

11 Mangroves, People and Cockles: Impacts of the Shrimp-Farming Industry on Mangrove Communities in Esmeraldas Province, Ecuador

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Abstract

The Ecological Mangrove Reserve Cayapas-Mataje is located in the delta formed by the estuary of the Cayapas–Santiago–Mataje rivers in Esmeraldas Province, Ecuador, on the border with Colombia. This area harbours the most pristine mangrove ecosystem of Ecuador and is one of the last sites where traditional mangrove resource exploitation activities have not yet been displaced by other uses. Some 6000 inhabitants rely on the mangrove forest for their livelihood; however, changes brought about by new developments such as African palm culture and commercial shrimp farming are having an impact on the mangrove ecosystem. This research examined how these effects on the mangrove ecosystem are affecting local communities. Research found that fishing and cockle gathering are the most important economic activities, with 85% of the households depending on them. In contrast, the 3000 ha of shrimp farms employ only 0.6% of the locals. Construction of shrimp farms has led to the destruction of cockle-gathering grounds and damage to agricultural land. Local people responded to these changes by creating new management strategies, from the creation of mangrove defence groups to the implementation of a novel stewardship practice called ‘custodias’.

Introduction

The rapid development of shrimp farming has been accompanied by increasingly controversial debates over its environmental, social and economic impacts. There is considerable uncertainty about appropriate policy and management responses, not least because of the perception that shrimp culture generates substantial benefits in coastal regions and nationally. Recently, increasing publicity locally, nationally and internationally has been given to environmental and

social issues related to shrimp farming, such as sustainable development, environmental interactions and the long-term sustainability of aquaculture (Chamberlain and Rosenthal, 1995; Reinertsen and Haaland, 1995; Paez-Osuna, 2001). Since 99% of shrimp farms are located in tropical areas, the impact of the industry on developing countries has received special attention (Pullin, 1993; Bagarinao and Flores, 1994; Parks and Bonifaz, 1994; FAO/NACA, 1995; Menasveta, 1997; Nambiar and Singh, 1997; Hein, 2000; EJF, 2003, 2004; Barbier and Cox, 2004).

In Ecuador, the first commercial shrimp pond was constructed in 1969, and by 1982 Ecuador had the world's largest area under shrimp production. By 1991, 132,000 ha of coastal land had been converted to shrimp ponds (Tobey *et al.*, 1998) and, according to the Ecuadorian Forestry and Natural Areas Wild Life Institute (cited in FUNDECOL, 2000a), this had increased to 208,714 ha by 1999.

One of the most significant impacts of the industry in Ecuador has been the cutting of mangroves for the construction of ponds. Mangrove cover was 362,727 ha in 1969 (MAG, 1987) and this had dropped to 154,087 ha in 1999: a loss of 57% in just 30 years. This rapid loss has been attributed mainly to the uncontrolled expansion of shrimp aquaculture (Bodero and Robadue, 1998). Figure 11.1 illustrates the increase in shrimp-farming construction and the decrease in mangrove cover in Ecuador since 1969.

Some of the factors that made this rapid expansion possible were the incentives given by the Ecuadorian government to the shrimp farmers, plus the absence of clear property rights and effective management regimes for mangroves. The objective of this research was to examine how the degradation and loss of the mangrove ecosystem are affecting local communities. This chapter describes effects of the shrimp-farming industry in Ecuador by focusing on the Ecological Mangrove Reserve (REMACAM), the last remaining fully functional mangrove ecosystem in Ecuador (Rosero, 1999). In particular, it examines changes in the use of natural resources, the responses from the local communities and the new management strategies created to protect the remaining mangroves and the livelihoods associated with them.

Study Area

The Ecological Mangrove Reserve Cayapas-Mataje (REMACAM)

REMACAM is located in the delta formed by the estuary of the Cayapas-Santiago-Mataje

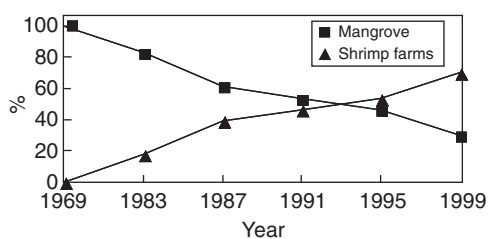


Fig. 11.1. Percentage change in mangrove cover and number of shrimp farms in the Ecuadorian coastal zone (adapted from FUNDECOL, 2000b).

rivers in Esmeraldas Province of Ecuador on the border with Colombia (Fig. 11.2). It is part of a continuous mangrove belt that commences in the central area of the Colombian Pacific coast (Cape Corrientes) and finishes in the south of Esmeraldas.

The reserve encompasses 53,200 ha, of which 32,250 ha are terrestrial habitats and 18,000 ha are mangroves. REMACAM is part of the Protected Areas National System of Ecuador and was established in January 1996 (Resolution 001 DE 052-A-DE). It is under the jurisdiction of the state, making the state the only legal owner. It is administered and protected through the Ministry of the Environment.

REMACAM is one of the last places in Ecuador where traditional mangrove resource exploitation activities have not yet been displaced by other uses. Its inhabitants, most of whom are Afro-Ecuadorians, rely directly on the mangroves and other local natural resources for their livelihood. They are grouped mainly in small communities along the rivers and on the mangrove islands. There are 31 rural communities in the reserve, with a total of about 5600 inhabitants. Geographically, the reserve includes the large urban towns of San Lorenzo and Limones (Fig. 11.2), with 13,000 and 7000 inhabitants, respectively. Administratively, they do not belong to the reserve, but in practice they use the reserve and its resources.

Although the reserve is considered the most pristine mangrove system of Ecuador, the shrimp-farming industry is already present. According to the latest survey (FEPP-Manglares, 2002), there are 45 shrimp farms in the reserve, occupying a total of 3114 ha,

of which 90% are illegal. The big shrimp farms are located in the central and southern parts of REMACAM and thus they affect some communities (e.g. Tambillo and Olmedo) more than others.

Methodology

The fieldwork focused on the rural communities located in the mangrove islands where

the majority (87%) of REMACAM inhabitants live. Socio-economic information was gathered using 170 socio-economic surveys (SES) and 100 semi-structured interviews (SSI). These were conducted in 12 different communities, ranging from small to large, dispersed throughout the reserve (Fig. 11.2). The SES included information on the different economic activities undertaken in the area, and the uses of mangroves and other resources associated with mangroves.

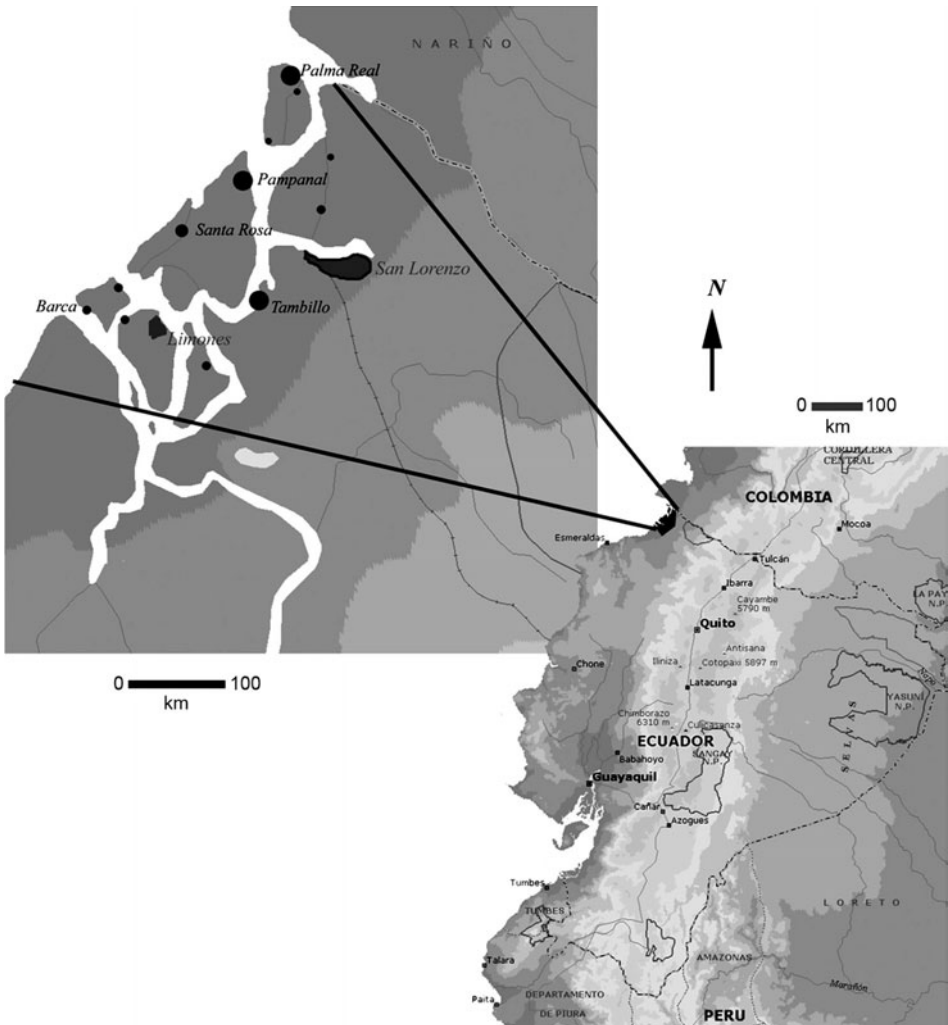


Fig. 11.2. The Ecuadorian coastal zone showing the location of REMACAM. The detailed inset shows the communities where the socio-economic survey and interviews were carried out. The size of the communities is represented by the size of the dots. Urban towns (San Lorenzo and Limones) were not part of the study and are depicted for information purposes only.

Information regarding education, social organizations and migration was also collected. The SSIs and additional informal questioning were used to understand people's attitudes and thoughts about mangrove defence, fishing and cockle gathering, and the new management strategies. To fully understand the history of the mangrove defence movements in Ecuador, the creation of the REMACAM reserve and the background to the custody process, in-depth interviews were conducted with social movement leaders working in the area, government authorities and technicians working with various NGOs.

One of the most important methodological components of the research was participant observation; the researcher lived full-time in the area as part of the Mangrove Project team (implemented by the Fondo Ecuatoriano Popularum Progressio, FEPP). Fieldwork was done between March 2002 and February 2003.

Results and Discussion

Socio-economic characteristics of the communities

The communities in REMACAM are well adapted to the mangrove ecosystem. They are always located in sheltered areas behind mangrove stands so they are protected from strong waves and winds. The houses are commonly built on stilts (Fig. 11.3). The communities are isolated from the continent and the only access to them is by sea. During high tides, the sheltered estuaries allow people to navigate to very distant places in the small open boats they call 'water horses' (*potros*).

REMACAM communities are normally small: 74% of them have from four to 28 households, only 13% of them have more than 130 households and the biggest (Pampanal) has 225 households. The average is 4.46 people per household. The houses are normally small, and 88.7% of them are built of wood, of which 55% is mangrove wood. Others are made from a mix of wood and other materials such as bricks and concrete. In almost all cases, the roof is made of corrugated iron.

Basic social infrastructure in the communities is scarce. There is a correlation between the size of the communities and the type of infrastructure: the smaller the community, the scarcer the infrastructure. For example, electricity and basic health care facilities (a small medical centre with a community nurse) are found only in the larger communities (Pampanal, Palma Real and Tambillo). The small communities have to rely on irregular health campaigns from San Lorenzo and Limones hospitals. A few communities, for example, Pichangal and El Viento, have a small solar plant that produces electricity for 4 h in the evening. Two communities, La Barca and Canchimalero, have no access to electricity. Palma Real has a basic piped water system, and a treated water system is being installed at Pampanal and Tambillo. In the smaller communities, rain is sometimes the only and, in all cases, the most important source of water. Some communities also have small wells for use during dry periods. Rainwater and well water are treated (boiled or bleached) by 23% of the households. There is no sewage system in any of the communities and household wastes are discharged directly into the estuaries. Only a very small percentage of households in the bigger communities have latrines (15.5%), and even these have direct discharges.

There is little use of mangrove wood for charcoal production, fuel-wood and house construction in REMACAM. Natural gas is the most important cooking resource, with 87% of the households having gas stoves. Only the poorer families use mangrove wood for cooking, though some households occasionally use mangrove wood for cooking when the bottled gas runs out. Nobody reported the use of mangrove charcoal and only one family had the production of charcoal as its main economic activity. These findings do not support local concerns about mangrove damage coming from excessive fuel-wood use and charcoal production by local communities.

Even though several communities (Bajito, Viento and Canchimalero) have more than 100 children, there was no school. Furthermore, in the communities that have schools, these are only very basic primary



Fig. 11.3. A typical community in REMACAM.

schools and they are understaffed. Palma Real has only one secondary school. Because of this poor educational infrastructure, parents are forced to send their youngsters to urban areas for continuing education.

Household income in REMACAM stems from multiple sources, and these activities are normally carried out by different members of the family. The husband, wife and children all normally contribute to the household income. Table 11.1 shows the occupational structure in REMACAM. Mangroves are clearly the most important source of income, with fishing and/or cockle gathering being carried out by more than 85% of the households.

The commercial dependence on the mangrove ecosystem varies among the communities (Table 11.2). Fishing and cockle gathering are the most important activities in all communities, but, in two communities (Campanita and Bajito), a high percentage of households depend on agriculture. Many households own small plantations that are normally worked during the fishing or cockle gathering off-season. In this case, agri-

culture is not perceived as an economic activity but as an insurance policy for bad times. In addition, many of those who make their living through agriculture or commercial activities collect cockles, fish, crabs, timber and firewood on a subsistence basis.

Two important aspects should be recognized from these data. First, multiple sources of income are a very important component of the household economy in REMACAM communities; therefore, changes in one economic activity will not only affect the total income in the household but will also affect the relative importance of the remaining income streams. Second, although communities appear homogeneous, this is not the case, and awareness of this heterogeneity will help to target the type and content of projects implemented in REMACAM.

Use and perceptions of the mangrove ecosystem

Traditionally, mangrove wood has been a direct source for building, firewood and

Table 11.1. Occupational structure in REMACAM. 'Commerce' refers to small corner shops and 'external help' refers to households that receive money from relatives in other cities or countries.

Main economic activity/income source	Percentage of households
Fishing and cockle gathering	67.7
Cockle gathering (only)	10.0
Fishing (only)	8.3
Agriculture (only)	6.5
Commerce	2.4
External help	1.2
Shrimp farming (only)	0.6
Other occupations (not related to mangroves)	2.9
Other occupations (related to mangroves)	0.6

Table 11.2. Economic profile of each of the communities studied.

Community	No. of households	Fishing (%)	Cockle gathering (%)	Agriculture (%)	Shrimp farm (%)
Gauchal	9	77.8	66.7	11.0	0
Campanita	11	72.7	45.5	63.6	0
Pichangal	11	81.9	81.9	0	0
Bajito	12	30.0	30.0	84.6	0
Viento	14	56.0	87.0	6.0	0
Barca	18	93.7	50.0	12.0	0
San Antonio	26	40.0	70.0	60.0	0
Canchimalero	28	85.7	64.0	21.0	0
Santa Rosa	65	60.0	73.0	30.0	0
Tambillo	130	26.0	63.0	7.0	3.9
Palma Real	184	36.0	40.0	4.0	0
Pampanal	225	76.9	40.0	3.0	0

charcoal production. During the 1950s, the area now covered by REMACAM was the centre of a large-scale exploitation of mangrove wood, which was used by the construction industry, and the bark was used for tannin production. Several logging companies were dedicated exclusively to this exploitation (Labastida, 1995). After 1968, the use of bark stopped because of the collapse of world tannin markets (Snedaker, 1986). The centre of wood exploitation also shifted during the 1960s with the introduction of chainsaws and opening of new roads into the rain and cloud forests.

Charcoal extraction continued until recently, but has almost disappeared in the last 5 years because of the introduction of strict regulations when the area was declared an ecological reserve. Furthermore, the intro-

duction of bottled gas has reduced reliance upon mangrove wood as the primary fuel source to a minimum. Mangrove wood is still used at a subsistence level, especially for building houses. The subsistence use of fuelwood and some medicinal uses were also identified, but one of the most interesting findings is the fact that local communities have a more holistic perception of the mangrove ecosystem. They identified the importance of mangrove more for its life-supporting functions than for its direct uses (Table 11.3).

Local people recognize fully the important role played by mangroves in their local economies. As they see it, mangroves are the source of all life and the most important source of work and protein. When questioned about the importance of mangroves

Table 11.3. Ecological functions of mangroves as identified by respondents in the semi-structured interviews undertaken in REMACAM.

Function	Example given
Nursery	Juvenile fish and shrimp in inlets and mangrove roots
Feeding grounds	Fish and shrimp feed during high waters
Habitat	Cockles, crabs and other molluscs live in the roots
Beach protection	Mangrove protects from erosion
Oxygen producer	Mangrove trees produce and recycle oxygen

for their well-being, community members stressed the importance of the mangrove ecosystem for their livelihood. Common statements during interviews and informal questioning were as follows: 'mangrove is our life, it gives us cockles, crabs, fish'; 'mangrove is the most important thing for us'; 'if we don't have mangrove we will not eat, we will not live'; 'mangrove cockles are the life of the poor'; and 'if mangroves disappear, we will all be finished, mangrove is our life, our source of work'. They believe that the disappearance of the mangroves will inevitably lead to the disappearance of their communities. It is likely that some of the identified environmental functions are borrowed from the environmentalist and development narratives that they have acquired during their struggle against the shrimp-farming industry.

In contrast, the shrimp-farming industry is perceived as producing very few jobs in the area. There is only one household in which shrimp farming is the sole source of income, and only two households obtain work on a temporary basis from the shrimp industry (see Tables 11.1 and 11.2). One of the arguments for the development of the shrimp-farming industry is the creation of local employment, but the perception of the local communities is that the employment provided by the industry is minimal and does not compensate for the loss of livelihoods when mangroves are replaced by ponds. Tobey *et al.* (1998) reported that the range of employment provided by the shrimp industry in Latin America is generally from 0.1 to 1.0 person per ha. Activists contesting the shrimp-farming industry argue that 1 ha of shrimp farming provides only 0.1 job, whereas 1 ha of mangrove pro-

duces enough resources for at least ten families (FUNDECOL, 2000b; Greenpeace and Trópico-Verde, 2002). Isherwood (2000) estimated that goods amounting to a total of over US\$14,000,000 are extracted annually from the reserve. Non-marketed goods accounted for 14% of this value.

Goods and services from the reserve benefit not only the inhabitants of the reserve but also the fishers, gatherers and businesses based in San Lorenzo and Limones. Most of the marketing of fish and cockles is done through San Lorenzo, from where the products from the mangroves are sent to the rest of the country. San Lorenzo and Limones are also where the mangrove communities obtain external products such as ice, fishing nets, petrol and fresh and preserved foods. Thus, even though San Lorenzo and Limones do not belong administratively to the reserve, they benefit directly from it.

Natural resource use and allocation

In REMACAM, the use and allocation of natural resources are divided along gender and age lines; men fish and women and children gather cockles. When male children reach age 14 to 15, they switch to fishing. When health deteriorates, fishermen (around 60 years of age) take to cockle and mollusc gathering as their main activity.

Small agricultural plots (farms) and coconut plantations are the realm of men, with women helping in their maintenance. This research found only one woman with agriculture as her main economic activity. This division of labour is not so evident in the marketing of the products: some middle-women buy cockles and sometimes fish.

They normally live in the communities and sell directly to the bigger towns or to external middle-people that visit the communities every week. Because of the lack of infrastructure and electricity in the mangrove communities, fish are normally sold every day to external middle-people from other communities. External middle-people are normally men and, even though some of them live in San Lorenzo or Limones, they are normally *mestizos* (mixed-race people), originally from inner cities.

Artisanal fishery

In economic terms, artisanal fishery is the most important source of income in the Reserve, employing about 2500 fishers (FEPP-Manglares and INP, 2002) and accounting for 77% of the income generated by natural resource extraction (Isherwood, 2000). The fishery is also a vital source of protein for the communities in REMACAM, with smaller fish from the catch generally kept for home consumption.

Fishing is exclusively a male activity. Of the 75 households that reported fishing as their main activity, all were men. Only a few women were found that help their husbands put the nets together when the nets are new. On average, fishermen work 6.3 h per day in a single daily trip, 6 days a week excepting fiestas and bad weather.

A wide variety of fishing equipment is employed in REMACAM. Fishers in the

smaller and more remote communities tend to use low-investment equipment and non-motorized canoes, whereas a number of fishers in larger communities own big canoes with outboard motors (Table 11.4). Motorized canoes have appeared in the reserve only in recent years, when petrol for outboard motors was heavily subsidized by the government. Today, twice as many fishers are working from motorized boats as there were in 1995 (Rosales, 1995). Until the arrival of outboard motors, fishing activity was mainly restricted to the estuaries and creeks. Today, fishers can work the coastal waters up to several kilometres out to sea (Table 11.4).

The more economically valuable species are shrimp and prawns. In 2002, shrimp averaged \$2 per kg and prawns \$9 per kg (FEPP/INP, 2002). The small trawl fishery is the most lucrative, but also the one that needs the most capital investment. The most common fishing gear is the seine and beach gill nets, which can be used with either motorized or paddle canoes, and 73% of the fishermen own their own fishing gear. Small trawls, however, are owned by more wealthy individuals and often a single person owns several that are rented to other fishermen. Men using big and medium-size canoes fish in improvised groups that are formed only for a specific trip. The income from the fishing trip is divided in two (after the expenses for petrol, oil and others are deducted): 50% is for the owner of the boat and the fishing

Table 11.4. Principal fishing equipment used in REMACAM, showing the local name and target species (from FEPP-Manglares and INP, 2002 and fieldwork observations, 2002).

Type of gear	Local name	Type of boat/propulsion	Target species	Fishing area
Small trawl	<i>Changa</i>	Big/big motor	Shrimp	Coastal
Seine	<i>Red de enmalle de fondo</i>	Big/small motor	Prawn, finfish	Coastal and estuarine
Beach gill net	<i>Chinchorro de playa</i>	Small/paddle	Prawn, finfish	Beach and creek mouth
Cast net	<i>Atarraya</i>	Small/paddle	Prawn, finfish	Estuarine
Tangle net	<i>Red de estacada</i>	Small/paddle	Finfish	Creek mouth
Long line	<i>Espinol de fondo</i>	Small/paddle	Finfish	Creek mouth
Shrimp larvae net	<i>Red larvera</i>	None	Shrimp postlarvae	Creek and beach
Traps	<i>Trampas</i>	Small/paddle	Crabs	Estuarine

gear, the other half for the crew. Fishermen in the small canoes fish on their own in the small estuaries and mangrove creeks.

Fishermen from communities in the south of the reserve (where the number of shrimp farms is higher) have changed their traditional fishing methods and now fish for shrimp postlarvae and pregnant female shrimp to sell to hatcheries and shrimp farms. They have developed several types of improvised gear using monofilament nets with very small mesh size. These are used in the intertidal areas around the beaches and the mangrove creeks. Because there is no need for a boat and the equipment is made at home, the investment for this type of activity is minimal and attracts people from other communities.

The perception among the communities and researchers in the area is that this new activity is causing serious damage to the wild shrimp population and other commercial fishing species. The nets are non-discriminatory and as a result there is a very high by-catch of commercial and non-commercial shrimp and fish larvae, which are normally left to die on the beach. The impact of this new activity has not been assessed, so there is no regulation of the size of the nets used, the number of fishermen or the area they can fish. In communities such as Olmedo, more than 150 of these new types of gear can be found.

Cockle gathering

Mangrove cockles (also called arc-cockles or arc-shells) are harvested commercially and as subsistence food by a large number of people along the Pacific coast from Mexico to Peru. Three cockle species (*Anadara tuberculosa*, *A. similis* and *A. grandis*) are gathered in REMACAM. *A. tuberculosa* is the most abundant species in the muddy areas around the mangrove roots. Because of its high abundance and its fortitude (it can stay alive up to 8 days after harvest), it is the most commercialized species in the area.

According to MacKenzie (2001), there are at least 15,000 cockle gatherers on the Mexico–Peru seaboard, and Ecuador supports at least 31% of them. According to data

from secondary sources and data collected in REMACAM, it is estimated that 79% of Ecuadorian cockle gatherers can be found in REMACAM, even though it protects only 11% of the mangroves in the country.

Customarily, each community in REMACAM has specific gathering grounds. These have been respected by the other communities. Traditionally, cockle gatherers used small wooden canoes with paddles, which limited foraging distances. Furthermore, women prefer gathering grounds close to their communities. Local gatherers used to rotate the grounds, leaving some areas alone for a couple of weeks so that the cockles could recover. Gatherers traditionally left the ‘mother’ (brooding stock) alone so it could reproduce and also left small shells (less than 5 cm) to grow.

Cockle gathering has traditionally been a female activity. One reason for this is because cockles are picked singly by hand so there is no need for any capital investment. Also, the gathering areas are close to the communities, allowing the women to take their children, making cockle gathering easily combined with housework and other chores. According to the SES, cockle gathering is the most popular female activity in the area. In the 99 households that reported cockle gathering as a main economic activity, 82.4% of the gatherers are female. In addition to the female gatherers, another 2.4% of the women buy cockles to sell to external middle-people. One of the most important findings is that 20% of the female-headed households depend almost exclusively on cockle gathering and, for 10% of the mixed-head households, both the husband and wife gather cockles as the main and, in some cases, the only economic activity. Cockles are gathered for subsistence by 16% of the households in REMACAM. During cockle gathering, other mollusc species are harvested, but, these do not have a market value and are used to provide protein for the household.

Cockles are sold by ‘cientos’ (units of 100 shells) and, with *A. tuberculosa* fetching up to \$3.50 per ciento, cockle gathering can provide substantial household income (Table 11.5). Because of its high value, at least 98% of *A. tuberculosa* is sold, whereas

at least 55% of *A. similis* is kept for home consumption.

Changes in resource allocation and practices

Interestingly, 17.6% of the cockle gatherers are now male. According to the interviews, men have taken to cockle gathering because they do not have any other source of income. Men have been displaced from agriculture after selling their land to the shrimp-farming industry. Some of the farms have also been lost because of flooding caused by changes in the hydrodynamics when the shrimp ponds were built. In other cases, it is impossible for local people to travel to their agricultural plots as some of the creeks and estuaries are now blocked by armed guards. Some men who used to work for logging companies that have closed have switched to cockle gathering. Other male gatherers are ex-fishermen who do not fish any longer because of the decrease in fish stocks and the increasing cost of fishing gear.

In some cockle grounds, local gatherers are being displaced by big groups of gatherers from San Lorenzo. These are usually young men, travelling in large fibreglass boats with powerful outboard motors. These are improvised groups: the owner of the boat takes them to the cockle grounds and then buys the cockles they harvest at a much lower price than the market value. The gatherers in these groups do not need to make any investment and after the gathering have no obligation to the boat owner. These young men have been displaced from their traditional logging jobs, as the logging companies are going out of business due to the rapid development of African palm plantations. These groups are attracted to the cockle fish-

eries because there is no need to invest in any equipment, and because the mangroves are open to all. The cockle-gathering grounds are perceived by these itinerants as a free common resource.

With the use of outboard motors, it is easy for the new itinerant gatherers to go anywhere in the reserve and, because they do not belong to any of the traditional communities, there is no community pressure upon them not to use any gathering grounds left fallow. They argue that mangrove areas belong to all Ecuadorians and, because of that, they are allowed to gather anywhere they wish. These itinerant gatherers use machetes to cut the mangrove roots, making it easier to gather cockles, but thereby destroying the gathering area. According to local people, and direct observations, it takes more than 2 months for the grounds to recover after itinerant gatherers have damaged an area.

These new gatherers are going to have a large long-term impact on the cockle fishery as their practices do not leave brood stock or juveniles. They take everything they find and they often tell the traditional gatherers that they do not know how to gather as they are always leaving cockles behind. Thus, natural replenishment of stocks will take longer. The other problem is that areas that were inaccessible before are now being accessed and gathered. As these areas act as reserve grounds for the cockle populations, their disturbance may lead to a complete failure of the fishery.

The perception that cockle resources are decreasing is corroborated by a monitoring programme started in 2001 by the Mangrove Project and the local communities. A preliminary analysis shows that both the size and abundance of the cockles are diminishing. As

Table 11.5. Income generated from mangrove cockles in REMACAM in 2002 (from preliminary FEPP/INP report, 2002 and fieldwork data).

Species	Average collected per week	Average sold per week	Average consumption per week	Price per ciento (US\$)	Weekly income (US\$)
<i>Anadara tuberculosa</i>	928	909 (98%)	19 (2%)	3.00–3.50	27.30–32.00
<i>A. similis</i>	307	137 (45%)	170 (55%)	2.00–2.50	2.80–3.40

a consequence, traditional gatherers are having to travel farther to reach the gathering areas and some of the traditional grounds are no longer productive (FEPP/INP, 2002).

These problems are exacerbated by the destruction of gathering grounds by the shrimp-farming industry. The impact of the shrimp farms can be easily observed when travelling in some areas of the reserve, as there are 'no-entry' signs in several of the estuaries and some smaller creeks have been sealed off. Limiting the access to gatherers results in a concentration of gatherers in certain areas; this increases the pressure on the cockle resources and generates conflicts between gatherers from different communities.

Another impact of the shrimp farms is on the use of water. Pond effluent is discharged directly into adjacent estuaries. Local dwellers have reported several cases of massive fish and crab mortality – all, according to them, related to these discharges. No research has been undertaken to verify these claims but research in other countries suggests that pond effluent can produce serious degradation of water quality (Paez-Osuna, 2001).

Community responses

The impact of shrimp farming in Ecuador has led to the creation of several political, ecological and social organizations. Among these is a grass-roots resistance movement in Esmeraldas Province: the Fundación para la Defensa Ecológica (FUNDECOL), which was founded in 1989. At the same time, in the north of the province, the Black Communities Process (BCP) has been fighting to make the north of Esmeraldas an independent territory in the same manner as indigenous territories and districts have become autonomous under national decentralization programmes. This is relevant to REMACAM as the communities are primarily composed of Afro-Ecuadorians who hope to gain collective management rights over the mangroves and their natural resources.

These two movements came together in the north of Esmeraldas to defend the mangrove areas from the shrimp-farming indus-

try. After 5 years of struggle, local and national protest mobilizations, and radio and television campaigns, the Ecuadorian government granted the status of an ecological reserve to REMACAM. As part of REMACAM's creation, the Mangrove Project was approved. The project was conceived by community members, fishermen and women cockle gatherers' associations and is carried out by FEPP, a national NGO with financial support from the Dutch government. The main objective of the project is to preserve the mangroves as a source for people's livelihoods and to look for conflict resolution.

Understanding that one of the major problems was the ill-defined property rights and open access to all of the mangroves, the national coordination for the mangrove defence (C-CONDEM), together with FUNDECOL, the Mangrove Project, and supported by the local communities, devised a novel stewardship practice called '*custodias*'. Under this practice, mangrove areas are allocated to each community for their traditional use and management. Economic practices such as charcoal production or logging are forbidden. Gathering practices are permitted but they have to be carried out by only local gatherers. The custodial permit is given by the Minister of Environment and has a duration of 10 years. After this period, the *custodia* will be inspected by the Ministry, and an extension of 90 years will be granted if the community has appropriately looked after it.

The requisites for getting the *custodias* are very strict. The community needs to have a legally recognized association, which has to present a management plan and a geo-reference map of the *custodia*. Areas eligible for custody are those that have customarily belonged to the community and have been traditionally used for wood or cockle collection. Importantly, traditional fishing grounds are not part of the *custodias*, as the sea and estuarine waters are not part of REMACAM. The Mangrove Project has provided the expertise and money to make the maps and the management plan required by the government. Overall, there has been great success in obtaining custodial areas (Table 11.6).

The success of this stewardship programme can be seen in the slowdown of

Table 11.6. Custodial areas obtained by REMACAM communities up to 2002.

Community name	Size (ha)	Date
Campanita	522.0	18 Dec. 2002
Canchimalero	362.0	18 Dec. 2002
El Bajito	877.0	18 Dec. 2002
El Viento	1207.0	14 Apr. 2000
Guachal	1022.9	18 Dec. 2002
La Barca	785.0	14 Apr. 2000
Olmedo	385.2	7 Nov. 2001
Palma Real	1057.0	8 Aug. 2000
Pampanal	2953.0	14 Dec. 2002
San Antonio	195.7	8 Aug. 2000
Santa Rosa	1114.4	14 Apr. 2000
Tambillo	2576.6	14 Apr. 2000
Total	13,057.8	–

mangrove destruction. It has been calculated that 98% of illegal mangrove removal has been stopped (E. Lemos, Limones, personal communication, 2002). Another important aspect is the strengthening of the local mangrove defence groups and the creation of organized groups in other communities, some of which are now formally requesting their own custodial areas. It is important to point out that this programme is part of a national process to defend the mangrove ecosystem and the traditional livelihoods associated with it, so its success will have national repercussions. For example, in the south around Muisne, FUNDECOL and the National Mangrove Network (*Red Manglar*) have obtained government agreement to administer and rehabilitate 3200 ha of mangrove. This area has also been declared a Protected Area (FUNDECOL, 2003).

The deterioration of the cockle fishery in REMACAM has led to talk of a self-imposed restriction by the local communities. Under this scheme, cockles smaller than 45 mm will be left in the gathering grounds. There are now talks with the Ministry of Environment to implement this scheme, which will be coordinated through the Local Mangrove Committee. This committee was created in 2001 and has representatives from each community group, the Ministry of Environment, the Mangrove Project and the Navy. Under Ecuadorian decentralization laws, this committee acts as the administration authority

and is able to engage with municipalities and county authorities in all aspects related to the mangrove ecosystem. One of the most important functions of the committee is the prompt identification and halting of illegal activities such as mangrove clearing and the solution of conflict generated between traditional gatherers and gatherers from San Lorenzo.

The *custodias* used in REMACAM resemble the extractive reserves used since 1990 to co-manage natural resources in Brazil (Glaser and Oliveira, 2004). Both processes demonstrate how integrating local users into the management of their own resources enables the implementation of a better and more viable mechanism for mangrove protection and their sustainable use. Success in REMACAM can be considered part of the growing empirical evidence that local communities are more likely than the state to manage natural resources in a responsible way because their livelihoods depend on this (Hesse and Trench, 2000), and that common property systems can actually work (Berkes, 1989; Ostrom, 1990; Ostrom *et al.*, 2002; Dolšak and Ostrom, 2003).

Conclusions

This study has shown the great importance of the mangrove ecosystem to people living in mangrove areas in Esmeraldas. It has shown that the mangroves are particularly important to the women living there. It has also exposed clearly how shrimp farming is having a negative impact on the livelihoods of the people living there. This impact is exacerbated by displaced people becoming itinerant cockle gatherers. These impacts have led to the creation of several political, ecological and social organizations. Among them are grass-roots resistance movements which are pressing the Ecuadorian government to adopt strategies to defend the mangrove ecosystem and the livelihoods associated with it. The creation of REMACAM has been one of the most decisive steps in this struggle. The stewardship practice based on *custodias* that has been implemented in REMACAM is now being replicated in other regions.

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