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Achieving coordination of decentralized fisheries governance through collaborative arrangements: A case study of the Sian Ka'an Biosphere Reserve in Mexico

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ABSTRACT

Decentralization of fisheries management in Mexico has created overlapping state agencies without clearly defined responsibilities. This has generated a management dilemma for national fisheries enforcement, due to ambiguity in implementation and legislation among agencies. Through a case study in the Sian Ka'an Biosphere Reserve, in the Yucatan Peninsula, we explore how local actors have addressed problems resulting from the implementation of these decentralized policies. We focus on local Community Surveillance Committees to understand how cooperation occurs at the local level to enforce fisheries regulations. Through a systematic review of fisheries policies in Mexico, we describe the political context to understand the implications of decentralization. The first author conducted ethnographic fieldwork from 2013 to 2017 in three fishing communities and attended meetings with actors involved in local fisheries management. As part of fieldwork, 42 in-depth interviews with fishers and representatives from state agencies were conducted. Using a polycentric approach, we look beyond the performance of individual fishing cooperatives to focus on the relationships among governance actors. We found factors strengthening the Sian Ka'an surveillance system are local actors' capacity to create rules, their relative autonomy from the government, and the existence of more than one decision-making center. We highlight that ambiguity in the implementation of decentralization also enabled local actors to be innovative and fill gaps in the national fisheries policies enforcement system, through diverse configurations of institutional arrangements. In this case study, those arrangements are the result of a constant process of social innovation and improvement in the fishery's organization.

1. Introduction

Decentralization became popular in Latin America during the 1980s and 1990s due to international pressure following the legitimacy and financial crises of many centralized governments. These crises made it attractive to transfer functions to other levels of government, such as state, municipal, and local[1] [1]. Since then, decentralization has become the prevailing orthodoxy in many public policy arenas, where it is promoted as a solution to both local and national administrative and governance problems [2]. Governments, philanthropists, civil society organizations (CSOs), and academics have defended decentralization on the grounds that it improves efficiency, equity, and responsiveness of bureaucracies to citizen demands [3–5]. The underlying logic behind decentralization is that local institutions have a better understanding of local needs, and so when endowed with power are more likely to respond effectively [6]. Decentralization can also open participation in

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[1] Implementation of decentralized policies in Latin America was driven as part of a regional development strategy by international organizations like the World Bank (WB), Inter-American Development Bank (IDB), Organization for Economic Cooperation and Development (OECD), and United Nations Development Program (UNDP). The principal idea was to reduce the inefficacy of hyper-centralized governments [1].

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decision-making processes to a broader set of interested parties, such as non-governmental organizations and academic councils [7,8]. In the 1990s, a policy consensus in favor of local participation and decentralization reached the fisheries sector across Latin America and became progressively more prevalent in fisheries discourse (see [9,10,11]).

Mexican decentralization processes are unfinished, in part because both state and municipal governments still depend on the federal administration, and because power-sharing is not well defined in policy guidelines [12]. The outcomes of decentralization vary in different contexts, depending on the division of power and responsibilities. This frequently results in imprecise or overlapping powers and responsibilities [13], mainly in recently democratized countries [14]. Decentralization initiatives have been launched in the majority of developing countries, but these countries often lack the necessary foundations to achieve decentralization's efficiency and benefits [15]. In Mexico, this inconsistency has created confusion among government agencies responsible for implementing regulations, as well in the general population who often do not understand existing regulations [16]. In the nearly three decades since decentralization began, expectations have not been met. State and municipal governments often lack the capacity to take on their new functions, and most have not consolidated sufficient financial resources to act effectively [17].

In this paper, we analyze the problems that arise from the decentralization process in the context of Mexican small-scale fisheries, and how these problems are interpreted and addressed at the local level. We use a case study that involves fisheries and conservation in the Sian Ka'an Biosphere Reserve in Mexico's Yucatan Peninsula to further explore this topic. Fisheries in Sian Ka'an are exclusively accessed by fishing cooperatives, who have partnered with other stakeholders like CSOs and academics. Fishing cooperatives and CSOs have co-created institutional arrangements that have allowed the cooperatives to manage their fishery in the absence of coordination among government agencies.

Decentralization processes have theoretical support from two broad analytical frameworks. From a poverty alleviation perspective, decentralization can promote good governance and democracy [18,19]. From a common-pool resource framework, studies about decentralization focus on the importance of local rights, as well as land tenure, access to natural resources, and community management [19]. Our study employs a common-pool resource perspective. We address the outcomes of Mexico's decentralization processes employing a polycentric approach to look beyond the performance of individual fishing cooperatives, instead focusing on the relationships among governance actors. Polycentricity involves a complex system of powers, incentives, rules, values, and individual attitudes combined into a complex relationship operating at different scales [20]. Scholars of polycentric governance [21–23] address the analytical need to consider degrees and forms of nestedness of political actors within larger political systems.

Andersson and Ostrom [24] argue that patterns of interaction and outcomes depend on the relationships among governance actors at different levels, and the problems they are addressing. Following their proposal, polycentricity has been described as a form of organization that implies many independent centers of decision-making [25]. We focus on local Community Surveillance Committees (CSCs) to explore the diverse configurations of institutional arrangements[2] among local stakeholders. In this paper we explore how the existence of multiple overlapping decision-making centers, operating with some degree of autonomy, act in ways that benefit the local community [25]. The ambiguity among agencies that resulted from the incomplete decentralization process in Mexico also permitted the emergence of a space where actors could implement a local system of surveillance, which in turn has helped them achieve a common goal: functional surveillance of fishing resources within the Sian Ka'an Biosphere Reserve.

The way environmental issues are approached in the Mexican decentralization process serve as an example to analyze gaps in decentralization processes, especially during the implementation of monitoring and enforcement mechanisms to protect natural resources. The agencies in charge of monitoring and enforcement have not fulfilled their responsibilities, principally because of a lack of clarity about how coordination should occur. Part of the problem stems from a deficiency of the decentralization process itself: the lack of transparent and efficient resource distribution between agencies [1,12,27].

In the first section of the paper, we discuss the political setting to establish a baseline to evaluate the effects of the decentralization model for governing natural resources in Mexico. This section is based on a historical review of scholarly literature and legal documents about fisheries policy and regulations, dating back to 1940. The second section of the paper is based on ethnographic fieldwork, especially the analysis of statements and observations of key actors.

2. The political setting: decentralization of natural resource governance in Mexico

Decentralization processes have been implemented differently around the world, depending on political context [3,9,28]. Studies of the diversity of decentralization outcomes often focus exclusively on the characteristics and performance of local institutions [24]. Using a polycentric approach, we review decentralization reforms in the specific context of fisheries, focusing on how management responsibilities are now shared among government agencies in charge of fisheries, and fishing communities or their representatives.[3] To better contextualize the characteristics of those relations, it is important to review historical decentralization processes at a broader level. Situating and analyzing decentralization processes in the Mexican political context allows for identification of the gaps resulting from the implementation of decentralized reforms.

Centralized governance in Mexico was inherited from the colonial period [29]. The first period of decentralization in Mexico, as in other developing countries, emerged in the 1980s, as a backlash to hyper-centralized governments [30,31]. It continued during a second period, due to the resurgence of federalism as a national political project [17].

The first period of Mexican decentralization (1983–1993) was characterized by attempts to delegate more responsibilities and decision-making power to municipalities [1]. To achieve these goals, two types of actions were implemented. The first was decentralization of services. New government agencies were thus created to provide public services. An example is the creation of national management commissions, and the creation of national research institutes, to support the decision-making process of these commissions [32–34].

The second type of action was directed at providing more autonomy to the regions. Local government, at the level of the municipality and state, was supported and strengthened [17]. One of the more relevant achievements from this period was the amendment to article No. 115 of the constitution, which describes the responsibilities and functions of the municipality [29,35]. The amendments allowed for a new conceptualization of municipal government, with the establishment of

[2] In this work, we understand cooperation as a broad category that involves voluntary joint action that is inclusive of processes such as collaboration and contractual undertakings [23]. Institutional arrangements are defined as "the rules used by individuals for determining who and what are included in decision situations, how information is structured, what actions can be taken and in what sequence, and how individual actions will be aggregated into collective actions" [26].

[3] In fisheries literature, decentralization reforms are known as co-management, which refers to shared management responsibilities between government agencies in charge of fisheries and fishing communities or their representatives [2].

expanded obligations and rights. Despite these *de jure* efforts to empower local governments, *de facto* municipal governments still lack the power to establish or implement policies to respond to local needs, because their financial capacity remain limited [35].

The second period in Mexico's decentralization process, known as new federalism (2000–2006), was characterized by an active attempt to create strategic plans under the principle of "transversality", where different government agencies shared common goals and achieved these goals through coordination. However, there was a lack of binding mechanisms or mandatory obligations to facilitate coordination of efforts among governmental institutions [27]. This led to a lack of clarity in responsibilities, funding sources, action protocols, and the scope of each agency [10,12,29]. There was no institutional framework to regulate the implementation of decentralization, which limited the performance of government agencies.

3. Methods and study area

3.1. Data sources and analysis

Qualitative research was conducted in three fishing communities inside the Sian Ka'an Biosphere Reserve to understand, from a local perspective, the communities' relationships with different state agencies, and how official regulations were implemented at the local level. For this, the first author carried out three ethnographic fieldwork campaigns in three communities between 2013 and 2017. The first occurred in the fishing community of Punta Allen in 2013 over five months. A second followed in 2015, with five months split between the communities of María Elena and Punta Herrero, and the fieldwork concluded with a third, four-month re-visit to the three aforementioned communities in 2016–2017.

The first author lived in the communities, participated in daily activities, and attended meetings of the actors involved in the management of Sian Ka'an fisheries. As part of the ethnographic fieldwork, the first author participated in patrol activities, observed the presence of several state agencies in the communities and interviewed fishers that are members of the community surveillance committees, as well as government agencies officers from CONANP, CONAPESCA and PROFEPA. This experience was documented in detail in a field journal. As part of this ethnographic fieldwork, the first author conducted a total of 42 in-depth interviews[4] (14 for Punta Herrero, 15 in Punta Allen, and 13 in María Elena) with fishers in all three communities, each approximately 1.5–2.5 h in length. These inquired about community demography (history of the community, migration, characteristics of the population), property rights (local and formal rules, sanctions), and property rights institutions (local and formal rules). Interview questions also addressed production practices (social organization of fishing, fishing gear, other activities, changes over time), relationship with other actors (CSOs, academics, state agencies), and perceptions about the role of the State in resources governance.

Ethnographic fieldwork in the fishing villages was complemented by six semi-structured interviews, (each 1–2 h in length) with representatives from state agencies (CONANP, CONAPESCA, and PROFEPA) located outside the communities, about the responsibilities of their respective agency, cooperative arrangements with other actors, challenges they confront in the agency/organization they work for, management strategies and regulations. To identify key informants within the fishing communities, i.e. fishers with profound knowledge of, for example, the history of the community, and/or involvement in decision-making processes, we used snowball sampling [36]. This sampling technique allowed us to draw on the knowledge of key informants to guide us to other knowledgeable community members. Snowball sampling was combined with judgment sampling [37] for the selection of informants based on conceptual criteria, such as being state agents, or members of the Community Surveillance Committees. Also, as a part of the ethnographic approach, the first author reviewed historical documents of the cooperatives from 1961 to 2015, such as assembly minutes, statutes, and membership list. The review consisted in identifying and tracing moments where the cooperatives established institutional arrangements with different actors. This revision helped to contextualize institutional arrangements in the present.

Using the Institutional Analysis approach [38] observations and interviews were focused on how property rights and institutions came into existence and developed over time, and how they have dealt with social dilemmas. As part of the analysis, the data was classified and coded using the following variables: local institutions, formal rules, local enforcement, government monitoring and surveillance, perceptions about legitimacy, perceptions about the role of the State in monitoring and surveillance, relationship between local communities and state agencies, and relationships between local communities and other actors.

3.2. Study region

The Sian Ka'an Biosphere Reserve is part of the Mesoamerican Reef, the world's second-largest coral barrier reef system (see Fig. 1). Sian Ka'an is a conglomerate of three protected areas, the Sian Ka'an Biosphere Reserve (528,148 ha) [39]; the Reefs of the Sian Ka'an Biosphere Reserve (34,927 ha) [40] and the Uaymil Protected Area (89,118 ha) [40] (Fig. 2). The marine portion includes a 100-km barrier reef that is a focal point for coastal conservation [41].

Fishing in Sian Ka'an is undertaken by cooperatives, who have been granted exclusive territorial user rights (TURFs) for spiny lobster extraction, known as fishing concessions (see Fig. 1). The artisanal lobster fishery provides the principal source of income for each of the three case study cooperatives. The "Pescadores de Vigía Chico" cooperative, located in the northernmost community of Punta Allen, has 70 members and an 843 km^2 fishing concession in Sian Ka'an's northern large bay, Bahia de la Ascension. The "Cozumel" cooperative, located in the central region, with 26 members, operates from a fishing camp known as María Elena, while the "José María Azcorra" cooperative, located in the southernmost area, has 21 members in the community of Punta Herrero. These last two cooperatives share 320 km^2 in the southern bay, Bahía del Espíritu Santo, with the Cozumel cooperative fishing the northern half and the José María Azcorra cooperative the southern half [42].

3.3. Property rights in Sian Ka'an

The management and administration of natural resources in Sian Ka'an is the responsibility of several government agencies (Fig. 2). The Ministry for Environment and Natural Resources (SEMARNAT, by its Spanish acronym) is responsible for environmental management, and includes at least five decentralized agencies that have jurisdiction over the management of coastal resources. One of them, the National Commission of Natural Protected Areas (CONANP) holds the right to distribute access and use rights over the resources located inside of the reserve. However, it does not hold the right to distribute use rights for fishery resources. Instead, the National Commission for Aquaculture and Fisheries (CONAPESCA) holds this right. CONAPESCA belongs to the Ministry of Agriculture and Rural Development (SADER), the department responsible for regulating all areas of food production.

One critical element in the Sian Ka'an case study lies in the fact that fishing cooperatives hold legal authority to create access rules among their members, with some degree of autonomy from the government.

[4] Ethnographic interviewing is a type of qualitative research that combines immersive observation [registered in field journals] and directed one-on-one interviews. The interviews take place in situ, where the informant does the work under study. The idea is to interview actors in their natural setting, while they are performing their tasks, asking them questions about what they are doing and why (when necessary).

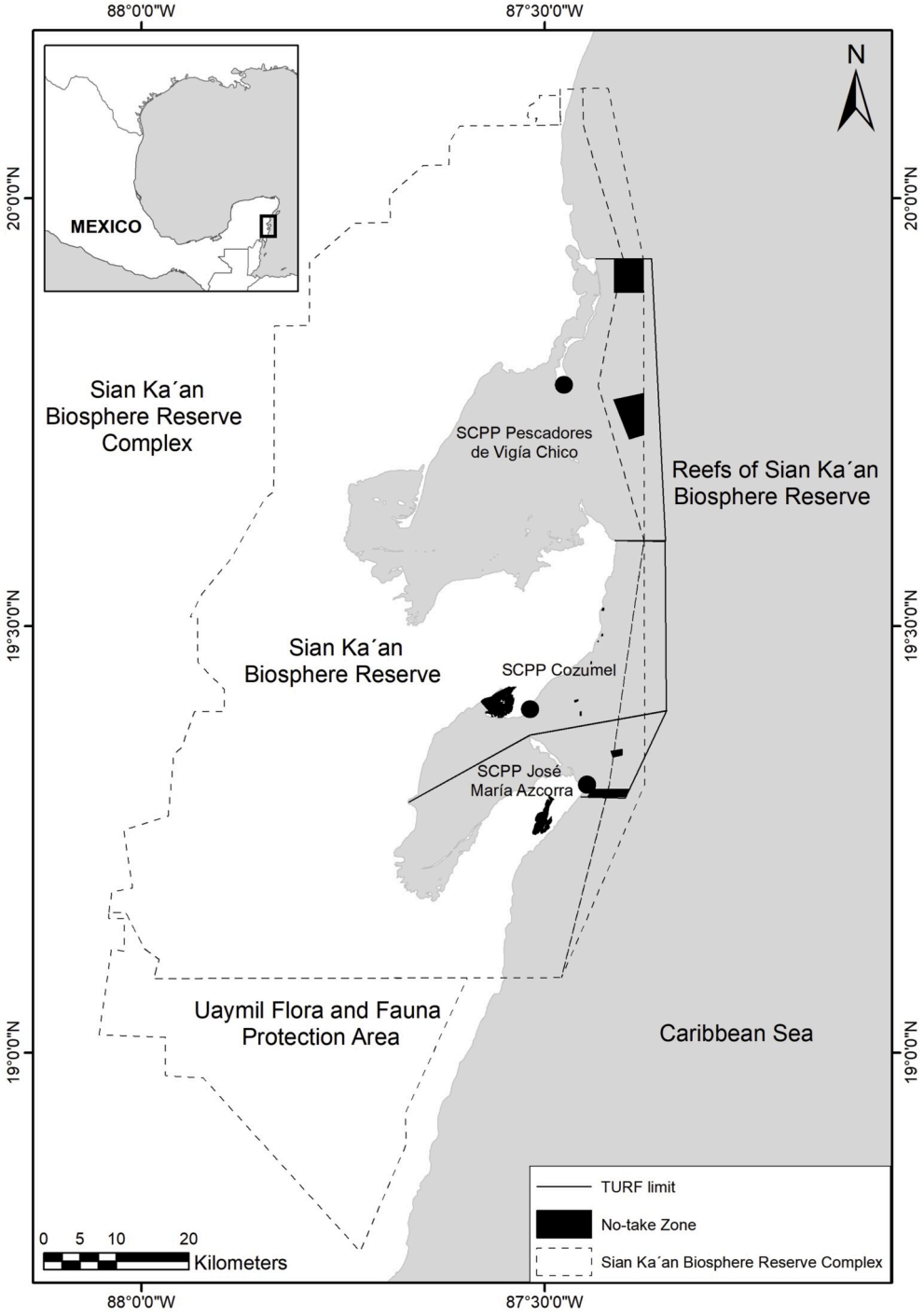

Fig. 1. Map of the cooperatives' territorial rights in Sian Ka'an Author: Stuart Fulton.

The way in which the Sian Ka'an cooperatives organize their fishing has been described by different studies [43–47]. A general conclusion of these studies has been that, at the local level, each cooperative has developed a surveillance system to ensure that all members of the cooperative respect the internal rules [48,49]. So far, the high degree of functionality of the Sian Ka'an cooperatives has been attributed to their social organization, and the fishing gear they use, which has a low ecological impact [45,46]. The cooperatives have developed a system of local rights that strengthen them internally [45,46,50,51]. Despite this system of local rights, the cooperatives' adaptive capacity[5] is not solely

[5] We use the definition of adaptive capacity as "the ability of a resource governance system to first alter processes and, if required, convert structural elements as response to experienced or expected changes in the societal or natural environment" [52]. This includes adaptation through the design of new institutions [23,51].

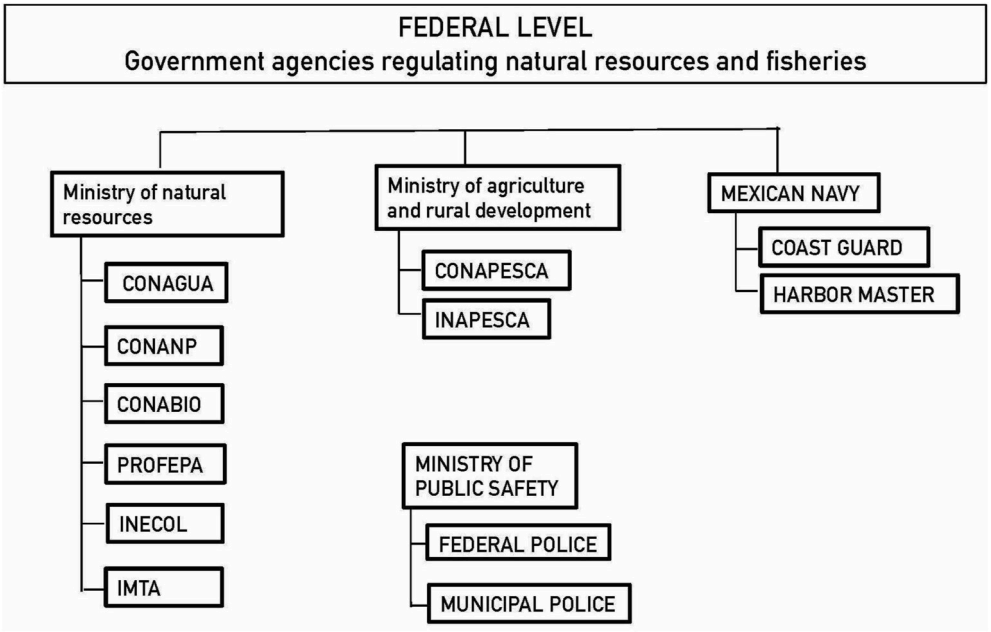

Fig. 2. Government agencies regulating natural resources inside natural protected areas. Author: Crisol Méndez-Medina.

related to the organizational ability of individuals in the cooperatives. The fishers are part of a governance system forged by a network of collaborative relationships among actors (state agencies, CSOs and cooperatives) thereby increasing the adaptive capacity of the system as a whole [26].

4. Results

4.1. Monitoring and surveillance of natural resources in Sian Ka'an

The current regulatory structure of protected areas in Mexico offers an illustrative example of the complexity of Mexico's political decentralization process. The territory inside the protected area is dedicated to conservation, management, and administration of natural resources. As such, it is under the jurisdiction of four state agencies (see Fig. 3).

CONAPESCA is responsible for monitoring compliance with fishing regulations. They are tasked to patrol the area with SEMAR (Mexican Navy), which oversees navigation on federal waters. The park rangers of CONANP should in turn coordinate with SEMAR and CONAPESCA to monitor access to resources in the marine areas of the reserve. Likewise, CONANP should monitor inland resources in coordination with the Federal Attorney for the Protection of the Environment (PROFEPA) and the federal police. Although monitoring, surveillance, and enforcement should *de jure* be coordinated between these four agencies, *de facto* in Sian Ka'an there are no coordinated efforts (see Fig. 3).

The performance of the government agencies in charge of monitoring and enforcing fisheries regulations in Sian Ka'an allows us to observe some of the gaps resulting from the incomplete decentralization process in Mexico. There is a lack of clarity in legal obligations and scope, funding sources and action protocols for each government agency, and an absence of binding mechanisms or mandatory obligations for agencies to fulfill their responsibilities [1,27,33].

a) CONANP

CONANP regulates natural resources through local administrative units within protected areas, meaning that each area has an administrative office to implement federal programs. As with CONAPESCA and PROFEPA, CONANP-Sian Ka'an struggles with financial constraints that limit their officers' operative capacity. Mexico's protected areas generate some revenue from visitors, which go to a central treasury and then back to the protected areas. However, the mechanisms for distributing the budget to the local level in the administration of protected areas are unclear. As a result, external mechanisms to finance and manage the area have become necessary for CONANP's basic functioning. The administrative director of the reserve articulated these operative issues:

> "We have budget limitations; there is never enough money. There is a budget, and with this, we have to maintain operations. If there is no money you can't do anything, you can't buy radios, build a checkpoint, get new uniforms for park rangers … Sian Ka'an is lucky as it gets resources from the World Bank, and this helps us. At the moment, we're even running operations with this money … we're buying fuel, we'll buy a new radio, a new power system for the checkpoint … but this money comes from the World Bank. This highlights the need for us, as government, to be able to generate responsibility over the material and financial resources of the area." (Director of the Sian Ka'an Biosphere Reserve Complex, 18th April 2016)

CONANP carried out a program to perform community surveillance in Sian Ka'an called Promoting Community Surveillance (PROVICOM), implemented through Community Surveillance Committees, and which is a good example of decentralization impacts at the local level. The funds to finance the program originate from the Temporary Employment Program (PET) managed in coordination with several state agencies under the transversality principle, and created to meet a variety of goals, depending on the objectives and needs of each specific agency. The goal of PET is to create shared objectives among state agencies that can be achieved through coordination. Contrary to the idea of working together to accomplish a goal, in practice CONANP, PROFEPA and CONAPESCA each have their own program to implement community surveillance of natural resources. However, the presence and coordination of CONAPESCA and PROFEPA in Sian Ka'an has been inefficient, resulting in local communities often being unaware of the existence of the CONAPESCA and PROFEFA community surveillance programs.

Park rangers from CONANP are responsible for the PROVICOM community surveillance program in Sian Ka'an. Ten community members are selected by the cooperatives to participate in the program. They receive equipment and an itinerary for combined surveillance activities

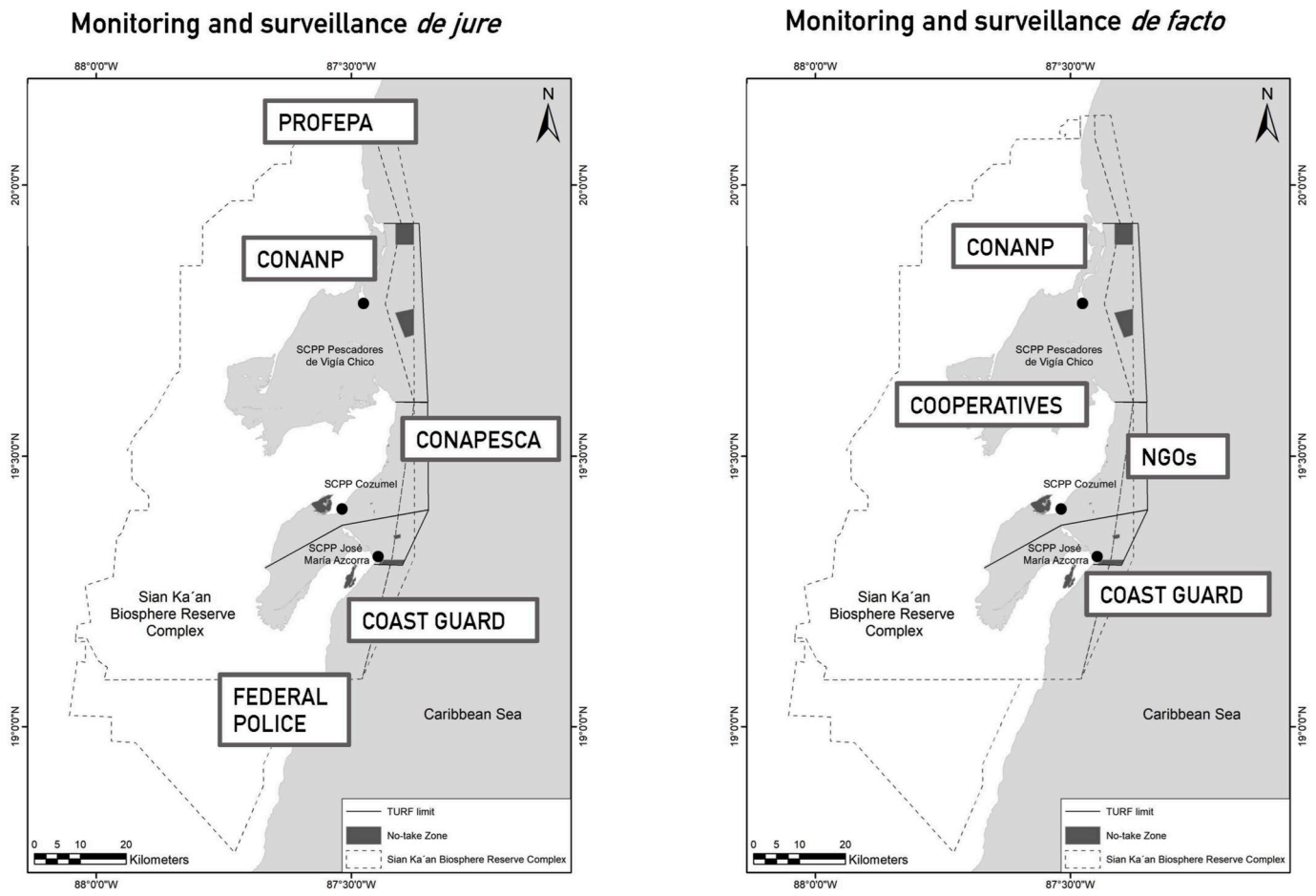

Fig. 3. Actors participating in monitoring and surveillance of natural resources in Sian Ka'an.Author: Crisol Méndez-Medina and Stuart Fulton.

(park rangers together with fishers). Fishers receive payments of US $10–15 for each day on patrol. The CONANP surveillance activities include not only fishing areas, but also journeys outside of fishing grounds and on land routes. If these rangers find someone committing an illegal act, they do not have the authority to make arrests, so the standard procedure is to take photographs, fill out an information log describing the activity, and deliver these materials to the local CONANP office, which will report the illicit act to the corresponding authorities (Federal and Municipal Police). The administrative director explained how the coordinated process of fisheries surveillance should work:

> "If we find a person fishing and they don't have a fishing permit or aren't inside their fishing zone, well, it's not that simple. What we have to do is ask the person to leave, and if the fisheries authorities are onboard, then they have to start a process that begins with having the product [illegal catch] confiscated and starting an official administrative procedure. If we find a person with a sea turtle, this is a criminal offence; we have to tell the nearest authority. The local fishers can act in these cases, but this is a big responsibility, and they could be accused of kidnapping. Here, they have to give notice, talk on the radio, and the Navy must go to the site; we are also close by." (Director of the Sian Ka'an Biosphere Reserve Complex, 18th April 2016)

b) PROFEPA

PROFEPA has a weak presence in the study area. Stakeholders interviewed reported the absence of this agency and believed that PROFEPA is only responsible for forestry issues. As PROFEPA does not make surveillance trips by sea, local stakeholders are unclear about its role in the protection of fishery resources.

> "CONAPESCA … they are exclusively dedicated to marine products, that is, they really focus on that, be it nets, shark, grouper … everything that is a product of the fishery, nothing more. PROFEPA is … they are mostly … what's it called? From the forest … Yes, mostly forestry, because with catches [fishery] they don't get involved … mangroves, wetlands, dredging, sediments, vegetation, this is their job, but not fisheries, they don't have anything to do with fishing …" (President of the internal surveillance committee of a fishing cooperative, 15th October 2016)

Local fishers are not aware of the role of PROFEPA in fisheries issues in the area and have no expectations of working with the agency for surveillance. PROFEPA agents themselves recognize the agency's local limitations and lack of capacity. They attribute this lack of action to a limited budget and a lack of adequately trained staff, which has repercussions on the performance of inspectors when they are on patrol. A former inspector discusses this:

> "We coordinate with the people from CONAPESCA, as far as possible, firstly because they don't have many staff, and neither does PROFEPA. So, one of the biggest challenges is that—the lack of human resources and the lack of other resources, limiting our abilities somewhat." (Former surveillance inspector PROFEPA 20th January 2017)

The officers do not have the monetary, political, or social incentives to better respond to the needs arising from managing natural resources.

Nor do they have the technical training to effectively record the required information in such a way that the information complies with the requirements of their agencies' legal departments to build a court case. The testimony of a former Assistant Prosecutor highlights this problem:

> "There is no political will because money is spent on nonsense, like a national meeting of the delegates in a nice hotel, with lovely food, when the inspectors have to go to the field and do their work without travel expenses …. Another great challenge … having done fieldwork, I know the technical part … is the gap between the legal and technical personnel, where the legal team says that they cannot defend a case because the field record is poorly completed. The field officer is always upset because the legal team thinks they just went sunbathing on the coast …. The inspectors don't eat well during the fieldwork, and at the end of the day, the legal team loses the trial." (Former Assistant Prosecutor of PROFEPA, 5th October 2016)"

c) CONAPESCA

CONAPESCA inspectors are assigned to patrol their working area by the central federal office. CONAPESCA does not have a regional office responsible for enforcement at the local level (state or municipality). Just three federal inspectors are tasked to cover 50,350 km^2 of marine territory in Quintana Roo. CONAPESCA's monitoring and enforcement is integrated by two administrative areas, a legal team and field inspectors, responsible for carrying out operations on land and water. Operations includes monitoring restaurants and hotels to verify the legal provenance of seafood, vehicle checks at strategic points to control the passage of illegal marine products and trips by sea to verify that fishing takes place within the regulations. Both the local fishers and CONAPESCA inspectors recognize that monitoring and enforcement actions in the field have been inefficient because of severe budget limitations and a lack of trained staff, including the legal team. CONAPESCA also lacks a clearly defined enforcement process and coordination of actions with Federal and Municipal police. These problems stem from an unfinished decentralization process, translated into limited operational capacity. One of the coordinators of surveillance and enforcement articulated the way that these operational problems are impacting the performance of enforcement in Quintana Roo:

> "There is a lack of personnel; there is no equipment, no boats, no vehicles, to be able to better undertake surveillance and enforcement work …. We don't have enough staff. For example, last year, of the six officers that we have in the state, from February until the start of October, we only actually had three officers on the ground. The other three were commissioned to other states. The three officers who remained had to look after the entire state …. In Quintana Roo, there is a lot of import and export through the airport … and also the customs office in Puerto Morelos, which requires a lot of attention … basically one inspector is almost permanently on this task, leaving the other two free for the state …. The lack of staff has always been a reality … it's like this each year and everywhere. They commission thirty or forty officers to one state to address the same problematic closed seasons. Well, where do you get them from? From us: they weaken some states to strengthen others …. " (CONAPESCA federal official, Coordinator of Surveillance and Enforcement, Quintana Roo, 20th January 2017)

4.2. Community surveillance committees: local configurations of informal institutional arrangements

Sian Ka'an's Community Surveillance Committees have been able to overcome the inability of government agencies to monitor and enforce fisheries regulations by coordinating with government agencies to achieve enforcement, creating informal institutional arrangements to perform the surveillance of fishing resources in two main areas.

a) Northern area

When the reserve was created in 1986, ecotourism was perceived in Mexico as a panacea for sustainable development. Reserve managers began a campaign to promote its implementation, to convince fishers to stop using nets and become involved in tourism (see [53]). Fishers were able to significantly reduce finfish catches using nets in the northern bay due to the economic revenues provided by tourism (see [54]). The fact that tourism became the main source of income motivated the community to engage in the surveillance of natural resources since they had a vested interest in improved conservation, which they could now see reflected in higher incomes.

The high level of social organization, removal of high impact fishing gear, and an efficient local system of cooperative-led surveillance and enforcement motivated CONANP to protect the organizational system of the Vigía Chico cooperative in Punta Allen. The system of local rights has now been legitimized and protected by the Reserve's management authorities (see [53]) since they recognize the relatively low environmental impact of that fishery.

> "I attribute it [the effective surveillance in the area] more to the fishers' organizing power. It has a lot to do with the fact [that] they are in a natural protected area and that there has been the presence of an authority [monitoring activity] since 1995. This agency, and the work that was done with the communities, was a watershed. We have highly organized communities and conscientious fishers who are working in a community surveillance process. They were already doing this, and it is because there was no government agency" (Director of the Sian Ka'an Biosphere Reserve Complex, 18th April 2016).

There are two military bases within the biosphere reserve. One is located within the community of Punta Allen, and the other near Punta Herrero. In both communities, the fishers believe that the navy, SEMAR, has a good performance record in enforcement activities. However, in Punta Allen, informal collaborative institutional arrangements have been developed between the cooperative and SEMAR. Because fishers grew tired of not receiving support from CONAPESCA, and in an attempt to guarantee their safety during community surveillance operations, they pursued informal agreements with the local base's naval officers to accompany them on their terrestrial and marine patrols.

> "[fisher member of the CSO says that they have to go to look for the commander of SEMAR to see if they can accompany them tonight for a surveillance tour]. I asked them if it is very dangerous to go by land and they tell me that it is not too dangerous but they have been threatened with knives or the outsiders become aggressive, so if they are accompanied by the marines, they protect them. It's just the presence of the marines that does the trick, because they scare away the poachers. They tell me that the arrangement they have with this naval commander is not official, that the higher echelons do not know that they have that agreement, but that the new commander is very supportive and when they can they accompany them on their patrols … "(First author's field journal, Punta Allen, 16th October 2016) ".

The fishers and CONANP park rangers feel protected by the presence of the marines during patrols. This committee of local fishers and SEMAR officers had confiscated fishing equipment from illegal fishers they have encountered:

> "A fisher says that his job [community surveillance with the marines] is effective because a few weeks ago they came across a bunch of poachers. He tells me that one of the poachers got aggressive and wanted to fight, but a marine loaded his gun and pointed it at him.

He stopped, and it turns out that they had a catch of illegal lobster. He says that they confiscated the equipment and they are now delivering it to CONANP to store at the northern reserve checkpoint. " (First author's field journal, 16th October 2016).

In 2008, a project began to create a network of no-take zones (known as fish refuges) inside of the reserve, promoted by the Kanan Kay Alliance,[6] with input from the CSO Comunidad y Biodiversidad (COBI) (see [55, 56]). The reserve administration at the time did not agree with the delimitation of fish refuges within the Sian Ka'an polygon. They argued that establishing no-take zones within an area that had already been designated for conservation was unnecessary, although the no-take zones were created in areas where fishing was permitted. The Kanan Kay Alliance has supported the fishers with legal training about how to fill out and process a complaint of illegal activities, because CONANP and the Community Committees do not have coercive capacity. COBI provides technical support to the cooperative with data collection to measure the impacts of implementing no-take zones.

In the northern area, the cooperative Vigia Chico is leading the negotiations among actors, and the strong commitment among stakeholders, including the cooperative, CONANP, SEMAR, and the CSOs, allows the community committee to operate more effectively.

b) The Central area

In the central area, for the María Elena fishing camp, the relationship between CONANP and the Cozumel cooperative has not been as close. This community has had a closer relationship with academia and CSOs involved in conservation projects than with state agencies. The creation of no-take zones in the reserve, the first network to use this legal framework in the Mexican Caribbean, precipitated the organization of María Elena's surveillance committee. The Kanan Kay Alliance, with COBI, supplied a boat, training, equipment and a daily payment for the fishers patrolling. COBI has also supported the cooperative through data collection to measure the impacts of the no-take zones. There are no collaborative arrangements between CONANP or SEMAR in the central region. Reserve managers argue that because surveillance activities in the central area have already been financed (i.e. with a boat and committee member stipends provided by philanthropic funds) it is not necessary to invest time and effort in that zone. The relationship between the fishing camp in María Elena and CONANP focuses on programs to promote ecotourism, but they had not yet established a strong collaborative relationship for enforcement at the time of writing.

c) The southern area

In the southern area, the relationship between the community of Punta Herrero and CONANP shows strong economic dependence by the fishing cooperative on CONANP programs. CONANP's park rangers have established a close relationship with the community; one ranger is a member of the fishing cooperative. Community surveillance in the southern area is organized by the park ranger on shift and depends entirely on the institutional arrangements between CONANP and SEMAR. They have established a joint itinerary for surveillance and enforcement activities.

The reserve administration has been involved in solving some of the fishers' basic needs through the temporary employment program. The reserve administration is also currently trying to eliminate the use of nets for fishing (which is prohibited in the management plan) and strengthen participation in ecotourism, as tourism is not fully established in the area. The local community welcomes these government subsidies provided via CONANP, and supports ecotourism as an alternative source of income.

In the south, there are no institutional arrangements between SEMAR and the local fishers. Here CONANP mediates the collaboration and establishes an official work schedule with SEMAR. The two agencies coordinate surveillance patrols in the Punta Herrero area and towards the southern limit of the reserve, but these are independent from the Community Surveillance Committee patrols. The patrol days for the Community Surveillance Committee are organized by the park ranger and involve only the park ranger and local fishers.

5. Discussion

5.1. Addressing a resource management dilemma: how local institutional arrangements bolster community surveillance committees

In spite of the decentralization enthusiasm of the 1990s, the actual outcomes of decentralized policies adopted around the world have been mixed. Andersson and Ostrom [24] argue from a polycentric approach that the outcomes depend on the relationships among governance actors at different levels and the problems they are addressing. Decentralization increases the number of political actors who are participating in, competing for, and clashing over the management of fishery resources [15]. This is the case in Sian Ka'an, where several state agencies have been involved in the creation and application of rules and arrangements for the governance of natural resources inside protected areas. The fragmentation and increasing complexity of jurisdiction over fisheries governance inside protected areas in Mexico has led to an overlap of organizations sharing power and authority, such that no single organization has a monopoly over legitimacy, or the authority to independently create laws and norms. This outcome has also been observed by Ribot and colleagues in their study of decentralization in Senegal, Uganda, Nepal, Indonesia, Bolivia, and Nicaragua [15].

Despite the polycentric nature of the fisheries governance system in Mexico, government agencies involved in the management of fishery resources have not been able to develop institutional arrangements that enable adequately coordinated management. Effective decentralization requires the construction of accountable institutions at all levels of government. This case study illustrates that the problem does not lie in the existence of multiple state agencies involved, but in the lack of both resources and cross-jurisdictional institutions that regulate coordination among agencies, a problem also described by Bené and collegues [2] and Andersson and Ostrom [24].

Under the Mexican decentralized management model, *de jure,* monitoring and surveillance of natural resources should be performed through coordinated actions among state agencies. Incomplete decentralization in Mexico has resulted in a lack of clarity regarding the legal obligations and scope of different government agencies. It is unclear, for example, which ones should be the sources of funding; how the national budget should be distributed; action protocols for each agency; and whether there are binding mechanisms for fulfilling their responsibilities. *De facto*, in our case study, local actors in Sian Ka'an have found innovative ways to fill the gaps in the national fisheries policies enforcement system and in its implementation, given legislative ambiguity: they have established diverse configurations of institutional arrangements [53–56].

Factors strengthening the Sian Ka'an surveillance system are local actors' capacity to create rules, their relative autonomy from the government, the existence of more than one decision-making center, external actors supporting the system, and the diversity of institutional arrangements.

a) Capacity to create and enforce rules and autonomy from external government

[6] The Alliance was officially launched in 2012 in an effort to integrate collaboration among diverse actors, such as the academic community, government agencies and CSOs, to coordinate marine conservation and sustainable fisheries actions http://www.alianzakanankay.org/.

The cooperatives in Sian Ka'an are relatively autonomous and have the capacity to create and enforce resource access rules within their fishing concessions. This allows them to establish mechanisms to meet internal regulations and create institutional arrangements[7] with local stakeholders.

The cooperatives have developed robust institutions that allow them to sustain their socio-ecological systems. A key component of success in this case study is that the authorities do not challenge local rules; they accept, and work within these autonomous structures. CONANP recognizes the high functionality of the cooperatives and respects their social organization. The cooperatives have a well-defined system of community agreements with clear fishing boundaries, through fishing concessions and individual plots inside the concession. They have developed local access institutions as well as a system of graduated sanctions for rule violators.

However, the adaptive capacity of Sian Ka'an stakeholders stems from the cooperatives' participation in a governance system that is sustained not only by the organizational capacity of each cooperative as a decision-making center, but also by the combination of multi-level and diverse types of actors. Stakeholders have established forms of collaborative institutional arrangements that allow them to resolve conflicts. The director of the reserve recognizes that Sian Ka'an's strength and potential comes from their collaborative work:

> "I continue to think that Sian Ka'an is a model for conservation … Recently some researchers came to the reserve, and they were surprised not by the work of the public officials, but by the work done between civil society, researchers, fishers …". (Sian Ka'an Biosphere Reserve Complex director, 18th April 2016)

The low ecological impact of the Punta Allen lobster fishery has been attributed to its social organization and fishing gear [48,49]. The cooperatives' organizational capacity and local rights systems enhance their overall functionality [45,46,50,51], based on their capacity to implement rules. Cooperative leaders are aware of their degree of autonomy from state agencies, which they have achieved through demonstrating their capacity to create and enforce their own rules. "The role [of the] president of the cooperative's enforcement committee is to solve the internal problems of the cooperative. CONANP cannot get involved in our internal surveillance …" (Secretary of a fishing cooperative, December 5, 2016).

The fear of having local community efforts overturned by higher authorities is one possible reason why some groups do not stay organized and maintain collaborative arrangements over time [25]. State recognition and endorsement of local institutional arrangements has been associated with positive outcomes of decentralization in other contexts. Satria and Matsida [4] studied the case of Lombok Barat in Indonesia, where decentralization became an important factor in the strengthening of local systems. The Indonesian case shows, as does the Sian Ka'an example, that the strength of the community's resource management system depends on whether these are supported by government agencies. The government's recognition of local people' capacity for managing their marine resources was a key component for successful resource management in both cases.

b) Multiple decision-making centers, including CSOs' participation

Andersson and Ostrom [24] studied decentralization outcomes in Guatemala, Bolivia and Peru, focusing on the relationships of particular characteristics of multilevel interactions among local governments. They suggest that the key for effective governance arrangements lies in the relationships among actors who can decide on resource governance. Under Mexico's decentralized government model, spaces for participation were opened up for civil society, and these have been strengthened through collaboration with local users. Better communication among actors involved in governance - central and municipal governments, CSOs, users, and other individuals - has been associated with better governance outcomes in other places in Mexico [19].

In Sian Ka'an, each actor makes a key contribution to the improvement and function of the community surveillance system. Authorities from CONANP contribute to the system, working as a local administrative unit. The boundaries of the reserve protect a well-defined territory and promote collaboration among stakeholders in the management of natural resources. Some of the state actors working in the reserve understand local problems, and some are even members of local communities. Federal conservation policies that regulate all natural protected areas in the country are being adapted to local needs by CONANP officials in collaboration with local communities.

Local-level decision-makers have found ways to craft institutions (see [21]) that are adapted to local interests and norms but lack the capacity or authority to independently deal with issues that go beyond their boundaries and capacities, such as enforcement in fisheries. CONANP does not have the coercive capacity to make arrests, but through the informal and formal arrangements established with the cooperatives and SEMAR, functional surveillance exists. The relation between SEMAR and fishing cooperatives exemplifies the importance of the existence of more than one center of decision-making with the autonomy to make institutional arrangements. Punta Allen has gone one step further: the cooperative actively manages its resources, as well as protecting its territory.

Local CSOs lack the formal capacity to create resource-use rules, but their active presence in the area strongly influences the establishment of surveillance committees and activities by providing technical and financial support for creating informal institutional arrangements. Through this process the CSOs enrich the system, since CONANP does not have sufficient equipment or trained personnel to undertake an effective surveillance program.

c) Collaborative agreements foster local institutional diversity

There are several studies that explore how the ability of local communities to collaborate with other actors has led to improved outcomes, including economic, environmental and social improvements. In Chile, Marin and colleagues [58] found that one of the most important characteristics of Caletas, the highest functioning fishing cooperative in Chile, is the presence of high-level connections with diverse actors and organizations, such as universities, government agencies and fishery federations. This is the case of several cooperatives in Mexico as well [53,59,60]. Nenadovic and colleagues [61] found that the capacity to collaborate with other actors such as higher nested organizations (i.e. federations and confederations), government agencies and CSOs influences cooperatives' performance in Mexico, as is the case of the Sian Ka'an cooperatives. In the northern zone, there is a strong commitment among stakeholders, the cooperative, CONANP, SEMAR, and CSOs, which allows the surveillance committee to operate more effectively. The leadership of CONANP park rangers, together with cooperative members, has enabled the cooperative to establish arrangements with other state agencies, such as SEMAR. In the central zone, collaborative arrangements only exist between two stakeholders, the cooperative and certain members of the Kanan Kay Alliance. Government recognition of these informal collaborative arrangements, and the active participation of government agencies in Community Surveillance Committee activities could enhance the forging of institutional arrangements.

In the southern zone, the collaboration between the fishing cooperatives and SEMAR is currently relatively weak. If there were stronger recognition from the government as well as collaboration with other agencies (as is happening in Punta Allen), the fishing cooperative might be better motivated to monitor their resources. Without this

[7] Institutional arrangements are defined as "the rules in use by a community that dictates what is explicitly allowed or prohibited" [57] in their fishing areas.

institutional support, they do not have the capacity. Their actions could be supported by the active presence of government personnel performing collaborative patrols with the cooperatives (SEMAR-CONANP-Cooperatives). Currently, in the southern area, fishers participate in surveillance due to financial incentives from government subsidies for patrols (from PROVICOM). The mere presence of the Committee patrolling the southern area helps to protect the resources, albeit without the same degree of functionality as in the northern zone, where there is more extensive collaboration and better-motivated fishers.

The cooperatives have created collaborative arrangements with CONANP and SEMAR to serve a need that CONAPESCA has been unable to address. As we can see in the structures that regulate fisheries within Sian Ka'an, the existence of multiple state agencies capable of creating different rules could create serious management problems if mechanisms to regulate the activity were not included. In practice, the implementation of decentralization has led to greater political fragmentation and greater complexity, *de jure* and *de facto* [2], more government agencies lacking clarity about their responsibilities, and unclear rules about how to collaborate. CONAPESCA and PROFEPA should legally play a key role in the management and monitoring of fisheries resources, but in Sian Ka'an, they have not been able to establish collaborative actions with any other the state actors, such as CONANP (in its capacity as the state agency responsible for the biosphere reserve), the cooperatives, or CSOs. Mexico's unfinished decentralization has resulted in CONANP and CONAPESCA lacking operational capacity, preventing them from implementing a more effective enforcement system.

6. Conclusions

The Sian Ka'an case presents an interesting paradox: on one hand, ambiguity in the implementation of decentralized reforms presents an obstacle for resource management, yet the degree of autonomy that local actors have achieved from the government as a result of this ambiguity has allowed fishers to develop institutions to reinforce local systems.

From the polycentric perspective, the effective implementation of decentralization and enforcement of local property rights depends in part on the governance arrangements within which specific decentralization reforms are located [62]. Under a decentralized model of government, space for participation opened up for civil society organizations, which have been strengthened through collaboration with local users. In Sian Ka'an, each actor makes a key contribution to the improvement and function of the community surveillance system. However, the gap in coordination among government agencies cannot be fully filled by civil society participation. Policymakers could use such comparative analyses of the shortcomings of decentralization in Mexico to determine better ways forward to support effective decentralization. If there is no agency capable of operating at the local level with a certain degree of independence from the federal government and the ability to direct coordinated work among cross-scale jurisdictional institutions, the accountability of state agencies could be challenged (see [63, 64]). The combination of formal and informal institutional arrangements among actors from different jurisdictions can help deal with conflicts and improve adaptive capacity, as observed in the Sian Ka'an case study (see [23]).

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CRediT authorship contribution statement

Crisol Méndez-Medina: Conceptualization, Methodology, Investigation, Funding acquisition, Formal analysis, Writing - original draft. **Birgit Schmook:** Conceptualization, Methodology, Funding acquisition, Supervision, Writing - review & editing. **Xavier Basurto:** Conceptualization, Methodology, Supervision, Writing - review & editing. **Stuart Fulton:** Resources, Writing - review & editing. **Alejandro Espinoza-Tenorio:** Writing - review & editing.

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