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The Punta Allen cooperative as an emblematic example of a sustainable small-scale fishery in the Mexican Caribbean

Crisol Méndez-Medina¹, Birgit Schmook¹ and Susannah R. McCandless^{2*}

* Correspondence: smccandl@uvm.edu

²Department of Geography,
University of Vermont, 94 University
Place, Old Mill Building 200,
Burlington VT 05405, USA
Full list of author information is
available at the end of the article

Abstract

We present an institutional ethnography and historical case study of the Vigía Chico fishing cooperative, located in the community of Punta Allen within the Biosphere Reserve of Sian Ka'an, México. The top producer of spiny lobster (*Panulirus argus*) in the state of Quintana Roo for over 30 years, this cooperative has been claimed as an example of a sustainable artisanal fishery. To better understand and assess this success story, we performed an in-depth study of multiple factors to analyze their influence on the cooperative's success. The indicators selected were level and form of social organization, resilience to socio-environmental perturbations, changes in fishing gear, and the fishing concession as avenue to cementing institutional success. We conducted ethnographic fieldwork over five months, complemented by an in-depth analysis of the cooperative assembly's minutes. We found that the knowledge the cooperative acquired of the functioning of Mexican public policies was a factor in their success. Cooperative leaders were able to translate that knowledge in ways that benefitted the cooperative, enabling them to build a set of policy-responsive operational rules that could be effectively applied to artisanal fisheries more broadly. The isolated conditions of the area and the presence of natural perturbations such as hurricanes forced the community to increase their willingness to cooperate, and improved their capacity to respond as a group to perturbations. These successes in turn demonstrated the value of cooperative approaches to achieve individual and collective livelihood goals, within and beyond fishing. Such approaches have been further enhanced by the incorporation of academic knowledge and scientific techniques. We conclude that Punta Allen is a successful example of a community that has managed to creatively engage public policy instruments and translate them into effective local practices, enabling organizational persistence despite repeated changes in policies governing fisheries in Mexico.

Keywords: Small-scale fisheries; Fishing cooperatives; Fisheries governance; Common-pool resources; Fisheries conservation

Introduction

In Latin America, most artisanal fisheries are degrading rapidly, provoking widespread concerns about overexploitation of fisheries resources (Defeo and Castilla 2005). Many of these fisheries began as open access regimes under national jurisdiction. Initially, products from artisanal fisheries supplied domestic markets. Once national markets were integrated into the global economy, fishery products became export commodities, which often resulted in overexploitation of the resource (Defeo and Castilla 2005;

Orensanz et al. 2013). Concerns over how to manage fisheries resources sustainably have resulted in intensive research interest in successful artisanal fisheries (Defeo and Castilla 2005; Gallardo et al. 2011; Gutiérrez et al. 2011; Orensanz et al. 2013).

One salient conclusion has been that rights-based management systems tend to function better for sustainable artisanal fisheries. Case study examples from Latin America illustrate the benefits of such systems, such as the Seris in Sonora, Mexico (Basurto et al. 2012; Orensanz et al. 2013), and the Juan Fernández Archipelago lobster fishery (*Jasus frontalis*) in Chile (Orensanz et al. 2013). Other rights-based systems studied include the Territorial Use Rights for Fishing in North Central Chile loco abalone fisheries (*Concholepas concholepas*) (Defeo and Castilla 2005; Gallardo et al. 2011; Orensanz et al. 2013), and the concessions of Central Baja California, Mexico (Orensanz et al. 2013; McCay et al. 2014). The Punta Allen spiny lobster fishery (*Panulirus argus*) in the Mexican Caribbean has also been extensively profiled (Seijo and Fuentes 1989; Schlager and Ostrom 1992; Seijo 1993; Defeo and Castilla 2005; Seijo 2008; Sosa-Cordero et al. 2008; Brenner 2010). On the other hand, rights-based management alone is not the key to successful and sustainable fisheries. Research has shown that if divergent interests among stakeholders are not reconciled, serious conflicts may arise, threatening both the resource base and local livelihoods. Examples of less successful rights-based artisanal fisheries include that for the sea urchin (*Loxechinus albus*) in Chile (Defeo and Castilla 2005), and the Galapagos sea cucumber (*Isostichopus fuscus*) of Ecuador (Orensanz et al. 2013).

The Juan Fernández lobster fishery in Chile shares some characteristics with the Punta Allen fishery. Both share informal territorial access rights. Local fishers designate individual fishing spots, and in both cases non-invasive fishing gear is employed. Both are single-species lobster fisheries, with the benefit of high commercial value. Both developed their fisheries in geographic isolation, a characteristic that forced them to adapt and respond to environmental perturbations as a group. Unlike in Punta Allen, however, in the Juan Fernández case, the government has not recognized the system of traditional rights. This renders their system vulnerable to the incorporation of disruptive, externally imposed rules (Ernst et al. 2013).

Gutiérrez et al. (2011) analyzed 130 cases of fisheries with community-based co-management, and found them to be a key management strategy across countries with different degrees of economic development (Punta Allen was included in the study). The authors found that the attributes contributing to co-management success are the presence of strong leadership, followed by the implementation of community quotas, social cohesion, and protected areas limiting access to non-group members. All these elements are present in Punta Allen. However, the presence of these attributes does not fully explain the success of the case study, either.

The example of the Maine American lobster fishery (*Homarus americanus*) (Ernst et al. 2013) contributes a few additional elements to the analysis of successful artisanal fisheries. The Juan Fernández, Punta Allen and Maine fisheries all feature informal territorial rights. Maine lobster fishers access a common territory, in contrast to the two other cases, where fishers hold rights to specific fishing locations individually (Ernst et al. 2013; St. Martin 2001). In Maine, a well-rooted conservation ethic among local fishers in the industry resulted in laws that heavily support and facilitate resource conservation. For example, these laws established minimum and maximum lobster size measurements for extraction, a prohibition on the extraction of “berried” lobsters (egg-carrying females),

and the use of non-invasive fishing gear. The most important aspect of the above-mentioned laws is their compatibility with existing territorial systems (Acheson and Brewer 2003), a characteristic that the Maine fishers share with those of Punta Allen. This successful integration of local rules with law and policy—in conjunction with factors such as relatively easy access to high-market-value species and isolated geographic conditions—have resulted in a very particular form of social organization. That organizational form represents the essential ingredient in the maintenance of a system of rights that sustains the life of the fishery developed by the Vigía Chico Cooperative of Punta Allen in the Mexican Caribbean. Tracing the evolution of these distinctive conditions in the Punta Allen case thus has the potential to inform both artisanal fisheries management policy, and community practice in far-flung locales.

Setting the scene

In Mexico, fisheries are listed as secondary activities in State development strategies because of their minor contribution to the Gross Domestic Product (GDP). Nonetheless, small-scale fisheries make significant economic contributions. According to official data, in Mexico 70 % of fisheries resources are fully exploited, 10 % are in potential development and 20 % are in or close to collapse (Arreguín-Sánchez 2006). Artisanal fisheries in the country represent a huge management challenge. Catch levels are not fully recorded, and poaching and violation of closed seasons occur along the coasts of Mexico. The role of artisanal fisheries in the worldwide fishery crisis is often ignored or regarded as marginal compared to the effects of industrial fishing (Defeo and Castilla 2005). Nonetheless, small-scale overfishing can lead to serious local environmental and economic consequences.

In the Southern Yucatan Peninsular state of Quintana Roo, fishing has major social, political and commercial significance. Along the state's 900-km coastline, social life is organized by a system of artisanal fisheries. Experts consider these fisheries to be highly organized, second only to those of Baja California, nationally (Hidalgo and Méndez 2007). The system is dominated by cooperatives formed by local fishers, with little involvement of the outside commercial sector (Sosa-Cordero and Ramírez-González 2001). The fishery resources that historically have had the greatest economic significance for the state are the spiny lobster (*Panulirus argus*), shrimp (*Farfantepenaeus brasiliensis*), and the queen conch (*Strombus gigas*). Spiny lobster production has significant economic importance for Quintana Roo. From 2000 to 2008, 165.1 tons were produced (counting both tails and live lobsters). The catch represented six percent of the state's fishery production; fisheries, in turn, represent 40 % of the state's total gross product (Sosa-Cordero 2011).

There are three fishing areas in the state: North, Central and South. Each area has different levels of development, habitat characteristics and types of fishing gear employed in lobster catching. In the Central area, the focus of our study, the predominant types of gear used are *sombras*, or shades^a, and *jamo*^b, a type of net (Seijo 2008). This area includes the bays of La Asunción and Espíritu Santo, both located with the boundaries of the Sian Ka'an Biosphere Reserve.

Spiny lobster abundance was a decisive factor and one of the principal drivers of the formation of the first cooperatives in Quintana Roo in the 1950s (César and Arnáiz

1986). After the 1970s, the activity lost importance in Federal development strategies (Sosa-Cordero and Ramírez-Gonzalez 2011). When conservation emerged as an important issue in Federal environmental development concerns in the 1990s, lobster fishing was identified as a threat to the Mesoamerican Barrier Reef. Fisheries became a key target of State strategies for coastal management (Velez et al. 2014). These changing socio-environmental circumstances make the lobster fishery of Punta Allen a valuable case study. Despite these apparently adverse conditions and the increasingly bleak scenario of many fisheries globally, the cooperative has emerged as a success story.

The Vigía Chico lobster cooperative of Punta Allen is located in what is today the Sian Ka'an Biosphere Reserve. As an instance of a sustainable artisanal fishery coexisting with marine conservation, the case has been frequently analyzed. The establishment of property rights over marine space and the efficacy of cooperative members' harvesting techniques have drawn the attention of many researchers (Seijo and Fuentes 1989; Seijo 1993, 2008; Defeo and Castilla 2005; Sosa-Cordero et al. 2008; Brenner 2010). To better understand the cooperative's success, we employed a historical perspective and an ethnographic lens. This combination of approaches facilitates an analysis of the community's interaction with changing state policies and institutions.

The lobster fishery of Punta Allen has been studied previously using an institutional analysis framework (Seijo 1993; Cochran 1998). The framework analyzes how collectively managed fisheries function, how group members are accepted or rejected, and whether possession of these rights to common property permit or prohibit the holder's sale of the resource. Institutional analysis is a well-recognized analytical approach. It defines institutions as the shared conceptions that humans use in recurring situations, which are organized by rules, norms and strategies (Ostrom 2007). By the term rules we refer to:

"The result of implicit or explicit efforts by a set of individuals to achieve order and predictability within defined situations by: (1) creating positions (e.g., member, convener, agent, etc.); (2) defining how participants enter or leave positions; (3) agreeing on which actions participants in these positions are required, permitted, or forbidden to take; and (4) stating which outcome participants are required, permitted, or forbidden to affect." (Ostrom 1986:5).

We can see examples of these operational rules when fishers specify what types of fishing gear are permitted within a fishing ground (Schlager and Ostrom 1992:251). The rules that create and enforce property rights regimes play a primary role in institutional analysis. Rules can also be understood as the variety of rights and their allocations to particular stakeholders or categories of stakeholders (Poteete 2010). We understand "rights" as particular actions that are authorized (V Ostrom and John 1976). Rights are a product of rules, and thus not equivalent to rules (Schlager and Ostrom 1992). The institutional analysis framework has been invaluable in understanding the organization of fisheries and other governance regimes around the world (Schlager and Ostrom 1992; Jentoft 2004; Basurto and Coleman 2010; Gallardo et al. 2011; Basurto et al. 2012).

By employing a historic and ethnographic approach to the Punta Allen case, we seek to deepen the understanding of how this common property right of use has come into existence. The factors affecting contextual emergence of common property rights of use remain a vital question (Kadekodi 2004), and the principal concern of our paper.

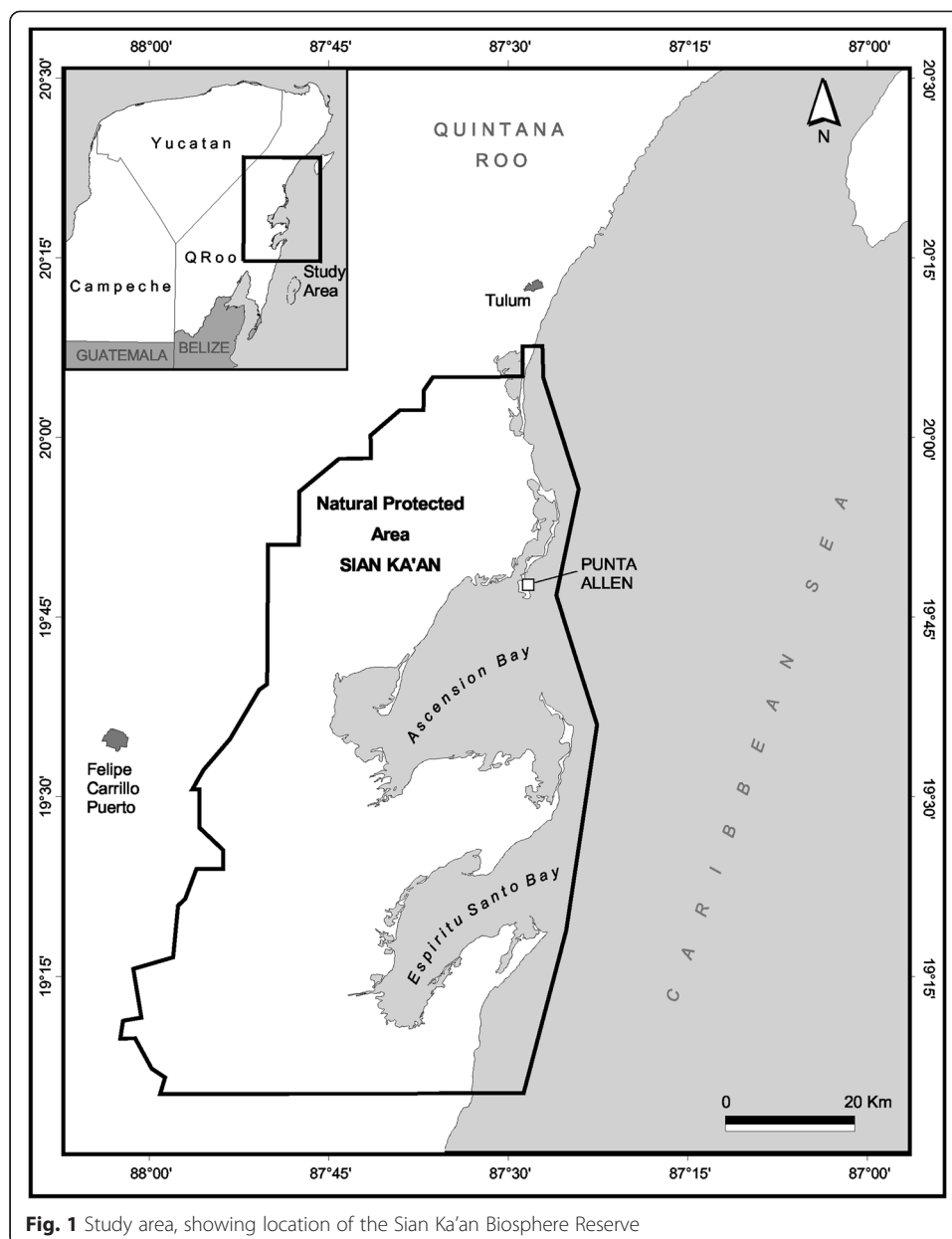
Methods and study area

We conducted our case study on the Javier Rojo Gómez fishing colony—the official name of Punta Allen—within the perimeter of the Sian Ka'an Biosphere Reserve, Quintana Roo, Mexico (Fig. 1). Demarcation of the Sian Ka'an Biosphere Reserve began in 1982. It was gazetted in 1986, in a process led by the Research Center of Quintana Roo (CIQROO) with support from the National Council of Science and Technology (CONACYT). At the time of its demarcation, the only human settlements recognized within its boundaries were Punta Allen and Punta Herrero. Today María Elena, another fishing camp belonging to the Cozumel fishing cooperative, is also recognized.

The Sian Ka'an Biosphere reserve has an area of 652,193 hectares, of which approximately 120,000 are marine. The marine portion includes an 110 km-long continuous barrier reef, which makes it a focal point for the preservation of coastal ecosystems. This position also makes the territory of Sian Ka'an a priority focus for the tourism industry. The reserve encompasses a transition zone between terrestrial and marine ecosystems, containing an extraordinary diversity of environments in good condition. However, its poor soils are not suitable for agricultural activities. Due to a warm and humid climate, the region features mesic forests, flooded forests and mangroves (INE 1996). Hurricanes, northerlies (*nortes*), and droughts periodically affect the area.

For many years, the extraction of gum (*chicle*) was the main productive activity in the region, together with timber extraction and copra plantations for coconut oil production. Between 1960 and 1980, timber extraction faltered before an increasing scarcity of commercial timber species, due to overexploitation, and the chicle bubble popped with the emergence of synthetic gum. Copra production declined precipitously due to “lethal yellowing”, a viral disease of the coconut palm. Given this grim economic scenario, local populations began to exploit marine resources through fishing. To ensure their resource use rights, in 1968 they established the “Vigía Chico Cooperative Society for Fishery Production” (Sociedad Cooperativa de Producción Pesquera Vigía Chico), followed in 1970 by the “Javier Rojo Gomez Fisheries Camp” (Punta Allen) in Ascension Bay (Brenner 2010). Today Punta Allen is highly dependent on the extraction of fishery resources (primarily spiny lobster) and tourist activities. In Ascension and Espiritu Santo Bays (located at the center and south of the Sian Ka'an Reserve, respectively), the use of *casitas*, or capture shades, and *jamo* as fishing gear currently dominate (Seijo 1993; Sosa-Cordero et al. 2008).

Ethnographic fieldwork was conducted from February to May 2013 and in July of the same year. The first author conducted in-depth interviews with 30 members of the cooperative, using a snowball sampling technique (Biernacki and Waldorf 1981). Guest et al. (2006) recommend conducting 30 to 50 interviews to allow the ethnographic researcher to achieve saturation of information on a particular topic, while capturing variability, for the purposes of thematic analysis. The first author interviewed current leaders of the lobster cooperative, as well as founding members, and accompanied some of them during their working hours (both off-season and in the fishing season). During ethnographic fieldwork, she spoke with leaders of the cooperative, and with some of the families opposed to the current Board of Directors, to triangulate the degree of legitimacy of the shared access rules. Ethnographic fieldwork additionally included interviews with residents who were not current cooperative members. The first author conducted four semi-structured interviews with officials of the National Commission of Natural Protected Areas (CONANP), and one informal anonymous interview with an official of the National



Committee for Fisheries and Aquaculture (CONAPESCA). She also interviewed members of non-governmental organizations working in the study area. Finally, she interviewed three fishermen who no longer live in the community, but who had been founding members of the cooperative.

We conducted a review of the cooperative's historical documents, including records of the assemblies and meetings of the Board of Directors during the cooperative's first 20 years of existence. We triangulated this information with a review of historical literature covering 100 years of public policy in Mexico. This enabled us to situate our understanding of the process of cooperative decision-making over time. We also traced how informal institutions and relationships between Punta Allen's Vigía Chico Cooperative and a variety of state-level stakeholders developed.

Historical review of coastal settlements

The lighthouse keepers: the basis of social organization

The first settlers of the eastern coast of the Yucatan Peninsula (presently the State of Quintana Roo) were descended from the Chontal, a Mayan ethnic group. The Chontal brought their prowess in navigation from the State of Tabasco, enabling them to master the coast and coastal waters (César and Arnaíz 1990). During pre-Columbian times, salt production and fishing were the main productive activities in Yucatan. Dating well back into the pre-Colombian era, cultural exchange and trade existed throughout the Caribbean (Thompson 1979). During the era of conquest English and French pirates from the Caribbean islands repeatedly attacked the coast of Quintana Roo, making the rapid settlement of the area by other Europeans impossible. Nevertheless, the Maya were able to establish trade agreements and alliances with the pirates. These relations were retained during subsequent periods of repopulation.

Throughout the nineteenth century, the Yucatán Peninsula witnessed numerous battles between incoming settlers and the Mayan residents. The most significant conflict in the area's history was the Caste War (1847 to 1901), which lasted more than half a century. At the end of the Caste War the population, who had fled the region for decades, began to return. Repopulation began in the south of the state and was made official with Mexican state promotion of the establishment of Rancho San Miguel (now Cozumel Island). Subsequently the municipality of Isla Mujeres was established on the eponymous island—named for its cultural importance as a site of Mayan women's rites of passage—and adjacent mainland. Regional resettlement occurred very slowly, as the territory was isolated from the rest of the country, and navigating the Caribbean waters remained difficult because of long hurricane periods (César and Arnaíz 1990).

At the beginning of the 20th century, the Mexican government established a Navy presence along the coast. The Marine Corps recruited local fishermen from nearby Isla Mujeres (César and Arnaíz 1992), who took advantage of local food resources like sea turtles, and practiced small-scale fishing while simultaneously protecting Mexico's southern border. The establishment of lighthouses was another piece of the government's strategy to secure and populate Mexico's southern border, thereby integrating this marginal territory into the nation-state. Those in charge of the lighthouses became the region's first non-Mayan settlers, and extracted copra. These settlers earned their living as farmers, fishers, and hunters, and created a form of social organization in the territory based on extractive and farming practices (César and Arnaíz 1986; 1990).

The presence of lighthouse keepers along the coast was essential for the consolidation of the social organization of most of the fisheries in Quintana Roo, and remains so today. Punta Allen was part of that early-20th century network of lighthouses. Among the records of the first lighthouse keeper we found the first formal proposal of how life and work in the settler community should be organized. The Punta Allen fishers' co-operative initially operated out of the lighthouse keeper's ranch, and one of the current cooperative leaders is that founder son.

Fisheries in Quintana Roo: the early years

During the early decades of the 20th century, the population living along the coast of Quintana Roo remained fairly isolated from the rest of the country. Socio-economic

exchanges happened through contacts with Cuban and Belizean fishermen, who arrived by sea. Local populations traded lobster with the Cubans and Belizeans for scarce staples like sugar, alcohol, salt and oil, transforming a product used for local consumption into a commercial commodity with high economic value. During these early years of the lobster fishery anyone could harvest lobster without restrictions; most extraction happened in areas close to the coast and reefs. Given resource abundance, lobster fishing was easy and required little effort. As commercial exploitation increased, interviewees say that the Cubans explained to one of the fishers how to use capture shades (*sombras*) to make lobster fishing more economically attractive and labor-efficient.

At the national level, fisheries were consolidated during the 1930s and 1940s. Nationwide, the 1940s and 1950s were of great importance for the development of the fishing industry. For Mexico, the Second World War boosted the fishing industry, creating an increased demand for seafood products for the U.S. domestic market (Cruz-Ayala and Igartúa-Calderón 2006). The introduction of diesel engines into local fishing practices represented an adaptation of military technologies to civilian uses after WWII. During the 1940s and 1950s, the government also promoted nationwide migration from urban centers to coastal areas. As part of a territorial reorganization plan, government policy concomitantly supported major investments in port infrastructure (Soberanes Fernández 1994; Cifuentes-Lemus and Cupul-Magaña 2002). In Quintana Roo, however, fisheries did not gain economic importance until after Hurricane Janet, in 1955 (César and Arnáiz 1990). After Janet hit the coast, most of the region's coconut palms were destroyed. Copra extraction ceased to be economically viable, and the territory's economic identity had to be redefined. The first fishing cooperatives of Quintana Roo were formalized during this time. Although initial efforts to encourage the creation of productive groups were made during the government of Lázaro Cárdenas (1934–1940)^c, it was not until the mid-1950s to the late 1960s that extractive practices were organized by Cooperative Societies for Fisheries Production (César and Arnáiz 1986).

Drivers of success

Social organization

The Punta Allen community was established under particular socio-geographical conditions. State development plans did not include significant infrastructure development in the area, so the first inhabitants had to travel long distances on rough roads to reach major regional urban centers like Felipe Carrillo Puerto and Chetumal. After copra plantations began to decline in the 1950's, fisheries came to the fore as an important economic activity in Quintana Roo. During the early years of settler community formation, this isolation from the rest of the territory was decisive for the practices of production and consumption enacted by fishing families and the few other individuals who lived in the community.

The first settlers belonged to three extractive traditions: copra, the quintessential coastal agriculture; fishing, practiced by fishers in Cozumel and Holbox, some of whom who traveled to Punta Allen to continue plying their trade; and finally, other agricultural and forestry traditions. One of the most important activities in these first years of the settlement (1950's-1970's) was crocodile hunting (both of the American crocodile, *Crocodylus acutus* and Morelet's crocodile, *Crocodylus moreletii*). A few lobster fishers

participated in this activity and sold crocodile meat and skin in Chetumal. Also, some new settlers worked exclusively in the manufacture of fishing shades and cutting chit palm (*Thrinax radiata*), used to construct the first shades and for roofing houses.

In this isolated settlement, social life was organized collectively; the few women living there washed and cooked as a group. The group's representatives in charge of marketing the product outside the community were responsible for bringing back basic supplies. Some fishers' wives accompanied their husbands on fishing trips, and prepared food along the way.

During the early years of the cooperative in Punta Allen, lobster was distributed to the city of Chetumal by sea, or was transported overland via a truck whose winding route ran from the Vigía Chico Carrillo harbor and could take 2 or 3 days because of the hostile terrain. Once the distributors managed to get out to the main road, the product was brought to Merida, Chetumal and Felipe Carrillo Puerto. Along with lobster, they transported turtle meat, one of the most popular seafoods at that time. Some trips went as far as the Mexico City.

Control over access to common resources was organized from the early days of the cooperative into three production groups, centered on three individuals with high leadership capacity. Though the early leaders had different views on how the fishery should be organized, the aforementioned conditions of geographic isolation, scarcity, and rough roads forced them to combine their efforts to market the product and purchase the products necessary for Punta Allen families' subsistence. These leaders started families in the town, and today remain the power holders in the community. The first leader, a founder of the community, came from a family of Spanish origin. He had little formal education, but was highly skilled in the management of economic resources. The second leader was the descendant of fishers who had participated in the formation of the Cozumel cooperative, which he left due to a conflict. He was the driving force behind the formation of the cooperative as the local mode of labor organization. The third leader was known in the community for his conciliatory capacity. He came from the area's farming tradition and was the individual who conducted negotiations and mediated between the community, NGOs and the government during the early years of the community and cooperative.

At this time, a local fisher deployed the *sombra* technique introduced by the Cubans. The new technology involved investment in materials, manpower and time during the lobster harvest, and thus disputes over resource ownership emerged. The first fisherman to place a capture shade into the sea was followed by other fishers, who noted where he was placing them with the intent of later stealing his catch. Another fisher followed suit, placing his own sombras, but they suffered the same fate, and his catch was stolen. These events were the genesis of the marine tenure system characteristic of Punta Allen. The catch-stealing problem was resolved by a fisherman who had previously worked as a farmer in the municipality of Felipe Carrillo Puerto. He decided to establish a fishing zone as a "*parcela*^{dn}", bounding an area of marine space. Other fishers imitated him and established that each fisher would have an assigned area in the sea for lobster fishing, in which he could place shelters to catch lobsters, just as a farmer would install infrastructure on his land. People in Punta Allen do not say that they fish lobster; instead, they harvest lobster. This apparently minor linguistic shift carries important symbolic weight in their fishing practice.

Once the cooperative was formed, extractive practices continued to be organized in working groups. In the process of delimiting lobster fields, fishers who belonged to one of the three major groups managed to defend their chosen marine territories and consolidate their ownership.

“When we began to divide the sea... it was terrible, there were fights in the cantina. So that it wouldn’t go on for too long, I made groups... you know, don’t grab this plot just for yourself, divide it among four; so, when someone fights with you, you are going to fight as a foursome...whereas if you were alone, they would plaster you in the cantina. They made groups... [so now] you are talking about how you are going to fight six people, and it [acts as a deterrent]... I do not know if you understand how the strategy works...” (Rodrigo, founder, member of the Board of Directors, personal interview, April 20, 2013).

As the years passed and the cooperative matured, the families of these three leaders became the community leaders. They were responsible for negotiations with governmental institutions, participation in academic projects, and decision-making on how access to resources in the zone was allocated. Since the cooperative’s inception, Mexico’s Federal Cooperative Law (1938) served as a basis for regulating practices within the community. However, this was not an easy task. The low level of formal educational level of the majority of the fishers in the cooperative and the isolated geographic conditions spawned constant trips to the State capital (Chetumal) to ask government authorities to serve as arbitrators in many disputes. These iterative learning interactions with the State began to confer legitimate power on these leaders, who held administrative positions on the Board of Directors.

“Before, no, we did not carry out our responsibilities because we didn’t know about the performance of our activities, our responsibility... we always went and were told ‘that’s what conciliation and arbitration are for, conflicts.... The surveillance guy, that’s his job to see that all the committees work well, and [bring to the Board’s attention] those that don’t, those are your duties’...” (Rodrigo, founder, member of the Board of Directors, personal interview, April 20, 2013).

This reinforcement of the legitimation of local authority figures via state backing helped ensure that interpretations of the Cooperatives Act would become instrumental to the regulatory practices of the community. This process further promoted the cooperative as the dominant form of community social organization. Notably, tourism, which has become an important economic activity in the community, is regulated by these same cooperative rules. The original leaders of the lobster cooperative continue to hold power in almost all spheres of public life, and the descendants of these leaders sustain this system of concentration of power.

Governmental organizations collaborate with the cooperative because of its implementation of sustainable extractive practices and its participation in the policing of marine conservation at a low cost to the State. Local fishers have firmly supported the surveillance system because the Ascension Bay fishing concession, which was granted by the State, provides them with security over the resource and protects their internal system of regulation.

In 1992, the cooperative's exclusive right to the fishery resource was eliminated by changes in State policy during the Salinas de Gortari government (1988–1994). At that time, the Fisheries Act was modified to include active private sector participation in fishing extractive activities. Species reserved for exploitation by cooperatives disappeared from the Act and a new regime was designed to grant concessions, permissions and authorizations, whereby these rights of use could be transferred to private investors. Additionally, early bids began for the sale of the state-owned enterprises Ocean Garden and Mexican Fishery Products (Soberanes Fernández 1994; Cifuentes-Lemus and Cupul-Magaña 2002). Even though cooperatives lost exclusive fishing rights under these changes in national fisheries legislation, the cooperative continues to be the only way the Punta Allen community can conceptualize the social organization of labor. The cooperative was able to maintain and consolidate power, because since its early days the founding leaders had respected state regulations, and used them to legitimize their decisions. Through their repeated consultations with regional authorities, and long-time adherence to State regulations, these leaders had strengthened their connections with state agencies and actors in ways that continued to benefit them, and offer legitimacy, despite the changes in legislation.

Responses to socio-environmental perturbations

When Hurricane Gilbert hit the coast of Quintana Roo in 1988, just 2 years after the formalization of the Biosphere Reserve, the course of local fisheries changed unexpectedly. The model of fishing had shifted at the federal level, with the 1983 implementation of the Exploration and Assessment of Fisheries Resources of the Exclusive Economic Zone and Territorial Waters program, a multi-agency and industry partnership^e. Its intent was to estimate the resources that Mexico could extract from its exclusive economic zones and territorial waters. With this measure, the State changed its discourse from one of resource protection and regulation to one of deregulation. For each newly inventoried marine resource, trade values were assigned, and changes were introduced to fisheries legislation to encourage the participation of the private sector, as well as foreign companies (Soberanes Fernández 1994). The State also conducted an inventory of state-owned assets and commenced their sale. Multiple interviewees reported that before 1988, state-owned Mexican Fishery Products and Ocean Garden had been economically important, and responsible for most of the processing and distribution to packing companies in Quintana Roo (Soberanes Fernández 1994). State-sponsored deregulation forced local fisheries to identify new ways to survive in the national and international market.

The Punta Allen cooperative faced one of its worst financial crises in the 1990s. The cooperative had enjoyed a boom in productivity a few years before Hurricane Gilbert struck in 1988 with devastating impact. Several fishers recalled needless and excessive spending of the cooperative's financial resources in the mid-1980s. Given resource abundance and a seemingly endless flow of money, people in the community were not concerned about investing their earnings or consolidating family savings. The cooperative's leaders did not worry about money management, and expenses were often much higher than actual income. The cooperative directors decided to build a packing plant in the town of Tulum, 55 km distant, to receive, package and market all products from the fishing cooperatives in the State. The ice factory and baler were built first, followed by the marketing offices.

After the ice factory and baler were completed, bank managers provided the credit for the marketing offices in a single payment. Construction began shortly before Hurricane Gilbert hit the northern coasts of Quintana Roo. Lobster extraction plummeted. Debts became unsustainable, and cooperative members learned about the financial situation of the cooperative the hard way. Before the 1988 financial disaster, the accountant and directors had kept the cooperative's finances secret. Given this situation, no one wanted to take charge of the bankrupt cooperative, and the responsibility fell to the cooperative's president. The cooperative's debt far exceeded its productive capacity, and many members left the community. Others, in despair over their low incomes, sold lobsters outside of the cooperative. This clandestine selling became such a problem that it seriously threatened the cooperative's continued existence (for a related example, see McCandless and Emery 2008).

The Board of Directors began to crack down on violators, initiating a wave of expulsions of all members who violated the internal rules. The membership rolls shrank from approximately 120 to 70. In 1993, 5 years after Hurricane Gilbert, the cooperative managed to pay off their debt to Ocean Garden, as well as to the Bank of Mexico. The cooperative also decided not to accept new members, including former cooperative members who had left the cooperative during the crisis. The children of former members also lost the right to aspire to membership. After the debt crisis, only the children of current, active members could become members, thereby effectively limiting resource access to a subset of the community. Rights to lobster fields could only be sold to members of the cooperative, and the cooperative regulated all transactions. The selling of a "lobster field" did not refer to the marine parcel itself, but only to the improvements: the "shades" the previous rights-holder had constructed. The cooperative re-emerged as a result of the restructuring of the internal rules of operation. The reorganization had implications for the way fishery resource property rights were protected, which subsequently permitted the cooperative to comply with the requirements to obtain a fishing concession.

Changes in focus and fishing gear

In the 1950s, 1960s and 1970s, area residents harvested, turtle, shark and caiman, as well as scaly fish. Although these were not primary economic activities, they represented a significant portion of the revenues generated during the off-season for lobster. However, shortly after the Sian Ka'an reserve was gazetted, government efforts shifted, following international trends set at the 1992 Earth Summit in Rio. The new policies focused on the diversification of productive activities to lessen the impact of extractive practices on area ecosystems. The government's intention was to put an end to fishing as a primary commercial activity, and replace extractive practices with environmentally friendly activities. As part of this policy, during the 1990s, the National Commission of Natural Protected Areas (CONANP) engaged in an ongoing campaign to convince fishers to stop fishing for turtle and caiman and abandon their fishing nets.

The perceived panacea for unsustainable resource use was tourism. The government promoted tourist cooperatives running sightseeing tours, and some of the fishers created the first tourist cooperatives in Punta Allen and Vigía Grande. The Gaytanes and Las Boyas tourist cooperatives followed. More recently, area residents formed the Nativos de la Bahía and the women's Orquídeas de Sian Ka'an cooperatives (though at the time of

writing the latter is not yet operating tours). After a long process of negotiations and exploration into tourist activities, the fishers decided to withdraw the use of fishing nets. The rationale for this change was the nets' negative impacts on the population of high commercial-value sport-fishing species such as ladyfish (*Elops saurus*), snook (*Centropomus spp.*), permit (*Trachinotus falcatus*), and dolphinfish (*Coriphaena hippurus*).

In the 1990s, tourism was already complementing family incomes, but it was not until 2000 that tourism became the most important economic activity in the community of Punta Allen. Some fishers combined fishing and tourism, while other cooperative members simply abandoned fishing. Over time, a series of tourism cooperatives emerged to regulate the area's resources, strengthening the local community's decision-making capacity. Influenced by external buyers, the remaining lobster fishers decided to change their fishing gear, leaving the hook behind and shifting to the *jamo*. The change in fishing gear was a response to the observed increase in commercial value of the undamaged product harvested with the *jamo*.

Academics have also been important actors in this renewed fishery. At the beginning of the 21st century, the cooperative requested support from some of the universities and research centers working in the region. Using new technologies, a map of all the lobster fields was created. Previously, the local fishers had delimited the boundaries of their lobster fields with buoys or stakes. Their profound knowledge of the marine space allowed them to find the exact locations of their traps; however, they had never been able to visualize the shape of each field or its actual dimensions. Academics taught them how to use global-positioning systems (GPS), allowing the fishers to improve their surveillance systems and resource usage. Researchers systematized the knowledge about lobster population behavior and performed bathymetry^f that was subsequently incorporated into a database.

"...Through SISIERRA [a national research program]^g, a map was made using GPS, and it was from that point that we learned the shape of our lobster fields... if you were my neighbor along my boundary, I knew you were my neighbor and where you were, but I didn't know about the others; when we did the mapping in 2001, each of us saw. This is something that we had always wanted, that information could be provided to us (by the academics)... so when this young man showed us the GPS, boom! Our eyes opened...the objective was to map, but now we use the GPS to locate the lobster shades...."(Ramiro, founder, member of the Board of Directors, personal interview, March 6, 2013).

Through these collaborations, the fishers continued to expand and formalize their knowledge of their primary resource, and the environment in which lobster fishing takes place. This knowledge gave them greater negotiating power and control relative to other stakeholders involved in territorial management. All of these processes resulted in a very particular way of understanding territory. The fishery's continued advancement within a conservation area, and the establishment of the Biosphere Reserve, add additional layers of regulation on permissible resource use within those boundaries. The capacity of the Reserve to formally grant and preclude access came to establish a kind of invisible lock that protected the local cooperative and their property rights over the fishery resources, whilst excluding others.

The fishing concession as avenue to cementing success

As mentioned earlier, the Fisheries Act of 1999 recognized two types of usage rights for fishery resources: permits and concessions (DOF 1999). That the Punta Allen cooperative obtained the latter is key to understanding their success and re-emergence. The radical difference between permits and concessions lies in the temporality of rights and forms of access. Under the Fisheries Act, concessions are granted based on an evaluation of the results of technical and economic studies, as well as the amount and predicted recovery time of the investment. It can be granted for up to 50 years. Concessions give rights over benthic resources (such as lobster) in defined geographic areas (Ramírez Félix and Manzo Monroy 2004). Permits are granted for smaller investments and do not require technical and economic studies. For permits, only the nature of the activities is evaluated, and the ownership of the required fishing gear and vessels must be demonstrated (1999 Fisheries Act regulations). While concessions, as a type of right-to-use, are regulated under Mexican law, their application is not an everyday practice in Mexican fisheries, because this kind of access right is not easy to obtain. Though policy at the federal level showed a trend towards deregulation of resources and the inclusion of private capital in extractive practices, in 1993 the fishery cooperative in the Punta Allen community obtained an exclusive 20-year concession for lobster fishing in the Bay of Ascension. This achievement is a significant example of the Punta Allen community's success—most fishing cooperatives in Mexico are not sufficiently well-organized or economically strong enough to obtain such a concession.

The Vigía Chico cooperative received this concession because of their internal organization and marketing capacity, as well as the support of various non-governmental and academic organizations. The cooperative's receipt of this concession is highly significant. The cooperative can then confer rights, also known as concessions, on its authorized users. They provide local fishers with tenured security over their resources and the opportunity to develop future strategies to continue fishing in the area. Those rights, though, are not guaranteed, and must be actively husbanded.

“...There is a lot of private initiative behind these concessions, so even if you've had it, it could happen. Although I have lived here for years, I will go into tourism, but if I lost my concession...it could happen even if I have the concession that I could lose it, if I didn't care for it; it has a lifespan, it expires...it's not as simple as I want it and it is given to me. You have to fulfill certain requirements...but there are interested parties...the director [of the Reserve] already mentioned to us that there are people after them [for the concession]... then anything we fail to do...” (Ramiro, founder, member of the Board of Directors, personal interview, April 13, 2013).

The cooperative's concession allows local fishers to use this renewable rights-granting mechanism to reinforce their systems of resource policing, and exert ongoing pressure on State authorities to support them in this process. The concession also gives local stakeholders the mechanism to obtain greater control over the organization of extractive practices, via participation in the defense of national sovereignty occurring within their local territory.

“...We cannot detain a person because we are civilians, so when we go about our operation, we bring the military, as clearly we are civilians... [The military] are

entitled to detain you; we cannot put anyone in jail and much less detain them, like, say, a pirate.... We operate by boat, dragging and towing the boat, and bring them up here...with the Marines.... Since we go out on operations, we have to assemble three elements. We are going to go prepared, because we can't go find them [pirates] and then later bring the Marines; [it has to be] all at once, three marines or four to set out..." (Rodrigo, founder, member of the Board of Directors, personal interview, April 20, 2013).

The maritime space of the Bay of Ascension, granted in concession as a common property to a productive social organization, effectively becomes the locus of interaction between various stakeholders. Tourism cooperatives, fishing cooperatives, non-governmental organizations, state agencies and entities and academia have negotiated a shared understanding of the resource—and the space it occupies—resulting in sustainable management practices.

Throughout the process of settlement, the Punta Allen community developed an awareness of the importance of adhering to state policies in order to pursue their livelihood activities. The cooperative creatively introduced and adapted these policy prescriptions into their local system of rules. Specially, three significant strategies were developed. First, the cooperative was not only designed and perceived as an organization focused on the productive aspects of fisheries, but also as the primary social institution in the community. Second, cooperative members recognized the Sian Ka'an Biosphere Reserve as an effective organizing structure to support their exclusive management of the marine space. Finally, fishing concessions were effectively deployed as a strategy to control extractive resources access.

Conclusions

To fully understand the success of the Punta Allen lobster fishery we carefully reviewed the settlement history of the community, which yielded a particular social structure. Today, we can trace the positive impacts of forms of spatial and institutional organization linked to particular lobster fishing strategies. These forms of organization have shaped the life of Punta Allen, and now extend beyond the fishery to influence other economic sectors. In Punta Allen, the cooperative, in tandem with the community, has developed a robust, well-tended and strictly enforced system of rights. Through them, the cooperative and community ensure sustainable resource use: they have fostered tourism as an important new dominant economic activity, while still profiting from lobster extraction. We identified several factors enabling this particular set of socio-environmental relationships.

One of these factors was the isolated conditions incomers had to confront during the early days of settlement. Difficulties in marketing the fishing catch, which was necessary to purchase goods needed for survival, forced the villagers to address community issues collectively. The strong community bonds motivated the three leaders, who originally departed from a top-down decision-making approach, to find ways to integrate the existing knowledge and worldviews of community members into collective forms of action. These initial leaders' capacity and willingness to be advised on the legal mechanisms to exercise the rights and obligations as a cooperative also proved critical. Understanding the inner workings of these legal mechanisms allowed the community to effectively integrate federal laws and regulations into local policy and practice. This

bridging between governmental laws and local rules gave symbolic and legal authority to the community's modes of social organization, thereby strengthening locally established systems of sanctions and community rights, as in the Maine lobster fisheries case analyzed by Acheson and Brewer (2003). Cooperative working relationships with regional representatives of various state institutions and NGOs also advanced the community and cooperative's legitimacy in the eyes of government officials.

The ongoing presence and interest of academics in the community has helped to legitimize the state's strategy of enforcing conservation measures while allowing extractive activities. It has simultaneously positioned academics as mediators between the state and local actors. For example, at the time of writing, local fishers and academics are working together to generate a resource inventory, to enable reliable monitoring of natural resources and generate valid indicators for sustainable resource use. This resource inventory will provide the basis for greater scientific management capacity, further legitimating the cooperative's activities and establishing a better position for negotiations with other involved stakeholders. Their position may come to resemble that of the concessionaires of Central Baja California, Mexico (see Orensanz *et al.* 2013; McCay *et al.* 2014). At the same time, the group's locally and academically co-produced knowledge of the characteristics of the resource and the institutions involved in its regulation makes users aware of which practices might affect both the resource and the group's existence over the long term. This helps the community keep its informed interests at the forefront of negotiations with government agencies and buyers.

Market influence fostering changes in fishing technique and equipment have also repeatedly influenced the fishery, increasing the value of the spiny lobster as a product and improving fishers' income. More recently, changes in gear have reduced impacts on the area's marine ecosystem. Furthermore, the biogeographic conditions of the bay imposed challenges on inhabitants, forcing them to increase their degree of cooperation and improving their capacity to respond to perturbations, such as hurricanes. This gave the community the ability to understand the significance of cooperation for achieving goals. The ecological and economic perturbation following the aftermath of Hurricane Gilbert offered a window into the potential socioeconomic consequences of a livelihood scenario without fishing. That crisis also forced cooperative members to rethink the system of rules that allow or prohibit group membership and to strengthen its system of internal rules.

The success of this particular community is influenced by a complex of socio-environmental factors not shared by all artisanal fishing communities globally. Even given its particularity, an analysis of the historical foundations of this particular case allows us to identify indicators worth taking into account in fisheries management more broadly. Punta Allen's Vigía Chico Cooperative increasingly serves as a model for other fishing cooperatives, as well as for NGOs and government bodies. These visitors are gradually developing efforts to reproduce elsewhere some of the mechanisms that have maintained the strength of the Punta Allen cooperative over more than three decades. We hope that our detailed analysis contributes to these efforts.

Today, fishing in Mexico presents many challenges. Fishing permits, when granted, apply to the entire Mexican coast. Government monitoring efforts are inadequate. The result is an institutional apparatus that has been unable to meet the challenges of fisheries management. However, despite the policy of deregulation, the undoing of legislation

privileging the cooperative model, the requirements of formal conservation, and the pressure exerted by private initiatives to access high-commercial-value resources, the Punta Allen cooperative persists. Its continued success offers a clear example of how locally generated, tended and enforced rules can be legitimated and strengthened by strategic engagement with State regulations and regulators. Together with the support of ongoing innovation and collaboration with outside experts, these practices can support successful management.

The Punta Allen cooperative has managed to engage with available governance mechanisms and technologies and collectively fit them to their local context. Their adaptability and tenacity has permitted them to successfully negotiate the shifting terrain of a succession of state actors, policies, and priorities, as well as market and environmental shifts. Equally important has been how the different stakeholders interact in a territory of economic, ecological and strategic importance at the regional and national level.

This case, and other studies of successful artisanal fisheries reviewed here, show the multiple benefits that accrue when different stakeholders work tenaciously to reconcile their interests. Through direct negotiations, legitimacy derived from adherence to regulatory standards and scientific management, processes of exclusion, and skillful engagement of different parties in the performance of everyday practices, Punta Allen's success attests that well-organized local groups can secure viable fisheries and coastal livelihoods.

Endnotes

^aThe shelters or shades are made with concrete and represent an artificial refuge for lobsters. This fishing gear allows the selective capture of live lobster, decreasing damage to juveniles and egg-bearing females, which are returned to the sea during fishing season (Seijo 1993).

^bThe *jamo* is a net that is used to collect lobsters without injuring them. It resembles a butterfly net, but is woven from very strong fishing line.

^cThe time during which this president held office was called *Cardenismo*, and was characterized by its policy of support for the working class, land distribution, the promotion of the cooperative movement and the nationalization of property (see León and Marván 1999; Semo 1993).

^d"*Parcela*," or parcel, is a term that farmers use to designate their agricultural plots.

^eIn 1983, during the presidential tenure of Miguel de la Madrid, the "Program of Exploration and Assessment of Fisheries Resources of the Exclusive Economic Zone and the Territorial Waters" was initiated with the participation of the Secretary of the Navy, the National Council of Science and Technology, the National Cooperative Conference of the Mexican Republic, the National Chamber of the Fishing Industry, the state-owned company Mexican Fishery Products, the National Autonomous University of Mexico and the National Polytechnic and other universities in the province. Its purpose was to estimate fishery resources for allocation (Soberanes Fernández 1994).

^fBathymetry is the study of the relief of the seabed and its depth contours.

^gSISIERRA (Sistema de Investigación Justo Sierra) was the name of a research program founded by CONACYT, the National Council of Science and Technology (2001).

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

CMM and BS designed the research; CMM performed the research; CMM and BS drafted the manuscript; SRM improved and added to the text. All authors read and approved the final manuscript.

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Author details

¹Department of Biodiversity Conservation, El Colegio de la Frontera Sur (ECOSUR), Av del Centenario Km 5.5, Chetumal, C.P. 77014, Quintana Roo, Mexico. ²Department of Geography, University of Vermont, 94 University Place, Old Mill Building 200, Burlington VT 05405, USA.

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