water, or rather, waters that start and finish within the same ecological property (Sernapesca 2004). These activities, however, are not excluded from complying with the health and environmental regulations, and those who carry them out must register in the National Aquaculture Register before starting any activity.

The Office of the Undersecretary of Fisheries is responsible for preparing the technical studies necessary for the determination of the AAAs, and must consult the corresponding organizations in charge of the alternative uses of the lands and waters, taking into special consideration the existence of hydrobiological resources or the capacity for their production, and the protection of the natural environment. Also taken into consideration are the non-industrial or artesanal fishing areas and communities; the tide water access between islands; the exits of ports and coves; the anchored boundaries of the national territory and areas used for naval exercises; the interests of tourism; and the protected areas constituting National Parks, Reserves, and Monuments. The granting of aquaculture concessions and authorizations is prohibited in areas where there are

natural beds of hydrobiological resources, including forests of natural algae. The AAA's are not excluded from realizing other activities, as they simply constitute a regulative plane upon the national territory where it is possible to solicit a space for the cultivation of hydrobiological resources. To date, the marine waters of some regions have not been defined according to AAA standards, and there are still no AAA's for land-based waters (Sernapesca 2004; Vergara 2003).

National Policy and the Use of the Coastline

In 1994, Supreme Decree No. 475 of the Ministry of National Defense established the National Policy for the Use of Chile's Littoral Coastline. This policy is a multidisciplinary and systematic application to promote compatibility between the multiple activities carried out along the coast boarder. In addition to other objectives, the policy promotes developments that are balanced, integrated, and harmonious, maximizing the rational use of areas, preventing the possibility of more requirements in the future, and taking into consideration the current use. The preferential, specific uses are determined by considering the geographic and natural factors, the existing resources, the plans of development, the neighboring and distant populations, and the definitions of uses already established by the relevant organizations. In order of priority, the specific uses are: ports or other installations of similar use; industries of boat construction and repair; regularization of new or existing fishing villages and settlements; public use of areas for recreation and leisure; and activities related to economic development such as tourism, artesanal or sport-fishing, aquaculture, commercial fishing, and mining. The resulting

legislation and definitions adopted must be considered foremost for those areas that the State or its related institutions see as a potential for specific developmental projects, or need to reserve for future projects. The legislation and definitions adopted must give priority to those areas that have a potential for specific development projects, or where the State or its related institutions determine the need for an area's preservation for future projects (Sernapesca 2004; Vergara 2003).

Limitations to the Use of Space

With the objective of constructing the adequate usage of the nation's pubic resources, DS No. 550 of 1992 from the Ministry of Economics, Development and Reconstruction, considered the dimensions and nature of the elements that are utilized in aquaculture activities as well as the hydrobiological resources to be farmed, differentiating between algae, mollusks, and salmon and trout. Technical projects that pertain to resources or technologies not considered by this regulation are not evaluated in relation to the maximum surface area used for the aquaculture industry. In other words, aquaculture sites using the latest technologies available are not limited by the space restrictions in their concession. With regard to the use of spaces, the required distances in between aquaculture sites are stated in the Environmental Regulation and the Sanitation Regulation for Aquaculture (Vergara 2003).

The National Register of Aquaculture dictated by DS No. 499 of 1994 of the Ministry of Economics, Development, and Reconstruction, is built upon a computational database, which makes available as public information on the names of the participating

representatives. Registrations in the National Register of Aquaculture, which are obligatory and constitute a formality that must be fulfilled to practice aquaculture in Chile, can be annulled by judicial resolution on grounds of having incurred in causes for cancellation by resignation of holder of registration or registration assignment, transfer or transmission of ownership. The National Fisheries Service is in charge of registering all holders of concessions and authorization. It is also responsible for resolutions assigning, transferring, or leasing concessions, and persons carrying out aquaculture activities who do not require aquaculture concessions or authorizations (Sernapesca 2004).

Aquaculture Law and the Environment

When the Basic Environment Law (LBMA) took effect in 1994 (Law No 19,300), aquaculture was included as an activity to be reviewed under the Environmental Impact Assessment System (SEIA). This system stipulates that, before the Office of the Undersecretary of Fisheries can approve a technical project and grant an Environmental Permit for a Sector, it must have the consent of the Regional Commission of the Environment (CONAMA). This calls for observations and pronouncements over the base of faculties and legal attributes from the following institutions: The Maritime Authority; Regional Office of the Agriculture and Livestock Service; Regional Water Authority; Regional Office of the National Tourism Service; Regional Secretariats of the Ministries of: Housing and Urban Development, Agriculture, National Property, Planning and Coordination, Health Service, Regional Road Development, Regional Office of the

National Forestry Corporation, Office of the Superintendent of Health Services; National Fisheries Service, and the Office of the Undersecretary of Fisheries (CONAMA 2005)

The Environmental Impact Assessment System (SEIA) was modified in 2001 by means of DS No. 95, exempting small-scale projects from the above-mentioned assessments, which are expressly classified. In the same year, DS No. 320 of the Ministry of Economics, Development, and Reconstruction, issued the Environmental Regulations for Aquaculture (RAMA). These regulations established a series of new requirements for the environmentally sustainable development of aquaculture in order to prevent, mitigate, and correct associated impacts. It defined the environmental conditions that must be maintained in sectors where aquaculture is developed. The RAMA established clear rules regarding the granting and the operation of aquaculture sites, establishing stringent provisions demanding compliance with international environmental standards. Within its fundamental contents are: the setting of minimum distances between aquaculture concessions, which are differentiated according to whether the production systems are extensive or intensive; the measures to prevent and mitigate negative environmental impacts, and the elaboration of environmental reports for each aquaculture site. Regarding the operation of the last two, various conditions must be fulfilled, like maintaining the work area and surroundings clean, proper solid and liquid waste disposal into appropriate containers and in conditions that are not harmful to the surrounding environment, reclamation of the area after shutting down the farming center, removing all kinds of support systems, prevent the physical contact of aquaculture systems with organic sediments, and have a contingency plan to address each circumstance that may involve risks of environmental damage (CONAMA 2005).

Future of Aquaculture in Chile

While all of these environmental regulations are a start to the sustainable development of the industry, their compliance still has a long way to go. The fjords and coastline are littered with broken and abandoned infrastructure such as cages, floats, and nets, and there is evidence of sedimentary and benthic contamination. Regardless of the cause and effect of contamination, fishermen are in a tight battle with aquaculture farms over species availability, rights of access or common property, contamination and environmental justice, and ultimately, for their existence. While fishermen and various NGOs are calling for a moratorium on the expansion of the salmon industry in order to curtail some of these major environmental impacts (Oceana Chile 2005), the Chilean government, with encouragement by lobby organizations such as the Association of Salmon Producers, is actively promoting an expansion phase for salmon companies. Through a project called “Salmon Valley”, the government hopes to spur the industry into doubling its salmon exports within the next seven years. More than 2,700 salmon aquaculture concessions were granted to companies in southern Chile during 2002 as part of the project, and approximately 4,000 more are expected to be approved in the next two years. Most of these new farms are slated for development in the largely untouched waters south of Chiloé, near Puerto Aisén. At this time, however, there is a push to make part of this region a biosphere reserve, which would disallow much of the farming in the area in favor of biodiversity conservation. The Cape Horn area achieved that designation from UNESCO in 2005, the first in Chile since 1984, establishing precedent for sustainable growth.

On the positive side, research is continually being carried out to improve farming practices on an international scale. In Chile, some universities have dedicated aquaculture institutes, funded by the government. As a relatively new industry, large-scale aquaculture has been in a constant state of adaptation. For example, the conversion ratio of food to product began at around five to one, meaning it took five kilos of fish protein to produce one kilo of salmon. The food was historically based exclusively on fishmeal and fish oil, extracted from certified sustainable fisheries (anchovy and jack mackerel caught in Peru and Northern Chile). This method was inefficient, and food manufacturers have now improved that ratio to between .09 and 1.05 to one on the biological conversion rate, owing to a shift in the composition from predominantly fish to other sources of protein including soy, and ultimately a more efficient product (Personal Communication Juan Carlos Petersen, Salmofood 2005).

The recent ban on malachite green in salmon producing nations has had a positive impact on contamination and potential associated human risks. Malachite green is a synthetic dye used in the fabric and paper industry, though was used in the aquaculture industry as a fungicide, particularly to treat fish eggs. Leucomalachite, produced through the transformation of malachite green, may persist in fish tissues for periods long enough to be ingested by humans, and is a suspected carcinogen (Roberts 2003). Malachite green is still found in some farmed salmon because it is inexpensive and readily available, and some countries have more relaxed regulations and product testing (Roberts 2002). It may also be a result of non-point source contamination from paper mills and other manufacturing plants that use the substance. Chilean salmon exports are occasionally screened for the fungicide by importing nations, and recently several shipments were

returned for testing positive, though its use was banned in Chile in 2002.

Though salmon predominates in the Chilean aquaculture industry, other species are being farmed at significant rates. Some of these species, like mollusks and seaweeds, can in fact be beneficial to the environment. Polyculture is being studied energetically at this point as a means to make some of the more waste-producing farmed species more sustainable (cf. Schneider 2005; Erler 2004; Neori 2004). While salmon still predominates in Chile, pelillo (*Gracilaria chilensis*), a seaweed, and the Chilean mussel (*Mytilus chilensis*), two endemic species, come in second to salmonids, a favorable sign that will be discussed in greater detail in future chapters (See Table 1). There are also another 31 species in the experimental "technological transfer phase" including both native and non-native species of fish, mollusks, and algae (Vergara 2003).

In 2002, the government and private sector cooperated to create the first Clean Production Agreement (APL) that was signed in the tenth region, covering the largest geographic area in Chile of any such regulation. Salmonid producers, supply companies, feed companies, and others signed the document for a total of 43 signatures. Clean production means managing the farms through preventative measures aimed at minimizing point source pollution with the goal of reducing the risk to environmental and human health. The National Council for Clean Production under the Ministry of Economics was the responsible government agency of this legislation, clearly indicating that economic growth still takes precedence in these efforts. However, Six million US dollars were invested to raise the environmental standards of aquaculture across the board, including shellfish, and will standardize practices (Vergara 2003). Many of these

regulations, now and in the past, have been a result of international pressure to comply with import regulations.

It was not until 2003 that Chile established the National Aquaculture Policy (PNA) under president Ricardo Lagos. It took a while for legislation to come into sync with activity. This policy regulates the systems of access to aquaculture activities, while at the same time facilitates and expedites approval of salmon farm consessions. The document proposes to combine the multiple policies and legislative bodies, such as the coastal zone policy, to encourage cooperation in terms of the improvement of the sale process, to generate information, and to establish private-public alliances to improve company performance. The difficulty in this new policy is that it clearly favors the industry, and within the industry, salmon. A part of the policy actually states that it will "solve the lack of security for holders of concessions and authorizations with regard to the validity thereof, so that they can carry out transfers, transactions, and rentals of this *public use property* [italics mine], with the purpose of creating incentives for business opportunities"(Vergara 2003:104). This policy clearly favors industrialization despite complaints from every other stakeholder sector claiming use rights. The artesanal fishermen in this region are quickly losing ground as their product does not come close to competing economically, which in turn makes spatial competition virtually impossible. Even the mussel and other small-scale aquacultural enterprises are feeling the pressure of access ability.

The University of Chile held a conference on mussel cultivation in Castro, Chiloé in May of 2005. The objective was to create an interdisciplinary dialog surround best practices in the industry, and to promote sustainability. The conference was also

supported by a local NGO called Mareja Roja (red tide), who's goal is to promote sustainability and health in the both the wild and farmed shellfish industries. The overall themes of the speakers in this conference were standardization and traceability. The latter, again, stemming from issues relating to import regulations and spurred by the international community's desire for such information (Contreras 2005).

Chapter 7: Research Design and Methodology

Objectives

The principle objective of this research was to evaluate the psychological changes taking place among wild-capture fishermen who become aquaculture employees in the salmon industry on Chiloé, and to understand what impact occupation and/or change within either sector had on particular characteristics. The overall goal was to extrapolate this information to the community level and to discern whether these characteristics indicate resilience among any of the occupational groups measured. Given that the goal was to measure these variables during a transition, it was essential to use a design that would serve as a proxy to measure change, since no baseline data were available for comparison. It was also critical to develop a sampling procedure that would allow for making assumptions about the community as a whole.

My observations were focused on the major themes that are affected by the transition from wild capture fisherman to aquaculture employee, and the overall community and environmental consequences of this shift. Artesanal fishing on the island, as in many parts of the world, is in trouble, due to the significant decline of near-shore fish, as well as the high cost of fuel to low price of catch ratio. In Chiloé, those who focus on fishing as their primary occupation are now only doing so out of a lifestyle choice, and not because they are making a living from it anymore. Artesanal fishing in Chiloé has lost

most of its practitioners to the aquaculture industry, since a steady paycheck is initially too compelling to pass up, and a specific skills set is not required to do the job. This shift in occupational base has been significant in terms of the number of people changing household subsistence strategies in this region, in which case I thought it would be interesting to see what, if any, attitudinal changes might be happening along with this shift, and if in fact these fishing communities are better off with these aquaculture firms taking over the seascape, and if not, if there might be a solution. It was not until halfway through the study that a solution became apparent, and was added to the systematic design of the study in order to empirically test its relevance to resilience among these groups.

This research took place over an eleven-month period from September, 2005 to July, 2006, during which time I lived in the town of Chonchi, halfway down the east coast of Chiloé island. The majority of this time was spent conducting interviews with fishermen and members of the community, though this was only possible after extensive participant observation through which rapport was achieved.

Research Design

This research was carried out in two consecutive phases. Following the exploratory/explanatory design outlined by Johnson (1998), I used both qualitative and quantitative approaches to systematically and empirically test the propositions. Though the type of data elicited in each phase are distinct, the complimentary contribution of

qualitative and quantitative data and information provide for increased rigor, validity, and depth.

Exploratory Phase	Explanatory Phase
▪ Chained referral sampling ▪ Establish key informants and conduct unstructured interviews ▪ Participant observation ▪ Adaptation of established Perceived Well-Being, Job Satisfaction, and Environmental Values questionnaire ▪ Archival research	▪ Exhaustive and stratified random sampling among groups (N = 277) ▪ Administer structured questionnaire ▪ Formal interviews ▪ Data analysis in SPSS (one-way ANOVA)

Figure 7.1: Summary of research design, methodology, and analysis using exploratory and explanatory phases (after Johnson 1998).

Methodology

The methodology I designed to fit this context was to use a cross-sectional, proxy-longitudinal design in order to:

1) Establish baseline data for future research on this topic

2) Establish an indication of social change to empirically measure resilience.

I used a pre-existing questionnaire for each of the three indicators, which were all based on three or five point Likert scales. The questionnaires were adapted to fit the context, and pre-tested among a small sample group for cultural integrity. Adaptation was accomplished by using data collected from semi-structured and unstructured interviews.

Each questionnaire lasted approximately one hour, and included several additional open-ended questions.

Exploratory Phase

The information collected during this phase was basic, yet rich with ethnographic detail that compliments the statistics with background information essential to painting the entire picture. I recorded the conversations and informal interviews on paper only, though I analyzed this critically for continuity and content validity during the analysis phase of the research. Based on the information gained from this phase I was able to begin the explanatory phase, during which I conducted interviews with a deeper insight into the issues than had I not had the benefit of qualitative, ethnographic data. This information also aided in the creation of survey instruments appropriate to the actual socio-cultural context. It was through the methods employed during this phase that the descriptive information provided throughout this dissertation was achieved, without which the quantitative data from the second phase would not be as informative. The descriptions provided during the informal interviews set the stage for understanding why Chilote culture is the way it is, why the mussel cooperatives were most likely a success, and why the data from this study are important to community development and common property resources. Figure 7.1 provides a short synopsis of the methods employed throughout this study.

Chained Referral Sampling and Key Informant Selection

Purposive, chained referral sampling, also known as snowball sampling, was used initially to identify key informants. These individuals were to be characterized as those who's peers identified them with the most amount of knowledge with regard to the fishing and aquaculture industries in Chonchi and on Chiloé as a whole, as well as historic attributes of each activity. Chained referral sampling is a valid technique for finding and identifying individuals within a particular universe who meet specific criteria (Johnson 1990).

This step was taken in order to establish rapport within the community, in addition to creating an accurate impression of the issues outlined in the study to form the foundation of the survey instruments. Through my own observations and communications with other individuals in and around the community, I was able to select seven people whom I considered to be accurate key informants. One fisher in particular, Pedro, became a key source of social networking, as he was highly regarded among the fishing community, and was the middle of three generations of his family fishing in Chonchi. His wife became a close friend and confidant, allowing for access to details of family life and women's participation in the community. During the first eight months of this study I spent as much time as possible with these seven fishermen who were either still exclusively involved in the practice, had retired altogether, or who had transitioned to work in the aquaculture firms. I spent time on the docks, in their boats, and in their homes, fully immersing myself into the world of fishing in Chonchi.

I conducted informal interviews with fishermen, aquaculture employees, owners of firms, biologists, academics, and community members and leaders. The people of Chiloé are extraordinarily kind, and will easily present their hospitality to strangers. While they are not rude, this hospitality is mostly superficial, and getting beyond that is extremely difficult. I spoke with several other researchers in the area, some Chilean, who all agreed that getting in with Chilotes, especially in the smaller communities, was very difficult to do. Working with a sample exclusively of males, my gender was also a hindrance, as it was almost inappropriate at first for me to be talking with these people. It took the curiosity of one fisherman, Pedro, to open the door for me to be allowed inside the world of fishing in Chiloé. His wife, Erica, became my closest friend, and through them I was able to network to other families and to integrate myself into the community.

Participant Observation

It was through these initial contacts that I was able to establish rapport, but not before a lot of difficulty in presenting myself as a researcher (not just a female) and as trustworthy. This portion of the study took over six months, though my persistence paid off in the end by facilitating and expediting the structured interview process in the explanatory phase. Though at first the people of Chiloé were untrusting and skeptical of my intentions, in the end I gained access and trust through my commitment to understanding the contemporary lives of fishermen on the island. I spent much of my time at the dock, talking with people when they would let me approach them, and asking benign questions. After several months I was invited on some boats for informal

conversations and interviews over mate, and eventually go to fishing, though with the criteria that I helped with various tasks on board. (see figure 7.2) Everywhere I have studied fishermen – Mexico, United States, Argentina – I've found that a sense of pride for being the focus of international investigation to be a universal attribute. Fishing is an industry that does not achieve much respect outside of its immediate confines, and therefore having a foreigner express interest in their daily lives provides for a sense of curiosity initially that eventually leads to trust.

Figure 7.2. Participant observation. Foraging for mussels (*Mytilus chilensis)* (above) and other mollusks at low-tide was a daily activity. This was especially important when the market was slow or closed in order to supplement the diet with free and critical protein.

Questionnaire Adaptation and Development: Selection of Resilience Indicators

I adapted well-established questionnaires from various studies (see appendix **XX**) focusing on the three indicators to fit the cultural context. Of the three, Perceived Well Being was not modified since it has been cross-culturally tested with a high alpha coefficient. Job Satisfaction was only slightly modified, with Environmental Values needing the most adjustments for cultural and geographical clarity and validity. The questions were five-point Likert scale format, and addressed individual characteristics of feelings of well-being, autonomy, environmental perspectives, and dependence on environmental resources. The three variables chosen have a high degree of interrelation. Job Satisfaction, for example, is shown to have an association with individual mental health (Kornhauser 1965; Pollnac and Poggie 1988) and community stability (Pollnac and Poggie 1988). Life satisfaction is thought to depend on life circumstances (Pavot and Diener 1993), and life circumstances can be affected by social and environmental actions and shifts. It was my assumption in selecting environmental values as a variable that there would be a relationship between occupation, satisfaction, and environmental values, based on the study by Kempton, Boster, and Hartley (1999). All three questionnaires were consolidated with some structured open-ended questions throughout in order to complete the process with each individual in one sitting, since some participants were difficult to locate more than once, if at all.

Job Satisfaction

Richard Pollnac and John Poggie (1988) suggest that a high degree of job satisfaction, including autonomy and self-worth produces more stable communities. They also acknowledge that to be a fisherman means more than simply having a job to make money, which has been a topic of consideration in much of the maritime anthropology literature, and generally acknowledged to be true (Smith 1977; Acheson 1981; Pollnac 1988; Gatewood and McCay 1991; Orbach 1997). Despite the enormous diversity among fishermen worldwide, the characteristics of the profession tend to be similar, and thus attract people with characteristics that correspond to the activity. While there are many variables that would account for job satisfaction among fishermen, it is clear through the literature that autonomy is a primary contribution to committing to this career choice. Within traditional fishing communities, there can also be a sense of pride associated with the activity, and identifying oneself with being a fishermen rather than a factory worker, for example, is preferred, even if the former activity is temporally less substantial than the latter (Taylor 1981). This is certainly the case the case on Chiloé, where few people want to admit having given in to the salmon firms and abandoning their more traditional way of life as autonomous sea faring individuals.

The job satisfaction study and questionnaire developed by Pollnac and Poggie (1988) and adapted by Gatewood and McCay (1990), include questions to assess these elements of autonomy, as well as detailed characteristics of the activity including subjects such as psychological characteristics of the job (e.g., sense of adventure, challenge,

prestige) and potential negative factors (e.g., sanitation, time away from home, mental pressure).

Perceived Well-Being

I selected the Satisfaction With Life Scale (SWLS) (Diener et al. 1985) for measuring perceived well being (PWB) for several reasons. This scale is regarded as the definitive measurement tool for PWB, as well as being the most widely used. It has an alpha coefficient of internal consistency of .87, and has been used cross-culturally. It is important to point out that the alpha coefficient for this study was .629, and that the reasons for this variation are unknown. While the other two questionnaires focus on criteria that I judged to be important to the overall goal of the study, it was also important to incorporate questions that were not specific to any one domain, but rather were general representations of the overall quality of life (Shin and Johnson 1978; Diener 1984). It is also assumed that individual's perception of life satisfaction hold steady over time, though can change when life events occur (Pavot and Diener 1993), which is a fundamental question of this study.

Data from cross-cultural use of the scale suggest that this scale can act as an index of life satisfaction, though the definition of *well being* has yet to be explored on a cross-cultural level to the degree that absolute confidence in its effectiveness is available (Pavot and Diener 1993). However, in studies conducted across 40 different countries, neither gender nor age had an impact of any statistical importance on perceived well being, and that most people, regardless of country and industrialized status, tend to report

feeling of slight to moderate well being (Diener et al. 1997) Some of the cross-cultural findings from other studies using the SWLS suggest that those with more autonomy tend to score higher than those who do not have a sense of independence and ownership (Diener et al. 1997), thus solidifying the importance of this attribute in assessing perceived well being and overall life and job satisfaction.

Environmental Values

The questionnaire I used for assessing environmental values was adapted from Kempton, Boster and Hartly (1999) in their study of *Environmental Values in American Culture*. This questionnaire was difficult to modify in a way that was culturally appropriate, since unlike the findings in American culture from the Kempton et al. study (1999), people on Chiloé did not necessarily associate themselves as a part of the system or as being interdependent on nature, therefore negating any cross-cultural similarity with this particular study. The authors of this study indicated that they had not included questions with regard to how and why others may care about the environment, inspiring me to do so. I found that individuals explain a lack of environmental values or concern when their interaction with nature is highly limited, which was my overall reason for including this questionnaire, since it was my assumption that when fishermen turned to employment in the aquaculture firms, their contact with nature would be less frequent and important for subsistence, which in turn would lead to diminishing concern.

The Kempton, Boster and Hartley (1999) study also provided the inspiration for this dual-phase study design. Instead of relying exclusively on either quantitative or

qualitative data, they successfully combined open-ended qualitative ethnographic information with systematically gathered data from questionnaires. This approach tends to strengthen both phases with complimentary information. It was Johnson (1998; 2000) who coined the "exploratory-explanatory approach" to describe this sequence. His studies, like this one, were aimed at testing hypotheses about cultural values and beliefs, which is why I chose this approach.

In sum, the positive or negative direction of these three indicators appears to correlate with and indicate a parallel direction in community stability. When measured in reference to change due to occupational shift, I assert that they may serve as indicators for resilience. These indicators are what then inspired measuring the cooperatives set up by the Fundación Chinquihue among fishermen's unions as a test to see if there is, in this context, a conclusive example of resilience.

Archival Research

I also conducted a good amount of archival research during this phase. The data collected from local libraries, the archives in Castro (Chiloé's capital), the Universidad Austral de Valdivia library, the library at SalmonChile, and various government agencies were essential for understanding not only the history of fishing and aquaculture on the island, but also for supplying critical demographic information and fisheries statistics, vital to showing a diachronic perspective of both activities in Chile.

Explanatory Phase

My objective was to empirically measure resilience on a social level within a complex social-ecological system. Resilience here is defined as the ability to maintain certain social-ecological values in the face of change, in this case change being the transition from wild-capture fisherman to aquaculture employee. While there are many researchers focusing on this topic (Gunderson and Holling 2002; Holling 1973; Holling 2002; Janssen et al. 2006; Peterson 2000; Walker et al. 2006), there is no definitive methodology established for doing this. Therefore, I selected three key indicators that define this system's resilience based on observations, which were participant's job satisfaction, their environmental values, and their perceived well-being. I chose these indicators for their social-ecological significance as well as having been previously established and tested through previous studies that designed the questionnaires. The potential for future cross-cultural comparison among samples was also a consideration in selecting these measures.

Systematic Sampling

Two field sites were used on the island of Chiloé in order to produce a viable sample. I began with informal interviews in the town of Chonchi for a two-month period. These interviews were conducted with anyone involved in the fishing and/or aquaculture industry, at all levels of the operational process and hierarchical structure. The purpose of these conversations was to introduce myself within the community, establish key

informants, and to understand the current situation from various points of view. As time progressed, I realized that in order to achieve a large enough sample, I would need to include the island of Lemuy, specifically the town of Puqueldón as a part of the sampling frame. The island of Lemuy is within the Comuna of Chonchi's jurisdiction, and also falls under the maritime responsibilities of the port of Chonchi Naval Authority. There is also much interaction between the two locations, and they share histories, families, and economies.

The first sample was comprised of individuals in three communities belonging to the same Naval maritime designated zone, which were Chonchi, Lemuy, and Vilupulli. They were selected along the trajectory of the transition from wild-capture fishermen to aquaculture employees, which included fishermen (n=53), fishermen who became aquaculture employees (N= 119), and those who were involved in both activities (N = 78). They were also selected according to the amount of time they had been involved in those activities in order to portray a more accurate example of a temporal continuum. The total N was 277. Given the differing characteristics of each group, a standard systematic sampling design was not possible. Therefore, the fishermen were selected using an exhaustive sampling procedure, the aquaculture employees were selected through a convenience sample, and the "both" category was selected via a question on the aquaculture questionnaire to select for this particular group. The second sample group of mussel aquaculture cooperatives was also exhaustive (N=3 cooperatives, 27 individual responses).

Questionnaire Administration and Interviews

The interviews and questionnaires were achieved whenever possible. After completing the sample lists or procedures, I did whatever it took to locate the appropriate individuals. In the case of the fishermen, I attended informal gatherings at the dock and formal meetings held by the union or the mayor until I completed the list. Achieving interviews with the other two groups that used a convenience sample were a bit more difficult, since the respondents had to first be screened. I waited outside each of the salmon and mussel farms in Chonchi and on Lemuy for an equal amount of time (one week) in an attempt to complete an equal number of interviews from each firm. The difficulty with this sampling procedure is that more often than not people were either not on the docks or not willing to spend time outside due to the inclement weather. With constant rain and winds, outside interviewing was exceedingly difficult, and was therefore completed mostly during the months of January and February when the rains decreased and the temperature warmed. The formal interviews were carried out over the course of the ten months with each of the key informants, typically in their homes.

Data Analysis

I entered the data from the structured interviews into an SPSS database (SPSS 2004), where I ran descriptive and statistical analysis of the data, including exploratory factor analysis (more than one independent variable and an unequal N), one-way analysis of variance – ANOVA (different group size and more than two groups), and the

Dunnett's T3 post-hoc test were used to produce results that looked for and compared significance across the groups and sub-groups, which were the social-ecological indicators (dependent variables) and occupation (independent variables). After determining that differences existed among the group means by using one-way ANOVA, I used a post hoc test (the Dunnett's T3) to see which of the means actually differed since there were more than two groups, and this test works for pairwise comparison. This particular test was chosen because I was unable to assume equal variances between the means, and the group sizes were also not the same.

Data collection for this project began in September, 2004 and ended in August, 2005. The first several months were spent establishing contacts and integrating myself into the community. Much of the conversation and observation focused on understanding the key issues involved within the realms of both wild-capture fisheries and aquaculture from varying perspectives.

Chapter 8: Discussion

Transformation

The transformation from household to corporate labor has been extreme in some cases. However, for those who have developed a cooperative, it appears as though the cultural and psychological structures of the household either remain in tact or return to this state after exposure to the corporate scenario. Within the discussion of aquaculture vs. wild-capture fisheries as an alternative is the effect this form of development will have on the social-ecological systems already in place (Stoffle and Halmo 1992). I have attempted to quantitatively and qualitatively identify the impact of this transition in traditional fishing communities in Chiloé for use as a proxy in understanding these changes in future development programs. The distinction I make in this study is between being an employee in an aquaculture firm and being a member of a mussel aquaculture cooperative.

An important point to make is that the development of mussel aquaculture was concentrated in Chiloé, and therefore produced a long and embedded history among Chilotes that has extended into the cultural domain. As described earlier, the inhabitants of Chiloé have traditionally been subsistence agriculturalists, though are currently limited in this activity primarily due to a severe reduction in terrain that each family group owns. This reduction is due in part to native forest preservation as well as extensive land not

suited for optimal use in this sense. This reduction of subsistence has led to a lower quality of life for Chilotes, as wage labor becomes increasingly more important.

Although some wage labor activities exist on the island, the one that predominates for the majority of Chilotes exists in the salmon farming firms. The transition to employee in these firms from autonomous workers, specifically in the artesanal fishing industry has not necessarily been a smooth one. This leads to an interest in finding an alternative that is comparable and complimentary to traditional activities, and that would fuel the local Chilote economy. The alternatives that I investigated in this study are the cooperative mussel aquaculture operations run by artesanal fishermen's unions. This activity permits the continuation and stability of local communities insofar as social networks, residency stability, use and application of traditional knowledge, and a stable income, contrary to the grim reality of the artesanal fisherman who no longer has the luxury of staying put.

The cooperatives that I investigated were established with initial financial and technological aid from the Fundación Chinquihue, a non-profit organization subsidized by the tenth regional government of Chile. The objective of this program is to provide an alternative for artesanal fishermen in Chiloé who are experiencing difficulty in maintaining their traditional craft in a means that provides economic stability. This initiative was based on an effort by the International Center for Development Research (CIID) and the Marine Research Center and Institute of Meat Science and Technology of the University Austral de Chile, who's main goal was to provide a development scheme for rural coastal communities on the big island of Chiloé focused on mariculture. This program was oriented on the establishment of mussel aquaculture and other bivalve

species of high commercial value, as well as processing methods. Of significant interest for this study is the interest the original effort paid to understanding the cultural and psychocultural characteristics of these rural coastal communities with regard to their responses to distinct alternatives to production.

The Fundación Chinquihue focused exclusively on mussel (*Mytilus chilensis*) cultivation on Chiloé, facilitating production efforts by using a native species. The foundation, from its headquarters near Puerto Montt on the mainland, grew its own seed and provided on-site processing and offered free services to the cooperatives formed under its initiative. To find willing communities, the foundation did some outreach among fishermen's cooperatives, but it was ultimately up to the organization and will of the fishermen themselves to see the project through. The foundation provided financial and technological support, as well as education on the process, but the fishermen were responsible for organizing themselves into a unit and attaining the various permits. They were also responsible for supplying the funds to lease the water space for their operation. This is where some communities ran into trouble. While all of the communities I questioned (N=7) were agreeable to this effort, the individual personality characteristics of each group affected the viability of the project. For example, in Chonchi, the fishermen are self-proclaimed individualists and though were excited and interested in the idea, were simply unable to organize around this effort despite repeated attempts on my behalf. Therefore, the effort was established on the neighboring island of Lemuy in the town of Puqueldón, where the fishermen were more apt to cooperate.

The original benchmark study found that this development program did change the structure of these coastal subsistence communities, though in ways that were positive

for social sustainability such as an outlet for market integration and some changes in social structure that were beneficial for external communication. In addition, having this increased economic stability has actually aided in maintaining the traditional subsistence agriculture by allowing for the purchase of animals, home improvements, and fishing and diving materials essential for survival in this manner, overall increasing the standard of living of these coastal communities. With regard to the ecosystem, mussel cultivation has meant a management strategy that on one hand protects the resource by re-populating the species for future harvesting, as well as strengthening a conservation ethic through and understanding of the issues involved in the life-cycle and ecosystemic participation of the species.

The Traditional Chiloé

Figure 8.1 The view of Chonchi's harbor coming in from diving for sea urchin on Raúl's boat.

The study area of Chonchi and its environs has origins with the indigenous group the Huilliche. Even after attempts at colonization, “people were more united, had more goodwill, and had enough food” compared with today. However, “people developed their land but without thinking of long-term development, since the future was less important that today. The problem is that with this vision, they also destroyed the land by clearing forests and over-working the land, leaving almost nothing to sustain these populations without help” (Don Jorge Chiguay, personal communication, Chonchi 2005).

The island of Chiloé has long garnered attention for its beauty and abundance of natural resources. The Chilote way of life evolved and developed, particularly beginning around the 1970s, around an insular economy of potatoes and livestock, and the extraction of other primary products from the sea and land. This largely subsistence lifestyle cultivated a rural and traditional society, reflected by an informal economy (Grenier 1989). People today often refer to the days “before”, which loosely means when they were younger, and before the massive development began to occur. “Before we only had horses and boats to get around, there were hardly any people, maybe just a few houses, but the rest was only mountains” (Don Romelio Cardenas, personal communication, Chonchi 2005). Hearing these stories of a not so remote time makes one realize that the modern life on Chiloé has just recently been implemented. People are still accustomed to counting on the availability of natural resources for basic survival, but their availability is, like the Chilote way of life, becoming a thing of the past. “There used to be so much fish here, and every day we would go to the shore to *mariscar*, or collect shellfish, which was covered with mussels, clams, snails, seagull eggs, and the fish could

be caught without nets or line, just by grabbing them out of the water near the shore. We lived from working the land, grinding our wheat into flour, planting grains and vegetables – we always had these things, and we actually ate better then compared to now, and we didn't even have stoves, but used the *fogón*" (Don Raul Colivoro, personal communication, Chonchi 2005).

Today, however, while some subsistence is possible, it is mainly a complementary activity as resources become scarce and the market economy moves in. People have had to look for resources away from home, creating a form of dependency on external resources and markets, either to sell their goods or to work. The life for the typical Chilote can be best described as one of semi-subsistence, and of being in a state of transition between subsistence and market economies, taking with it the rural lifestyle typical of Chiloé in order to become a part of the capitalist production process for survival.

"People here aren't the same now. When someone needed something, there was always somebody to provide it, even if it meant going to town. Neighbors were very important and it was a beautiful thing. They were there to help, being happy with life" (Don Raul Colivoro, personal communication, Chonchi 2005). The social relations in this form of society as described by some of the older people in the community who remember these times were integral for survival – as much as the natural resources themselves. The institutions that developed through these relationships served to regulate society in a way that allowed for survival. When these institutions are threatened by changes in subsistence mechanisms and economies, a ripple effect occurs that may be positive or negative, depending on the ability and capacity for reorganization.

Many Chilotes looked to fishing as a means of entering into the market economy, and dedicated their lives full-time to the activity. During the years 1938 to the early 1960s, this activity was at a height in Chiloé, leading almost to the extinction of a native species of mussel called the choro zapato (*Choromytilus chorus*), as well as exhausting the natural banks of other native mussel species in southern Chile (Avila et al. 1994). This motivated the different government institutions charged with managing fisheries to establish mussel cultivation as a priority, not only on Chiloé, but in all of Chile (Caniggia 2000). This marked the inception of extensive mariculture in Chile.

This effort has had both positive and negative effects on the native Chilotes. On the one hand, there is a constant source of employment, which given the state of the land and of the market, is now essential. Employment in the firms is not ideal, but as the people say, at least it is there. The challenge is keeping these communities in tact in some regard in order not to destroy the fundamental beneficial attributes of the typical Chilote culture. As discussed in the methods chapter, this study sought to evaluate the effects of this industrial shift on the individual cultural and psychological level. The objective was to discover whether the fishermen[2] in these coastal communities were experiencing a positive or negative effect when they transitioned from wild-capture fishermen to aquaculture employee.

The data showe that in fact the fishermen were not better off in this instance in terms of the three chosen indicators. The data did, however, indicate that when fishermen were involved in a cooperative aquaculture initiative, where power was maintained and

[2] While fishermen in Chonchi and its environs no longer constitute the majority of the population, they are still representative of the population at large in terms of subsistence living by means of hunting and gathering natural resources, and only in the past 30 years entered into the market economy with their catch.

traditional skills and knowledge were employed, they were resilient in that their activity may have changed, but their basic foundation remained in tact and their indicator scores actually improved.

Results

These data have indicated multiple interesting results, as summarized in table 8.1. They reveal that the closer along the trajectory one gets to being an aquaculture employee and the farther away from being a fisherman, the lower the overall scores. Surprisingly, despite a steady paycheck from employment in the firms, the fishermen were not better off working there in terms of perceived well-being or job satisfaction.

Most important is the finding that those involved in the implementation and management of their own aquaculture cooperative show the highest scores of all three, with significant differences across all three variables. The importance of this finding is that there appears to be a solution to disappearing wild fish stocks in terms of resilience and sustainability for fishing dependent communities. This strategy has already been put in place in several US communities, most notably Cedar Key, Florida, where clam mariculture cooperatives have provided for the continued survival of an entire community.

Government organizations such as NOAA and the Chilean regional government in the 10^{th} region have both expressed interest in aquaculture employment as a solution to increasing difficulty in making a living from wild-capture fisheries. However, they have suggested that displaced fishermen would make ideal employees in aquaculture firms,

which, according to this research, is not the case. The individuals in the aquaculture employee categories scored consistently lower than any other group across the two most important indicators of job satisfaction and perceived well being, thus showing that their quality of life was not maintained, and that the system was so significantly altered by this change that it was unable to reorganize and adapt in order to be resilient.

On the other hand, when the fishermen were put in a position, although reorganized, they still maintained the original foundation in terms of basic socio-cultural characteristics, they were able to adapt and even excel, indicating that resilience is possible among this group. This strategy is not only important for the fishermen themselves, but transcends to the entire community (as defined as those who are fishing-dependent) to sustain socio-economic autonomy and cultural and societal foundations.

Table 8.1. Summary of questionnaire results as analyzed in SPSS

	Fishermen (N = 53)		Both (N = 78)		Aquaculture (N = 119)		Cooperatives (N = 27)		
	M	SD	M	SD	M	SD	M	SD	F**
PWB	26.63	2.89	23.69	3.89	23.45	4.45	**31.42**	4.67	12.33***
EV	71.77	4.30	70.46	6.80	74.73	6.43	**78.35**	6.21	12.23***
JS	56.26	2.77	52.74	5.40	48.16	1.27	**64.87**	4.68	115.17***

**** M = mean, SD = Standard Deviation, F = F score (*significance)***
***** P < .001**
PWB = Perceived well being; EV = Environmental values; JS = Job Satisfaction

In table 8.1, the sum of the scores of each variable: Perceived well-being (PWB), environmental values (EV), and job satisfaction (JS) are shown as represented by the mean, the standard deviation, and the F score. The F score denotes a significant difference between the scores of the cooperative members and the other three categories. These data show that being a member of a mussel cooperative in Chiloé significantly

raises one satisfaction with life in terms of well-being and employment, as well as how one perceives the environment. Figure 8.2. shows how each of the original three groups of fishermen, aquaculture firm employee, and both fisherman and aquaculture firm employee scored across the three variables. Fishermen are the happiest with their state of well-being (26.63) and job satisfaction (56.23), though score slightly lower than aquaculture firm employees in environmental values (71.77 vs. 74.73). At present, I do not have an explanation for this except for the potential of error in my adaptation of the questionnaire. As expected, the "both" category falls somewhere in the middle with scores for PWB (23.69), EV (70.46), and JS (52.74), and working exclusively for an aquaculture firm tends to lower scores in life satisfaction: PWB (23.45), JS (48.16).

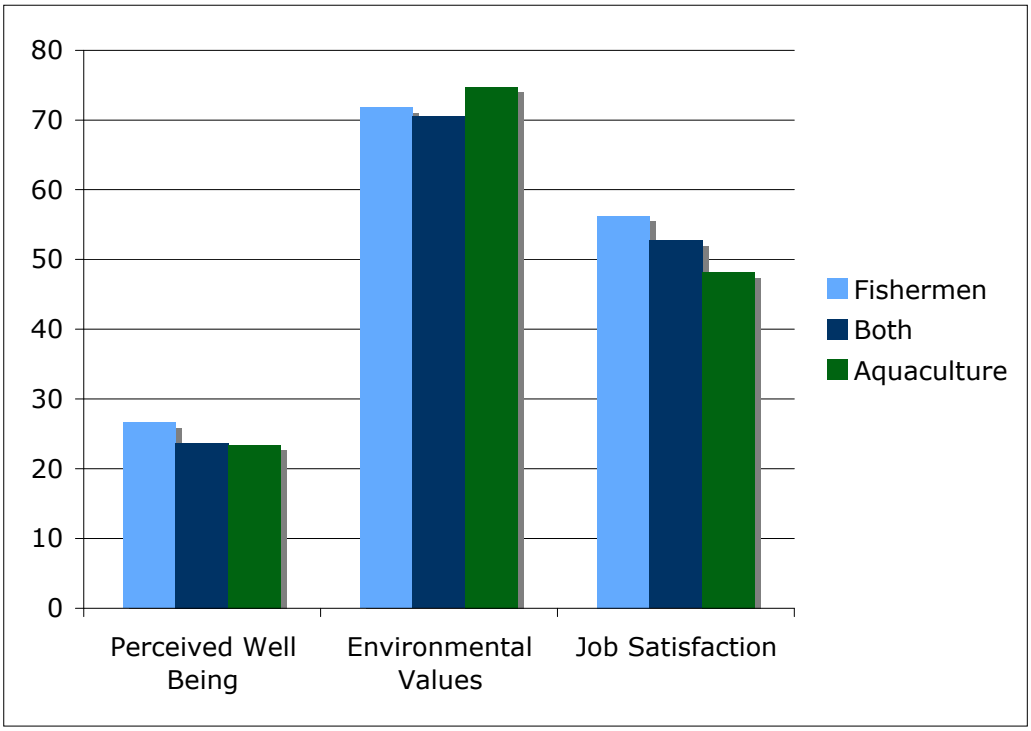

Figure 8.2. Indicator scores across the three original groups

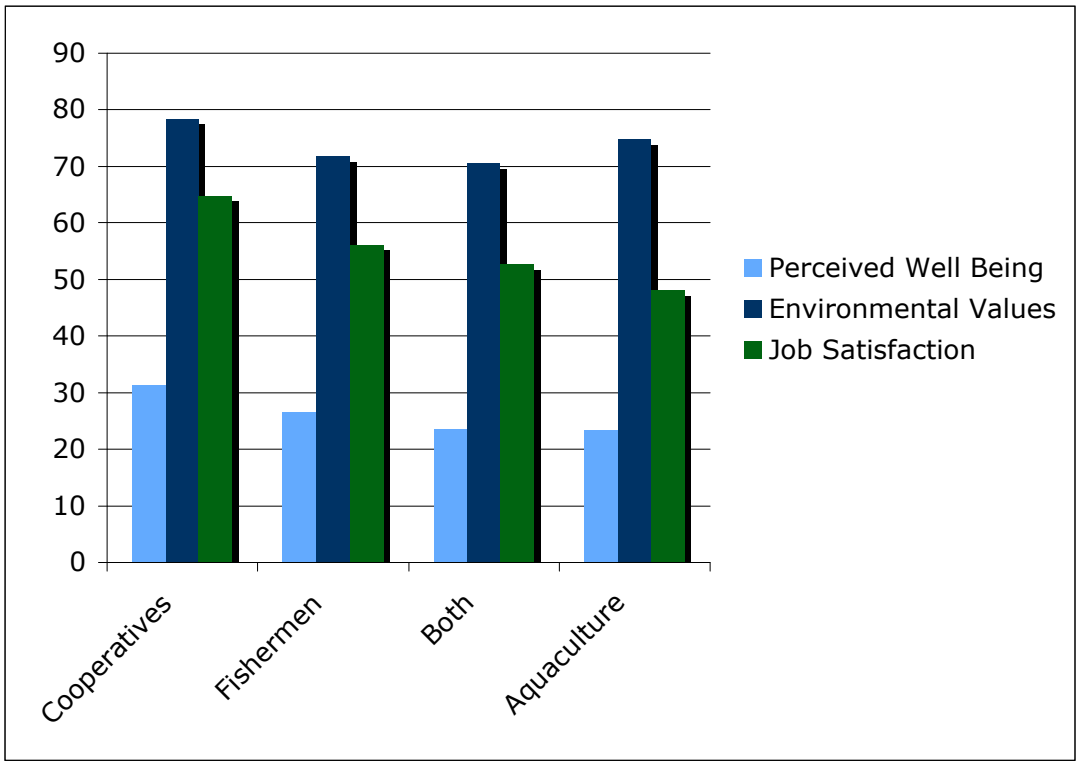

Figure 8.3. Indicator scores across the three original groups with the addition of the cooperatives.

Figure 8.3 shows that those fishermen who are members of the fishermen's union mussel aquaculture cooperatives show significantly higher scores across all three indicators (PWB – 31.42; EV – 78.35; JS – 64.87). The most significant result is that fishermen in the cooperatives show characteristics of resilience. Even though they have structurally changed their occupation, basic elements of their foundations persist, such as autonomy, use of pre-existing knowledge, and the maintenance of social networks.

Chilote Fishermen's Union Mussel Farms and the Path to Resilience

Resilience theory, by drawing upon systems ecology, conceptualizes socio-political and ecological processes as a set of hierarchically nested processes operating in a non-equilibrium state (Gunderson and Holling 2002). Such ecological theory is clearly well-adapted to political-ecological concerns (Abel and Stepp 2003) and with a progressive contextualization methodological approach, is used as that theoretical base of this study as an expansion upon the deficiencies of social-ecological theory.

Given the current predicament, it is clear that artesanal fishermen on Chiloé will need to adapt to this changing social and ecological environment if they are to create a sustainable situation for themselves and their communities. If whether they succeed or fail will depend on their capacity for resilience, meaning how much shock their system can absorb without changing its basic foundation or fundamental ways. The ability for resilience depends on three key characteristics: the degree of disturbance or change the fishing community ecosystem can take without altering its basic foundation; how well the system can organize itself; and how well the system can build resilience capacity through learning and adaptation (Carptenter et al. 2001; Gunderson and Holling 2002). Institutionalized management does not favor conceptualizing strategies that adhere to these guidelines, since they can be long and costly. Generally, standards and rigidity are preferred over long-term visions and ecosystemically conceptualized strategies. For social-ecological resilience to occur, however, the process must begin with holistic or ecosystemic thinking, and an understanding that human and natural systems are inextricably linked.

The Resilience Alliance is an interdisciplinary group formed in 1999 with the goal of providing a theoretical and practical foundation for sustainable development policy. Its members have assumed responsibility for establishing guidelines for exploring social-ecological resilience. One important aspect of this work is the concept of the adaptive cycle that suggests that systems change their structure and function over time through internal and external forces and in patterns that are similar in a wide range of social-ecological systems. Lance Gunderson and C.S. Holling, founding members of the group, describe this process as a continuous loop (see figure 8.5). The loop implies a perpetual cycle that begins with exploitation or growth and conservation. These are expressed in ecological terms as r and K phases – r representing rapid growth through resource availability and use. In ecological systems, this corresponds with succession, whereas in social systems it can mean the original users of a resource. The K or conservation phase is where the system slows its growth but increases interconnectedness and links, but at the same time becoming more susceptible to shock. In social systems, this would be related to organization of institutional structures or in ecological terms, the climax or equilibrium stage. The loop continues with the release phase (Ω) in which structures collapse from external or internal disturbances, though reorganization (α) follows, which is the start of another r or growth phase. This new phase of growth can be similar or different, depending on the many variables affecting the system. Resilience occurs if the new growth phase is fundamentally similar to the first r phase.

I apply this model to understand change within fisheries in Chiloé. Here, fisheries represent r, where growth occurred through exploitation of resources. The K or conservation phase of this system was the establishment of social networks, nested

hierarchies of institutions, and a specialization of skills that led to instability. The system here is in release or collapse, attributed to dramatic perturbations or shocks by the aquaculture firms. It is my premise that reorganization is occurring as a result of the union cooperatives. The key structural variables appear not to have been significantly altered, suggesting resilience.

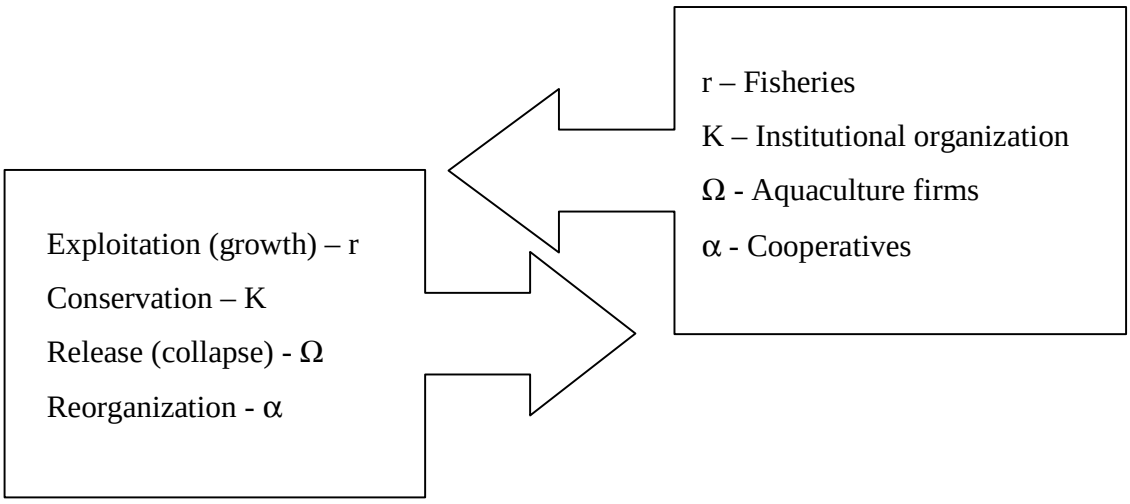

Figure 8.4: Representation of Resilience in the Case of Chiloé.

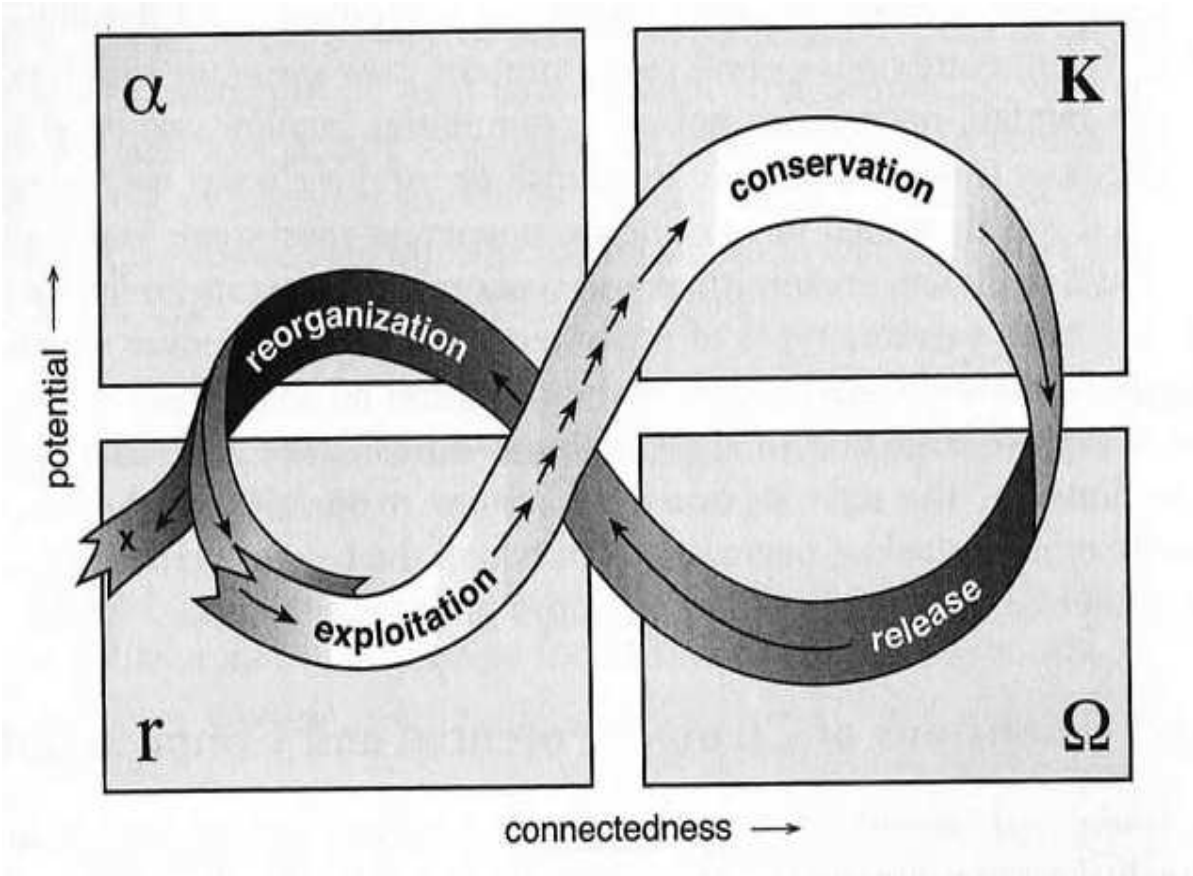

Figure 8.5: Resilience Feedback Loop. Source: Gunderson, Lance H. and C. S. Holling, eds. 2002. Panarchy. Island Press. Washington DC

There is still a lack of agreement as to whether aquaculture is a viable solution to the disappearance of fisheries, and would serve as an income alternative. The persistent idea that fishermen are too culturally dissimilar from the practice of controlled cultivation for it to be a viable solution is the primary reason behind such thinking (NRC 1998; Pollnac 1982, 1990; Pollnac and Weeks 1992). There is new evidence of success in this strategy, which may be due in part to an in-depth cultural understanding and compatibility, and perhaps most importantly, a need (Drewes 1986; Schmittou et al., 1985; Pollnac 1991; Pomeroy 1992). The success in the case of Chiloé is due to the foundation's success in following these guidelines, but also in their insistence on a "hands-off" approach that allows for ownership at a level beyond that of participation. This is not to say that participation is not a critical component, and the approach taken by the foundation may not be right for every circumstance, one again stressing the importance of socio-cultural compatibility.

According to Pomeroy, these initiatives should be implemented as a complimentary activity to fishing (1992). The difficulty with this assertion is that in many instances fishing is no longer an option due to closed and/or non-existent fisheries. One relevant point expressed by Pomeroy is the desirability of agricultural expertise or at minimum, understanding, that would aid groups of fishermen in making the transition since aquaculture is more akin to agriculture than to fishing (1992). I have expressed this as an important component as to why the initiative has been successful in Chiloé, given the historic dual-activity lifestyle of working both the land and the sea. Using agricultural knowledge and techniques that native Chilotes have with water-based activities has eased

Chapter 9: Conclusion - Measures of Resilience Among Coastal Fishing Communities on Chiloé

Research Findings

In this research I sought to explain what happens to wild-capture artesanal fishermen when they are forced out of their profession and lifestyle through environmental circumstances. Aquaculture is prevalent in Chile, and jobs are plentiful in the industry, so it seemed logical that many fishermen would be turning to the firms as an alternative. Since this turned out to be the case on Chiloé island where the majority of these firms exist, I used that industry as the point of transition. This decision provided for interesting analysis, not only in terms of employment characteristics, but in other social, ecological, and economic factors as well.

Aquaculture is not as related to fisheries as many would think, including some governments and Non-governmental Organizations that are seeking alternatives for displaced fishermen. In reality, the only similarities are water and fish. The modes of production, social structure of work, knowledge base, and relative independence are all extraordinarily different, comparative to hunting in the case of fisheries to agriculture in the case of mariculture. However, since this seems to be only one of few viable alternative sources of income for fishermen without fisheries, I decided that finding out what important life satisfaction characteristics are altered among fishermen who are making this transition. I chose three variables of life satisfaction that also included a

social-ecological element, since system dynamics are interrelated with quality of life. These were: job satisfaction, perceived well-being, and environmental values. All three of which had been well established in previous studies as being important to community sustainability (Diener et al. 1984, 1985; Pollnac and Poggie 1988; Gatewood and McCay 1990; Kempton, Boster, and Hartley 1999). However, I was not only interested in issues relating to sustainability, since sustaining a traditional lifestyle on Chiloé no longer seemed feasible due to rapid industrial change on the island, bringing with it just as rapid social change. Therefore, I decided to focus on resilience as the theme, using the three variables as predictor indicators for the ability to weather change but to still maintain original foundational qualities.

To do so, I set out to test the hypothesis that fishermen who become employees in aquaculture firms tend to score lower in these indicators than those who remain fishermen, despite extreme difficulty making a living. I chose three groups to represent this transition, which were fishermen, aquaculture employees, and those involved in both activities. The second hypothesis tested was that fishermen who became members of small-scale aquaculture cooperatives founded among their unions would score either equal to or above the other three groups. These hypotheses were based on the assumption that autonomy is the principle characteristic of satisfaction among fishermen (Acheson 1981; Pollnac 1988; Orbach 1997), which tends to be lost when they become wage-laborers.

To accomplish this research, I used a dual-phase approach that combines ethnographic detail with systematically gathered data. This combination of descriptive, in-depth information gained through formal and informal interviews and participant

observation, and quantitative, questionnaire derived uniform data provided for a complete picture from which predictions can be made based on statistics.

Limitations

While the sample size of 277 for the explanatory phase of this project was adequate to generate assumptions about the overall population, the lack of a sampling frame for all three groups and a standard sampling methodology threatens the external validity of the data. Within the time-frame of the study, it was not possible to achieve the necessary permission to gain access to aquaculture firm employees from within the company, which is why a convenience sample was used. It would be beneficial in the future to attempt an exhaustive sample with aquaculture employees, since this was the procedure accomplished with the fishermen. It was my hope to attain data with inferential integrity and to be able to apply this model cross-culturally. It will therefore be important to focus on systematic sampling in the future if these are the goals.

Another limitation was the lack of baseline data. Had this information been available, my design would not have been a "proxy", as is the case with many research projects aimed at measuring change. However, the data I collected will serve as baseline information for research in the future if change over time is to be the primary question. Measuring social-ecological change at this time of uncertainty in the world's fisheries is a trend among scholars interested in sustainability, policy and resilience (Folke et al. 2002; Walker et al. 2006). So while this study may not have the statistical rigor to make

inferences, it does show based on the best available options a valuable picture of the transformations taking place on Chiloé.

Coastal Policy Implications for Complex Social-Ecological Systems

Complex social-ecological systems are those that are a combination of equal influence of each ecological and human systems, neither of which can be extrapolated for independent evaluation (Walker et al. 2006; Walker et al. 2004; Westley et al. 2002). These systems are complex in that their temporal and spatial scales are massive, and are linked at multiple scales (Walter et al. 2006; Gunderson and Holling 2002). The system is constantly under stress from external forces that can have positive or negative effects, depending on the system's ability to be resilient. To be resilient, the system must maintain its original structure and function despite these disturbances (Carptenter 2003).

This research used qualitative and quantitative methods to empirically test and ultimately understand how occupation affects individual indicators of social-ecological resilience - perceived well-being, job satisfaction, and environmental values among fishermen making the transition from autonomous, independent actors to wage laborers in a corporate management regime. It also identified a strategy for resilience and community sustainability in the wake of this transition in the form of cooperative, small-scale, native species aquaculture farms. While this strategy has been adaptive to the changes taking place, it has actually been more of a transformation, which is still considered an element of resilience provided that original structures are maintained. In a

discussion of resilience in social-ecological systems, Walker et al. (2006) state the following:

> In contrast to adaptation, transformation involves changing the state space of the system by the addition of new state variables or the loss of others, which will most likely change the scales and the nature of the cross-scale relationships of the panarchy as well. It requires the emergence or development of a new kind of system, or a fundamentally new way of "making a living."

In essence, the change from being hunters to being farmers, to put it simply, has been a *transformation* for several fishing communities on Chiloé that has shown principles of being resilient. Adaptive strategies or transformations that are resilient are models that development initiatives should follow if sustainability is the desired outcome.

On a broad scale, the findings may have implications for future coastal community development in the form of aquaculture, which can be related to community resilience and sustainability. These data may be viewed as critically important to the validation and institutionalization of co-management regimes, as local-level participation or incorporation of values and knowledge may be a form of resilience for fishermen and their communities. Social research in the area of aquaculture and the communities that the industry affects is fundamental as this new paradigm emerges as a world-wide standard in the production and supply of marine products, and may potentially supplant the generations-old cultural heritage of artesanal fishing.

Future Direction

Fisheries world-wide are in a dire position, yet the demand for seafood continues to rise, making aquaculture a logical step in supplying this resource. Clearly, aquaculture is becoming an increasingly important economic activity and food production strategy throughout the world, in the North and South, and in temperate and tropical regions.

Intensive, large-scale operations, especially those that farm non-native species, can be detrimental to the human ecosystem that they are in. At the same time, international development agencies and state and local governments herald aquaculture as a means of economic development, resource diversification, and food security, and some scientists argue that it can be a strategy for taking the pressure off of wild fish stocks in order for them to recover.

This all may be true, but special attention needs to be paid to planning and conceptualization of these strategies at the community level, and that a long-term vision should be in place that ensures a resilient and sustainable operation. Social-ecological systems can be sustained in spite of perturbations such as the one discussed here by the introduction of aquaculture, but acknowledging the importance of resilience and its characteristics is critical to success. Though my research is in Chile, I use standard methodologies for empirical measurement to allow for replication and also comparison with other sites to allow for generalization. This then can have important implications for maritime and coastal policy both in Chile and elsewhere where aquaculture or other disturbances are supplanting small-scale fisheries and altering communities. Aquaculture cooperatives may not be the panacea for all fishing communities under pressure to find

alternatives, but I have demonstrated that in this case it is a viable and sustainable substitution for maintaining a sense of basic cultural and community structures in Chiloé.

While we see dramatic changes when cultures transition from terrestrial foraging to horticultural activities, the dynamics of groups reliant on marine resources differs. We can not necessarily expect to see similar transformations. Future research should explore the resilient nature of such communities in the face of potentially dramatic shifts in economic production and address the factors that maintain community structure. Within this line of thought, some questions arise, such as, under what conditions are these transitions sustainable and result in improvement of livelihood? How does cooperation change in this transition? Are cooperative firms competitive with capitalist firms? And also, how does community structure change or how it is maintained? In the case of Chiloé, a social network analysis would be beneficial, as would a more in-depth analysis of the changes in state variables and scales involved in the transformation.

Ultimately, it is up to the individuals within communities in a state of change to be amenable to and promote resilient strategies for sustainability. The fishermen of Chiloé are working toward this goal, and many have experienced success. Given the right parameters, it is possible to transform without being harmful or disruptive to the primary ecosystem of which they are a part. This was possible because of the flexibility of management and the willingness to be adaptive, both of which are critical components of successful policy. In a recommendation paper to the World Summit on Sustainable Development (WSSD) in Johannesburg, South Africa in August 2002, Carl Folke et al. (2002) concluded with the following:

> Policy should develop indicators of gradual change and early warning signals of loss of ecosystem resilience and possible threshold effects. Policy should encourage monitoring of key ecosystem variables and aim to manage diversity for insurance to cope with uncertainty. Policy should stimulate ecosystem friendly technology and the use of economic incentives to enhance resilience and adaptive capacity. . . Policy should provide incentives that encourage learning and build ecological knowledge into institutional structures in multi-level governance. Policy should invite participation by resources users and other interest groups and their ecological knowledge.

Despite criticism of such approaches because of time and economic constraints, this case has shown that neither need be impediments to resilience, and that with foresight and some basic variables in place, resilience and sustainability are possible for coastal communities facing change.

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APPENDIX A: QUESTIONNAIRE

NUMBER: _____

Chiloé, Chile Fisheries and Aquaculture Survey Date _____ Time _____

Location _____ Fisherman Employee Both

Quiero solicitar su permiso para participar en este proyecto. Es un proyecto de investigaciones para mi tesis doctoral en antropologia, y se trata de los cambios entre los pescadores artesanales a partir de la llegada de las empresas salmoneras. Si dice que sí, voy a hacerle unas preguntas sobre su punto de vista en cuanto a como se ve la naturaleza, su trabajo, y su nivel de satisfacion en la vida. Este ejercício debe tomar mas o menos una hora. Durante el ejercício, no voy a preguntarle su nombre, ní usar su nombre en ninguna parte de mi proyecto. No hay respuestas correctas. Lo que me interesan son sus pensamientos y sus respuestas honestas.

Esta investigación no le afectara ni podrá ocasionarle daño. Puede decidir no seguir participando en cualquier momento. Toda la información que se colecte será confidencial. Voy a usar un numero o un código en vez de un nombre para identificar sus respuestas. Todas las respuestas van a quedar en un lugar seguro. Usted no está obligado a participar en este proyecto y puede dejar de participar en esta activiadad en cualquier momento.

Entonces, quiere usted participar en este proyecto?

Por favor dígame si usted tiene preguntas o inquietudeds sobre la investigación ahora o durante el proyecto. Estaré aquí en Chile hasta el 1 de Julio. Después me puede llamar al número de teléfono 011-1-706-247-5802.

1. Que es el empleo mas importante que tiene ahora?
   (What is your most important source of employment now?)

Pescador / Buso (Fisher)	Empresa de salmon / choritos (Aquaculture firm)	Ambas (Both)

2. Es usted el dueno de la lancha o bote en que trabaja? Si No
   (Are you the owner of the boat that you work on?)

3. Donde aprendio ser pescador / buso?
   (Where did you learn to be a fisher?)

   Familia Escuela Amigos Otro _____

4. En que empresa trabaja usted? _____
   (What firm do you work for?)

5. Que es su trabajo alli?
   (What is your position there?)

6. Dondo nacio? _____
   (Where were you born?)
7. Cuantos anos ha estado con este trabajo? _____
   (How long have you had this job?)

8. Ha tenido otro empleo antes de este?
   (Have you had another job before this one?)

   Pescador / Buseo Empresa de acuicultura Otro _____

9. Tiene otro empleo o actividades para ganar dinero? Si No
   (Do you do anything else to make money?)

   Cuenteme de ello(s) (What?)

   1.

   2.

   3.

10. Esta casado? Si No Viudo
    (Are you married?)

11. Tiene hijos? Si No Cunatos? _____
    (Do you have children?)

12. Que edad tiene? _____
    (How old are you?)

13. Que nivel de educacion ha cumplido? _____
    (What is your highest level of education?)

14. Como eran las condiciones de la pesca hace 5 anos?
    (What was fishing like five years ago?)

Mejor que ahora Igual que ahora Peor que ahora

15. Como piensa que van a ser las condiciones cinco anos en el futuro?
(What do you think they will be like five years from now?)

Mejor que ahora Igual que ahora Peor que ahora

Aqui hay algunas frases con las cuales usted podria estar de acuerdo o no esta de acuerdo. Usando la escala debajo que va desde 1 a 7, quiero que usted indique su nivel de concordancia con cada una de las frases. Por favor, quiero tambien que usted este sincero y abierto con sus respuestas.

Satisfaction With Life Scale (Diener) (SWLS)

1 = estoy muy en contra
2 = no esoty de acuerdo
3 = esoty un poco en contra
4 = no tengo opinion
5 = estoy de acuerdo un poco
6 = estoy de acuerdo
7 = estoy muy de acuerdo
8 = no contesta

_____ 1. Por lo general, mi vida es lo mas ideal que puede ser para mi.
(In most ways my life is close to my ideal)

_____ 2. Los condiciones de mi vida son excellentes.
(The conditions of my life are excellent)

_____ 3. So soy satisfecho/a con mid vida.
(I am satisfied with my life)

_____ 4. Hasta ahora, he logrado las cosas importantes que quiero en mi vida
(So far I have gotten the important things I want in life)

_____ 5. Si pudiera vivir mi vida de nuevo, you cambiaria casi nada.
(If I could live my life over, I would change almost nothing)

---
1 = no estoy de acuerdo
2 = no tengo opinion

3 = estoy de acuerdo

Environmental Values (After Kempton et. al.)

_____ 1. Yo dependo en el mar para algo en mi vida.
(I depend on the sea for something in my life)
Que?

_____ 2. Si hay problemas con el mar, hay technologia para arreglar las.
(If there are problems with the sea, there is technology available to fix them)

_____ 3. Yo creo que el mar ha cambiado durante mi vida.
(I think the sea has changed during my lifetime)
Como?

_____ 4. La gente tiene la responsibilidad de usar los productos del mar de una manera responsible para no agotarlos.
(People have a responsibility to use marine resources responsibly, without depleting them)

_____ 5. Debemos usar los productos del mar de una manera que haga que existen para nuestros ninos y sus hijos.
(We should use ocean resources in a way that ensures their existence for our children and their children)

_____ 6. Los productos del mar existen para servir a los humanos.
(Marine resources exist to serve humans)

_____ 8. Yo creo que hay bastante reglas sobre los que trabajan en el mar.
(I believe there are enough rules/laws for those who work on the sea)

_____ 9. Yo creo que las empresas salmoneros y de choritos tienen el mismo sentimento sobre el mar que los pesecadores artesanales.
(I think that the salmon firms here have the same mentality about the sea as artesanal fishermen)

_____ 10. Yo creo que las generaciones futuros dependeran en el mar.
(I believe that future generations will depend on the sea)

_____ 11. De vez en cuando, tomo qualquier pescado o mariscos que quiero, pero solemente si los necesito para darle comida a mi familia.
(Sometimes I take whatever fish or shellfish I want, but only when I really need them to feed my family)

_____ 12. Debemos investir en la industria salmon y chorito para que la gente de aca puedan tener una vida mejor.
(We should invest in the salmon industry so that people here can have a better life)

_____ 13. Yo hago todo lo que puedo para mantener los productos del mar sanos, porque mi trabajo depende en su sanidad.
(I do what I can to keep marine resources healthy because my job depends on their health)

_____ 14. Mi punto de vista sobre el mar ha cambiado.
(My point of view about the sea has changed

_____ 15. Tener un sueldo bueno es mas importante que proteger a los productos marinos.
(A good income is more important than protecting marine resources)

_____ 16. Yo debo tener el poder de sacar pescado o mariscos cuando quiera, aunque haya reglas contra ello.
(I should be able to take fish or shellfish whenever I want, even though there are rules)

_____ 17. Yo creo que otras personas protegen los recursos del mar.
(I think that other people protect ocean resources)

_____ 18. Tener un mar sano es necesario para tener una economia fuerte.
(A healthy ocean is necessary to have a strong economy)

_____ 19. Yo tengo una obligacion para proteger el mar no solo para otra gente, pero para el propio mar.
(I have an obligation to protect the sea not just for other people, but for the sea itself)

_____ 20. El relacion entre la gente y el mar es uno de dominacion, no de concorcio.
(The relationship between people and the sea is one of domination, not of partnership)

_____ 21. Mi primer prioridad es para darle comida a mi familia. El salud del mar viene despues de esto.
(My first priority is to feed my family. The health of the sea comes after that)

_____ 22. Si existe mejor tecnologia que hace menos dano al mar, es obvio que las empresas lo usaran.
(If there is better technology that doesn't harm the sea as much, the firms will certainly use it)

_____ 23. La unica responsibilidad que la gente tiene sobre el mar es hacer que les sirvan sus intereses.
(The only responsibility that people have to the sea is to make it serve their own interests)

_____ 24. Los humanos deben dar se cuenta de que son parte de la naturaleza, y no deben manipularla.
(Humans should recognize that they are part of nature, and should not manipulate it)

_____ 25. Yo hago todo lo que puedo para proteger el mar.
(I do everything I can to protect the sea)

_____ 26. Las empresas solamente protegen el mar si el gobierno les dice que tienen que hacerlo.
(The firms only protect the sea if the government tells them they have to)

_____ 27. El mar no requiere tanto protegion que pensamos.
(The ocean doesn't require as much protection as we think)

_____ 28. Los beneficios del crecemiento economico son mucho mas importates que qualquier dano del medioambiente.
(The positive benefits of economic growth are much more important than any environmental harm)

29. Como se ve usted en relacion con la naturaleza?

30. Piensa que podria trabajar en un equipo, o prefiere trabajar solo?
(Aquaculture employee only)
30. Cree que la experiencia de trabajar en la empresa ha cambiado su punto de vista sobre el mar?

Job Satisfaction Questionnaire (After Gatewood and McCay 1990)

Ahora quiero preguntarle unas preguntas sobre el nivel de satisfacion que usted tiene con su trabajo. Usando una escala que uso antes, quiero que me indique el nivel de satisfacion de lo que piensa sobre las siguientas frases.

1 = descontento
2 = neutral / sin opinion
3 = contento

_____ 1. Los requisitos fisicos del trabajo
(The physical demands of the work)

_____ 2. Sus companeros del trabajo
(Your fellow workers)

_____ 3. El presion mental del trabajo
(Mental pressure of the work)

_____ 4. La sanidad del trabajo
(Healthfulness of the work)

_____ 5. El manejo de las reglas
(Management of the rules)

_____ 6. El desafio del trabajo
(The challenge)

_____ 7. La seguridad de su sueldo
(Predictability of your earnings)

_____ 8. El horario del trabajo
(Your work schedule)

_____ 10. Tiempo para su familia
(Time for family)

_____ 11. La aventura
(The adventure)

_____ 12. El tiempo que tarda en llegar a donde pesca
(Time it takes to get where you fish)

_____ 13. Cantidad de horas que trabaja a la semana
(Number of hours you work per week)

_____ 14. Estar conectado al mar
(Working in connection with the sea)

_____ 15. La seguridad del futuro del trabajo
(Job safety)

_____ 16. El sentido de la autonomia
(Feeling of autonomy)

_____ 17. Tiempo fuera de la casa
(Time away from home)

_____ 18. Usar sus habilidades en frente a la naturaleza
(Using your skill against nature)

_____ 20. El respeto que le da los de mas por ser pescador
(The respect people give you as a fisherman)

_____ 22. La limpieza
(Cleanliness)

_____ 24. El sentido que esta haciendo algo importante
(Feeling you are doing something worthwhile)

_____ 25. El sentido que tendra un futuro en este trabajo
(Feeling you will have a future in this line of work)

_____ 26. La cantidad de dinero que gana
(The amount of money you earn)

Si pudiera cambiar algun aspecto de su trabajo, que haria?
(If you could change an aspect of your job, what would it be?)

Los salmoneros y los choriotos me han mejorado la vida

Si No

Como?

Ha visto un cambio en las empresas desde que empezo a trabajar alla?

(For fishermen)
Porque no ha buscado empleo en las empresas?
(Why haven't you gone to work for the aquaculture firms?)

(For aquaculture)
Porque busco trabajo en la empresa?
(Why did you go to work for the aquaculture firm?)

Hay gerenetes que le ha preguntado sobre sus experiencias o habilidades sobre el mar?

Muchas gracias por participar en esta entrevista.

Si usted tiene más preguntas sobre sus derechos como participante, puede contactar a Christine A. Joseph, Ph.D., Human Subjects Office, University of Georgia, 606A Boyd Graduate Studies Research Center, Athens, Georgia 30602-7411, USA; Teléfono 011-1-706-542-3199; Email IRB@uga.edu.

APPENDIX B: DESCRIPTIVE STATISTICS

Descriptive statistics

Fishermen N=53

			% of sample for each response						
Label	M	SD	1	2	3	4	5	6	7
SWLS1	5.49	.669	0	0	0	0	60.4	30.2	9.4
SWLS2	5.47	.775	0	0	3.8	0	47.2	43.4	5.7
SWLS3	5.90	1.176	0	3.8	1.9	1.9	17.3	42.3	32.7
SWLS4	5.04	1.255	0	7.5	7.5	0	50.9	26.4	7.5
SWLS5	4.79	1.035	0	1.9	17.3	0	63.5	15.4	1.9
Total	26.634	2.89							

Table 1.1

Both N=78

			% of sample for each response						
Label	M	SD	1	2	3	4	5	6	7
SWLS1	5.68	.747	0	0	1.3	0	41.0	44.9	12.8
SWLS2	4.54	1.266	0	0	35.9	1.3	39.7	19.2	3.8
SWLS3	5.51	1.096	0	1.3	7.8	0	36.4	39.0	15.6
SWLS4	4.33	1.695	1.3	20.5	16.7	0	39.7	10.3	11.5
SWLS5	3.69	1.575	1.3	36.4	11.7	6.5	32.5	10.4	1.3
Total	23.688	3.887							

Table 1.2

Aquaculture N=119

			% of sample for each response						
Label	M	SD	1	2	3	4	5	6	7
SWLS1	5.68	.823	0	0	5.9	0	19.3	69.7	5.0
SWLS2	4.18	1.293	0	0	50.4	.8	35.3	7.6	5.9
SWLS3	5.35	10.46	0	0	11.8	0	37.0	43.7	7.6
SWLS4	4.21	1.692	.8	21.0	24.4	.8	20.2	28.6	4.2
SWLS5	4.03	1.722	1.7	31.9	10.1	0	33.6	19.3	3.4
Total	23.453	4.458							

Table 1.3

Salmon N=67

			% of sample for each response						
Label	M	SD	1	2	3	4	5	6	7
SWLS1	5.48	.943	0	0	10.4	0	20.9	68.7	0
SWLS2	3.61	1.302	0	0	79.1	1.5	9.0	0	10.4
SWLS3	4.91	1.055	0	0	19.4	0	52.2	26.9	1.5
SWLS4	2.97	1.087	1.5	37.3	41.8	1.5	17.9	0	0
SWLS5	2.99	1.441	3.0	53.7	17.9	0	17.9	7.5	0
Total	19.955	1.837							

Table 1.4

Mussels N=52

			% of sample for each response						
Label	M	SD	1	2	3	4	5	6	7
SWLS1	5.94	.539	0	0	0	0	17.3	71.2	11.5
SWLS2	4.90	.846	0	0	13.5	0	69.2	17.3	0
SWLS3	5.92	.710	0	0	1.9	0	17.3	65.4	15.4
SWLS4	5.81	.687	0	0	1.9	0	23.1	65.4	9.6
SWLS5	5.38	.932	0	3.8	0	0	53.8	34.6	7.7
Total	27.961	2.195							

Table 1.5

Total N=250

			% of sample for each response						
Label	M	SD	1	2	3	4	5	6	7
SWLS1	5.64	.770	0	0	3.2	0	34.8	53.6	8.4
SWLS2	4.56	1.289	0	0	36.0	.8	39.2	18.8	5.2
SWLS3	5.52	1.106	0	1.2	8.5	.4	32.7	41.9	15.3
SWLS4	4.42	1.637	.8	18.0	18.4	.4	32.8	22.4	7.2
SWLS5	4.08	1.599	1.2	27.0	12.1	2.0	39.5	15.7	2.4
Total	24.193	4.179							

Table 1.6