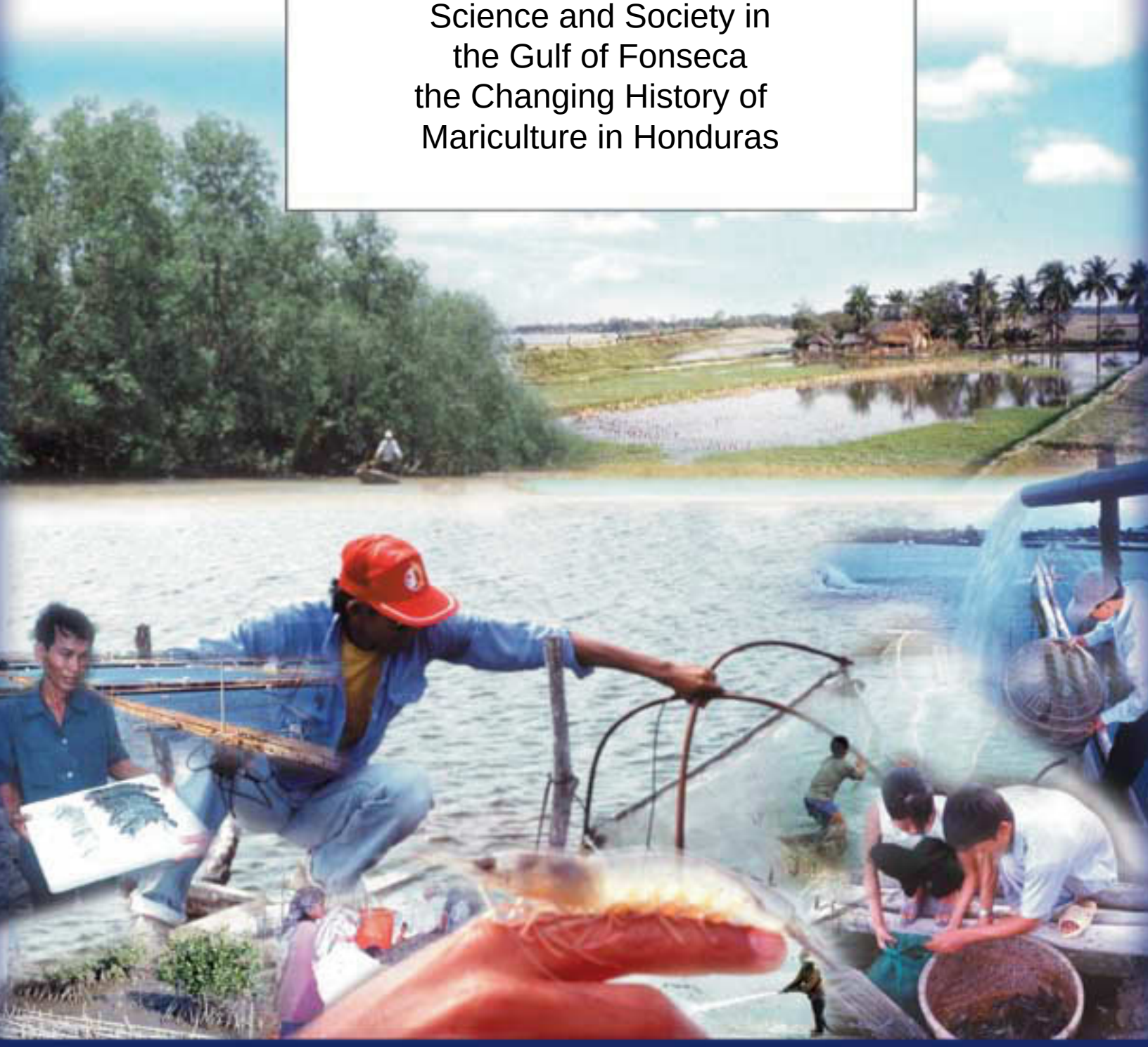
Shrimp Farming and the Environment

Science and Society in the Gulf of Fonseca the Changing History of Mariculture in Honduras



A Consortium Program of:

WORLD BANK

NACA

WWF

FAO FIAT PANIS

SCIENCE AND SOCIETY IN THE GULF OF FONSECA THE CHANGING HISTORY OF MARICULTURE IN HONDURAS

Denise Stanley
Department of Economics
California State University
Fullerton, USA.

and

Carolina Alduvin
Universidad Nacional Autonoma de Honduras, and
SERNA—Direccion de Biodiversidad

A Report Prepared for the

World Bank, Network of Aquaculture Centres in Asia-Pacific,
World Wildlife Fund and Food and Agriculture Organization of the United Nations
Consortium Program on Shrimp Farming and the Environment

The findings, interpretations, and conclusions expressed in this paper are entirely those of the co-editors and contributors and should not be attributed in any manner to the World Bank, to its affiliated organizations that comprise the World Bank Group, or to any of their Executive Directors or the countries they represent, or to the World Wildlife Fund (WWF), or the Network of Aquaculture Centres in Asia-Pacific (NACA) or the Food and Agriculture Organization of the United Nations (FAO). The World Bank, World Wildlife Fund (WWF), the Network of Aquaculture Centres in Asia-Pacific (NACA) and Food and Agriculture Organization of the United Nations (FAO) do not guarantee the accuracy of the data included in this report and accept no responsibility whatsoever for any consequence of their use. The boundaries, designations, colors, denominations, and other information shown on any map in this volume do not imply on the part of the World Bank Group, World Wildlife Fund (WWF), the Network of Aquaculture Centres in Asia-Pacific (NACA) or Food and Agriculture Organization of the United Nations (FAO) any judgment or expression of any opinion on the legal status of any territory or the endorsement or acceptance of boundaries.

Preparation of this document

The research reported in this paper was prepared under the World Bank/NACA/WWF/FAO Consortium Program on Shrimp Farming and the Environment. Due to the strong interest globally in shrimp farming and issues that have arisen from its development, the consortium program was initiated to analyze and share experiences on the better management of shrimp aquaculture in coastal areas. It is based on the recommendations of the FAO Bangkok Technical Consultation on Policies for Sustainable Shrimp Culture[1], a World Bank review on Shrimp Farming and the Environment[2], and an April 1999 meeting on shrimp management practices hosted by NACA and WWF in Bangkok, Thailand. The objectives of the consortium program are: (a) Generate a better understanding of key issues involved in sustainable shrimp aquaculture; (b) Encourage a debate and discussion around these issues that leads to consensus among stakeholders regarding key issues; (c) Identify better management strategies for sustainable shrimp aquaculture; (d) Evaluate the cost for adoption of such strategies as well as other potential barriers to their adoption; (e) Create a framework to review and evaluate successes and failures in sustainable shrimp aquaculture which can inform policy debate on management strategies for sustainable shrimp aquaculture; and (f) Identify future development activities and assistance required for the implementation of better management strategies that would support the development of a more sustainable shrimp culture industry. This paper represents one of the case studies from the Consortium Program.

The program was initiated in August 1999 and comprises complementary case studies on different aspects of shrimp aquaculture. The case studies provide wide geographical coverage of major shrimp producing countries in Asia and Latin America, as well as Africa, and studies and reviews of a global nature. The subject matter is broad, from farm level management practice, poverty issues, integration of shrimp aquaculture into coastal area management, shrimp health management and policy and legal issues. The case studies together provide an unique and important insight into the global status of shrimp aquaculture and management practices. The reports from the Consortium Program are available as web versions (http://www.enaca.org/shrimp) or in a limited number of hard copies.

The funding for the Consortium Program is provided by the World Bank-Netherlands Partnership Program, World Wildlife Fund (WWF), the Network of Aquaculture Centres in Asia-Pacific (NACA) and Food and Agriculture Organization of the United Nations (FAO). The financial assistance of the Netherlands Government, MacArthur and AVINA Foundations in supporting the work are also gratefully acknowledged.

Correspondence: Denise Stanley, Email: dstanley@fullerton.edu.

Reference:

Stanley, D. and C. Alduvin. 2002. Science and Society in the Gulf of Fonseca -The Changing History of Mariculture in Honduras. Report prepared under the World Bank, NACA, WWF and FAO Consortium Program on Shrimp Farming and the Environment. Work in Progress for Public Discussion. Published by the Consortium. 39 pages.

[1] FAO. 1998. Report of the Bangkok FAO Technical Consultation on Policies for Sustainable Shrimp Culture. Bangkok, Thailand, 8-11 December 1997. FAO Fisheries Report No. 572. Rome. 31 p.

[2] World Bank. 1998. Report on Shrimp Farming and the Environment – Can Shrimp Farming be Undertaken Sustainability? A Discussion Paper designed to assist in the development of Sustainable Shrimp Aquaculture. World Bank. Draft.

Abstract

Shrimp farming in southern Honduras has generated considerable controversy around the issues of natural resource access and management. This case study reviews the reasons for and history of that controversy. The early disorderly growth of the industry is seen as having created both public and private costs and benefits in these early years. But the shrimp industry's proactive stance and sustainability ethic after 1994 are factors that led to more cooperation among stakeholders in the zone. Additionally, international research efforts, vertical integration, and the pressure of environmentalists have considerably changed industry dynamics in the Gulf of Fonseca. The new protected areas legislation offers lessons of sustainable coastal management strategies available to other countries with mariculture programs. However, the case study concludes that additional data is needed to assess the actual social and environmental effects of mariculture on local communities.

The study relies on an extensive literature review and insights from the author's previous research trips to southern Honduras between 1991 and 2000. In addition, representatives from several government offices, the shrimp industry, and the primary nongovernmental organizations were interviewed in May 2000. These offices supplied written contributions integrated into this document and have reviewed its contents. Some provided written commentary.

Content

Abbreviations and Acronyms

ACTRIGOLFO	Trinational Civil Association of the Gulf of Fonseca
ANDAH	National Association of Aquaculturalists of Honduras
ANADERH	National Association of Shrimp Packers of Honduras
Lempiras	1 US$ = 15.59 Lempiras (May 2002)
BCH	Central Bank of Honduras
CBERA	US Caribbean Basin Recovery Act
CODDEFFAGOLF	Committee for the Defense and Development of the Flora and Fauna of the Gulf of Fonseca
COHDEFOR	Corporation for Honduran Forestry Development
COHECO	Honduran Consulting in Eco-Development
COHEP	Honduran Council of Private Business
CVC	Commission for the Verification and Control of the Gulf of Fonseca
D.A.	District attorney
DECA	Directorate for Environmental Control and Evaluation
DIBIO	Directorate of Biodiversity
DIGPESCA	General Directorate of Fishing and Aquaculture
ECLA	UN Economic Commission for Latin America
EIA	Environmental Impact Assessment
FAO	Food and Agriculture Organization of the UN
FENAGH	National Federation of Agriculturalists and Cattlemen of Honduras
FPX	Federation of Honduran Non-Traditional Export producers
GAA	Global Aquaculture Alliance
GIS	Global Information Service
GMSB	Granhas Marinas San Bernardo
Ha	Hectare (1 ha = 2.47 acres)
ICRW	International Center for Research on Women
IFC	International Finance Corporation
INA	National Institute of Agriculture
ISANet	Industrial Shrimp Action Network
ISO	International Standards Organization
Km	Kilometer
Km^2	Square kilometer
MT	Metric ton
NGO	Non-government Organization
NOAA	National Oceanic and Atmospheric Administration
OECAP	Organization of Central American Fishing and Aquaculture Businessmen
PL	Post larvae
PROGOLFO	Regional Conservation Project of the Coastal Ecosystems of the Gulf of Fonseca
RIT	Temporary Import Tax Exemption
RRNN	Ministry of Natural Resources
SECTUR	Ministry of Tourism
SEDA	Ministry of the Environment
SERNA	Ministry of Natural Resources and the Environment
SINAPH	National System of Protected Areas of Honduras
SINEIA	National System of Environmental Impact Assessment
UNIDO	United Nations Industrial Organization
USAID	US Agency for International Development
WAS	World Aquaculture Society
WWF	World Wildlife Fund

Introduction: Resource Conflict and Resolution

Changing management patterns of public wetlands for mariculture have led to controversy among stakeholders around the world. Generally, the issues revolve around mariculture limiting access to public wetlands, possible mangrove deforestation by some farmers, the effects of wild shrimp larvae capture on artisanal fisheries, and water pollution problems (Bailey 1988; Stanley 1996a). In each case, the production activities of one industry, or farms within it, are perceived to reduce the net income of another group of resource users. These are common externality effects that can accompany a rapid change of land use. Many analysts suggested that such effects characterized Honduran mariculture for nearly a decade. The nature of the shrimp industry's impact on the environment and society in the country remains disputed in both national and international circles.

A range of private and public actions exists to resolve conflicts between natural resource users. In many developed countries, nuisance laws and judicial relief allow the (negatively) affected parties to be compensated in a settlement. Actors in developing countries such as Honduras more often have relied upon on a public disclosure strategy. Allowing the parties to bargain among themselves to settle their disputes has been another alternative.

Alternatively, the government can take a more active role by applying penalties and exclusionary zoning. Zoning establishes clearly marked geographic zones and specifies their permitted and prohibited uses (Tobey et al. 1998). Moratoriums on shrimp farming have emerged in several Asian countries (Thailand and India), as an extreme example of zoning. These efforts have had limited success. In India, the Supreme Court issued a ban on coastal shrimp aquaculture via a December 1995 judgment in a public interest lawsuit (Bhatta and Bhat 1998). Producers later invested considerable effort to counter this ruling. In Thailand, a contentious debate around inland shrimp farming emerged in 1998. Different branches of the national government took different positions on whether to have an outright ban on the practice or just regulate the practice to allow permits for farms using “closed system” techniques (Flaherty et al. 1999).

However, the history of shrimp farming in Honduras may indicate another route to resolving environmental conflicts through producer and community education. Recognition by both shrimp farmers and fishermen that controlling development is in their mutual interest has led to some steps towards moderate, flexible zoning in the Gulf of Fonseca. The Honduran case offers the opportunity to see how the interaction between NGO pressure and leading producers can reduce community controversy. Scientific input has helped the industry to understand its maximum capacity. Thus, after a decade of acrimonious relations, the leading nongovernmental organizations representing shrimp farmers and fishermen appear to be moving to more cordiality. In 1999 the Honduran Congress passed legislation designating nearly 70,000 ha as protected areas, responding to support from both the environmental NGOs and the shrimp industry. They recognized the protected areas are not suitable for development. This new protected areas strategy may lead to a more sustainable outcome for the industry and the region’s ecosystems.

Implementation problems may arise. For instance, controversy generally surrounds zoning since in some instances land-use controls can impose an involuntary loss on resource users without compensation (Mandeleker 1981). This may become a problem in Honduras, since some mariculture concessions fall within the new protected areas. Divisions between the country’s smaller and larger mariculturists may become more apparent in this regard.

Analysis of the dynamics in Honduras offers the opportunity to draw lessons about specific steps taken to reach the recent consensus. These steps may be useful practices for other countries with growing and conflictive mariculture sectors. This case study outlines the brief history of the Honduran mariculture sector and its changing relationship with other stakeholders in the Gulf of Fonseca.

The study relies on an extensive literature review and insights from the author's previous research trips to southern Honduras between 1991 and 2000. In addition, representatives from several government offices, the shrimp industry, and the primary nongovernmental organizations were interviewed in May 2000. These offices supplied written contributions integrated into this document and have reviewed its contents. Some provided written commentary.

The second section of this case study outlines the expansion of Honduran mariculture in the Gulf of Fonseca. It discusses the original laws guiding land access and the resulting expansion of the industry and its conflicts with artisanal fishermen. A historical analysis of the primary activities of the shrimp farming association National Association of Aquaculturists of Honduras (ANDAH) and the fishermen's organization Committee for the Defense and Development of the Flora and Fauna of the Gulf of Fonseca (CODDEFFAGOLF) follows in the third section. The costs and advantages of not having begun stakeholder communication and consensus seeking earlier are covered. The changes in land management in the Gulf of Fonseca are the focus of the fourth section. This includes a discussion of the 1996–1997 moratorium, as well as the creation of protected areas for the Gulf of Fonseca. Interviews with different stakeholders in the southern zone suggest that the 1999 Protected Areas Legislation was a turning point in reducing controversy between fishermen and mariculturists, but management plans and actual implementation of the protected areas are outstanding concerns. The fifth section reviews the perceptions of environmental and social change in the region and how stakeholders continue to differ in their opinions. The sixth section offers suggestions on how other countries with emerging mariculture programs might implement sustainable land management programs to balance the needs of the industry, other stakeholders and the ecosystem.

Honduran Shrimp Farming: People and Programs

Setting and Stakeholders

Southern Honduras is a 6,840 km region that includes the Gulf of Fonseca and a lowland plain of mangrove swamps, small towns, and pastureland. The two departments of Choluteca and Valle represent about 5% of the national territory yet hold around 11% of the country's population; the departments have a population density of around 95 inhabitants per km^2, one of the nation's highest. Extreme poverty has been common, with a famine declared in the late 1980s. Agriculture and ranching traditionally played a predominant role in the regional economy.

Within this lowland plain, Honduras has about 733 km^2 of mangroves (Oyuela 1994) across the Gulf of Fonseca wetland area, which covers 1,032 km^2 of the total 5,757 km^2 surface area of southern Honduras (PROGOLFO 1998). Since these wetlands are near the coast, the majority of the area is national land, with private ownership usually occurring only beyond 200 meters inland. Land use patterns in southern Honduras have changed substantially. In 1987, 65% of the Pacific coast was forest, 20% in salt flats and 12% in shrimp ponds; by 1995, 58% was in forest, 4% in salt flats, and 34% of the coast was in mariculture (Economist 1998).

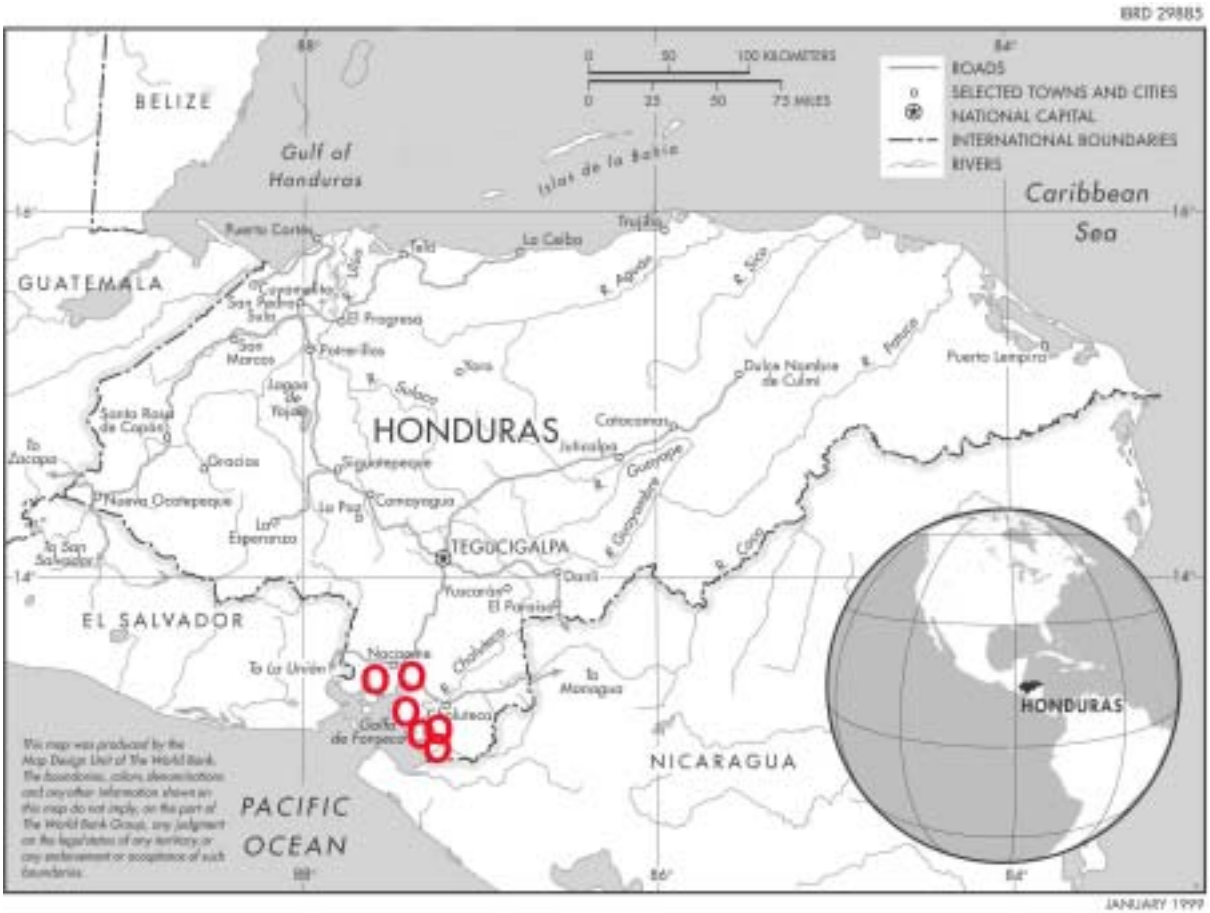


Figure 1. Map of the most important shrimp farming areas in Honduras. **O** = Shrimp farming areas (Rosenberry 2001).

Key stakeholders in the lowland zone include national and municipal governments, fishermen, shrimp farmers and employees, melon farmers and employees, salt pond operators, people who gather shellfish and wood products, and cattle ranchers. Only a few of these stakeholders are organized in relevant producer or user groups; for the purpose of this study, the main actors influencing wetland management include the governments, shrimp farmers, fishermen, and NGOs, each of which is discussed in more detail.

Relevant Governmental Bodies

National and municipal governments remain the primary owner of much of the coastal land and other natural resources in southern Honduras. Natural resource management is the job of several national bodies. The Ministry of Natural Resources (RRNN) has handled most aspects of environmental regulation. One of its offices, DIGPESCA (the General Directorate of Fishing and Aquaculture), is in charge of administering the wetland concession and aquaculture programs. As outlined in the 1959 Fishing Law and a 1993 revision, DIGPESCA aims to improve industrial and artisanal fishing, and aquaculture, through research and education, while also protecting mangroves and other components of the coastal ecosystem.

For a brief period, the Honduran government had a full Ministry of the Environment, (SEDA) with a specific National System of Environmental Impact (SINEIA) enabled through a general environmental law (Dec. No. 104-93). Governmental restructuring in 1996 passed these roles to SERNA (Ministry of Natural Resources and the Environment). Its branch DIBIO (Directorate of Biodiversity) is charged with protecting biodiversity and planning protected areas management. The Directorate for Environmental

Control and Evaluation (DECA) of SERNA grants permits to the farms, the permit is a contract between the government and the business; it usually includes some environmental mitigation measures a company is to complete (for example, reforestation of nearby pastures). Follow-up by the government to verify completion of the mitigation measures just started in 1999 (Arevalo 2000).

The requirement of the 1993 law of completing environmental impact assessments (EIAs) created additional procedures for new shrimp farms beyond the earlier concession requirements. The steps in the review/permit process have included public and technical input into the preparation of the EIA over a 30-day period (Myton 2000). Although the 1993 Environmental Law requires a bond to be posted upon receipt of the license, bonding has not been required of shrimp farms (Myton 2000). The 1993 Environmental Law also designates certain spawning areas for special protection, prohibits the discharge of all kinds of polluting wastes, and obligates wastewater treatment.

COHDEFOR (the Corporation for Honduran Forestry Development) was formed in 1974 with the stated objectives to protect, conserve, and promote the regeneration of forest resources (Oyuela 1994). COHDEFOR oversees the management of mangrove forest resources throughout the southern region, including the protected areas. COHDEFOR's role is changing; it generally has worked to prevent the illegal cutting of wood (including mangrove) and levies fines for such infractions (Oliva 2000). The National System of Protected Areas of Honduras (SINAPH) was created through the general Law of the Environment in 1993. It functions under the direction of COHDEFOR and is responsible for the protection of these zones using strategic alliances with civil institutions (PROGOLFO 1998).

The Special District Attorney for the Environment of the Public Ministry prepares and brings cases of environmental infractions to the court system. It was created in 1993 to receive complaints of environmental infractions and investigate whether each case has legal and technical merit (Santos 2000). Such cases are then sent to the relevant judicial body, where a decision can be made and appropriate penalty applied. To date, the district attorney has received 250 complaints about industries in the southern region, of which 50 were deemed to have legal merit (Santos 2000). Yet no judicial decision has yet been reached in any of these cases. The Environmental Attorney General, in representing the state, should provide follow-up to cases presented by the Special D.A. to the court system. On a few occasions the attorney general has cancelled some concession rights of developers; these concessions were transferred to other interested parties (Espinosa 2000). Over a dozen cases have been processed in the Choluteca local courts (Zelaya 2000).

In 1990, the Municipality Law passed in Honduras; it attempted to move the country towards greater decentralization. Since then nine municipal governments in southern Honduras have been playing an increasing role in environmental and social management of the zone. Although they do not possess the full power and training envisioned, the environmental units of each municipality potentially have the most constant governmental presence for programs concerning shrimp culture and environmental monitoring in Honduras.

Principal Industry Organization

Shrimp farming began in southern Honduras in 1972, when producers sought to develop a technology in tune with the local ecology and native species. After shrimp farming appeared profitable in Honduras, the first farms were constructed in 1984. Apart from the initial investors, salt pond operators and fishermen became involved in the early efforts. A core group of producers formed ANDAH in 1986. At this point various firms felt they needed to unite in an industry organization to overcome a series of obstacles. By 1995, over half of the nation's 88 shrimp farming businesses—with most of the area under production—belonged to ANDAH (Currie 1995). More recently, ANDAH membership includes 63 of the country's 200 artisanal producers, 30 of the 44 semi-intensive producers, and 6 of the 14 laboratories (ANDAH

1998, cited in Samayoa et al. 2000; Zelaya 2000). This membership represents 66% of the farmed area (Corrales 1998).

Although larger farmers form the membership core and directorate of ANDAH, ANDAH employees continue to monitor the small farm sector as well. Membership in ANDAH remains contingent on payment of the monthly quota and approval by the Executive Directorate (Zelaya 2000). The membership fee is used to fund ANDAH's activities, centering on member education and lobbying (Zelaya 2000). The organization sponsors an international symposium on shrimp farming. Other sustainability efforts emerging after 1992 are discussed in the third section. Eleven packing plants in southern Honduras later formed ANADERH (National Association of Shrimp Packers of Honduras).

ANDAH staff mentions the infrastructure and employment generated as some of the community benefits from shrimp farming. Additional activities include a program of environmental quality to certify shrimp operations, scientific research, and sustainability efforts such as post-larvae stocking. ANDAH members participated in the distribution of food aid and the reconstruction of access roads after Hurricane Mitch in 1998. ANDAH is a member of OECAP (Organization of Central American Fishing and Aquaculture Businessmen), COHEP (Honduran Council of Private Business), FPX (Federation of Nontraditional Agroexporters of Honduras), FENAGH (National Federation of Agriculturists and Cattlemen of Honduras), CVC (Commission for the Verification and Control of the Gulf of Fonseca), GAA (Global Aquaculture Alliance), and the WAS (World Aquaculture Society).

Local Nongovernmental Organizations

The artisanal fishermen are a diverse group and include a relatively high concentration of residents around the municipalities of Nacaome, San Lorenzo and Monjaras. Estimates of the number of artisanal fishers in the Gulf of Fonseca range from 2,000 to 5,000 (Tobey et al. 1998). The first major association emerged in the mid-1980s as some fishermen saw threats to their livelihood from shrimp farming. The Committee for the Defense of the Flora and Fauna of the Gulf of Fonseca (CODDEFFAGOLF) was formed in 1988 to promote the defense and rational use of the Gulf's natural resources. The organization was concerned about the ecological destruction caused by many resource users (salt producers and tanners, and some shrimp farmers) (CODDEFFAGOLF 1989). It is a nonprofit environmental organization made up of representatives from 100 community chapters of fishermen and peasants along the Gulf. CODDEFFAGOLF reports its membership includes 5,000 fishing families (CODDEFFAGOLF 2000a).

Many of the organization's members are concerned about enclosure of the public lands and access routes they had traditionally used for free. The organization has supported various marches, roadblocks, machine confiscation efforts, and international solidarity campaigns to publicize the negative side effects of shrimp farming on fishermen's livelihoods. The group publishes a regular newsletter and hosts a weekly radio spot. In 1992 and 1993, CODDEFFAGOLF received the Global 500 Prize given by the UN Environmental Program and the 17th Annual J. Paul Getty Prize coordinated by the World Wildlife Fund (WWF), as well as the Rainforest Alliance Ally Award in 1997. Honduran Environment Minister Carlos Medina presented the group with the National Prize for Environmental Protection and Conservation in 1995. Finally, in April 1999 CODDEFFAGOLF Director Jorge Varela received the International Goldman environmental prize. And the organization channeled food aid from a variety of international NGOs after Hurricane Mitch in the fall of 1998.

In the mid-1990s, CODDEFFAGOLF began involving government officials in monitoring mangrove destruction to a greater extent. Staff of government bodies and CODDEFFAGOLF created the Commission for Monitoring and Environmental Control of the Gulf of Fonseca (CVC). It includes volunteer representatives from various military, municipal and civil organizations who together observe whether a specific area has been destroyed or not. Through this commission CODDEFFAGOLF has

worked closely with relevant government officials—and eventually ANDAH—to investigate persons accused of mangrove deforestation and other forms of environmental degradation (La Tribuna 1999a). Protection of the Gulf's sea turtles is another ongoing activity of the CVC. Finally, the Trinational Civil Association of the Gulf of Fonseca (ACTRIGOLFO) was created in 1995 by El Salvador, Honduras, and Nicaragua. A multinational confederation of coastal environmental organizations, ACTRIGOLFO later received the WWF's J. Paul Getty Prize in February 2000.

Incentives and Industrial Expansion

Economic Incentives

The warm temperatures and extensive salt flats and mangrove areas make the southern zone of Honduras ideal for shrimp farming (DeWalt et al. 1996). International and national incentives have both stimulated and made shrimp farming profitable in southern Honduras. The U.S. Caribbean Basin Recovery Act (CBERA), passed in 1983 and later extended, provides duty-free entry of nontraditional exports and funds for agricultural development and diversification projects. Between 1986 and 1989 USAID provided loans to some large shrimp farms and a technology support program for smaller farmers. Although there were few such bilateral programs by the mid-1990s, Honduran banks continue to operate lines of credit funded by the Central American Bank for Economic Integration, and the IFC (International Finance Corporation) provides some direct financing to the Granjas Marinas group. Private sector funds remain the largest source of capital. The total current area under cultivation is 16,200 ha.

The Honduran government also has provided incentives such as tariff exemptions for input materials, tax rebates, special foreign exchange purchases, and customs benefits. One primary measure is the Temporary Import Tax Exemption (RIT) created under Decree 37 of 1984. This allows the suspension of customs, consular duties, sales taxes, and administrative fees on imported goods used to produce exports sold outside of Central America. It also exempts exporters from paying taxes on profits and the common 1% FOB tax on exports for a period of 10 years to firms developing a nontraditional export product and providing a specified number of jobs. Shrimp qualified as a nontraditional export since in the mid-1980s mariculture was new to the country and provided less than 5% of total export receipts. Despite the sector's current position as a large source of foreign exchange, the RIT exemptions remain in place. Generally, medium and large firms have completed the necessary paperwork to participate in the RIT program (Mendes 1999).

Land Concession Program

Although some 2,464 ha of shrimp farms in Honduras exist on private lands, most farms operate under use-right concessions on public lands (Currie 1995). Mariculture land concessions are essentially a development permit, with the total permit area based on the zone's projected capacity for shrimp farming. There have been changing opinions about the total potential area for shrimp farm development in southern Honduras. The fishermen affiliated with CODDEFFAGOLF have always wanted a low limit on farm expansion. But the shrimp farmers' perceptions of the appropriate limits to farm expansion have changed over time, with the current accepted limit stopping growth at less than 15,000 ha. Early analyses (including one by Tropical Research and Development) cited 31,000 ha as the maximum area for additional pond development (TRD 1987; Scura 1986, cited in Guevara 1991). This area included 18,000 ha of best potential land, 4,700 ha in low-lying agricultural zones and 8,400 has of less productive land (Dickinson et al. 1985, cited in Currie 1995) counted 35,254 ha of mangroves and 32,914 ha salt flats in the coastal zone. This report set an industry expansion level of 19,387 ha. A later study by the Honduran government (TRD 1988) identified 23,183 ha as suitable for additional shrimp farms.

Under Decree 968 of 1980 and Agreement 229 of 1991, the Ministry of Tourism (SECTUR) and DIGPESCA were required to transfer coastal land-use rights to exporters for a low rental fee, ranging

from 0–15 lempiras (less than US$1–5) per hectare. Under Presidential Agreement 2020-09, the fee increases over time to 50–140 lempiras (currently US$4–10) with the higher amounts occurring in later years. The renewable leaseholds normally run for a 20-year period, and the concessions contain the stipulation that producers avoid mangrove deforestation and other environmental damage.

In 1993, following the passage of the National Environmental Law, the Environmental Ministry (SEDA, Secretaria de Ambiente) was briefly involved in the concession process. Additionally, INA has granted some public lands concessions to agrarian reform groups. The Attorney General's Office ("Procuraduria"), together with DIGPESCA, remains the main government institutions designated to give final authorization of the rental contracts for public lands. In reality, the state authority responsible for supervising aquaculture has changed frequently, providing an inadequate legal basis for environmental management. For instance, restructuring of the agriculture and natural resource ministries in 1993, and the uncertain role of COHDEFOR, has caused confusion (Currie 1995).

By 1995, there were 55 different state concessions given out, covering 24,774 ha. Another 2,090 ha were being processed, and there were 117 outstanding applications for areas totaling 11,434 ha (Teichert-Coddington 1999). By 1998, there were 26,868 ha in concessions, with more than 200 applications (covering more than 10,000 ha) in the offices of the SAG and DIGPESCA (DIGPESCA 1998).

Some shrimp farmers have criticized the concession process administered by these various government agencies. In general, the high volume of work required by DIGPESCA to process the applications has led to a haphazard process (Currie 1995). Although the lease rate is low, the process of obtaining a concession costs a lot. Guevara (1991) shows the concession acquisition process involved some 47 steps and 5 agencies, taking an estimated 14 months and costing US$2,500 in 1990; this proved to be a frustration for many shrimp farmers. Boundary limits of concessions sometimes overlapped, and some investors started shrimp pond construction and operation before having the legal authorization completed. And concessions—as mere use rights on public lands—cannot be used as collateral for shrimp farming loans, although banks have made exceptions following Hurricane Mitch (Espinosa 2000).

The Expansion of Farm-Raised Shrimp in Honduras

Nevertheless, these financial incentives, as well as technical and personnel support from Ecuador and Panama, have contributed to the growth of shrimp farming in Honduras. By 1995 there were 11,296 ha under production across 88 firms. In 1997 the 13,600 ha under production were operated by 66 firms and 157 family operations (Teichert-Coddington 1999). Figure 1 shows the approximate location of shrimp farms in the Gulf of Fonseca. In 1999 the 16,000 ha in ponds were operated by some 229 businesses, of which 185 artisanal operations covered 2,000 ha and 44 industrial operations farmed 14,000 ha (Gonzalez et al. 1999). Current estimates cite 4,000 ha in artisanal operations and 1,500 ha in medium-scale farms. Most Honduran farmers have relied upon semi-intensive production methods; however, in recent years since viral problems have occurred, lower stocking densities and more extensive production methods has been observed (Varela 2000).

Following Hurricane Mitch in 1998, anecdotal evidence suggests, substantial changes in farm size and production area have been occurring. Some farms were insured against such risks, while other enterprises went bankrupt. According to ANDAH, the current area in production is 16,200 ha operated by 265 farms (Green 2000). Table 1 summarizes the best mariculture land data available from ANDAH. (Other sources have presented area information that differs slightly.) During 1998–2000, 15 hatcheries produced about 3.7 billion post-larvae annually, and 11 processing plants also were started (Lara 1995); currently 12 hatcheries and 10 packing plants operate.

Table 1. Development of Land Concessions and Shrimp Operations in Southern Honduras (Currie 1995; DIGPESCA 1998; Green 2000)

	Concession Area (ha)	Production Area (ha)	Production (000 lbs., tails)	Productivity (lbs./ha)
1985	5800	780	1150	1474
1986	6800	1450	1875	1293
1987	8100	2100	3437	1637
1988	13030	2700	4750	1759
1989	16115	5500	5275	959
1990	22200	6975	7125	1022
1991	23777	7951	10350	1289
1992	24000	8622	13125	1522
1993	24500	9250	21200	2292
1994	25780	11050	17925	1622
1995	25100	13620	14575	1070
1996	26000	13620	16400	1204
1997	26558	13620	19387	1423
1998	26686	13730	22160	1614
1999	26686	14954	22500 (est.)	1505
2000	27000	16200		

Productivity trends in the industry, however, have been more erratic. According to Varela (1997), while the farmed area grew from 780 ha in 1985 to 7,950 ha in 1991, production increased from 0.8 million lbs. to 8.4 million lbs. (for an average yield of 1057 lbs./ha.). Productivity actually peaked in 1993 at some 2275 lbs./ha. (Wainwright 1993). Disease problems have lowered yields since 1994. The Taura Virus began in the 1994–1995 cycles. Production recovered slightly in 1996-97, and some new farm expansion occurred. But then the onslaught of Hurricane Mitch caused 90% of the farms to suffer losses; and approximately 29% of shrimp production was lost (Green 1999; Rosenberry 2000). These production losses amounted to about US$23 million in 1998 and US$11 million in 1999, plus US$10 equipment and infrastructure. The White-Spot Virus now threatens producers of the industry (La Prensa 2000c).

Shrimp is the country's third principal export product, but varying data on export levels and dollar earnings from mariculture are common. Data maintained by FPX showed shrimp export values climbing from US$2.8 million in 1985 to US$72 million in 1994 (Noti-ANDAH 1995b; Teichert-Coddington 1999; FPX 1993). Weidner (1992) reports U.S. import data showing shrimp imports increasing from US$15 million in 1980 to US$28 million in 1989. Various reports state that in 1992 exports were valued at about US$40 million (Verge et al. 1993; Wainwright 1995). By 1995 the tail-on production generated some US$77 million (Lara 1995). Figures from the Honduras Central Bank's balance of payments section are reported in Table 2. ANDAH representatives state that exports of the sector (based on Table 1) have remained at around US$100 million in recent years (Zelaya 2000). Alternatively, data on U.S. imports of Honduran shrimp (both farmed and capture) provide an indirect indication of trends in production (NOAA 2000). The quantity of U.S. imports does not reflect all Honduran production since some shrimp go to European markets. However, the U.S. import data do demonstrate a downward trend in production beginning in 1996, with a sharp drop-off in the first six months of 2000 (Table 3).

Table 2. Volume and export earnings from farmed shrimp in Honduras (BCH 2000).

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Value (mill. US$)	29.0	43.2	53.3	100.5	106.7	93.9	124.6	130.8	135.9	130.3
Kilogram (Thousand)	3323	4675	5966	9092	8190	6962	9296	9083	10037	9411

Table 3. U.S. Imports of shrimp from Honduras. *Values for January – June 2000 (NOAA 2000)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999/2000*
Kilogram	4,176	5,893	7,324	9,514	9,052	8,446	8,887	8,219	8,624	7,747/1,436

Stakeholder Relationships During the Mariculture Expansion

Numerous controversies have emerged between shrimp farmers and fishermen during the last 15 years. The primary concerns voiced by the fishermen of CODDEFFAGOLF are outlined in Box 1, while Box 2 demonstrates some of the responses voiced by shrimp farmers affiliated with ANDAH. The fifth provides an overview of the existing data in support of some of these conflicting claims. Each claim may be true for a certain location over a given time period, but whether any can be generalized is another question. As discussed above, some of these areas of contention between fishermen and shrimp farmers may center on competitive resource use by these actors. For instance, fences around farmed land may close access routes, so fishermen must spend more time and expense (for fuel) to reach their work zones. But the third and fourth sections will show that the incompatibility of resource use has declined over time as the shrimp farmers adopted a more sustainability-oriented approach. Thus, the presentation in Boxes 1 and 2 is not intended as a definitive statement on which party is correct but instead summarizes the opinions on these issues.

BOX 1:
CONCERNS RAISED BY CODDEFFAGOLF ABOUT SHRIMP FARMING IN SOUTHERN HONDURAS

- Shrimp farmers deforest mangroves to construct ponds and access roads; future biodiversity may be threatened due to the habitat destruction and interruption of important biological processes such as bird migration and hydrology
- Fishermen and gatherers suffer reduced access and income sources in salt flats and wetland fishing zones
- Fishermen and gatherers using public waterways are harassed by shrimp farm security guards
- Larvae gatherers collecting fry kill the fish by-catch of other species
- Shrimp farm effluents increase water pollution in public estuaries and change the hydrology of coastal areas
- Shrimp farms create few permanent jobs for unemployed men
- Shrimp farmers should be subject to greater government regulation

BOX 2:
ANDAH'S RESPONSE TO CRITICISMS OF HONDURAN MARICULTURE

- Most farms are located not in mangroves but in salt flats
- Fishing income has not suffered because of reduced access but because of increased fishing activity and more fishermen
- Shrimp farms face a high risk of poaching, so a security presence is necessary
- Many farms are turning to hatchery-produced fry for stocking ponds
- Shrimp farming suffers from other, more harmful sources of water pollution in the estuaries, and in fact often releases higher quality water than it receives
- Shrimp farming provides a large number of direct and indirect jobs and the industry generates significant foreign exchange for Honduras
- The industry can operate most efficiently through self-regulation and in accordance with laws direct to sustainable production

Changes in Stakeholder Conflicts: A Historical Analysis

The level of controversy created in Honduras as a consequence of aquaculture was notable for its absolute level of tension and the international publicity it generated. However, important steps have been taken to resolve some of the differences over land access and natural resource use issues that lie at the heart of different perceptions of the problem. CODDEFFAGOLF initially took the lead in aggressively denouncing environmental degradation, and ANDAH reacted strongly. Since 1992 ANDAH has taken a more proactive stance. Table 4 highlights the actions of these stakeholder groups in roughly chronological order. Early tensions are notable, with a trend towards more cooperation since 1993 and especially since 1996.

The Early Years (1985–1994)

In the late 1980s, conflicts between fishermen and mariculturists were especially strong. Although industry leaders have stated that farms were built in salt flats, visiting delegations (Dickensen et al. 1985) cited early deforestation to build shrimp ponds. It also appeared that fishing community dwellers, which were relatively recent migrants to the coastal zones following expulsion from the mountains, were then being dislocated by shrimp farms (Stonich 1991). This may have occurred where shrimp farms blocked off traditional public access routes to fishing areas, as farmers who received concessions quickly built fences around their leaseholds. Observers began to note that the rapid and inadequately controlled concession process and farm development were contributing to social and environmental problems (Weidner 1992). Others suggested the low concession fee and short period of the leaseholds probably distorted farmer behavior regarding land management (Stanley 1996b).

Throughout this early period CODDEFFAGOLF found much sympathy in the local press. The group relied on a public disclosure strategy of denouncing a shrimp farmer's mangrove destruction in the local press, after which the farm owner would send a reply letter (La Tribuna 1993a and 1993b). TV and radio spots were used to get the government's attention (CODDEFFAGOLF 2000). The group's monthly bulletin also reported instances in which farmers would cut mangroves, install fences, and block fishermen passage, or in some way alter the natural environment (CODDEFFAGOLF various years). The organization led fishermen in several protest marches—including blocking two bridges—to bring attention to the perceived problems caused by shrimp farming. In 1992 an agreement was signed with COHDEFOR to begin studies for a protected area in southern Honduras. Through these activities CODDEFFAGOLF established itself as a respected protest organization relying on a variety of nonviolent techniques, and the organization won the first of several international awards.

Table 4. Key Events in Environmental Management and Controversy in Southern Honduras, 1985–2000

	ANDAH actions	Other local and international efforts	CODDEFFAGOLF actions
1985–88	Counter news articles		Public disclosure: news articles, radio shows
1989–90	Focus on poaching problems at farms	Community-Farm bargaining results	Newsletter debuted, marches and protest actions
1991–92	1st and 2nd symposiums held		Protest over possible fishermen deaths; Global 500 Award; initial lobbying efforts
1993–94	3rd symposium; educational forums promote sustainability principles; water quality testing laboratory started; Taura Virus begins; EIAs required	1st Greenpeace visit; pressure and dialogue with international agencies	Boycott discussions; 17th Getty Wildlife Conservation Award
1995–96	Vertical integration develops	Shrimp Tribunal; Choluteca declaration	Moratorium promoted; lobbying efforts
1997–98	Pathology lab; larvae by-catch training program; support for moratorium on expansion, protected areas	GAA and ISANet formed and made presentations at WAS meetings; PROGOLFO & Pro-Arca Costas; Hurricane Mitch hits	First protected areas legislation introduced; CVC activities; Rainforest Ally Award; food aid programs; public agreement with ANDAH reached in 8/98
1999–2000	White Spot Virus appears; good management practices promoted		Goldman Environmental Prize awarded to Director Jorge Varela; protected areas emphasis

CODDEFFAGOLF initially declared support for sustainable shrimp farming with regulation, rather than a complete closure of the industry (Membreno 1994). However, the death of five fishermen under mysterious circumstances in 1993 caused a series of counter accusations and counteraccusations in paid newspaper advertisements, and at this point CODDEFFAGOLF first publicly suggested the idea of a boycott of Honduran farm-raised shrimp (La Tribuna 1993c).

ANDAH's response during this early period centered on counterattacks and paid advertisements in the national and international press. Concerns about poaching on farms and overfishing were highlighted. A loss of about 15% of yearly production to illegal extraction was cited (El Heraldo 1994d). Even in recent years, robberies continue to cost the industry nearly US$200,000 per year; thus farmers have maintained a large security staff (Oliva 2000). Illegal nets, rather than mariculture, were blamed for any decline in fisheries productivity (La Prensa 1991). ANDAH also began a program of member education in the techniques of mariculture through a biannual international symposium and other extension activities. The content of most of these presentations focused on improving to pond efficiency as well as the industry's interpretation of its historical development and place in society.

By 1995 outside consultant reports noted that strong polarization had existed for over 10 years between those promoting shrimp farming and those who opposed it (Currie 1995). The actions of individual fishermen, such as burning construction machinery—as well as the authoritarian management of some shrimp farms—worsened the divide in 1993. Both ANDAH and the environmental organizations were seen as "highly-politicized" (Currie 1995).

Internationalizing the Controversy (1994–1997)

Tensions between CODDEFFAGOLF and ANDAH were particularly high between 1994–1996 with the involvement of Greenpeace, Acción Ecologica, and other international environmental activist groups in the Honduran debate. A Greenpeace boat visited the Gulf of Fonseca in September 1994 and demanded more government presence to halt the expansion of shrimp farming (La Tribuna 1994b). Shrimp farms including those in Honduras received additional negative publicity at the April 1996 meeting of the "Shrimp Tribunal"of NGOs at the United Nations in New York.

Then the CODDEFFAGOLF-Greenpeace October 1996 conference in Choluteca, "Aquaculture and Its Impacts," with the participation of 23 international NGOs, included discussion of a possible worldwide boycott of farmed shrimp. The resulting Choluteca Declaration demanded a global moratorium on "industrial" shrimp farming. However, there was also a call to transform the industry towards social and ecological sustainability. The NGOs supported 16 principles for sustainable aquaculture, covering factors such as minimum infrastructure, harmony with the environment and fishing systems, and the participation of social organizations (CODDEFFAGOLF 2000a).

Thus, by 1996 groups such as CODDEFFAGOLF were actually moderating their position to support certain types of shrimp farming associated with more traditional systems. But subsequent to the Choluteca Declaration, there was a round of negative accusations by ANDAH, numerous newspaper advertisements, and even a march outside the conference in support of the industry. More conservative press commentators focused on possible job loss in the southern zone if a boycott was enacted (La Prensa 1996; Washington Times 1997).

The formation of ISANet (the Industrial Shrimp Action Network) occurred in October 1997. Its objective is to unite the different nongovernmental organizations concerned about the negative impacts of shrimp farming. ISANet's presence at the World Aquaculture Society meetings in Seattle in 1997 (with billboards calling for a shrimp boycott) shocked many Honduran shrimp producers present.

By contrast, the Global Aquaculture Association (GAA) was formed in early 1997 to represent the interests of shrimp farmers and affiliated industries. Producers felt they needed an international lobbying association to offset the negative publicity surrounding mariculture as well as to promote a greater sustainability ethic within the industry. At the extreme, industry members were encouraged to use some sort of conflict resolution to avoid an international boycott of shrimp (Lockwood 1997).

The Costs of Rapid Growth and Controversy

Without doubt during this period from 1985–1994 the shrimp industry in Honduras grew substantially. Inherent physical factors of the Gulf of Fonseca and generous incentives both spurred this growth. Also, a neo-liberal model of growth influenced Honduran economic policy. Budgets to state regulatory bodies were reduced, and there was little role for either national or local governments in coastal zone management. Although some larger farms had long-range planning and wetland management programs, the whole industry had not yet devised an effective pattern of self-regulation. Thus many observers of Honduran mariculture now characterize these years as the time of "disorderly expansion."

This early growth of the shrimp industry in Honduras brought benefits to a few groups, but there were numerous public, and eventually private, costs involved, as well. Public controversy between shrimp farmers and fishermen made clear some of the social costs emerging; however, private parties and the government accrued additional costs (and benefits). Table 5 outlines some of the explicit and implicit economic costs of the conflict that emerged in southern Honduras during the early period of mariculture expansion. Other countries beginning a mariculture sector must consider these broader costs and benefits in deciding whether to adopt a strategy guided by free market–led export growth or coastal zone management.

Table 5. Costs and Benefits of Disorderly Growth and Controversy in the Gulf of Fonseca, 1985–1994.

Costs	Benefits
Private (paid by shrimp farmers)	**Private**
1) Public relations expenses paid by ANDAH and individual farms: newspaper advertisements, time in press conferences, meetings. 2) Additional expenses to security guards. 3) Continued poor community relations. 4) Possible medium-run user costs as worsened water quality affects yields. (Threats to carrying capacity). 5) Some farms' decrease in profits from poor pond construction.	1) Windfall profits and land speculation gains to some farmers. 2) Increased job opportunities and earnings for some farmers.
Public (paid by government and third parties)	**Public**
1) Externalities to third parties: possible diminished income, job opportunities in fishing communities. 2) Social costs: ambiguous deaths of fishermen, public expenses for policing and investigation. 3) Expenses of disclosing of environmental damage to national and international NGOs. 4) Diminished respect for Honduran government agencies among private and international parties. 5) Opportunity costs and state's loss of natural resource rents derived from public wetlands: low return on land and some concessioned lands not developed.	1) More rapid generation of foreign exchange to service national debt. 2) Additional tax revenues make some national budget funds available for other purposes besides environmental regulation. 3) Strengthening of nongovernmental groups to balance the public sector.

A quick review of Table 5 suggests that the rapid expansion strategy offered few benefits and many costs, which is not surprising given the lack of constraints. The short-run strategy may have been logical if there was a premium on the benefits and the costs were "discounted" (apparent in the medium term). The benefits of rapidly expanded mariculture may be extremely important to a country faced with a huge debt repayment burden. Whether Honduras indeed faced such a reality in the early 1990s is open to debate. What is clear is that both private and public parties faced unforeseen costs due to the ensuing controversy around shrimp farming expansion. Some of these controversy-related costs arose in a much shorter time frame than might have been originally anticipated.

Turning first to the costs to the industry itself, ANDAH and its members had to put forward considerable time and effort to defend the activities of their industry against the critiques made by CODDEFFAGOLF and other observers. These public relations expenses have involved paid advertisements in Honduran newspapers, time spent at press conferences, and participation in international meetings. These expenses were not trivial in the early years; for instance a quick review of newspaper archives suggests that in 1993 alone ANDAH paid for a full monthly supplement and four advertisements in the Honduran papers

("campo pagados"). And controversy with communities over unclear access rules, and possible poaching, led farmers to incur additional costs in security guards. While initial feasibility studies calculated the cost of guards as a tiny part of the budget, recent data show the cost of security guards is 26% of the annual permanent labor budget (and 5% of the total budget) on small farms (Wainwright 1998). Larger farms spend a smaller proportion of total budget (Zelaya 2000). Continued tension with some fishing villages may be a related, though unquantifiable, cost of the early controversy to some farm owners. Finally, the disorderly growth strategy implies tangible revenue losses to some farmers. Forgone future profits are common user costs when system productivity begins to fail. For instance, some Honduran farmers faced reduced yields during the Taura Syndrome crisis of 1994.

Turning to the public costs, members of society and the Honduran government shared many other problems resulting from the disorderly growth. The "externality costs" to third parties are discussed in the first and second sections. Additionally, the ongoing controversy between shrimp farm guards and local residents has resulted in violent incidents. And while the Honduran government reduced its costs by pursuing a low-regulation strategy, in reality these monitoring costs really were passed on to CODDEFFAGOLF (and international donors), who pursued the public disclosure strategy during this period. Travel costs to inspect mangrove disturbance or destruction and the expense of newspaper advertisements are included here. But by shifting these costs to the private sector, the Honduran government inevitably lost some of its credibility. Thus, the state's decision to not participate in coastal zone management—and the resulting stakeholder conflicts that ensued—ultimately hurt the state's reputation.

Finally, the "disorderly growth" strategy of the 1985–1994 period probably was inefficient, in the economic sense of lowering the total social benefits that could be derived from these public wetlands. The very low concession fee set before any study of the true economic value of the coastal lands was completed has meant a lower income stream for the state. Essentially, this price ceiling below market equilibrium represents a transfer of the resource rent from the public to the private sector (Stanley 1996a). Also, that some concessions were transferred to irresponsible private parties (who fenced off large tracts of land but never developed them into ponds) suggests inefficiencies and opportunity costs to society. The alternative uses of these wetlands (for community fishing and gathering) were lost, and the employment and foreign exchange generation potential of these areas was wasted.

The Honduran Industry's Adoption of a Sustainability Orientation (1993–1999)

Tensions between the fishermen of CODDEFFAGOLF and the shrimp farmers associated with ANDAH have decreased remarkably since their peak in 1994. The changing relationship between these two stakeholder groups has developed around two fronts: their perceptions of the ecological "sustainability" of shrimp farming in the Gulf of Fonseca and, second, complaints over access to resources (land, water and mangroves) by fishermen and gatherers. While considerable progress has been made on the first front, there remain strong differences of opinion on the second.

Around 1994 the "disorderly" expansion of mariculture and poor management of forest and fishery resources was recognized by the industry (El Heraldo 1994c). Part of the impetus for ANDAH's change in priorities was several public forums in which research presentations demonstrated that the industries own future depended upon water quality and enhanced land management. ANDAH responded to pressure from international and local environmentalists, as well (Currie 1995; Stanley 1996a). By 1996, leaders had formed a movement within the shrimp industry to limit its own growth to maintain the survival and profitability of its existing members.

Debating the Limits to Honduran Shrimp Farming: New Laws, The Taura Crisis and International Organizations

The 1993 Environmental Law forced new shrimp farmers to undertake environmental impact analyses, and some older enterprises also undertook these studies. The EIA exercise served as a form of environmental education for many members of industry (Myton 2000). The reported number of shrimp farms holding environmental licenses has varied; currently, nearly 30 medium and large shrimp farms (covering at least 60% of the farmed area) hold licenses (Arevalo 2000).

At the same time an international research program on water quality began. The Honduran shrimp industry had long been preoccupied with the quality of pond intake waters, but it took several years before the first monitoring system was implemented, so there is no preindustry baseline water quality data available across the region. Additionally, officials at USAID and other donor agencies were growing increasingly concerned about the industry's sustainability and future. USAID representative Marshall Brown, when interviewed at the First Central American Shrimp Farming Symposium, stated, "We do not want the shrimp farmers to repeat the history of the failed cotton industry in the southern zone" (Nuila 1992).

So in 1993 an agreement was signed between DIGPESCA, the Panamerican Agricultural School, ANDAH, and the University of Auburn to operate a water quality laboratory in southern Honduras. The laboratory's goals are to monitor the assimilitative capacity of the Gulf of Fonseca estuaries, investigate production techniques, and minimize the sector's environmental impacts. USAID initially facilitated financing, while funding for the laboratory now remains the responsibility of ANDAH.

The onslaught of the Taura virus in the 1994–1995 cycles led even more of the industry's technicians to actively take on sustainability efforts. It became clear the coastal economy was on a path of over development that may have been out of sync with the carrying capacity of the region's ecosystem. By 1994 the government had granted, or was in the process of granting, concessions for the full 30,000 hectares originally projected for the industry. The fact that so many concessions had been granted—or were in process—led analysts to question future business start-ups and production in these additional areas that might not be profitable (e.g., the ANDAH-financed study by COHECO 1994). Public and private leaders began to feel that the ability of the gulf's estuarine waters to dilute the pollution created by household and industrial activities could be surpassed if dozens of additional farms were to operate. As Currie (1995) wrote, "Worried about this (Taura) problem and conscious of what has happened in countries such as Ecuador, Taiwan, Thailand, Indonesia and China, the Honduran shrimp farmers through ANDAH have put their efforts in the search for a sustainable development path of the industry."

Thus viral diseases have been an important contributor to the industry's attitude change. An initial conference on sustainability issues was sponsored by ANDAH in March 1994 to educate producers about the need to establish standard scientific criteria for resource conservation and present scientific advances in disease prevention (*El Heraldo* 1994a). Various national and international scientists discussed mangrove preservation and water quality issues in the forum entitled "The Shrimp Industry in the Search for Long-Run Viability." Presentations by estuarine water quality specialist George Ward helped to reinforce the need for planning and development controls (Ward 1995). A later 1994 conference, "Regional Meeting on Sustainable Development of the Gulf of Fonseca and its Waterways," continued this focus (*El Heraldo* 1994c). Warning signals were also emerging from the La Lujosa water research; these reports recommended avoiding new farm development at the upper reaches of riverine estuaries (Teichert-Coddington 1999). And the largest firm (in agreement with ANDAH and governmental organizations) began a laboratory to study the pathogens and diagnosis of shrimp diseases in 1995 (Acuacultura en Honduras 1999).

Finally, the 1995 Currie consultant report was another important effort to organize and update the existing and pending public land concessions data. The data have provided some additional control to the state agencies charged with public land management as well as helping the industry manage its future growth path (Currie 1995). Also these activities led one observer to comment that the Honduran industry was now "listening to the experts" to avoid the appearance and spread of disease that occurred in Asia (Rosenberry 1996).

Changing Business Structure

Several farms in Honduras formed vertically integrated production groups in the mid-ninties. This more sophisticated business structure within the mariculture sector is an additional factor that may have led to a greater sustainability focus. Currently, there are five production groups—GMSB (Granjas Marinas San Bernardo), Grupo Deli, Grupo Chestnut Hills, Grupo Faro, and Grupo Ibermar—that integrate hatchery larvae, farming, processing, and marketing. The largest group currently combines five farms totaling more than 7,000 ha of ponds (GMSB 2000).

It is generally recognized that shrimp farming lends itself to vertical integration since aquaculture requires large-scale technologies, skilled capital formation, and developers willing to take inordinate risks in this new field (Briggs 1979). Vertical integration allows the synchronization of hatchery production with pond availability and strategic market price windows. Such a move was considered necessary by investors in Honduras to lower costs and respond to disease problems and changing consumption quality standards (Pineda 2000). Common feed, pond management, and harvest strategies are now employed in farms belonging to the same group, although some variations may occur between operations in different locations.

Vertical integration may have the beneficial side effect of allowing more sustainability-oriented technicians from a lead farm (such as Granjas Marinas) to disseminate knowledge more widely across a group of producers. For instance, each farm in the Grupo Deli is required to have oxidation ponds and sedimentation canals (Pineda 2000). Linking the product from all the group farms to a specific label also has been beneficial. As an example, members of the Grupo Deli marketing under the Sea Joy label are required to avoid using antibiotics or steroids in production (Pineda 2000). The subsequent cleanliness of the processing plants to meet strict international standards has also been ensured (Woodhouse 1998).

Broadening the Sustainability Focus

The industry's concern about maintaining mangrove cover also emerged in the mid-1990s. Some technicians had argued since the beginning that knowledgeable farmers would never enter a mangrove swamp because the overly high salinity levels and soil type there tend to produce lower yields (Torres Diaz 1991). Some well-educated managers of the largest Honduran farms have sought to advance the importance of mangrove protection for several years. As early as 1993, staff from the largest farm within ANDAH helped to create the San Bernardo Wildlife Forestry Reserve (GMSB 2000). By the late nineties more farmers in Honduras understood the need for mangrove preservation to protect fisheries stocks and water quality, since intact forests can be useful as a natural waste filtering method (Economist 1998).

The ex-president of ANDAH, Carlos Lara, has stated that after early damage to the regional ecosystem was discovered, shrimp producers became conscious of the need for more efficient management methods that would be in tune with the ecosystem (El Heraldo 1997a). ANDAH's philosophy is based on compromise and dialogue, scientific management of natural resources, and sensitivity to the social and economic problems of coastal communities. Lara (1995) cited the association's adoption in 1992 of a more sustainable development policy in its new articles of association and 1994 producer training forums. Additional activities have included a program of environmental quality to certify shrimp operations under the ISO 9000 and 14000 standards, a regional seedling reforestation program ("Escudo Verde"), annual

stocking of larvae in the Gulf of Fonseca, protection of sea turtles, and aquaculture high school training programs at a regional vocational school, Luis Landa, started in 1993 (Bachillerato en Ciencias y Tecnicas Acuicolas). In 1995, ANDAH members adopted a (voluntary) code of conduct with ten guidelines to promote responsible production (Corrales 1998). And in 1997 a program to train larvae collectors and small farmers was undertaken, with financing from the United Nations Industrial Organization (UNIDO). Additionally, ANDAH has encouraged its members to stop using chemical fertilizers and to use lower stocking densities (Teichert-Coddington 1999; Zelaya 2000).

The industry also sponsors a semiannual Central American Shrimp Farming Symposium to disseminate results of practices tried in Honduras and elsewhere; scientific research results from farms are transferred to ANDAH, which then distributes them via the symposium and association magazine. Some of the practices reported (particularly those done on the Granjas Marinas farm) save costs and help the environment, such as reducing fertilizer use (Rodriguez, et al. 1991), low-protein diets (Rodriguez, et al., 1993), feeding trays (Rivas 1997), and reduced water exchange (Green et al. 1999). Research through the GMSB group also is underway to develop new types of feed (Tobey et al. 1998; see also Teichert-Coddington and Rodriguez 1995; Woodhouse 1998).

Thus the new laws, disease threats, and changed management strategies have led to significant changes within the Honduran shrimp farming industry. Additionally, the quiet pressure of international donors (especially USAID) may have had some role in leading the industry to adopt a more sustainability-oriented foundation. The activities of ANDAH have gone beyond the organization's original reactive stance to a more proactive approach to promote sustainability. Relations between CODDEFFAGOLF and ANDAH have improved somewhat. Nowhere is this more evident than in their joint support for the protected areas legislation in Honduras. A discussion of such land management innovations follows below.

Changing Ideas of Land Use Management and Government-Industry Relations

Although external consultants have frequently promoted integrated coastal zone management (e.g. Dickenson et al. 1985), the Honduran government and other stakeholders have not yet fully embraced this methodology. Instead, private efforts by some shrimp farmers and fishermen have served to provide checks and balances on destructive land use over the past decade. In 1996 the Honduran Congress announced a moratorium on new shrimp farming, and in December 1999 legislation to create 10 protected areas in southern Honduras was passed. The progress towards reaching a moratorium in 1996 began through slow negotiations between fishermen and shrimp farmers. Ultimately, these events resulted from the changed sustainability ethic adopted by ANDAH and continued pressure by CODDEFFAGOLF.

Early Land Management Plans

The Honduran courts, unlike those in several Asian countries, have not been involved in any coastal zoning or development moratoriums. The executive branch and its ministries are the main players in land management efforts. An early attempt to regulate mariculture came through 1990's Presidential Decree 041-90, which that required shrimp farms renting state land to mark their boundaries and develop ponds within 90 days of being granted a concession. This measure was not widely implemented (Currie 1995).

The idea of having a public lands reserve in southern Honduras first took hold with Presidential Decree 1118-92 of 1992. The decree followed a 1990 resolution by the Natural Resources Ministry urging better delimitation of mariculture areas and abandonment of ponds located in winter lagoon areas. The 1992 document, signed by then- President Callejas, created seven wildlife and artisanal fishing reserves to keep fishing zones available for some 2,500 fishermen and ecological research. Two additional wildlife reserve areas comprising 4083 ha were set up by the state forestry corporation, COHDEFOR, and ANDAH member farms in Las Iguanas and San Bernardo in 1993.

Several international organizations enthusiastically endorsed the 1992 Presidential Decree (Guzman 1992). But in 1994 it was reported that only El Jicarito, located alongside the Aquacultura Fonseca shrimp farm, was being actively managed as a nature reserve (Oyuela 1994). CODDEFFAGOLF stated that other shrimp farms were expanding into four of the winter lagoon reserve areas in 1992 (Oyuela 1994). Violations of the Jicarito reserve, as well as the damaging effects of foreign tourists hunting birds, were reported in 1997 (CODDEFFAGOLF 1997).

In cases filed between 1994 and 1996 the Environmental Ministry took the lead in accusing shrimp farmers of resource degradation (La Prensa 1994). Environment Minister Carlos Medina noted that many farmers had become concerned about sustainable development but had not followed all the procedures outlined in the 1993 Environmental Law (La Tribuna 1994a). For its part, CODDEFFAGOLF charged that in too many cases SEDA approved the construction of new farms with weak environmental impact statements (CODDEFFAGOLF 1996). This follows observations elsewhere (such as the Bay Islands) that the Honduran public believed that the agencies involved were not implementing a fair review process (Forest 1998). Members of the shrimp farming industry complained about the Ministry's role in the moratorium and environmental impact requirements that seemed biased against mariculture (Mejia 1996).

Meanwhile, private agreements between individual farms and neighboring villages were occurring. These actions represented bargaining among the various stakeholders (fishermen and shrimp farmers) to settle their differences without government intervention. The shrimp farm Aquacultura Fonseca provided one of the early signs of reconciliation between some members of the industry and CODDEFFAGOLF. By late 1992, the firm stopped plans to extend its production area by 1,200 ha so that the area could be declared a wildlife zone (Noti-ANDAH 1995a); this saved area became El Jicarito. Similar letters of agreement were worked out between CODDEFFAGOLF and individual farms in Quebrachal and San Bernardo. A compromise between the CRIMASA, Finca Sur, and El Faro farms was published in early 1996; stipulated actions included the firms' allowing free access by artisanal fishermen to the Berberia lagoon, community infrastructure construction, and removal of fences and nets by both parties (CODDEFFAGOLF 1996). Another compromise agreement to allow fishermen access through concessioned mudflat areas was reached between CODDEFFAGOLF and the Deli Group of farms (BIOMAR, INEXA and Acuicolas La Berberia) in November 1997. Local attempts to establish reserve areas have also emerged. For instance, in 1996 the community leaders of Boca de Rio Viejo (near Marcovia) provided a written statement to the press declaring their island a reserve zone (CODDEFFAGOLF 1996).

The Government-Imposed Moratorium of 1996–97

As mentioned above, by 1995 the Honduran government and some members of the shrimp industry were increasingly concerned about the possible overexpansion of the Honduran shrimp industry. Additionally, the general disorder of the post-larvae gathering and wood extraction need to be controlled (CODDEFFAGOLF 2000a). DIGPESCA and SEDA promoted a presidential decree of January 6, 1995 (Agreement 0041-95), which banned construction of new shrimp farms and the authorization of concessions or environmental licenses until applications included a more complete impact statement. But the decree was not enforced, due to pressure from some branches of the private sector (Nuila 1995).

Another government document, Executive Decree 5-96 of June 1996, set a moratorium to delay shrimp farming expansion. Passage of the moratorium was facilitated by the intervention of then-Environment Minister Carlos Medina (Myton 2000). Additional lobbying by CODDEFFAGOLF and some members of ANDAH, and the march of several thousand fishermen to the Honduran Congress, also played a part in the legislation's passage (Oliva 2000). Executive Decree5-96, upon its publication in the Honduran national record (La Gaceta), set a one-year suspension of new use contracts and environmental licenses for shrimp farms in the Gulf of Fonseca. The goal was to allow the relevant government ministries, non-governmental organizations, and members of the general public to determine the "maximum carrying

capacity" that the gulf and its coasts could support. The government ministries were also stopped from approving applications for use rights in the protected areas for an indefinite period.

In July of 1997 the Honduran Congress approved a decree (#105-97) that extended until March 31, 1998, the prohibition on new concession contracts (or environmental licenses) for the public lands of the Gulf of Fonseca (El Heraldo 1997b). This legislation prohibited any new mariculture, melon, and cotton operations. This decree also required environmental impact studies to recommend the measures necessary for mangrove forest conservation (Nuila 1998a). Since it was not published in the *La Gaceta* immediately, the moratorium was in effect from October 1997 to June 1998.

Officially, some members of ANDAH supported the moratoriums on new shrimp farm development until the region's carrying capacity could be determined through water quality studies (Corrales 1998; Tobey et al. 1998). But a consensus did not exist among all members of the association (Santos 2000). Oswaldo Kafati, then-president of ANDAH, declared the moratorium to be a "political game" (El Heraldo 1997c). He argued that shrimp farmers were not the primary agents of mangrove destruction, but he did agree that more environmental impact statements were needed for new farms (La Tribuna 1997a). The shrimp farming industry then became incensed because during the moratorium the government did not proceed with the carrying capacity study, while also arbitrarily licensing and allowing new cotton farms to operate (La Tribuna 1997a). Shrimp farmers were concerned about the environmental impact of neighboring agricultural activities on regional water quality, and ANDAH even threatened to sue the Honduran government for granting permits to new cotton farmers (El Heraldo 1997d).

Thus, during the moratorium, larger shrimp farmers were genuinely concerned about deteriorating water quality and disease transfer that further expansion could bring. The costs of the moratorium in terms of undeveloped areas were not a problem for those businessmen that had large areas already in production and could use those areas as collateral for future financing (Oliva 2000; Zelaya 2000). The large farmers had already obtained the best areas. But small farmers, who saw their possibilities for expansion cut off, made pronouncements against the moratorium.

The penalties for those who did not abide by moratorium legislation were not clearly stated. Thus it is widely believed that the 1996–97 moratorium was ineffective in halting all shrimp farm expansion (Oliva 2000). Violations of the moratorium, in the form of small and medium-sized shrimp farm construction, were reported during 1997, particularly in the area of Guapinol (CODDEFAGOLF 1997). Additional construction was observed in San Bernardo and Guapinol in 1998 (CODDEFFAGOLF 1998). Observers in the local press have commented that given the strong export revenues generated by farm-raised shrimp, it was unlikely the government would fully enforce a moratorium on the sector's expansion (Nuila 1998a).

Additionally, few environmental impact studies were carried out by the appropriate government ministries or shrimp farmers, as stipulated under Decree 105-97 (Nuila 1998a). Clearly, dividing responsibility among different government agencies created obstacles to achieving results (Espinosa 2000). COHDEFOR was to study mangroves and carrying capacity, while SERNA was to investigate the status of environmental impact statements and mitigation measures filed by shrimp farms. DIGPESCA was supposed to stop granting concessions and strengthen the training of wild PL gatherers (through the UNIDO project). In each case, there were insufficient funding and manpower to complete the tasks (Espinosa 2000).

By April 1998, international environmental organizations had sent notes to President Carlos Flores asking him to enforce the moratorium and to complete studies determining the Gulf of Fonseca's carrying capacity (Nuila 1998a). Then in August of 1998, CODDEFFAGOLF President Jorge Varela threatened to sue the Honduran government or shrimp farms before the Central American Water Court (La Tribuna 1998). Consultants were being contacted to prepare the case, yet Varela mentioned that the suit could be

withdrawn if further progress were made on the protected areas legislation. Indeed, by late 1998 a breakthrough concerning progress toward protected areas legislation did occur between the shrimp farmers and fishermen in Honduras, which enhanced environmental protection in the region. Intermediary organizations arriving to work in southern Honduras facilitated the acquisition of information and consensus among stakeholders during this period.

Concurrent Projects in the Zone

The PROGOLFO project was started in 1997 with funding from the IUCN and the Danish government. PROGOLFO prepared an influential report, "Diagnosis of the State of Natural, Socioeconomic, and Institutional Resources of the Coastal Zone of the Gulf of Fonseca" in 1998 (PROGOLFO 1998). The organization is now moving towards promoting local natural resource management through training mayors and municipal officials in legal issues and GIS techniques for coastal zone management (Guzman 2000). It is hoped that municipal governments can become the focal point for receiving evidence of environmental destruction and serve as an intermediary between communities and the relevant national government bodies, since the CVC (Commission for Verification and Control) consists only of volunteers without any budget.

A second effort, the PROARCA-COSTAS program, was started in 1997 with funds from USAID and an NGO consortium to promote participatory planning and coastal zone management in Central America. It has the goal of strengthening protected areas in Central America and developing regional expertise in coastal zone management. Its activities have included workshops on environmental legislation, agreements with the relevant municipalities, and developing an information database. An agreement was signed between COHDEFOR, CODDEFFAGOLF, and PROARCA-COSTAS in October 1997, after which the National University's Biology Department prepared the first draft of a management plan for the Chismuyo Bay. PROARCA-COSTAS also has mediated relations between ANDAH and CODDEFFAGOLF in the process of passing protected areas legislation (Munoz 2000). It facilitated dialogue by providing scientific evidence to the many stakeholders involved in the gulf's resources, through reports and workshops. The financing and participation of PROARCA-COSTAS, the apparent cooperation between stakeholders, as well as the government support to technicians in the delimitation process, were factors making the protected areas a reality in 1999 (Fuentes 2000).

The Protected Areas Strategy for the Gulf of Fonseca

In 1997, at the end of the moratorium, joint government and private sector efforts revived the protected areas legislation. The draft legislation aimed to protect and sustainable manage 10 wildlife areas dispersed over an area of 56,107 ha of coasts, mudflats, lagoons, and mangroves (Nuila 1998a). The legal basis for the protected areas was drawn from the General Environmental Law of Honduras, the 1992 Presidential Decree, and the 1993 National System of Protected Areas (SENAPH). The legislation also would have put the 10 areas in the Mesoamerican Biological Corridor and provided some continuity following the moratorium's end. Around this time, ANDAH publicly supported the protected areas concept in presentations before the World Aquaculture Society and other forums (Corrales 1998). However, some confusion still existed about the nature of the protected areas, as ANDAH appeared to want the areas characterized as "multiple-use areas" (CODDEFFAGOLF 1998; Nuila 1998b). Presentations were made by ANDAH and CODDEFFAGOLF representatives on the protected areas strategy at the winter meetings of the AAAS (American Association for the Advancement of Science) and the World Aquaculture Society. The lack of apparent consensus among the shrimp industry and CODDEFFAGOLF, as well as insufficient biophysical data in supporting research, may have prevented the legislation from passing at this point (Fuentes 2000).

In 1998, three workshops led by PROARCA-COSTAS were crucial in bringing together the stakeholders and developing a technical consensus to support the protected areas concept. Through this process, the

parties were able to agree upon a compatible management category for the protected areas. The Wildlife and Species Management classification ("Manejo de Habitat y Especies") represents a compromise between CODDEFFAGOLF's earlier demands for a fully protected nature preserve and ANDAH's desire to keep the area under a multiple-use category (Oliva 2000). The category permits conservation through the rational use of existing resources as well as some human activity, to be defined in the management plans.

ANDAH and CODDEFFAGOLF, as cosignatories of the draft protected areas proposal, then started to push the Honduran government. After they gave the document to the Biodiversity Office of the Natural Resources Ministry (SERNA) in October 1998, some changes were made regarding the size of the proposed area and the inclusion of one controversial zone (Berberia). SERNA, with the collaboration of Pro-Arca Costas, led the biophysical and socioeconomic studies of the zone, as well as writing the relevant legal code. Hurricane Mitch relief efforts slowed the progress of the legislation for several months. Yet during this period CODDEFFAGOLF continued to press for the protected areas legislation in the local press. In June 1999 CODDEFFAGOLF, ANDAH, and government representatives joined together in San Lorenzo to celebrate the completion of the final version of the bill (CODDEFFAGOLF 2000a). They then delivered the final proposal (and the declaration of the Mesoamerican Biological Corridor) to the Honduran Congress and lobbied for its passage (Acuicultura en Honduras 1999; La Tribuna 1999b; El Tiempo 1998). Finally the law was approved in December 1999 and entered the public record on January 20, 2000. The government gave additional support to the protected zone by declaring most of the area (7 of the 10 sites) as the 1000th Ramsar Site, an internationally recognized legal agreement concerning wetlands.

Financing and elaborating the protected areas management plans are the next difficult steps for stakeholders in the Gulf of Fonseca. Outstanding issues appear to be the interpretation of the "species and habitat" area category and definition of which uses will and will not be permitted in each zone according to its designated category. Ideally, the protected area strategy will serve the interests of both ANDAH members and CODDEFFAGOLF of limiting new farm expansion (although their reasons differ, they share this interest). But currently there is no money to develop or execute the management plans. The area has not yet been demarcated, and there are few fences or signs noting the protected areas (Nuila 2000). The protected areas boundaries must be made consistent with the requirements of a biological corridor. Methods of enforcing the boundaries of the protected area—and penalties for those who violate boundaries—need to be set. The management plans will involve consultation with communities to determine their preferences for land uses and to enable their participation in monitoring the areas (Cruz 2000). Unfortunately as time has progressed, it appears that the collaboration between ANDAH and CODDEFFAGOLF has not deepened; the parties have not been able to agree even on the reference terms for the most advanced management plan, in the San Lorenzo Bay area (Varela 2000).

Actually, several NGOs and private firms will be preparing management plans for each site in the protected area, after which the relevant government offices of SERNA will review the plans and select the administering organization(s), to be supervised by COHDEFOR (Fuentes 2000). Local protected areas committees will be created to administer the plans and oversee their completion. Management plans that are approved will provide the actual interpretation of this new law, specifying which uses are and are not permitted. Use of the protected areas by PL gatherers, salt producers, firewood gatherers, and shrimp farmers are likely to be points of contention. For example, it is unlikely COHDEFOR will authorize the extraction of mangrove for firewood from the protected areas (Oliva 2000). Yet some cutting of mangrove wood in the protected areas has already begun this year, as the legal force of the new law remains uncertain (Oliva 2000). Few procedures have yet changed in practice since the declaration was passed.

Discrepancies could arise and affect the shrimp industry. The total land area covered by concessions is about 27,000 ha (Espinosa 2000). Of this, about 15,000 ha are developed in ponds leaving 12,000 ha of

land to which investors still hold development rights. Technically, these farms must develop their concession rights within a year. The draft of the protected areas proposal had some requirements about the use of the concessions within the protected areas within a time limit set for infrastructure development. This development allowance caused some friction between the fishermen and small shrimp farmers not affiliated with ANDAH. The final delimitation of the protected areas attempted to exclude the existing farms and their owners' other concessions so that the industry would not feel prohibited from developing these sites (Fuentes 2000). But some government officials believe that conflicts may arise because 13.3% of the farms (Currie 1995) have concession areas in the newly legislated protected areas zone (Espinosa 2000). And Article 2 of the final legislation suggests that those with concessions can build their farms, subject to a strong technical review during environmental licensing. Negotiations between individual investors and the government will be likely (Zelaya 2000), and one farm has already returned part of its concession area that falls within the protected area (Fuentes 2000).

Interpreting Recent Cooperative Efforts in the Gulf of Fonseca

Economic and social differences, along with intermittent periods of public reconciliation, have characterized the 15-year relationship between shrimp farmers and fishermen in Honduras. Yet in recent years the extent of this chasm has diminished. Each side has stepped down from its strongest divergent positions. The changes towards a sustainability ethic announced by the president of ANDAH in 1994 are noted above. And in 1996 Jorge Varela, the executive director of CODDEFFAGOLF, publicly declared it was no longer supporting the international shrimp boycott (cited in Rosenberry 1996 and Varela 1998). The country's new environmental law and the concrete steps taken by ANDAH were factors in CODDEFFAGOLF's decision. Since then, outside observers have noted CODDEFFAGOLF's newsletter has taken a less combative approach, with a broader focus on the gulf's environmental problems and Hurricane Mitch recovery efforts (Espinosa 2000; Velasquez-Nazar 2000). The organizations in southern Honduras have since begun to discuss a wider range of topics, such as marine turtle recovery (Munoz 2000). ANDAH has joined the Commission of Control and Verification in the Gulf of Fonseca and supported the conservation activities of CODDEFFAGOLF and the gulf's municipalities.

How then does the protected areas legislation represent a united effort between CODDEFFAGOLF and ANDAH? CODDEFFAGOLF has interpreted this changed relationship with ANDAH as a reflection of the larger farmers' willingness to change their thinking and recognize sustainable development as an important factor for the long-run success of the industry (Varela 2000). Basically, it had become clear to both parties that they needed to form a tactical alliance to prevent unsustainable growth in the southern region (Velasquez-Nazar 2000). Other commentators have noted this changed thinking. "The attitude and evident conservation results obtained by the shrimp farmers, without ignoring their production activities, meant in some manner that the environmentalists would consider a strategy change possible, because their goals were no longer antagonistic" (Fuentes 1999).

Each of these major players has a common interest in the protected areas idea. CODDEFFAGOLF would like the Bahia de Chismuyo (and other areas) to remain as a zone for artisanal fishing and resource gathering, without shrimp farms. In particular, the organization may wish to avoid access problems of fishermen and security guard-community conflicts, which could arise with new farms (Amaya 2000; Oliva 2000). And viral problems remain the largest threat to the shrimp industry. Thus it appears that members of ANDAH would like to prevent the arrival of new farms that could deteriorate water quality and stretch the carrying capacity of important estuaries in the San Bernardo area. In essence, there may be so much competition for a scarce resource (clean water) that the more established firms are seeking to limit entry into the industry. ANDAH has stated that the specific benefits of having a protected area include limiting development to within the carrying capacity of the zone, providing time to study water quality trends and management, and the opportunities to improve the livelihood of local populations (Zelaya 2000).

Some tensions will always remain between two organizations with such disparate interests as ANDAH and CODDEFFAGOLF, yet future controversy between the two groups now seems somewhat fruitless, as the major farm expansion has already occurred (Nuila 2000). And ANDAH has advanced steps toward self-regulation of the industry, particularly since the moratorium. Various people interviewed spoke of the recent case of a shrimp farm investor entering the Carey zone of the Punta Condega protected area; his actions were denounced by both CODDEFFAGOLF and ANDAH (Munoz 2000). The individual has been denied an environmental license by the Natural Resources Ministry (SERNA), and the CVC undertook inspections to verify the illegal mangrove cutting, with the case now being handled by the Fiscalia de Ambiente (Santos 2000). A similar complaint about shrimp farm expansion in La Iguana wildlife refuge was recently filed (La Tribuna 2000c). And most recently, CODDEFFAGOLF marched in December 2000 to denounce the Carey case and protest further expansion of the GMSB and Hondufarms ponds in the San Bernardo area.

Environmental and Economic Changes in the Southern Zone: Improvements and Outstanding Issues

Alongside these improvements in stakeholder relations and land management schemes, development outcomes in southern Honduras remain a concern. There are still differing perceptions about whether the natural and economic environments of the region have improved or worsened during the 15-year period of shrimp farming. The concurrent expansion of other exports, out-migration of population, and natural disasters makes it difficult to determine the influence of mariculture per se in the trajectory of the region. The final section of this case study draws together data and stakeholder opinions on economic and environmental changes in southern Honduras, described above in Boxes 1 and 2. It suggests some outstanding issues for investigation as a means of continuing the sustainable development ethos of the country's shrimp farming.

Employment and Socioeconomic Impacts in the Southern Region

The socioeconomic effects of Honduran mariculture are the most difficult to clarify, and these issues have been downplayed in the debate around mangrove deforestation dominating the ANDAH-CODDEFFAGOLF discourse over the last 10 years. Analyzing the socioeconomic changes brought on by Honduran mariculture is increasingly important for a region often characterized by high unemployment. Several trends can be identified. Fishermen and gatherers have lost some access rights to public wetlands, and they have rarely been able to switch occupations and become shrimp farmers. Early consultant reports emphasized small shrimp farm development through the creation of cooperatives (Dickenson et al. 1985), but later studies concluded that only larger-scale operations were profitable (USAID 1989).

Data on the structure of production appear to confirm this. The industry grew slowly between 1973 and 1992; the number of farms then doubled between 1992 and 1995. By 1991, a few large-scale operations dominated semi-intensive production in a highly unequal distribution of land: 8% of the farms controlled 72% of the operating area while 84% of the operators worked on 13% of the area (Stanley 1996a; see also Stonich 1991). Samayoa et al. (2000) reported that the 17 largest firms operate over 65% of the area and provide 73% of the total sales.

The industry's profitability has decreased in recent years, and medium- and large-scale farms remain the most viable. Some poorer households produce shrimp through a variety of ownership arrangements. Contract farming and production sharing arrangements have incorporated poorer households as producers in Asia (Csavas 1994), yet these innovations are less common in Honduras. A few medium-sized farm owners, indebted since the White Spot Virus and Hurricane Mitch hit, have rented out their pond area to be managed by technicians from the GMSB group, which retains the residual profits. And some have entered into interlinked input-marketing agreements with packing plants to lower their costs.

The small-farm sector continues to operate with varying profit levels; according to ANDAH those that have continued shrimp farming have improved their knowledge, achieved high profit levels, and received support for new technologies and marketing strategies (Zelaya 2000). Some of these small farmers rely on a diverse set of production activities, including fishing, and salt and shrimp production. This sector continues to be the most problematic for environmental management, as many of these farms operate without complete concession papers or environmental licenses (Fuentes 2000). However, many small farmers have joined regional associations with ANDAH's backing (Amaya 2000). These farmers received some financial assistance through FUNHDER (Honduran Foundation for Rural Development) and private banks in the late 1990s; however, many remain in a particularly precarious position following Hurricane Mitch. Most small farmers, with poor pond siting and no insurance coverage, suffered large financial losses. Due to the high interest rates and strict bank limitations for lending in Honduras, these producers are unable to obtain working capital to start another cycle and earn revenues to pay back the previous loans (Zelaya 2000; La Prensa 2000b). Foreclosure on private houses used as collateral may be imminent (Amaya 2000; La Prensa 2000a). Some relief may appear through a recent government program of refinancing producers (La Tribuna 2000b).

A greater number of poor households are involved in shrimp farming through employment than through ownership. Understanding how the changed land-use patterns have altered the demand for labor, and whether shrimp farming generates more jobs than it displaces, are outstanding concerns. Shrimp farms in Asia locating in land previously used for labor-intensive rice production appear to have contributed to an absolute decrease in the number of jobs available, although seasonal fluctuations may make job reductions appear worse than they are (Bailey 1988; Bhatta and Bhat 1998).

This phenomenon is more difficult to assess in Honduras. Any negative changes in artisanal fishing income (or increases in absolute poverty) brought on by mariculture have not yet been measured. Most studies suggest an uncertain number of coastal dwellers gathering fish, crabs, and wood from seasonal winter lagoons before the arrival of shrimp farms; some areas possibly supported cattle grazing and honey collection (Stonich 1991; Stanley 1998). These fishermen and gatherers most likely have had to travel longer distances once access routes through shrimp farms were closed. Survey data could determine the additional time and diesel expenses occurred by these people. But the average labor requirements of this previous land use may be more difficult to calculate. In general, such extensive natural resource extraction generates low labor demand per hectare, but it can play an important role in the diversification of household incomes and income risk management of the poor (Pattanayak and Sills 1999).

It is also difficult to verify how many resident families have been completely displaced from the winter lagoon areas over the last 15 years. The displacement issue has been particularly contentious in communities such as Guameru, Puerto San Bernardo, Costa Azul and Tenonostal. The more recent UN Economic Commission for Latin America (ECLA) Annual Surveys of Population and Income—in particular the Permanent Multiple Household Survey—are coded so that detailed analysis at the level of coastal municipalities and hamlets is impossible, but some rural to urban migration patterns are noticeable in southern Honduras (Stanley 1999a). The early national cadastral data show no residents in the coastal hamlets, while population counts do appear in the 1974 and 1988 national census reports. Full information about how population and migration levels have changed in southern Honduras due to mariculture will likely not be available until the next full census (2001). The outstanding questions to be answered are how many fishing families live in the zone, how many people moved to southern Honduras for shrimp farming jobs, and how many left.

Slightly more data are available to assess employment participation in shrimp farming. Not all of the area transferred to concession holders has been developed into ponds, so the sector has not reached its full employment potential. To date, shrimp employment opportunities for men include land clearing and other construction tasks, PL gathering, harvesting, and permanent work such as fish feeding, pond cleaning, and

administration. A few men are employed in seed hatchery operations. Women work mainly in the post-harvest tasks of deheading and packing shrimp. The industry has also encouraged indirect employment in the production of ice, feeds, cartons, and heavy cargo transport (Stanley 1996a).

Total employment from shrimp farming in southern Honduras was first estimated at 1,560 people in 1987, growing to 6,037 people in 1991 (Duarte and Reanos 1993, cited in Currie 1995). At various points industry representatives have claimed that 93,445 people (or 1/3 of the region's population) depend on shrimp farming employment, including all family members who are related to the 18,689 holding direct and indirect employment positions (El Heraldo 1997a). For example, initial reports in 1994 cited 21,621 employees with 82,000 beneficiaries (El Heraldo 1994b).

1993 survey data suggest the employment creation potential of semi-intensive shrimp farming is probably less than one permanent full-time job per hectare (Stanley 1996a). Many workers were employed periodically during the year. A careful study by outside consultants in 1995 suggested that the industry employs only 5,259 people; women held 95% of these positions and only 30% of the positions were permanent (Currie 1995). In general, the industry exhibits decreasing intensity of labor use with size, so that the big farms create fewer jobs per land unit than the smaller ones (Shang 1990). Since 1995, ANDAH and affiliated researchers cite shrimp farm employment of 0.49 persons per hectare of ponds, and an additional 1.5 indirect jobs per hectare (Wainwright 1995; Teichert-Coddington 1999). These figures may decline if the industry continues to practice more extensive production methods. Yearly salary payments to the industry's employees were estimated to be 123 million lempiras in 1997 (BCH 1998).

It is still unclear whether the industry's growth has significantly affected the regional labor market and unemployment rates. Permanent farm workers enjoy membership in company solidarity associations (Associations of Integral Development) and higher than average wages (GMSB 2000). Additionally, a few of the employee solidarity associations offer full-time workers a small profit-share benefit. But such high benefits may be contributing to a segmented labor market, with fewer, in effect rationed, opportunities for employment (Stanley 1999a). Also, since the number of (primarily male) PL gatherers has diminished in recent years, young women working in the packing plants are currently the largest single employee group in the sector. Many of these women are new entrants drawn into the labor force by this opportunity. And there may be new arrivals to the region so male unemployment rates may not have changed much even though job growth has occurred. Indeed, the growing stream of outmigration from the departments of Valle and Choluteca demonstrates the continued lack of employment opportunities for young men. This concurrent export of labor services from southern Honduras—and the growing value of dollar remittances—clouds any analysis of the mariculture industry's impact on regional economic growth (Stanley 1999c; La Tribuna 2000a).

Additional socioeconomic impacts of the Honduran mariculture industry include some infrastructure development that has occurred in the areas near ponds. At least three construction firms and two ice plants in Choluteca now depend on sales to the shrimp industry (Stanley 1999b). Numerous farm access roads were constructed in the 1990s and repaired after Hurricane Mitch. ANDAH reports that the total investment in the industry over the last 15 years is around US$430 million and that the industry purchases some US$10 million in services and inputs annually. Additional church and community development efforts occur alongside some farms. National tax payments by the industry have been low, due to the fiscal incentives provided and nonpayment of concession fees by some producers (La Prensa 1999). Yet the city of Choluteca has enjoyed an increase in tax receipts (ibid). Under the Honduran Law of Municipalities (Dec. 134-90), all firms are subject to a real estate tax for all land in operation, as well as taxes on local sales and personal salaries. Together these contributions provide the southern municipalities a base of some US$136,000 per year (BCH 1998).

Opinions on Environmental Change

The main issues in the environmental debate between fishermen and mariculturists have centered on the use of forests, water and fishery resources. Throughout this period, shrimp farmers have stressed their desire for self-regulation (and, increasingly, process standards), rather than strict government regulation and performance standards. While the mangrove deforestation debate has diminished, concerns about water pollution have increased. Interestingly, CODDEFFAGOLF and ANDAH reached an early consensus on the problems associated with the capture of wild PL.

There have been numerous studies of mangrove deforestation in southern Honduras, with widely varying estimates of land changes due to mariculture operations. Unfortunately, most of these studies do not discuss the ecological problems of the conversion of another important ecological niche—salt flats. A controversial study by the Tropical Research and Development consortium reported that more than 6,700 ha of the zone's 30,000 ha of mangroves were destroyed between 1973 and 1992; of this area, 4,037 ha of shrimp farms were developed in areas previously covered by mangroves (Vergne et al. 1993). The 2,132 hectares of high-quality mangroves destroyed by mariculture represent some 7% of the original forest cover (Teichert-Coddington 1999), and 44% of the total 4,839 ha lost. In addition, some low-quality mangrove stands were also converted. Interpretation of this report has led CODDEFFAGOLF to state that 14,000 ha of wetlands have been converted to shrimp ponds (CODDEFFAGOLF 2000). Similar studies by COHDEFOR estimate 3,032 to 4,300 ha of mangroves lost to shrimp farms between 1987 and 1996 (Oyuela 1994; see also Ramirez 1994 and El Heraldo 1997d).

More recent satellite imagery shows shrimp farm expansion has occurred primarily within *Manglar arbustivo* and salt flat areas. Between 1986 and 1997, the area occupied by shrimp and salt farms rose from 3,025 ha to 13,945 ha, while the area under dwarf mangrove declined by 8,119 ha (PROGOLFO 1998). However, a GTZ-PROFOR study, also using satellite imagery, reports that mangrove gains (and mangrove expansion in some shrimp farm areas) should be taken into account (Sanchez 1998). From this, it appears that a net 2,521 ha of mangroves have been converted to shrimp farms, with some 5,578 ha of salt flats converted to mariculture. These studies suggest that most of the shrimp farm expansion (some 75% by 1992) occurred in salt flats, although some mangrove areas were also affected. The contrast in the maps between 1976 and 1996 suggests that mariculture's displacement of mangrove has been most in the areas around Monjaras and Marcovia.

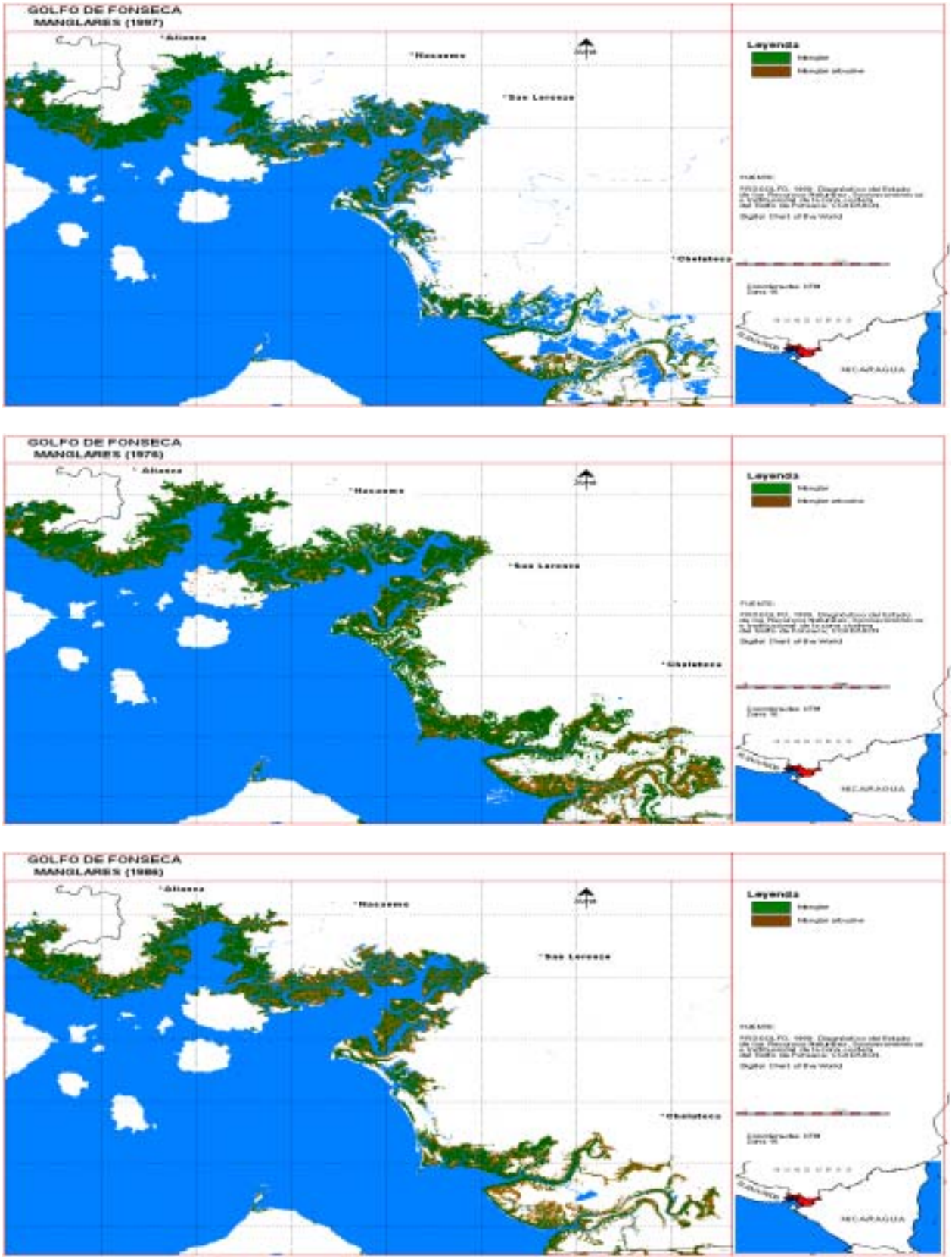


Figure 2. Shows the changes in mangrove forest cover in Golfo De Foncesa (from 1976-1997).

In their contribution to the present case study, ANDAH representatives stated that they lack current data on the actual area of mangroves converted to ponds, and that the total conversion trend is difficult to calculate because some mangrove land was first converted to salt flats, then later to shrimp farms. However, they believe that aerial photos verifying early losses in mangrove show that the losses were mainly due to natural conditions (Zelaya 2000). ANDAH members have often argued than other parties are more to blame for mangrove deforestation in southern Honduras (El Heraldo 1997c). Other industries that use mangrove wood and so contribute to forest destruction include housing construction, tanning, and firewood extraction. For instance, traditional salt ovens still acquired 80% of their firewood from mangrove locations, according to a 1992 survey (Oyuela 1994). Firewood extracted from mangroves remains the primary source of fuelwood for some 95% of households, in a recent survey (ICRW 2000). Additionally, estuary sedimentation from upland deforestation is a growing problem; such sedimentation prevents water passage into mangrove areas, with subsequent forest loss (Samayoa et al. 2000; Zelaya 2000).

Water quality is potentially a more serious concern for the industry and other estuary users. As mentioned in the third section, ANDAH members have grown concerned about the damage wrought by household waste and upstream industries as well as the industry's self-pollution. The proportional contribution of each sector to declining water quality has not been established. Data from La Lujosa water chemistry laboratory are still being analyzed. Initial results of samples from thirteen sites in six estuaries show more pollution in the riverine estuaries than the gulf embayments. This is because there is less water exchange with the gulf at farms further upstream. However, the total calculated discharges from the mariculture sector were less than those attributable to the Choluteca River discharges, primarily contaminated by municipal wastes (Teichert-Coddington 1999). The US Geological Service recently began to support this research effort and will undertake several projects related to the assessment of water quality, the modeling of uptake and release of nutrients by mangrove forests, storm damage, and sediment deposition (Proffitt 2000). This work should clearly demonstrate any physical or chemical degradation of estuary waters.

Some 3,000 larva gatherers operate in the Gulf of Fonseca, and the possible loss of by-catch from this activity has been a constant concern (PRADEPESCA, cited in Corrales 1998). One study reported the loss of 3-4 animals per every larva captured (COHECO 1994). Thus CODDEFFAGOLF has often called for a transition to hatchery-raised seed. Currently the industry is following projections made earlier of relying upon laboratories for 60-70% of the seed (Alduvin 1994; Corrales 1998). Some concern has been raised about the possible displacement of the wild larva gatherers through this transition (Stanley 1996a); in this regard ANDAH sponsored a program with UNIDO funding to train the gatherers to use more selective gear (Corrales 1998). And both ANDAH and CODDEFFAGOLF are working through the CVC to confiscate illegal fishing nets ("Tamiz"), which are prohibited under DIGPESCA's Resolution 009-90 (CODDEFFAGOLF 2000b).

Fishery productivity changes from these possible environmental impacts of mangrove deforestation, water pollution, and by-catch overfishing are nearly impossible to assess. There have been no time series studies of the Gulf of Fonseca fisheries. As one commentator notes, the quantitative data on the number of fishermen operating in the Gulf have been contradictory and confusing (Rodriguez and Windevoxhel 1999). A study commissioned by PRADEPESCA (Duarte 1996) reports 12,900 fishermen operating some 5,705 boats on the Honduran Pacific coast. This represents an increase in fishermen over the previous years. So falling catch per unit effort also may be related to an increase in fishing effort (Rodriguez and Windevoxhel 1999). On the other hand, there has been extensive outmigration from fishing communities in the Honduran department of Valle since 1990 (Stanley 1999b).

Conclusions: Understanding the Conflicts and Reducing Controversy in Honduran Mariculture

The case of Honduran shrimp farming suggests that the negative effects of the industry can be diminished over time. The combination of pressure by nongovernmental organizations and self-education among producer groups can lead to a positive outcome in coastal zones. Producers have long favored self-regulation of their activities, but it has taken time for external actors to believe that self-regulation can be effective and move towards cooperative legislative efforts.

The mariculture industry in Honduras has expanded rapidly over the last 15 years to become the country's third largest export. The area under production increased tenfold over five years, and currently there are nearly 15,000 ha in operation. Investors have received concessions to operate an additional 15,000 ha, but this future conversion of land into mariculture has been a source of contention between communities and shrimp farmers and, more recently, between newer and established firms within the industry. Initial attempts at placing a moratorium on new farm development were unsuccessful, but by 1998 environmentalists initially opposed to shrimp farming and the shrimp farmers themselves were able to come together to support land use legislation for southern Honduras. The new protected areas law sets aside nearly 70,000 ha for multiple uses and careful environmental study. The goal is to provide a framework for sustainable land management. The law is an interesting product of collaboration between mariculturists and community representatives, work that was possible once both of these parties became aware of their common interests in environmental protection.

Currently, each of the primary stakeholders in southern Honduras is seeking to define its future. CODDEFFAGOLF's current mission is to "promote sustainable development in coastal ecosystems with community participation" (CODDEFFAGOLF 1999). Its central program is called "Together Towards the Sustainable Development of the Gulf of Fonseca," with specific projects funded by the MacArthur Foundation, Caritas, and other international donors (CODDEFFAGOLF 2000). Food-for-work programs financed by the FAO's World Food Program are also underway. The new strategic plan of CODDEFFAGOLF focuses on goals such as organized communities promoting the development of consolidated protected areas, and a higher standard of living for fishermen. Wider fishermen and student participation are envisioned, as well as the promotion of more conservation practices and dialogue. Activities could include small ecodevelopment projects, particularly those initiated by women. One specific example is the training program in GIS for local governments that CODDEFFAGOLF supported in November 1999 (CODDEFFAGOLF 2000).

Members of the shrimp farmers association ANDAH appear to be focused on maintaining or increasing pond productivity, rather than a further extension of area or intensity (Zelaya, cited in ICRW 2000). Productivity improvements will continue, using new techniques and modern aeration equipment, oxidation and sedimentation ponds, and water recirculation. No full management plan yet exists for the whole Gulf of Fonseca, so leaders and individual farmers of the Honduran shrimp industry are still working to define a joint production plan by monitoring the carrying capacity of individual estuaries (Green 2000; Ward et al.1999). Meeting international purity and other commercial standards will be important for market expansion. ANDAH also plans to help the Honduran industry remain competitive by reducing production costs, diversifying markets, and improving the value-added contribution of shrimp farming in Honduras (Zelaya 2000). Examples include packing plants starting to implement processing innovations, such as making breaded shrimp (Pineda 2000).

ANDAH also has been participating actively in researching specific farm management practices that enhance profits and reduce the industry's environmental impacts. ANDAH is working with the Coastal Resources Center of the University of Rhode Island to develop good management practices (GMPs) for its members. The GMPs aim to improve production efficiency (and thus maintain or increase profits) while

reducing the impacts of mariculture (Boyd and Haws 1999). These practices may also improve the public image of shrimp farming and possibly allow some shrimp to be certified for ecolabeling. The practices suggested to date by the Global Aquaculture Alliance focus on site selection, farm design and construction, and farm operation. The first two categories are often considered the most important sources of problems for shrimp farming. Honduran producers with existing ponds will have to focus on management strategies. Surveys are underway to assess the implementation of such practices by Honduran farmers. And in the medium-term future, a "Center for Sustainable Shrimp Aquaculture" may include a demonstration farm and training courses, to facilitate adoption of better practices by ANDAH members and other regional farmers (Nuila 2000).

For the moment, the Honduran case offers some tangible lessons for other countries with an emerging mariculture industry and incidence of conflicts with local communities. In Honduras, government regulation has not been fully effective, so private parties were forced to undertake some local environmental management functions. Intense controversy has occurred. But notable events over the past 15 years may have contributed to a stronger industry and improved community relations that are noted today. Such developments may be applicable to mariculture sectors emerging in other nations. The most important factors from the Honduran case include:

- The passage of a national environmental law requiring the elaboration of environmental impact statements (EIAs) in the permitting process. Farms established since 1993 in Honduras have completed these studies, which force managers to consider environmental factors in upcoming production plans. Firms established earlier than 1993 also have benefited by preparing the EIAs.
- The existence of a strong nongovernmental organization that documented early practices of the industry, some of which could be detrimental to other members of society. The negative publicity generated about shrimp farming (and some ostracism of mariculture in the national press) may have had a role in encouraging greater producer responsibility. When such negative publicity was taken to the global level, the NGO's use of consumer demand as a leverage tool may have also influenced some farmers' actions.
- The application of dialogue and quiet pressure by international donors and lending agencies. The role of international organizations in promoting a sustainability ethic was cited by several actors in southern Honduras. USAID originally enjoyed close communication in supporting the Honduran producers, and the World Bank Group has recently moved into this role. In particular, the recent expansion of the GMSB operation was required to meet the strict environmental impact procedures of the International Finance Corporation and the World Bank (Sanchez 2000; World Bank 1999).
- The formation of intermediary organizations and coastal management projects, which have promoted discussions among the conflicting stakeholders. The PROGOLFO and PROARCA-COSTAS projects in the zone sponsored many regional seminars and the opportunity for social interaction and education among the parties in southern Honduras.
- The trend towards vertical integration within the industry. This more sophisticated business organization has fostered common sustainability-oriented management strategies across all farms within a production group.
- The leadership of some industry members in the dissemination of information related to water quality. ANDAH members were influenced by the timely presentations by international scientists voicing concerns about the region's carrying capacity following the onslaught of the Taura virus. The training of many shrimp farmers in the problems of water quality and disease vectors contributed to the industry's support for limiting the expansion of new farms. However, the absence of baseline data in Honduras was a problem that diminished the potential of this leadership early on.

- The realization among the region's primary conflicting parties (ANDAH and CODDEFFAGOLF) that they could achieve more progress by working together than by fighting. Both organizations have experienced frustration with the governmental regulatory process, and they decided that jointly sponsoring legislation would make its passage more likely.

Researchers analyzing the Honduran case face several outstanding questions, particularly those related to the socioeconomic impact of the industry in the southern zone. First, assessing the number of households suffering from externalities created by the new industry, and whether there has been a net increase or decrease in unit labor demand, is nearly impossible given current data limitations. The next census, in 2001, may provide the necessary data. Second, separating out the industry's impact on regional development apart from other concurrent trends is another outstanding research task. Such work requires more accurately determining the regional domestic product and the contributions of different industries and remittance flows to value-added totals. Third, scientific studies have progressed substantially towards characterizing the nature of mangrove disturbance over the last 15 years. Continuous monitoring will be necessary; however, there may be room to design innovative regulatory tools to prevent further encroachment. Finally, the task of understanding the role of shrimp farms in the long cycle of estuarine water quality at different points along the Gulf is just beginning. We hope that the continuing collection of water quality data across various locations and periods will assist in this effort.

Acknowledgements

The research reported in this paper was supported under the joint World Bank/NACA/WWF/FAO Consortium program entitled "Shrimp Aquaculture and the Environment". The funding for the research carried out under this program is provided by the World Bank-Netherlands Partnership Program, World Wildlife Fund (WWF), the Network of Aquaculture Centres in Asia-Pacific (NACA) and Food and Agriculture Organization of the United Nations (FAO) The comments of ANDAH, CODDEFFAGOLF, Dr. Jason W. Clay, Dr. Becky Myton and Dr. Billie DeWalt are greatly appreciated. All views and omissions remain those of the authors and not necessarily those of the supporting organizations.

References

Acuacultura en Honduras. 1999. La ANDAH en Acciones Ambientalistas, and Desarrollo del Laboratorio de Patologia Acuatica de Choluteca, 2nd Edition. October. Choleteca, Honduras: ANDAH.

Alduvin, C. 1994. La industria de la camaricultura en Honduras. *Tiempos Nuevos* May, pp. 30-33.

Amaya, A. 2000. (Independent shrimp farmer and APAGOLFO member). Interview May 26, Cedeno, Marcovia, Honduras.

ANDAH. 1998. Expertos Continuan Estudios Sobre Sindrome Que Affecta el Camáron. *NotiANDAH, Boletin No. 1*, April.

Arevalo, F. 2000. DECA/SERNA. Interview, May 29. Tegucigalpa.

Bailey, C. 1988. The social consequences of tropical mariculture. *Ocean and Shoreline Management 11*:31-44.

BCH (Banco Central de Honduras), Departamento de Estudios Economicos. 1998. *Producción e Industrializacion del Camáron Cultivado en Honduras*. June.

BCH (Banco Central de Honduras). 2000. Website at: http://www.bch.hn. Accessed on May 15.

Bhatta, R. and M. Bhat. 1998. Impacts of aquaculture on the management of estuaries in India. *Environmental Conservation 25*:109-121.

Boyd, C. and M. Haws. 1999. Good management practices to reduce environmental impacts and improve efficiency of shrimp aquaculture in Latin America. In B. Green, et al. (Eds.) *Central American Symposium on Aquaculture (Memorium)*, 18-20 August, San Pedro Sula, Honduras.

Briggs, P. 1979. The status of vertically-integrated aquaculture industry in the United States." In T. Pillay, and W. Dill (Eds) *Advances in Aquaculture*. Fishing News Books, Surrey, UK.

CODDEFFAGOLF. (Committee for the Defense and Development of the Flora and Fauna of the Gulf of Fonseca). 1989. Planteamiento del Comite Para la Defensa y Desarrollo de la Flora y Fauna del Golfo de Fonseca ante la Comision de Recursos Naturales del Congreso Nacional. Tegucigalpa, Honduras. May 1.

CODDEFFAGOLF. 1996-1999. *Boletin Informativo.* Editions 32, 34, 36, 39, 40, 41, 42, 43, 46, and 47-52. Tegucigalpa, Honduras.

CODDEFFAGOLF. 2000a. *Breve Descripción de la Trayectoria Historica del CODDEFFAGOLF en el Golfo de Fonseca en sus 12 años de Existencia*. Tegucigalpa, Honduras. June. Tegucigalpa, Honduras.

CODDEFFAGOLF. 2000b *Report for the Exchange of Experiences.* Puerto Barrios, Guatemala, February 28-March 3. Civil Trinational Association of the Gulf of Fonseca (ACTRIGOLFO) and the Trinational Alliance of the Gulf of Honduras (TRIGOH). Tegucigalpa, Honduras.

COHECO (Honduran Consulting in Eco-Development). 1994. *Evaluación de Impacto Ambiental: Camaroneras de la Zona Sur*. Tegucigalpa: COHECO.

Corrales, H. 1998. *Sustainable Shrimp Aquaculture: The Producer's Responsibility*. Presentation to the AAAS Annual Meeting, New York, May 1998.

Cruz, A. 2000. CODDEFFAGOLF. Interview May 23. Tegucigalpa.

Csavas, I. 1994. Important factors in the success of shrimp farming. *World Aquaculture 5*:35-56.

Currie, D. 1994. Sustainable aquaculture in developing countries: who can make it happen? *World Aquaculture 25*:20-26.

Currie, D. 1995. *Honduras: Ordenación y Desarrollo del Cultivo del Camarón Marino.* Report prepared for GOPS consultants and PRADEPESCA. Program for the Development of Artisinal Fishing, Panama City.

DeWalt, B., P. Vergne and M. Hardin. 1996. Shrimp aquaculture development and the environment: people, mangroves and fisheries in the Gulf of Fonseca, Honduras. *World Development 24*:7.

Dickenson, J., J. Bustillo, J. Jimenez, C. Onuf, D. Rouse, J. Varela and E. Villega. 1985. *Estudio ambiental de las pequenas fincas camaroneras*. PTR (Program of Rural Technologies). USAID, and Honduras Tropical Research and Development.

DIGPESCA. 1998. Situacion actual de los arrendamientos de tierras estatales para el cultivo de Camaron. *Informe Preliminar*. Mimeo, January.

Duarte, R. 1996. *Artisanal Fishing Situation in Honduras*: Report on the country. RRNN/ DIGPESCA. Mimeo.

Economist, 1998. Shrimp farming: going swimmingly. *Economist February 21:* 81-82.

Espinosa, E. 2000. DIGPESCA. Interview May 22. Tegucigalpa.

Flaherty, M., P. Vandergeest and P. Miller. 1999. Rice paddy or shrimp pond: Tough decisions in rural Thailand. *World Development 27*:2045-2059.

Forest, N.B. 1998. Assessment of coastal regulations and implementation: Case study of Roatan, Bay Islands, Honduras, *Coastal Management 26*:125-155.

FPX (Federation of Honduran Non-Traditional Export Producers). 1993. *Informe Annual* (Annual Report) 1993. San Pedro Sula, Honduras: FPX.

Fuentes, J.A. 1999. Los normadores ambientales se pronuncian sobre el papel de la ANDAH en las areas protegidas. *Acuacultura en Honduras*, Ed. 1, June, pp. 18-19.

Fuentes, J.A. 2000. Dirección de Biodiversidad, SERNA. Interview, May 29. Tegucigalpa.

GMSB (Granjas Marinas San Bernardo). 2000. Sea Farms Group Website: http://www.seafarmsgroup.com/company.htm. Accessed February 28.

Gonzalez, R., J. Espinoza and B. Aspra. 1999. Propuesta conceptual para reorganizar la administracion nacional de la pesca y la acuicultura de Honduras. Report prepared for PRADEPESCA (Regional Program of Support to Fishing in the Central American Isthmus), October.

Green, B. 1999. The effect of Tropical Storm Mitch on the Honduran shrimp industry. *World Aquaculture*, pp. 5-6, March 6.

Green, B. 2000. (Auburn University) Personal communication, May 15.

Green, B., D. Teichert-Coddington, C. Boyd, J. Wigglesworth, H. Corrales, D.Martinez and E. Ramirez 1999. Efecto de recambio de agua en la produccion semi-intensiva de *Penaeus vannamei."* In B.W. Green, H.C. Clifford, M. McNamara, and G.M. Moctezuma, (Eds) *Fifth Symposium on Aquaculture in Central America,* 18-20 August, San Pedro Sula, Honduras. Asociación Nacional de Acuicultores de Honduras, Pond Dynamics CRSP, and the Latin American Chapter of the World Aquaculture Society.

Guevara, R. 1991. Ponencia sobre la acuicultura en Honduras. In G. Foer and S. Olsen, (Eds) *Central America's Coasts: Profiles and an Agenda for Action.* Narragansett, RI: Coastal Resources Center, University of Rhode Island, USA. pp. 165-197.

Guzman, C.M. 2000. PROGOLFO. Interview May 25. Choluteca, Honduras.

Guzman, D. 1992. Protección Presidencial Para Lagunas de Invierno. *La Tribuna,* September 5.

El Heraldo. 1994a. Ambientalistas y camaroneros han fumando la pipa de la paz. *El Heraldo,* December 12.

El Heraldo. 1994b. Camaroneras estudian politicas para preservar el ecosistema. *El Heraldo (Sureno),* March 26.

El Heraldo. 1994c. Ecologistas de AID y de la ANDAH. *El Heraldo (Sureno),* December 3.

El Heraldo. 1994d. La Industria Camaronera Revoluciona la Economia Hondurena. *El Heraldo,* January 29.

El Heraldo. 1997a. Camaricultura aun amenaza destruir ecosistema del Golfo de Fonseca. *El Heraldo,* April 22.

El Heraldo. 1997b. Camaroneros han destruido 14,272 hectares de playones y manglares. *El Heraldo Economico,* July 29.

El Heraldo. 1997c. Camaroneros podrían femandar al estado. *El Heraldo,* August 26.

El Heraldo. 1997d. En El Golfo de Fonseca: diputados declaran prohibitiva la instalación de nuevas camaroneras. *El Heraldo,* July 23.

ICRW (International Center for Research on Women), CEASDES, and CODDEFFAGOLF. 2000. *Proceedings from the Conference "Population, Consumption and Environment in the Gulf of Fonseca."* San Salvador, El Salvador.

Lara, C. 1995. *Desarrollo de la Camaricultura en Honduras*. Presentation to the Third Central American Shrimp Farming Symposium, Tegucigalpa, April 26-29.

Lockwood, G. 1997. World shrimp production with environmental and social accountability: a perspective and a proposal *World Aquaculture, September*:52-55.

Mandeleker, D. 1981. *Environment and Equity: A Regulatory Challenge*. New York: McGraw-Hill.

Mejia, T. 1996. *Honduras: Ambiente, Un Ministerio Indeseable*. Inter-Press Service, December 5.

Membreno, A. 1994. CODDEFFAGOLF says no to uncontrolled growth. *Honduras This Week,* July 30.

Mendes, C. 1999. (Ministerio de Economia/regimen de importación temporal.) Interview July 13.

Munoz, E. 2000. (Pro-Arca Costas.) Interview, May 27. Tegucigalpa.

Myton, B. 2000. (CARE Honduras.) Interview, May 24. Tegucigalpa.

NOAA (National Oceanic and Atmospheric Administration). 2000. National Marine Fisheries Service (Trade) Database. Website: http://www.st.nmfs.gov/ows-trade. Accessed September 1.

Noti-ANDAH. 1995a. *Tecnificando la Industria Acuicola*. No. 2, May.

Noti-ANDAH. 1995b. *Exportaciones de Camáron Cultivado*. No. 5, December, p. 14.

Nuila, R. 1992. Camaroneras: limitaciones ambientales. *La Tribuna*, October 26.

Nuila, R. 1995. Revolucion moral y camarones. *La Tribuna*, March 31.

Nuila, R. 1998a. Disrespectful shrimp farmers? *La Tribuna*, June 2.

Nuila, R. 1998b. Corredor biologico costa sur. *La Tribuna*, October 9.

Nuila, R. 2000. (Radio America.) Interview, May 28. Tegucigalpa.

Oliva, L. 2000. (COHDEFOR—Honduran Corporation for Forestry Development) Interview, May 25. Choluteca, Honduras.

Oyuela, O. 1994. Los manglares del Golfo de Fonseca. In D. Suman, (Ed). *El Ecosistema de Manglar en America Latina y la Cuenca del Caribe: Su Manejo y Conservacion*. Miami: Rosenstiel School of Marine and Atmospheric Science, University of Miami.

Pattanayak, S. and E. Sills. 1999. *Do Tropical Forests Provide Natural Insurance? The Case of Small Farmers in the Brazilian Amazon*. Duke/University of North Carolina Program in Latin American Studies, Working Paper #23, May.

Pineda, A. 2000. (Deli Group/Empacadora Deli.) Interview, May 25. Choluteca, Honduras.

La Prensa. 1991. *Con Redes Ilegales Acaban con el Camáron*. February 14.

La Prensa. 1994. *Acusan a dos Camaroneras Ante Ministerio Publico.* September 12.

La Prensa. 1996. *Ahora el Camáron*. October 15.

La Prensa (electronica). 1999. *Camaroneros Adeudan L. 1.5 Milliones en Impuestos al Estado*. November 8.

La Prensa (electronica). 2000a. *Bancos del Sur a un Paso de ser los Nuevos Hacendados y Terratenentes.* June 18.

La Prensa (electronica). 2000b. *Productores del Sur Protestan Porque Banqueros Quieren rematarles Bienes*. June 10.

La Prensa (electronica). 2000c. *Virus 'Mancha Blanca' es lo que Afecta Camarones.* June 20.

Proffitt, E. 2000. (Chief, Wetland Ecology Branch, USGS/BRD.) Personal communication, June 16.

PROGOLFO (Regional Conservation Project of the Coastal Ecosystems of the Gulf of Fonseca). 1998. *Diagnostico del Estado de Los Recursos Naturales, Socioeconomicos e Institucionales de al Zona Costera del Golfo de Fonseca.* Tegucigalpa: PROGOLFO.

Ramirez, X.A. 1994. CODDEFFAGOLF: Los defensores de los manglares del Golfo de Fonseca, Honduras. *Revista Forestal Centroamericana 9*:27-32.

Rivas, J. F. 1997. El Uso de comedores (charolas de alimentacion) en lagunas de cultivo de camaron en una finca de Honduras. In D.E. Alston, B.W. Green, and H.C. Clifford, eds. *Fourth Symposium on Aquaculture in Central America: Focusing on Shrimp and Tilapia*, 22-24 April. Tegucigalpa. Asociación Nacional de Acuicultores de Honduras and the Latin American Chapter of the World Aquaculture Society.

Rodriguez, J. and N. Windevoxhel. 1999. Analisis regional de la situación de la zona marina costera centroamericana, *Informe Tecnico ENV-121*. Banco Interamericano de Desarrollo, Departmento de Desarrollo Sostenible, División de Medio Ambiente.

Rodriguez, R., O. O'Hara and D. Teichert-Coddington. 1991. Efecto de la tasa de fertilizacion inorganica y la calidad de agua sobre el crecimiento y economia en el cultivo semi-intensiva de camaron Penaeus spp en Granjas Marinas San Bernardo. In *Proceedings: First Central American Symposium on Cultivated Shrimp*, 24-26 April, Tegucigalpa.

Rodriguez, R., G. Nunez and D. Teichert-Coddington. 1993. "Evaluación de dos dietas alimenticias con diferente porcentaje de proteina, bajo dos densidades de siembra epoca de invierno en Granjas Marinas San Bernardo." In *Proceedings: Second Central American Symposium on Cultivated Shrimp*, 26-28 April, Tegucigalpa.

Rosenberry, B. 1996. *Shrimp News International*, Vol 21: March/April.

Rosenberry, B. 2000. Mitch's Reign. *Shrimp Farming News International website*, http://members.aol.com/brosenberr/Mitch.html; accessed May 9.

Rosenberry, B. 2001. *World Shrimp Farming. Number 14*. Published by Shrimp News International.

Samayoa, A.M., A. Thurow and T. Thurow. 2000. *A Watershed-Level Economic Assessment of the Downstream Effects of Steepland Erosion on Shrimp Production, Honduras*. Technical Bulletin No. 2000-01. USAID Soil Management Collaborative Research Support Program, Texas A&M University, College Station, Texas. February.

Sanchez, A. 1998. Evaluación de los manglares del Golfo de Fonseca mediante un analísis multitemporal de imagenes del satelite Landsat^{TM} entre los años 1989-1995. *AFE-COHDEFOR, Programa Social Forestal PSF/GTZ*, San Jose, Costa Rica. February.

Sanchez, B. 2000. (Unidad Ambiental, Municipality of San Lorenzo.) Interview, May 23. Tegucigalpa.

Santos, A. 2000. Fiscalia de Ambiente, Ministerio Publico. Interview May 24. Tegucigalpa.

Shang, Y. 1990. *Aquaculture Economics: Basic Concepts and Methods for Analysis*. Boulder, CO: Westview Press.

Stanley, D. 1996a. David vs. Goliath: fishermen conflicts with mariculturalists in Honduras. In H. Collinson (Ed), *Green Guerrillas*. London: Latin American Bureau.

Stanley, D. 1996b. Camáron cultivado: impactos economicos y ecologicos de un rubro de exportacion no-tradicional de Honduras. In H. Nuhn and A. Stamm, *Apertura Comercial en Centroamerica: Nuevos Retos para la Agricultura.* San Jose, Costa Rica: DEI Editores.

Stanley, D. 1998. Explaining persistent conflict among resource users: the case of Honduran mariculture. *Society and Natural Resources 11*:267-278.

Stanley, D. 1999a. *The Economic Impact of Mariculture on a Small Regional Economy*. Paper presented at the Southern Economic Association Meetings, New Orleans, LA, November 24-26.

Stanley, D. 1999b. Labor market structure, new export crops, and inequality. *Economic Development and Cultural Change 48*:71-90.

Stanley, D. 1999c. Understanding conflict in lowland forest zones: mangrove access and deforestation debates in southern Honduras. In U. Hatch and M. Swischer, (Eds), *Managed Ecosystems: The Mesoamerican Experience*. New York: Oxford University Press.

Stonich, S. 1991. The promotion of non-traditional agricultural exports in Honduras: issues of equity, environment and natural resource management. *Development and Change 22*:725-755.

Teichert-Coddington, D. 1999. Shrimp farming in southern Honduras: A case for sustainable production. In U. Hatch and M. Swischer, (Eds), *Managed Ecosystems: The Mesoamerican Experience*. New York: Oxford University Press.

Teichert-Coddington, D. and R. Rodriguez. 1995. Inorganic fertilization and feed reduction in commercial production of *Penaeus vannamei* during wet and dry seasons in Honduras. In H. Egna, J. Bowman, B. Goetze, and N. Weidner, (Eds) *Pond Dynamics/Aquaculture Collaborative Research Support Program, 12th Annual Technical Report*. PD/ACRSP, Oregon State University, 1995.

El Tiempo. 1998. *Entregan la Declaratoria del Corredor Biologico de la Zona Sur de Honduras*. October 7.

Tobey, J., J. Clay and P. Vergne. 1998. Economic, environmental and social impacts of shrimp farming in Latin America. *Coastal Management Report #2202*, Coastal Resources Center, University of Rhode Island.

Torres Diaz, A. 1991. *Manual practico de cultivo de camáron en Honduras*. San Pedro Sula, Honduras: Federation of Nontraditional Export Producers of Honduras.

TRD (Tropical Research and Development). 1988. *Study of the Honduran Shrimp Industry*. Gainesville, FL: TRD. April.

La Tribuna. 1993a. *Gobiernos y Politicos Nacionalistas Depredan Zona de Reserva en el Sur*. June 3.

La Tribuna. 1993b. *Mi Camaronera no Necesita Descombros: Elias Asfura.* June 9.

La Tribuna. 1993c. *Camaroneras: Feudos o Empresas?* December 1.

La Tribuna. 1994a. *Demandará Camaroneras por Negarse a Proteger Manglares.* September 14.

La Tribuna. 1994b. *Golfo de Fonseca es un Potencial Desastre Ecologico: Greenpeace.* September 12.

La Tribuna. 1997a. *Camaroneras Solo Han Depredado 5% de los Manglares.* July 24.

La Tribuna. 1997b. *Las Exportaciones de Camáron Hacia los Estados Unidos, Amenazadas.* August 20.

La Tribuna. 1998. *Estado enfrentaría demanda por destruir ecosistema del golfo.* August 18.

La Tribuna. 1999a. *Investigaran a Camaronera Que Supuestamente Destruye Manglar.* May 6.

La Tribuna. 1999b. *Buscan Formar un Pulmon Ambiental en Zona Sur.* June 19.

La Tribuna. 2000a. *Cronologia de la Veda Economica de Honduras.* July 12.

La Tribuna. 2000b. *Disponibles $17 million Para Productores.* May 27.

La Tribuna. 2000c. *En Refugio de Vida Silvestre se Construye Una Camaronera.* May 28.

USAID/ FEPROEXAAH (United States Agency for International Development/ Federation of Non-traditional Export Producers of Honduras). 1989. *Plan de Desarrollo del Camaron en Honduras*. Tegucigalpa: USAID/ Honduras

Varela, J. 1997. *La Camaronicultura y Sus Impactos en Honduras.* Paper presented at the World Aquaculture Society International Meetings, Seattle, WA, February 19-23.

Varela, J. 1998. Camaroneros y CODDEFFAGOLF llegan a acuerdo. *La Tribuna*, October 15.

Varela, J. 2000. Un triunfo en la protección del Golfo de Fonseca. *El Heraldo*, January 7.

Velasquez-Nazar, R. 2000. (IISE—Institute for Socio-Economic Investigations.) Interview, May 23. Tegucigalpa.

Vergne, P., M. Hardin and B. DeWalt. 1993. *Environmental Study of the Gulf of Fonseca.* Gainesville, FL: Tropical Research and Development.

Wainwright, F. 1993. *Caracterización Biofiscia y Declaratoria Como Areas Forestales Protegidas*. Choluteca, Honduras: ANDAH.

Wainwright, F. 1995. *Bóletin Informativo Tecnico, No. 1*, June. Choluteca, Honduras: ANDAH.

Wainwright, F. 1998. *Estudio de Factilibidad Tecnico Economico y Evaluacion del Impacto Medio Ambiental, CAMESUR.* Mimeo. Choluteca, Honduras, March.

Ward, G., B. Green and D. Teichert-Coddington. 1999. Estimation of carrying capacity for shrimp aquaculture in the eastern estuaries of the Gulf of Fonseca." In B. Green, et al., (Eds) *Central American Symposium on Aquaculture (Memorium)*, 18-20 August. San Pedro Sula, Honduras.

Washington Times. 1997. *Shrimp Farming Environmentally Sound*. Special international report prepared by the Washington Times' advertising section, May 21.

Weidner, D. 1992. Honduras. In *World Shrimp Culture, Vol. 2*. Silver Spring, MD: National Marine Fisheries Service/NOAA.

Woodhouse, C. 1998. Hondurans realise their Pacific dream. *Fish Farming International*, October:24-25.

World Bank. 1999. External unit project review summary website accessed June 3, http://www.worldbank.org/pics/ifcspi/hns9487.txt

Zelaya, A. 2000. (Director, ANDAH.) Interviews, May 25 and July 10, Choluteca, Honduras.

The World Bank - Netherlands Partnership Program

The World Bank
1818 H Street, NW
Washington D.C. 20433-1234, USA
Telephone : 202-477-1234
Facsimile : 202-477-6391
Telex : MCI 64145 WORLDBANK
MCI 248423 WORLDBANK
Web page : www.worldbank.org
E-mail : rzweig@worldbank.org

Network of Aquaculture Centres in Asia-Pacific (NACA)

Department of Fisheries
Kasetsart University Campus
Ladyao, Jatujak,
Bangkok 10900, Thailand
Web page : www.enaca.org
E-mail : shrimp@enaca.org

World Wildlife Fund (WWF)

1250 24th Street, NW
Washington D.C. 20037, USA
Web page : www.worldwildlife.org
E-mail : shrimp.aquaculture@wwfus.org

Food and Agriculture Organization of the United Nations (FAO)

Viale delle Terme di Carracalla
Rome 00100, Italy
Web page : www.fao.org
E-mail : FI-Inquiries@fao.org