



Contents lists available at ScienceDirect

Ocean and Coastal Management

journal homepage: www.elsevier.com/locate/ocecoaman

Uneven consequences: Gendered impacts of shrimp aquaculture development on mangrove dependent communities

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ARTICLE INFO

Keywords:

Gender
Mangrove fisheries
Mangrove forests
Participatory mapping
Shrimp aquaculture

ABSTRACT

Shrimp aquaculture is a primary driver of mangrove deforestation globally. The decline of these forests not only threatens the integrity of valuable ecosystems but can also produce detrimental impacts on mangrove-dependent communities. Ecuador is the largest producer of farmed Pacific whiteleg shrimp (*Litopenaeus vannamei*) in South America. This industry's growth and success have come at the expense of the country's mangrove forests. This paper analyzes the impacts of shrimp aquaculture development on a mangrove-dependent community in Esmeraldas province, Ecuador. Furthermore, this research highlights how gender and gendered norms inform the strategies adopted by different actors in response to these processes. Drawing from ethnographic and Global Positioning System data collected *in situ*, this study shows that women are disproportionately affected by the loss of mangrove forests. Mangrove forests have historically provided women sustenance, opportunities for income generation, and the ability to pass on cultural traditions. The establishment of the aquaculture sector also created a collapse of local livelihoods. Losing access to traditional livelihood practices pushed men into the mangroves to gather cockles, a productive activity customarily only practiced by women. This livelihood shift for men further contributes to the displacement of women from the mangrove forests. The introduction of industrial shrimp farming increased the community's reliance on mangrove resources. The overuse of these resources is leading to a depletion of mangrove cockle populations, putting the community in a vulnerable position as both men and women are increasingly dependent on this fishery to subsist.

1. Introduction

Shrimp aquaculture has been practiced for centuries in some parts of the world (Paprocki and Cons, 2014; Swapan and Gavin, 2011), but it is not an activity traditionally practiced in coastal South America (Rivera-Ferre, 2009). Industrial shrimp farming was introduced to southern Ecuador in 1968 (Schwarz, 2005). As in other coastal countries of the Global South, this industry was promoted as a development strategy to integrate Ecuador's "unusable" and "unoccupied" intertidal lands into the global economy (Islam, 2014; Latorre and Farrell, 2014; Páez-Osuna, 2001). Aquaculture proponents argued that revenues from the marketization of non-traditional goods like farmed shrimp could put the cash-poor but resource-rich country on "the path for export-led growth" (Martínez-Alier, 2002a, p. 80). The strategy worked. Industrial shrimp aquaculture placed Ecuador at the forefront of the blue revolution (Hamilton and Stankwitz, 2012). The country is the largest producer of

Pacific whiteleg shrimp (*Litopenaeus vannamei*) in South America and one of the top exporters of farmed shrimp globally (FAO, 2018). Following bananas, shrimp is the second largest non-oil export product in Ecuador (BCE, 2018), making shrimp farming one of the country's most lucrative economic activities (Armijos-Suárez et al., 2015). However, despite the success of this productive sector at broader scales, shrimp aquaculture has not produced such positive outcomes for coastal, rural communities.

The global aquaculture industry is one of the main drivers of mangrove deforestation (Duke et al., 2007; Kauffman and Bhomia, 2017; Polidoro et al., 2010). The shrimp farming sector alone accounts for an estimated 38 percent of mangrove cover decline worldwide (Barbier et al., 2011). In Ecuador, the expansion of the shrimp farming industry occurred at the expense of intertidal ecosystems, particularly mangrove forests (CLIRSEN, 2007; Perez and Robadue Jr., 1989; Terchunian et al., 1986). National baseline data for mangrove cover in

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<https://doi.org/10.1016/j.ocecoaman.2021.105688>

Received 16 September 2020; Received in revised form 6 April 2021; Accepted 1 May 2021

Available online 1 June 2021

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Ecuador are inconsistent (Gravez et al., 2013). There are studies that estimate mangrove forests have declined by 25–30 percent (Beitl, 2016; Shervette et al., 2007), while others indicate deforestation rates of as much as 40 to 60 percent (Romero Salgado, 2014; Veuthey and Gerber, 2012). In the southern region of Esmeraldas province (hereafter Esmeraldas), it is estimated that mangrove forests declined by as much as 80 to 90 percent (Vázquez, 2007).

The deforestation of mangrove forests threatens the integrity of valuable ecosystems and this can lead to detrimental impacts on mangrove-dependent communities (hereafter MDCs). Mangrove forests are life-support systems for an estimated 120 million coastal dwellers living near mangrove zones worldwide (UNEP, 2014). Mangrove fisheries provide nutritional value for MDCs, and the commercialization of fish, shellfish, wood, charcoal, fibers, and other mangrove products provide essential sources of income for rural coastal dwellers (Glaser, 2003; Ha et al., 2012; Hussain and Badola, 2010; Malik et al., 2017; Rönnbäck et al., 2007; Walters et al., 2008). These ecosystems also sustain non-utilitarian needs, serving as spaces for the formation of social, cultural, and spiritual values (García Quijano et al., 2015; James et al., 2013; Queiroz et al., 2017; Thiagarajah et al., 2015).

The social impacts of mangrove deforestation associated with shrimp aquaculture are well documented in the literature (Abdullah et al., 2017; Adger, 2000; Armitage, 2002; Aye et al., 2019; Benessaiah and Sengupta, 2014; Dewalt et al., 1996; Joffre and Schmitt, 2010; Kuhl and Sheridan, 2009; Lan, 2013; Martínez-Alier, 2002a; Mohammad Abdullah et al., 2016; Paprocki and Cons, 2014; Sebastiani et al., 1994; Stonich, 1995; Van Hue and Scott, 2008; Warne, 2011). Less attention has been given to understanding how MDCs adapt to the landscape transformations driven by large-scale shrimp farming (Hamilton and Collins, 2013). Existing research on gendered uses of mangrove ecosystems indicates that women, and specifically women-led households, are highly dependent on mangrove forest resources (Barnes-Mauthe et al., 2013; Carney, 1993; Ben Crow and Sultana, 2002; Britt Crow and Carney, 2013; Glaser, 2003; Hue, 2006; Mera Orcés, 1999; Santos, 2015). However, the gendered impacts of losing access to mangrove forests have been scarcely investigated. Even less focus has been placed on developing an understanding of how gender informs how different groups within an MDC respond to these processes.

This research sought to address existing gaps in the literature by 1) investigating the impacts of shrimp aquaculture development on the spatiality of local mangrove users, 2) analyzing local responses to the landscape transformations introduced by large-scale shrimp farming, and 3) identifying how gender, gender norms, and gendered relations inform the coping adaptation strategies taken by different groups within an MDC. To conduct this study, we employed a case study approach using the example of an MDC of the Muisne River Estuary (hereafter MRE) in south Esmeraldas, Ecuador. Mangrove dwellers of the MRE are multigenerational mangrove users who have developed distinct means of subsistence, livelihood strategies, and cultural traditions around the use of mangrove resources (Latorre and Farrell, 2014). Before the early 1980s, shrimp farming was entirely an unfamiliar practice in south Esmeraldas. By conducting this study in an area that experienced the introduction of aquaculture development in recent decades, we could examine adaptation strategies taken by locals over the years and current responses to ongoing aquaculture operations.

Using a gender lens to analyze how the impacts of large-scale development projects are distributed among a population can provide insight into how different marginal groups within socio-ecological systems are affected by and respond to environmental change (Gezon, 2012; Rocheleau et al., 1996). A focus on gender is of particular interest when working in fisheries-dependent societies because gender – not a person's capacities – widely informs who can access and control resources within a given fishery (Santos, 2015; Thorpe et al., 2014; Williams et al., 2012). This is the case of MDCs in Ecuador, where access to and uses of mangrove resources have been customarily allocated along gender lines (Bravo, 2003; Martínez-Alier, 2002a). Fishing in the estuary

and harvesting and processing mangrove wood resources are considered “masculine” tasks. In southern Ecuador, men also gather shellfish from the mangrove forests (Beitl, 2011; Kuhl and Sheridan, 2009). By contrast, gathering shellfish is an activity customarily practiced by women and children in the northernmost province Esmeraldas (MacKenzie, 2001; Mera Orcés, 1999; Ocampo-Thomason, 2006). Based on this information, we hypothesized that both men and women from MDCs in southern Esmeraldas had been affected by mangrove deforestation. However, the impacts and adaptation strategies taken in response to these changes would differ depending on a person's gender.

This paper is organized into five sections. Following this Introduction, Section 2 provides background on the study site, the site selection process, and the methodology employed to collect and analyze ethnographic and Global Positioning System (GPS) data. Section 3 presents findings from the interviews, household surveys, and GPS data highlighting the impacts of mangrove deforestation driven by shrimp aquaculture. It expands on this point by discussing how local livelihoods were affected and how gender and gender norms informed how mangrove users responded to these changes. Section 4 builds on the results of Section 3 by providing insight into the broader implications for the gendered impacts of industrial shrimp farming and the gendered livelihood shifts that resulted from the introduction and expansion of this productive sector. The paper concludes with Section 5, which summarizes the main findings and conclusions of the research and provides recommendations for future aquaculture development interventions.

2. Methods

2.1. Study site

This research employed a case study approach to investigate the impacts of shrimp aquaculture development on MDCs in Ecuador. Using the example of Bolívar, a parish within the MRE in Esmeraldas province (Fig. 1), this research investigated how replacing mangrove forests with shrimp ponds affects local livelihoods. The MRE is one of the areas most affected by the shrimp aquaculture sector in Ecuador (Hamilton and Collins, 2013). In 1987, the mangrove forests of the MRE encompassed 20,098 ha (ha). By 1999, there was 3,173 ha left – a decline of 84 percent (Vázquez, 2007). Bolívar was selected as the field site because, with 314 ha of mangrove forests, it is one of the parishes within the MRE with the largest continuous area of mangrove forests. It is also a community where a large proportion of the population is dependent on mangrove resources.

2.2. Data collection

This study employed a triangulation of methods consisting of ethnography and interviews conducted by the first author and GPS collected by mangrove users as they gathered shellfish from mangrove forests. Direct observation and formal and informal interviews, were conducted during an exploratory trip the first author made in July 2016 to learn about the community and its use of mangrove resources. While formal interviews are planned and follow an interview guide, informal interviews are impromptu conversations that allow researchers to build rapport in the early stages of fieldwork and to identify new topics of interest that might otherwise be overlooked (Bernard, 2017). Semi-structured and structured interviews were conducted during intensive field research between March and June 2017. Semi-structured interviews follow an interview guide, but they are versatile and conversational in nature, allowing for diversions from the interview guide to occur when needed. Structured interviews are more rigid; participants are asked identical set of questions and thus the interviews can be easily replicated (Bernard, 2017). The GPS data were collected from May to June 2017.

Ethnography was a substantial component of this research. To build



Fig. 1. The study site: Bolívar, a mangrove community within the Muisne River estuary (MRE), part of the Muisne municipality in Esmeraldas province, Ecuador.

rapport, learn about local social dynamics, and become immersed in the community's day-to-day rhythm, the first author resided in the community with a local family during the field stays in 2016 and 2017. Taking on the role of "observer as a participant" (Kawulich, 2005), the first author attended informal and formal community meetings organized by local leaders and nongovernmental organizations (NGOs). Engaging in participant observation (Bernard, 2017), the researcher participated in community-based mangrove reforestation activities and entered the mangrove forests with different groups of shellfish gatherers.

Semi-structured interviews were conducted with 49 participants – 35 shellfish gatherers and 14 key informants, including eight community elders and leaders, four NGO workers, and two agents of the municipal Ministry of the Environment office. These data were supplemented with information obtained during informal interviews and conversations with community members and local NGO workers. Face-to-face, structured interviews were conducted with adult representatives of 113 households (88% of total households). Household surveys (HHS) can be

used to gain insight into how social identity variables – age, gender, class, physical ability, formal education level, etc. – shape how individuals within a seemingly homogenous unit such as a household access and utilize natural resources (Rocheleau et al., 1996). The data obtained from the HHS were also helpful in obtaining up-to-date socio-demographic information at the community level.

This study combined methodologies from participatory Geographic Information Systems and participatory resource mapping to develop an approach for acquiring spatial data of the local uses of mangrove forests. Community mapping methodologies can be effective strategies for generating knowledge that is typically only deeply understood by local resource users (Dunn, 2007; Tripathi and Bhattarya, 2004). These approaches are also inexpensive and efficient means to collect detailed information on how different actors utilize the landscapes that support their livelihoods (Aynekulu et al., 2006; Cinderby et al., 2011; Mbile

et al., 2003). GPS data for this study were collected by 24 mangrove users who carried a GPS data logger¹ while they gathered shellfish in the mangrove forests every day for at least a typical work week, 4–6 days. These data were collected for 34 nonconsecutive days in May–June 2017. Although the participants collected these data, this was not entirely a participatory process because the community did not dictate how and why the data was collected. The GPS data were collected to generate graphical representations of how different groups of resource users navigate and utilize mangrove spaces and to identify the spatial distribution and density of mangrove resource extraction practices. These data also served to triangulate the ethnographic data and provided a geospatial dimension to the narratives collected through qualitative interviews.

2.3. Data analysis

All interview transcripts were qualitatively analyzed using an “open coding” approach where descriptive, “in-vivo” codes were applied to identify recurring patterns in the data (Bernard, 2017). Another round of analytical coding was completed to identify connecting threads between the data and broader literature informing this research (Cope, 2010). The HHS data were also coded and roughly quantitatively analyzed to identify factors influencing household dependency on mangrove resources. Intra-household analyses were completed to determine how social identity variables shape how individuals from different households utilize mangrove resources. The GPS data collected by the mangrove users were categorized into the three user groups based on gender and age: Group A, adult women under 34 years old ($n = 9$); Group B, women of ages 35 and older ($n = 8$); and Group C, adult men ($n = 7$). Some of the women under 34 years old had children who were five years old or younger, while none of the women of ages 35 and older had children that young. The men were all grouped together because they were all within the age range of 19–30. These data were analyzed by the second author using ArcGIS 13.1™ to identify spatial resource use patterns among the different groups.

3. Results

3.1. Impacts of shrimp aquaculture on local livelihoods

3.1.1. Empty promises of prosperity

Historical context for the local shrimp farming industry was gained from interviews with cockle gatherers, elders, community leaders, and NGO workers. According to participants who were adults when the industry was introduced to the inter-tidal areas of the MRE, shrimp aquaculture first emerged in 1982. An elder argued that this coincided with a period of widespread economic instability due to a declining local agricultural sector. He explained that commercial agricultural production was well-established in Bolívar as early as the 1920s. Smallholder farmers grew a range of cash crops, including cacao, coffee, coconut, and banana, which were commercialized locally and regionally. Other crops were also grown for household consumption. As local agricultural production began to decline in the 1970s – considerably that of the banana, one of the most profitable crops – many families found it challenging to sustain their farms economically. Local farmers started to sell their lands to aquaculture investors interested in buying agricultural plots along mangrove forests. These investors began to build earthen shrimp ponds on these lands but promptly extended their construction to the adjacent, “unclaimed” mangrove areas. Multiple participants explained that this is how shrimp farming was established in the area. A community leader stated that this was accomplished “in complicity with local government agencies” because converting agricultural lands into aquaculture ponds was and continues to be prohibited by federal laws. An NGO worker

corroborated that many early aquaculture entrepreneurs lacked proper permits to establish shrimp ponds in mangrove zones.

Despite the controversial means through which shrimp farming was established in the mangrove zones of the MRE, numerous research participants stated that initially, the community enthusiastically welcomed the industry. Shrimp farming entrepreneurs presented commercial aquaculture as a promising path to local economic prosperity. An elder explained that many people were “desperate for work,” and aquaculture entrepreneurs pledged to provide jobs for local men and women. In the introductory stages of the industry, employment opportunities were widely available. Men from the community were hired to log the mangroves and build the shrimp earthen ponds and dikes. Women were hired to burn the vegetation piles left behind as the men cleared the mangroves. Those who took those jobs argue that they were earning twice the average daily wages of the time.

The economic boost that followed the establishment of the shrimp aquaculture sector was not long-lasting. New shrimp pond construction ceased within a few years because, as an elder put it, “there were no more areas for [the shrimp farmers] to build more ponds.” He further explained that once shrimp farming entrepreneurs had their shrimp ponds constructed, they began to bring laborers from other parts of the country to operate their farms year-round. In the long term, the shrimp farming industry failed to provide secure and stable employment opportunities for the residents of Bolívar. When field data were collected in 2017, only three men out of 257 adults from the community had permanent positions at a local shrimp farm. Other men worked as seasonal laborers during shrimp harvests, but no women participated in any part of the aquaculture production process. A woman expressed that the industry is only beneficial to “the wealthy shrimp farm owners, and maybe the few people who work for them.” Locals who participated in the deforestation of the mangroves and the construction of the shrimp ponds argued it took years to realize how their actions would later affect them and their community. With remorse in their voice, people shared their regret of welcoming the aquaculture industry. Many residents feel angry, cheated, and ashamed to, as an elder put it, have been “blinded by the money [shrimp farmers] put in their hands” and allowing them to convert the mangrove forests into shrimp ponds.

3.1.2. A (re)genderization of mangrove livelihoods

As indicated, residents from Bolívar had access to work in the local agricultural sector before the introduction of shrimp aquaculture. While men were the primary agricultural laborers, women were also able to engage in farming activities. Agricultural workers lost access to these livelihood practices, but they were not the only ones affected by the landscape transformations driven by the introduction of shrimp farming. Households dependent on mangrove resources were – and continue to be – severely affected by the loss of mangrove forests. Furthermore, because subsistence and livelihood strategies involving the use of mangrove resources have been customarily defined along gender lines, the impacts of mangrove deforestation have a gendered dimension.

Women from Bolívar have extracted shellfish from mangrove forests since the ancestors of the present-day inhabitants of Bolívar established the town about 150 years ago. Shellfish were traditionally gathered for household consumption but were also bartered locally, usually for other food products. In the mid-1980s, mangrove cockles began to gain monetary value. The commercialization of these products presented women who historically had limited access to wage labor with a means to earn a living independently. Women who gather mangrove cockles as a source of livelihood are called *concheras*. Gathering mangrove cockles, locally referred to as *la concha*², continues to be the primary source of livelihood for many women from MDCs in the MRE. Because mangrove

¹ DG-100 GPS + Data Logger by Globalsat™.

² “*La concha*” literally translates to “the cockle.” When people say they are going to “the cockle,” they mean they are going to gather cockles from the mangrove forests.

deforestation driven by the establishment of shrimp aquaculture operations reduced mangrove cockle habitat, the introduction of the shrimp farming industry and its subsequent expansion directly impacts women's livelihoods linked to *la concha*.

Men's livelihood strategies involving the use of mangrove resources were also considerably affected by mangrove deforestation. Numerous men from MDCs of the MRE are descendants of multigenerational *madereros* – loggers and timber processors of mangrove wood – and *carboneros* – mangrove charcoal producers. Mangrove wood and charcoal were utilized locally, but charcoal was also exported to nearby port cities from the late 1800s until the 1980s. All activities involving the harvesting and processing of mangrove wood resources have always been tasks done by men. The knowledge required to engage in these practices was passed down to younger generations by older men relatives. This livelihood practice began to disappear with the decline of the mangrove forests. Although there are still men in Bolívar who were *madereros* or *carboneros* in their youth, none have engaged in these livelihood practices in at least two decades.

Aside from mangrove deforestation, the disappearance of men's mangrove livelihood practices further inhibits women from generating a viable income through *la concha*. Even as early as two decades ago, it was rare to see adult men *concheros*³ in MDCs of the MRE. Now it is not only a common sighting in Bolívar, but it has become the norm. Men who are unable to access secure employment in the aquaculture industry are now entering the mangroves to gather cockles to generate an income. Using data collected from the HHS, Fig. 2 shows that the population of adult cockle gatherers in Bolívar consisted of 55 women and 51 men. Fig. 2 also shows that men are slowly becoming the primary practitioners of *la concha*, as men of ages 20–24 comprised the largest group of cockle gatherers ($n = 17$). The number of men engaging in *la concha* could be higher due to underreporting. The activity is still stigmatized as an occupation for women. Some men who do not self-identify as being a *conchero*, and those who do often acknowledge it with shame. Instead, men prefer to self-identify as *jornaleros* (day laborers) who work in different jobs, *la concha* being one of them. Conversely, practicing a matriarchal trade extending as far back as five or six generations, women proudly call themselves *concheras*.

3.2. Uneven consequences across gender lines

3.2.1. Working in *la concha*

Gathering mangrove cockles is laborious, physically demanding, and time-consuming. The activity entails looking for cockles burrowed in the mangrove's mudflats during ebb tides when tidal currents flow seaward, exposing the mangrove substrate for several hours. A person's agility impacts how efficiently they move through the entangled and sharp mangrove prop roots. These skills can improve with practice. Experienced cockle gatherers are additionally better at identifying good *conchales* – cockle gathering grounds. Regularly entering the mangroves also allows a person to know what areas have been harvested in previous days, as signs of this can disappear when the tides cover the substrate. Traditionally, *concheras* visited *conchales* closest to town, either by foot or in canoes. However, due to the replacement of mangroves with shrimp ponds, *conchales* are scarce in what remains of the mangrove forests, and people must travel long distances to reach them. Therefore, aside from having experience and entering the mangroves regularly, cockle gatherers must also spend extended periods working in the mangroves. As a life-long *conchera* stated, *la concha* is “not only more difficult, but it is more tiring” and more time-consuming than it used to

³ The plural of women cockle gatherers is *concheras*. The plural of men cockle gatherers is *concheros*. The plural of groups of cockle gatherers comprised of men and women is also *concheros*. In this paper, the term “men *concheros*” will be used when discussing men who are cockle gatherers and the term “cockle gatherers” will be used to refer to mixed groups.

be.

Motorboats provide a means to reduce the amount of time and effort required to reach gathering grounds further away. However, cockle gatherers rarely belong to a boat-owning household and must pay *lancheros* (boatmen) for transportation. Depending on the distance, the fee is 1–1.50 USD per person for a round-trip. Cockle gatherers who want to avoid this expense travel by foot along the edges of the mangroves, on the beach, or if they have arrangements made with shrimp farmers, they may walk along the perimeters of their ponds. Traveling by foot is more time- and energy-consuming, but aside from being cost-effective, it allows cockle gatherers to visit multiple *conchales* in one day, including sites inaccessible by boat such as those landlocked by shrimp ponds.

In the mangrove forests of the MRE, cockles can be collected year-round and provide a steady source of income for those who engage in *la concha*. Cockle gatherers generate an income by selling the shellfish to *compradores* (middle-men buyers) for 0.08–0.10USD each, or 0.12USD during holidays and peak tourism seasons. There is no maximum quota; each person can extract as many cockles as they want. However, the number of cockles gathered per day, or the catch-per-unit-effort (CPUE), varies by person. There are cockle gatherers in Bolívar whose CPUE is 120–150. For others, it is 200–300. Some only gather 30–60 cockles a day.

The first author made attempts to keep records of the daily CPUE values among the study participants. However, when prompted, “How many cockles did you gather today?” there were cockle gatherers who exaggerated their estimated CPUE, while others responded with very low approximations. The reason for this is that there were people concerned about being judged if their numbers were too low, and those attaining high CPUEs were unsure if providing this information could negatively affect them. Nonetheless, even without records of the exact quantities of cockles gathered by each participant of the study, field observations and data from the semi-structured interviews indicate that men cockle gatherers attain higher CPUEs than *concheras*. Furthermore, men and women cockle gatherers regularly claim that “men *valen más* (are better) than women” when it comes to *la concha*.

3.2.2. Are men really “better”?

Based on the GPS data collected by cockle gatherers while working in the mangroves, we determined that men *concheros* typically spend four to six hours a day in the mangroves, compared to the two to five hours for *concheras*. This time disparity primarily exists because women have more domestic responsibilities than men. As a result, women are unable to dedicate as much time to *la concha* as men *concheros*. Household-related time constraints conspicuously affect women with young children who lack reliable access to childcare. Moreover, *concheras* argue that because they anticipate tending to the household's non-income earning needs after *la concha*, they try not to exert themselves excessively when working in the mangroves. Unless they have another work commitment, men *concheros* will dedicate as many hours as possible to *la concha* because the men trust they can rest when they return home. These attitudes create other disadvantages for women. Fig. 3 shows how women's mobility in the mangroves is more restricted than that of men. *Concheras* concentrate their gathering efforts on areas closer to town or sites along the estuary that are easily accessible by boat. This is especially the case of women under 34 (Fig. 3A). Women aged 35 and older reach areas slightly further away than women aged under 34, but they are not traveling by foot (Fig. 3B). Having the ability to dedicate more time and energy to *la concha* allows men to travel to gathering sites further away, including areas that are only accessed traveling long distances by foot (Fig. 3C). Therefore, although paying for transportation incurs a monetary cost, women can return home more quickly and with enough energy to tend to their household needs. Not having the same time constraints or energy consumption concerns, men have the option of avoiding these costs and overall can cover a broader range of *conchales* than women (Fig. 3D).

La concha was traditionally practiced as a group activity. To the

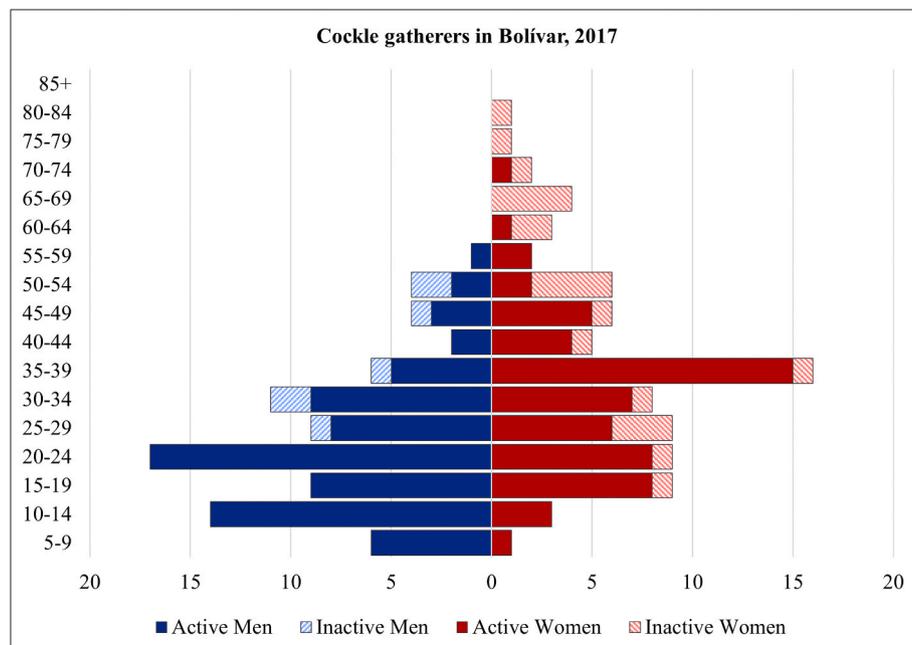


Fig. 2. Population pyramid of cockle gatherers in Bolívar in March–June 2017. “Active” gatherers indicate locals earning at least part of their income through *la concha*. “Inactive” gatherers indicate people who were permanently retired from the activity due to old age, or temporarily on hiatus due to an illness, an injury, recent childbirth, or seasonal work in another sector.

concheras, the mangroves have always been spaces where they can “spend time with compañeras (women friends)” and “share problems with one another.” Besides providing opportunities to socialize, *concheras* argue they prefer to go into the mangroves in the company of others in case they become injured. Cockle gatherers talked about cutting their hands and feet in the sharp mangrove roots. They also spoke of being exposed to animals like the “*pejesapo*,” a species of toadfish with poisonous spines that cause painful injuries, and “*la pudridora*,” – the rotter, a snake whose venom causes people’s skin to become severely infected making it appear like it is rotting. Women also spoke of fearing sexual assault if they enter the mangrove forests alone.

The benefits of engaging in *la concha* with a group come at a cost for women. Having to work around the schedule of other cockle gatherers may not only limit how much time someone spends in the mangroves, but how far they travel or which *conchales* they visit that day. It also means having to share these spaces – and the cockles found there – with the group. Boasting that they are not afraid of entering the mangroves unaccompanied, men argue they prefer to enter the mangroves alone, or at the most, with another person. Men claim that going with a larger group slows them down and makes it difficult to “concentrate on the work.” Moreover, men *concheros* argue that going alone, or even with another person, allows them to decide which *conchales* they want to enter and promptly decide how to proceed when they reach sites that have already been “picked over.”

Although Bolívar is one of the communities within the MRE with the most extensive mangrove forests, locals argue that “there are no more mangroves left, only fillos of mangroves” – thin strips of mangroves between the shrimp ponds and adjacent waterways. Fig. 4 supports this claim. There are limited spaces mangrove users can gather cockles from in what remains of the mangrove forests. Fig. 4 also shows the differentiated access to cockle gathering sites based on gender. *Concheras* concentrate their gathering efforts on sites closest to town or easily accessible by boat. Men *concheros* also utilize these spaces. The extensive overlap of the *conchales* utilized by men and women has made the areas where *concheras* gather resources more prone to overharvesting. Fig. 4 shows that men also extend their gathering efforts to areas unfrequented by women, including sites further away and only accessible on foot. Even if *concheras* had the time to reach these spaces, many of them argue

they would not feel comfortable accessing such *conchales* without the company of a man they trust. Men’s ability to gather cockles from areas inaccessible by women grants them access to spaces with lower harvesting pressures. Being able to gather cockles from these areas in addition to the *conchales* women utilize gives men *concheros* a competitive advantage over *concheras*.

3.2.3. Not the same livelihood practice for men and women

Not all those who engage in *la concha* are equally dependent on this activity to support their households. Although the activity has become a significant income source for men in recent years, having access to this work is a necessity for women. Women face more limitations than men in finding access to wage labor. Women with young children who cannot spend long hours outside the home find it considerably challenging to find paid work. A *conchera* explained that because *la concha* is a “job” with a variable schedule, it grants women access to employment that they can engage in “any time [they] want.” Young men also rely on the income they generate through *la concha*, but they can also access other employment opportunities to supplement their overall income earnings. For example, men can temporarily or intermittently work at shrimp farms, in local construction projects, at a farm, in the emergent tourism sector, or fishing in the estuary (although the fish only has local value). *La concha*, then, is an activity that men have the option of “turning to” when they are unable to find other work, but as a *conchera* put it, “if another job comes up, [the men] will do that instead.” Women do not have this option. For many *concheras*, the commercialization of the shellfish they gather is often the only means they can generate an income.

Mangrove forests supply more than an income for women. Aside from gathering mangrove cockles, *concheras* enter the mangroves to gather shellfish that do not have commercial value, including those shown in Fig. 5 next to the mangrove cockles. By bringing these products home, *concheras* can provide nourishment for their families. These products can provide more than nutritional value for the household; they are also a financial benefit because consuming “free” products from the mangroves allows families to utilize their household earnings on other expenses. While gathering other types of shellfish could also offer the same benefits for men, none of the men interviewed talked about

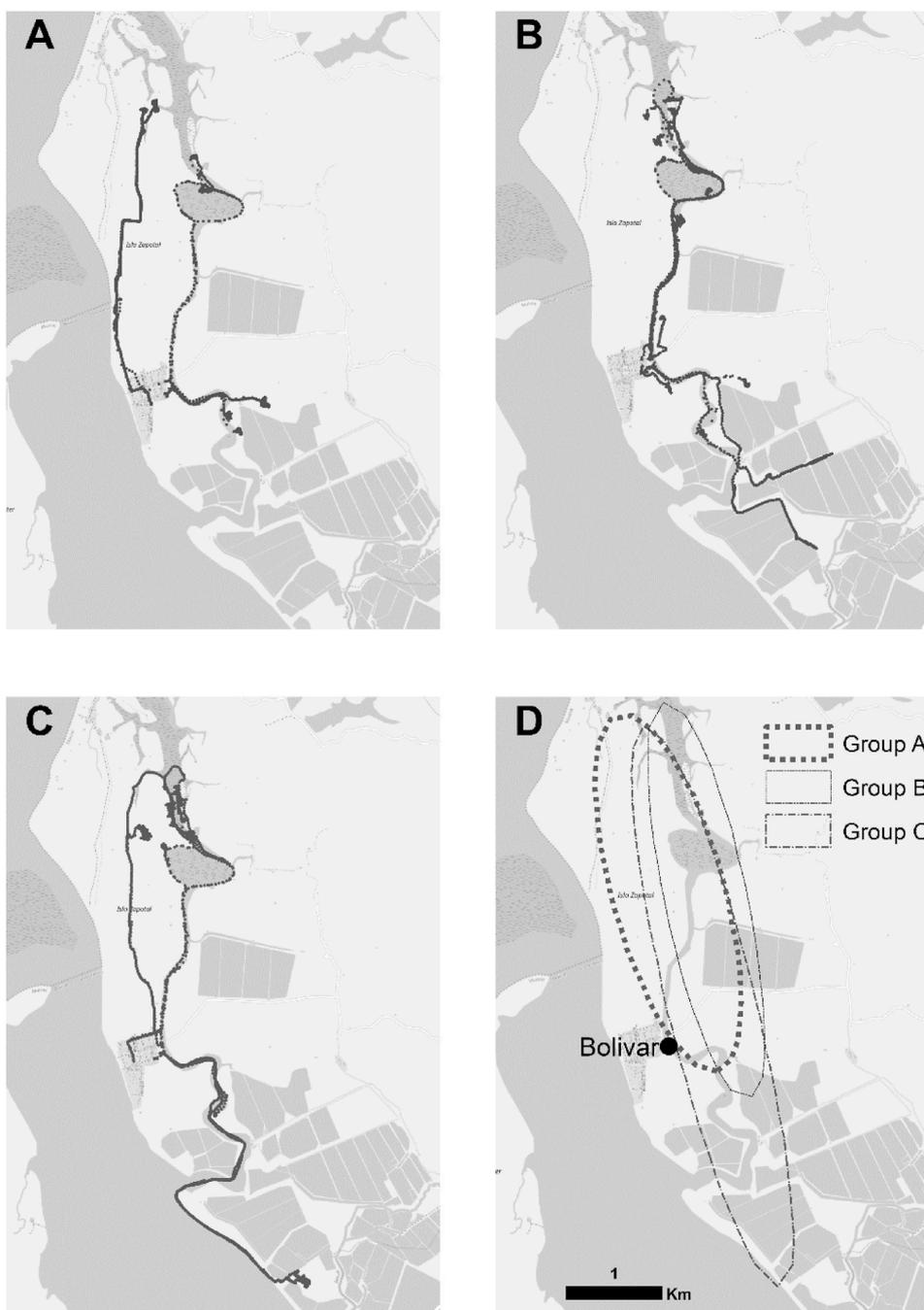


Fig. 3. Routes traveled by cockle gatherers. (A) Group A, women younger than 34 years old, (B) Group B, women aged 35 and older, and (C) Group C, men. (D) The ellipses represent the spatial characteristics of the routes based on central tendency, dispersion, and directional trends.

going to the mangroves to gather products for the consumption of the household. Some men even mentioned that they were not interested in gathering shellfish that they would not be able to sell. Unlike women, men *concheros* do not perceive shellfish that are not mangrove cockles as having value.

La concha filled employment voids for women for decades. In recent years, it has also had a similar role in the life of many young men. In an interview, a life-long *conchera* explained that mangrove forests are “truly the only industry that employs [people from Bolívar], without asking for any requirements.” Community members argue that the local economy is sustained by the mangroves, or as a retired *conchera* put it, by “the money [that] flows from the cockles.” *La concha* is presently regarded as the only secure source of income for “los pobres” (the poor), regardless of their gender. Therefore, although mangrove resources

currently provide “employment” opportunities for both the men and women of Bolívar, gender informs how locals perceive the value of the mangrove ecosystem and how they are affected by losing access to mangrove resources.

4. Discussion

4.1. A local failure

The introduction of shrimp aquaculture to south Esmeraldas converted the mangrove zones of the MRE into areas of intensive commercial activity. Residents from Bolívar initially supported the industry because they believed that the transition to a market-led economy fueled by shrimp aquaculture would allow their community to prosper

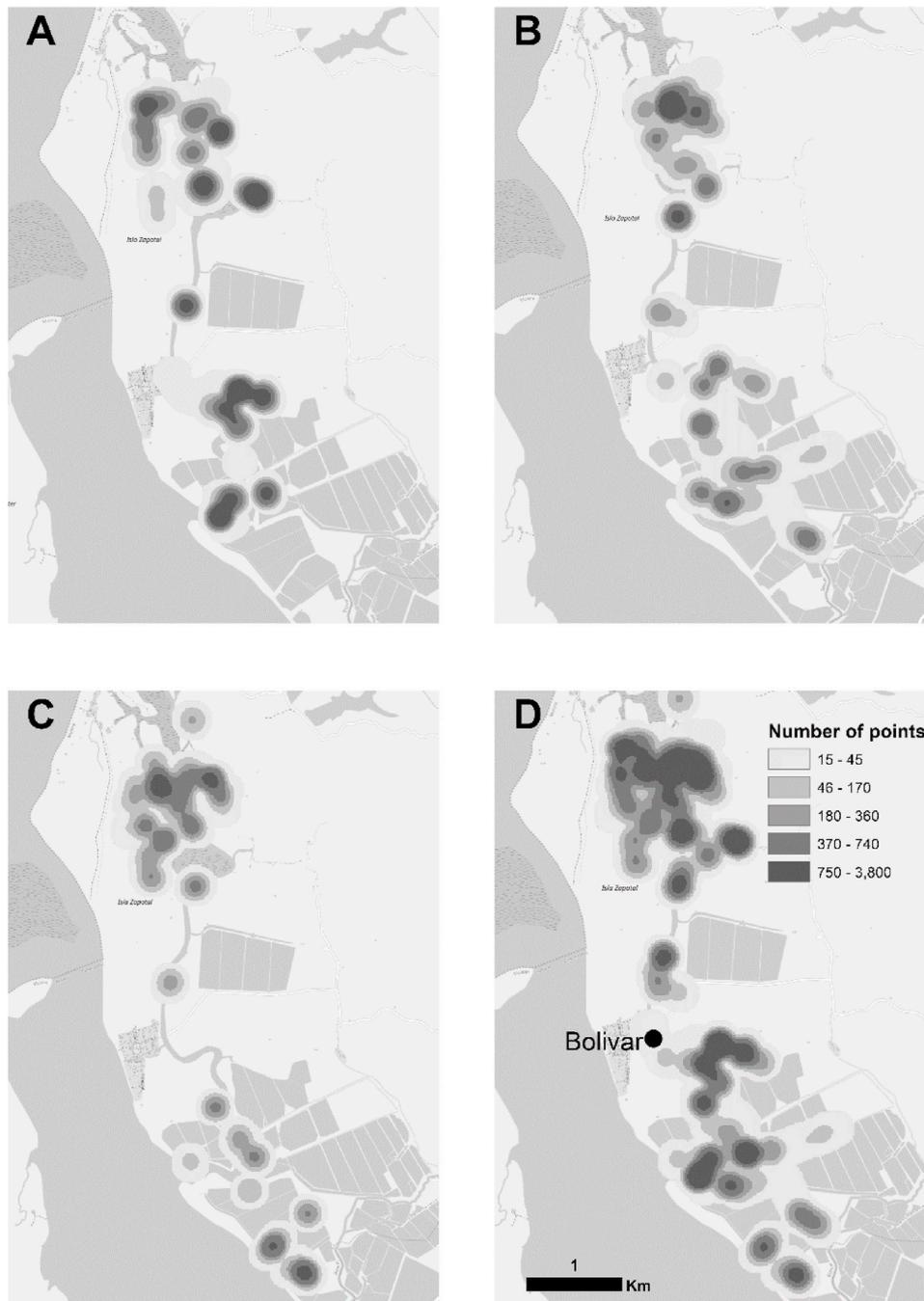


Fig. 4. Heatmaps representing spaces frequented by cockle gatherers are shown as the density clustered points. (A) Group A, women younger than 34 years old, (B) Group B, women of ages 35 and older, (C) Group C, men, and (D) Overlap in spaces visited by all groups.

economically. At the national level, shrimp aquaculture has been a success in Ecuador. At finer scales, the story is different. In Bolívar, shrimp farming created widespread underemployment driven by a decline of economic diversity and a loss of traditional income-generating activities. These patterns have been observed in other rural areas of the Global South where industrial shrimp aquaculture has been introduced (Abdullah et al., 2017; Benessaiah and Sengupta, 2014; Paprocki and Cons, 2014; A. K. Paul and Røskaft, 2013; Sebastiani et al., 1994; Stonich, 1995; Swapan and Gavin, 2011; Van Hue and Scott, 2008). In the MDCs of southern Esmeraldas, the transition from an agriculture- and a fisheries-based economy into a monoculture shrimp aquaculture economy led to a collapse of local livelihoods.

The shrimp aquaculture boom in Ecuador occurred in two stages.

First, when the industry first emerged in El Oro province in 1968 and spread to the Guayas province in the 1970s (Schwarz, 2005). The industry's second "boom" occurred when the industry extended to the northern provinces Manabí and Esmeraldas from the early 1980s to the late 1990s, the period shrimp aquaculture experienced the most rapid growth in Ecuador (Latorre et al., 2015). The spread of shrimp farming operations to the northern provinces was largely driven by the state's desire to promote growth in this productive sector (Martínez-Alier, 2002b), but also out of necessity. By the late 1970s, shrimp disease outbreaks had plagued shrimp farms in the southern provinces for years (Schwarz, 2005; Veuthey and Gerber, 2012). Private aquaculture investors – elites with familial or political ties to officeholders – flocked to the north to expand aquaculture operations (Armijos-Suárez et al., 2015;



Fig. 5. Shellfish gathered from the mangrove forests. a) mangrove cockles (*Anadara tuberculosa* and *A. similis*); b) mangrove mussels (*Mytella guyanensis*); c) zebra periwinkles (*Littoraria zebra*); d) ark cockle (*Anadara grandis*).

Martínez-Alier, 2007). The vast and “untouched” intertidal mangrove forests of Esmeraldas were targeted as prime locations for the construction of new artificial shrimp ponds.

In other countries, e.g., Vietnam (Ha and Bush, 2010; Lan, 2011), Thailand (Huitric et al., 2002; Phillips, 1995; Vandergeest et al., 1999), and Bangladesh (Abdullah et al., 2017; Guhathakurta, 2008; Paprocki and Cons, 2014; B. G. Paul and Vogl, 2011), shrimp aquaculture largely occurred through the conversion of agricultural land (especially rice fields) into shrimp ponds. In Ecuador, the growth of the industry was substantially prompted by the replacement of mangrove forests with shrimp farms (CLIRSEN, 2007). While the entrance of shrimp farming to south Esmeraldas was facilitated by the availability of “cheap” agricultural lands that could be converted into shrimp ponds, the prospect of transforming expansive “unoccupied” mangrove areas into shrimp aquaculture production zones was the main driver of this process. As public property, mangrove forests cannot be privately owned in Ecuador. However, the state established a stewardship mangrove concession-system in 1975 to allow private citizens to apply for “custody” of mangrove zones, granting them governance and exclusive use over the area for which the concession is approved (Gravez et al., 2013; Ocampo-Thomason, 2006; Veuthey and Gerber, 2012). Through this system, shrimp farmers can legally transform mangrove forests into private enterprises in Ecuador (Armijos-Suárez et al., 2015; Romero Salgado, 2014).

The expansion of shrimp farming in Ecuador occurred rapidly and was largely unregulated (Blanchard and Prado, 1995; Latorre et al., 2015; Perez and Robadue Jr., 1989; Terchunian et al., 1986). In the early decades of the industry, weak regulatory institutions presented opportunities for shrimp farming entrepreneurs to establish shrimp ponds without an approved mangrove concession (Meltzoff and LiPuma, 1986). This behavior became normalized within the industry. In Esmeraldas, an estimated 90 percent of existing shrimp farms were illicitly established using this approach (Bravo, 2003). In Bolívar, some community members feel a sense of responsibility for how shrimp farming was established in the area. Residents argue that their lack of local knowledge about existing national regulations when shrimp

farming was first introduced “coupled with corruption” facilitated the illicit expansion of shrimp farming operations within the MRE.

Shrimp aquaculture development failed to stimulate economic growth in Bolívar primarily because employment opportunities in the aquaculture sector did not replace income-generating activities locals had access to before the establishment of the shrimp industry. In other places, the introduction of shrimp aquaculture has been accompanied by opportunities for locals to participate in the industry as shrimp farm owners or even as full-time laborers (Benessaiah and Sengupta, 2014; Huitric et al., 2002; Lan, 2011; Vandergeest et al., 1999). In communities within the MRE, local men can barely secure positions as intermittent laborers in shrimp aquaculture. Initially, local men and women might have had access to jobs within aquaculture production, but these opportunities declined within a few years of the introduction of shrimp farming. The “boom and bust” nature of the industry further limits job security within the aquaculture sector. Therefore, instead of providing financial benefits locally, shrimp farming poses economic burdens on the people who expected this industry to lead their community onto a path of economic prosperity. Interviews with locals reflect a deep level of resentment. Feeling excluded and wronged by the shrimp farming sector, Bolívar residents share a sentiment that their well-being was never a priority of the shrimp aquaculture industry.

4.2. Everyone lost, but women lost more

As the findings of this study show, the socio-economic impacts of the shrimp aquaculture industry in southern Esmeraldas have not impacted all community members equally. Due to gendered norms and gendered access to resources, women have been disproportionately affected by industrial shrimp farming. One of the main reasons the aquaculture industry has impacted women is that they have not been able to participate in this economic sector for decades, even at a minimal capacity. In the early production years, women were seasonally hired to collect wild fry. However, after a series of shrimp bacterial diseases and viral infections ravaged the industry in the late 1990s, shrimp farmers began to source seedstock from hatcheries to decrease the spread of

disease and improve the quality of the product (Schwarz, 2005). For the women who worked as wild fry collectors, this meant losing access to the already limited employment opportunities they had within aquaculture production.

Patterns observed in Bolívar partially support the findings of other studies that have found that women can only access work opportunities at the emerging stages of commercial aquaculture when the industry is not yet considered valuable (Brugere and Williams, 2017). Once the industry is established, women's participation in aquaculture tends to be constrained to the most insecure, lowest paid, and least desired activities (Gezon, 2012; Islam, 2008; Weeraratunge et al., 2010). However, this has not entirely been the case in Bolívar. Once the industry was established, work opportunities for local men declined too. The scarce employment opportunities in aquaculture are constrained to casual, seasonal, and low-paid positions that are filled by local men looking to engage in any type of income-generating activity. Although these jobs are at the bottom of the income ladder, local men can at least minimally benefit from the shrimp farming industry. Local women have not been granted such considerations as they cannot even access such types of "lowly" jobs in the aquaculture sector.

This paper supports the argument that taking a gender-blind approach to aquaculture development can produce unequal consequences along gender lines (Brugere and Williams, 2017).

In Bolívar, the entire community has been negatively affected by the shrimp farming industry to an extent. However, women as a group have lost more than men. Women's invisibility in the shrimp aquaculture sector manifested as a lack of employment opportunities, but this is not the only factor contributing to the disproportionate impacts posed on women. Shrimp aquaculture development failed to consider how gender norms and gendered uses of natural resources that pre-dated the aquaculture industry could inform how different groups would be affected by the establishment of shrimp farming. Ignoring existing social dynamics and cultural norms in the planning process of aquaculture development in the MRE exacerbated existing gender inequalities. Moreover, this approach further disenfranchised already marginalized women – the *concheras*.

When mangrove forests were replaced with private shrimp ponds, *concheras* lost access to spaces that historically provided them access to resources used to support their livelihood and to nourish their families. Men who generated an income through agriculture or by processing and commercializing mangrove wood resources were also affected by the landscape transformations caused by the introduction of shrimp farming – they were pushed to become intermittent laborers or underemployed. Even then, men were not as adversely affected as the *concheras* because men can access employment opportunities in the aquaculture sector, albeit limitedly. Their ability to generate an income through these jobs provides an economic buffer for men who lost access to traditional livelihood practices. *La concha* is another buffer for men who increasingly find it difficult to find employment. Engaging in a productive activity that customarily was only practiced by women allows men to build economic resiliency. Conversely, this livelihood shift for men is posing detrimental impacts on women. *Concheras* lost access to mangrove resources due to mangrove deforestation. They are further losing access to these resources as a growing proportion of the men's population enters what remains of the mangrove forests to gather resources women depend on to sustain their livelihoods.

4.3. Compounded impacts on *concheras*

Men's involvement in *la concha* poses limits on women's ability to engage in, and directly benefit from, a fishery that had previously only been accessed and controlled by women. As the findings of this study show, how often and how much time cockle gatherers dedicate to the activity is influenced by a person's physical ability, endurance, family commitments (i.e., caring for a child or a sick relative), and economic need. However, the gender of a person significantly affects how they

engage in *la concha* and even how many cockles they gather a day. More saliently, the freedoms that allow men *concheros* to spend more time in the mangroves and attain high CPUEs concurrently inhibit women from doing so.

Mangroves can be perilous places where people are exposed to physical harm, such as injury from sharp roots or dangerous animals (Dahdouh-Guebas et al., 2020; Friess et al., 2020). *Concheras* also spoke about being afraid of being sexually assaulted in the mangroves if they go there alone. For these reasons, women enter the mangroves in groups. While this grants them a sense of security, it also means women working in groups have less autonomy to decide how and where they work. Moreover, having more household responsibilities than men means that women are often unable to spend long hours working in the mangrove forests. Therefore, *concheras* primarily enter *conchales* closest to town (see Fig. 3) and are thus constrained to areas experiencing higher harvesting pressure (see Fig. 4). Unafraid of entering the mangroves alone and unaffected by time constraints imposed by household chores, men *concheros* can more freely decide how much time to spend working and how to navigate these spaces. Consequently, even if they are more experienced or have more practical and traditional knowledge of *la concha*, *concheras* are being outcompeted by the growing number of men *concheros*. As men become the dominant practitioners of *la concha* (see Fig. 2), women increasingly lose access to this livelihood practice.

Although women's activities in fisheries require having a unique knowledge of ecosystems and often entail working under harsh conditions, women's work in fishing societies is typically perceived as less prestigious than men-dominated tasks (Nguyen and Dang, 2018; Williams et al., 2005). This is the case with *la concha*. The activity was historically considered a low-status occupation among MDCs of Esmeraldas (MacKenzie, 2001; Mera Orcés, 1999). This perception began to change when *la concha* started to transition from a subsistence to an income-generating activity. However, unlike in other fishing communities where men have taken over women-dominated activities once these gain commercial value (Fortnam et al., 2019; Porter et al., 2008), men from MDCs in southern Esmeraldas did not start engaging in *la concha* because the practice became profitable. The activity continued to be undervalued by men and regarded as a practice for women even when mangrove cockles had gained commercial value. It was not until traditional men-dominated economic activities lost viability after the introduction of shrimp farming that men from Bolívar began to exploit the mangrove cockle fishery.

Over the last 20 years, *la concha* transitioned from being perceived as a lowly activity for women to a valuable productive practice that stimulates the local economy. However, it is crucial to note that men did not begin to engage in *la concha* because of the activity's increased social prestige. Instead, it is because men became involved in this productive activity that *la concha* is now perceived as a valued practice. This process required the community to reconceptualize the value and meaning of the mangrove cockle fishery. Furthermore, for men to enter the mangrove forests to gather shellfish, the community had to redefine what it means to be a cockle gatherer. The image of a cockle gatherer had to shift from a nourishing mother to a masculine provider figure. Through these processes, women are continuously displaced from the mangrove forests, and *concheras* who perceive themselves as proud providers are being pushed back into roles of domestic workers.

Despite how the men have regarded *la concha*, the activity has been a source of economic empowerment and numerous non-monetary benefits for *concheras* for decades. Women's inability to engage in an income-generating activity may not only inhibit their capacity to control their livelihoods but can also result in women losing any decision-making ability they might have within their household (Biswas and Rao, 2014). Women's work in fisheries-based economies is often regarded as being a supplemental source of income for the household. However, studies have found that women's financial contributions can often be as vital for the support of the household as the work of the men in the household (Porter et al., 2008; Santos, 2015; Thorpe et al., 2014;

Williams et al., 2005). For *concheras* in Bolívar, *la concha* is not only an additional income for their households, but in some instances, women's work in the mangroves is the primary income that sustains the household's necessities. Attaining financial independence is especially important for single mothers, widows, and intimate partner violence victims who need to work to sustain themselves. Losing access to *la concha* does not merely mean a decrease in employment opportunities for women from Bolívar. It means losing access to a space that provides them the ability to provide nourishment for their families and a practice that allows them to have economic decision-making within their household.

4.4. Increased vulnerability and decreased autonomy

The introduction of shrimp aquaculture to the mangrove zones of the MRE destroyed the natural resource base many of the communities within the MRE historically depended on to support their livelihoods. Losing access to the natural and social resources on which communities depend increases their vulnerability to economic and environmental shocks (Swapan and Gavin, 2011). In the case of Bolívar, a growing reliance on mangrove resources has strengthened the community's cultural attachment and sense of identity toward the mangrove ecosystem. The community argues that they are "*un pueblo conchero*" – a people who live off mangrove cockles. However, this increased dependence on mangrove cockles has also put the community in a vulnerable position. Ongoing shrimp aquaculture operations continue to reduce and degrade the habitat of mangrove species gathered by mangrove users. The decline of shellfish makes it increasingly challenging for cockle gatherers to maintain a stable income source through *la concha*. Compounding the issue is the growing number of people gathering cockles from remaining *conchales* at unsustainable rates. As a cockle gatherer stated, "the mangrove is [like] an empresa (company) that is going bankrupt ... the mangrove is not providing enough [cockles] anymore."

Cockle gatherers are well aware of the danger of being so dependent on such a fragile and declining resource. While they fear the collapse of the cockle fishery, they do not feel like they have any option but to continue gathering cockles from the mangrove forests. Mangrove users need to sustain their families, and *la concha* is becoming the only viable source of income available to a growing proportion of the population. Community members argue that to enact more sustainable uses of the cockle fishery, they must have access to alternative sources of livelihoods. Participating in a more diversified economy would reduce the community's dependence on diminishing mangrove resources, thereby decreasing their vulnerable status.

The landscape transformations caused by the introduction of shrimp aquaculture to the MRE not only altered how MDCs perceive and value mangrove resources but also how they regard themselves. Residents lost access to traditional livelihood strategies as laborers in the local agricultural sector or as self-employed mangrove resource users. Men were pushed into seasonal, low-paying jobs at local shrimp ponds. Women were displaced from the mangrove forests and are losing their means to generate a source of income. These are not only livelihood shifts; they are a loss of self-determination, as people are no longer able to decide which livelihoods to practice.

5. Conclusion

Sustainable shrimp aquaculture development requires having more than effective production practices in place. Establishing a shrimp farming industry that is economically viable, environmentally sound, and socially just requires understanding how the social fabric of a community can be impacted by aquaculture development. This study shows that complex gendered relations and gendered structures in divisions of labor create uneven access to resources with a spatial dimension, as shown in Figs. 3 and 4. The findings also show that gender

norms impact the harvesting of a natural resource – mangrove cockles – and reveal a link between gender, ecosystem health, and income generation opportunities. Development projects need to heed these linkages. The livelihood shifts manifesting after the introduction of shrimp aquaculture in the MRE put increasing pressure on women's livelihoods and the uses and sustainability of mangrove fisheries. Moreover, as these coastal communities have become increasingly reliant on mangrove resources, they are more vulnerable to environmental shocks.

Studying the positive and negative impacts of industrial food sectors like shrimp aquaculture from diverse perspectives is imperative. As this paper shows, local communities can illuminate problems otherwise overlooked and provide insight into complex and unintended environmental and social outcomes. In this paper's context, rather than taking the community's critical perspective as an attack on the aquaculture industry, these local narratives should be examined to learn what can be improved as economic sectors like shrimp aquaculture continue to grow. Understanding these processes, especially of the social norms that limit opportunities for marginalized groups, can provide insight into creating strategies to ameliorate the social impacts of development projects and the planning of future interventions.

Funding

The first author received financial support for this project from the Oregon Sasakawa Young Leaders Fellowship Fund (Sylff) for International Research.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

The first author would like to thank Andrea Quintero Cortez and Víctor Arroyo Quiñónez for their support during fieldwork, the community of Bolívar for their hospitality, and the *concheras* and *concheros* for their openness to participate in this study. The authors thank Larry Becker, David Wrathall, Shireen Hyrapiet, and Joan Gross for their advice and support for the duration of this study. We also would like to thank the anonymous reviewers whose helpful comments and suggestions helped improve the clarity of a previous draft of this manuscript.

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