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## Do responsible fishing areas work? Comparing collective action challenges in three small-scale fisheries in Costa Rica

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**Abstract:** Costa Rica is supporting Marine Areas of Responsible Fishing (AMPRs) to enable small-scale fishing communities to apply for exclusive harvesting and management rights within spatially delimited areas under a co-management policy framework. Communities need to self-organize their own fishing association and develop a fishing management plan (POP) to apply. Seven AMPRs have been established in the Gulf of Nicoya, highlighting Costa Rica's efforts to follow the FAO Small-Scale Fisheries Guidelines, but all face collective action challenges to develop and achieve common goals and implementation. In this article, we conduct a qualitative comparative analysis by applying the Social-Ecological System Framework (SESF) as a tool to identify the social

and ecological conditions influencing collective action and co-management in three AMPRs in the Gulf of Nicoya, and we compare the similarities and differences between them. Our findings show that all three AMPRs face collective action challenges for different reasons. Nonetheless, some commonalities exist. Common drivers have motivated collective action in the creation of the AMPRs, including the desire to restrict certain types of fishing gears due to perceptions of resource scarcity and high dependence on local resources. Variables such as monitoring and sanctioning mechanisms, strong leadership and the economic heterogeneity of actors positively influence collective action in management. However, there are also variables hindering collective action, such as mistrust among actors, internal conflicts, lack of governmental support and resource unit mobility. Our findings suggest that AMPRs are a promising and potentially effective governance strategy because they can empower marginalized small-scale fishing communities and bring them into national development processes. However, there is an evident need for more state and local community investment into capacity building for self-organization and deliberation processes that can better enable AMPRs to move beyond “paper parks”, and towards being a practically useful governance strategy to showcase Costa Rica’s commitment to FAO Small-Scale Fisheries Guidelines. Adapting the AMPR model to fit the social-ecological context of each community is critical for success, despite the perceived similarity between the AMPRs.

**Keywords:** Co-management, collective action, common-pool resources, fisheries management, small-scale fisheries, social-ecological systems.

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## 1. Introduction

Small-scale fisheries (SSF) provide 90% of the livelihoods and account for 50% of the total fish capture in the global fisheries sector (FAO 2015b). In many tropical countries, SSF are a central pillar of wellbeing for rural coastal communities, providing a primary source of food, shaping cultural identity and maintaining an artisanal way of life (FAO 2014; Biswal et al. 2017). However, SSF face a myriad of critical challenges for sustainability. The characteristics of SSF as common-pool resources (CPR) makes them susceptible to overexploitation without effective governance institutions (Schlager 2004; Acheson 2006). Avoiding over-exploitation for long-term sustainability requires collective governance solutions

to mitigate the social dilemma (Jentoft et al. 1998), where it is presumed that the interests of individuals (to maximize the cost and benefits of harvesting) and the group (to ensure harvesting rates are sustainable) are often misaligned (Schlager et al. 1994). Overexploitation is intensified when state government regulations are weak or ineffective in guiding more sustainable fishing behavior (Holling and Meffert 1996; Torres Guevara et al. 2016; Biswal et al. 2017). Successful cases of self-organized community-based governance have been observed (Noble 2000; Jentoft 2004; Chuenpagdee and Song 2012); however, many SSF have not been able to self-organize effectively without some external support from the state or non-governmental organizations (Torres Guevara et al. 2016; Wallner-Hahn et al. 2016).

Community-based co-management is a form of collaborative governance typically involving multiple actors from the state, civil society and local communities who make joint decisions (Carlsson and Berkes 2005). This model is being adopted by many state governments to find joint solutions for management (Armitage et al. 2009; Bodin 2017). It has also been extensively studied in SSF with mixed results, but it is generally thought to increase the legitimacy of governance and compliance with rules by including fishers in decision-making processes (Jentoft 2005; Cinner et al. 2012). It is also seen to empower communities and to relieve the state from some of the management costs (Jentoft et al. 1998; Sutinen 1999). Furthermore, it may enable the fit of governance to the local context, if it can facilitate knowledge integration and social learning among actors involved (Armitage et al. 2008; Tengö et al. 2014), rather than generalized panacea policies that often do not adapt to context or include local actors (Jentoft et al. 1998).

Successful collaborative governance is often dependent on the self-organization of local actors and knowledge exchange between different organizations and institutions to develop mutually agreed upon goals and rules (Armitage et al. 2008; Berkes 2009). Collective action research on SSF has been able to identify trends in the enabling conditions for success. Strong leadership, social capital and trust have shown to be beneficial (Acheson 2003; Gutiérrez et al. 2011; Basurto et al. 2013), along with operational rules, collective choice arrangements and mechanisms for decentralized enforcement (Schlager 2004). Perceptions that rules developed are legitimate can increase rule compliance, as well as having similar mental models of how the system functions and should be managed (Madrigal-Ballesteros et al. 2013). Ecologically, small to medium-sized predictable ecosystems with non-mobile species have shown to be more manageable than large unpredictable systems with highly mobile species (Schlager et al. 1994; Epstein et al. 2014; Trimble and Berkes 2015). Overall, collective action can be effective in developing user-driven resource governance, especially when institutions are adapted to fit local social-ecological conditions (Armitage et al. 2009). These processes have shown to be influenced by a wide range of social and ecological factors, largely recognized by a fusion of research on collective action, common-pool resources, SSF and social-ecological systems (SES) (Basurto and

Nenadovic 2012; Kittinger et al. 2013). SES research on SSF has helped to sort out the complexity of interactions of an expanding number of variables influencing collective action and collaborative governance (Ostrom 2007, 2009; Basurto et al. 2013; Partelow and Boda 2015).

In Costa Rica, Marine Areas of Responsible Fishing (AMPRs) have been established as a community-based co-management model for SSF governance (Fargier et al. 2014; García Lozano and Heinen 2016a). The AMPR model was proposed and implemented by the Costa Rican National Institute of Fishing and Aquaculture (INCOPECA), a Costa Rican government organization. The AMPR model reflects Costa Rica's commitment to the implementation of the Food and Agriculture Organization (FAO) of the United Nations Small-Scale Fisheries Guidelines (FAO 2015a,b; Jentoft et al. 2017) and the code of Conduct for responsible fisheries (FAO 1995). In addition, a national decree<sup>1</sup> has approved the 'National Plan for the Development of Fisheries and Aquaculture', which commits to implementing the codes of conduct from the FAO, implement and follow more AMPRs, along with other goals. Recently, resources have been assigned to INCOPECA in the National Development Plan for 2015–2018 for the creation of more Marine Protected Areas (MPAs) and AMPRs, to promote the participation of local communities and facilitate sustainable use (MIDEPLAN 2014). Sánchez (2018) has reported on achievements between 2014 and 2018 regarding more participation of local fishing communities and the support of government and non-governmental organizations in financing and/or capacity building, developing aquaculture projects, facilitating access to markets, and network promotion between the AMPRs.

Costa Rica has been referred to as a “champion for implementing the [FAO] SSF guidelines,” (Sabau 2017, 375), in reference to the AMPR model. However, few studies to our knowledge have examined the successes and challenges of the AMPRs empirically (i.e. Fargier et al. 2014; García Lozano and Heinen 2016a; Rivera et al. 2017; Sabau 2017), all of which examined the same community of Tárcoles, only one of seven AMPRs in the Gulf of Nicoya. Thus, this study provides a much-needed empirical examination of the challenges facing the practical implementation of the AMPR model, and perhaps the FAO SSF guidelines more broadly, in three different AMPRs.

Seven AMPRs have been established in the Gulf of Nicoya since 2009 (García Lozano and Heinen 2016b). The first AMPR was established on Isla de Chira in the Gulf of Nicoya in 2009, evolving from a process that started many years earlier. This occurred before the development of the FAO SSF guidelines, despite claims that the AMPR model was a result of Costa Rica's willingness to adopt them, which rather acted as a catalyst. INCOPECA has since allowed other communities in the Gulf of Nicoya, Golfo Dulce and San Juanillo to apply for AMPRs, whose purpose is to protect fishing grounds and reduce resource overexploitation,

<sup>1</sup> Decree N° 37587-MAG. 2013. Approval of the National Plan for the development of fisheries and aquaculture of Costa Rica.

Table 1: Role of responsible entities to develop AMPR activities.

Responsible	Role
Costa Rican National Institute of Fishing and Aquaculture (INCOPECA)	<ul style="list-style-type: none"> <li>• Approve AMPR within two months since submission</li> <li>• Following of regulations and AMPRs' objectives</li> <li>• Regulating fishery, sanctioning infractions according to law</li> <li>• Participate in area delimitation and approve disposals of AMPRs; modification of AMPRs' decree.</li> </ul>
National Coastguard Service (SNG)	<ul style="list-style-type: none"> <li>• Patrolling, control and surveillance.</li> <li>• Illegal gear confiscation; arrestment</li> </ul>
Legal (community-based) fisher association	<ul style="list-style-type: none"> <li>• Guarantee AMPR rules compliance</li> <li>• Control and surveillance in coordination with SNG through a <i>surveillance committee</i>; report fishers' infractions to SNG and INCOPECA.</li> <li>• Report AMPR progress to INCOPECA through the <i>following committee</i>.</li> <li>• Request financing for area maintenance</li> <li>• Design the AMPR fishing management plan (POP)</li> </ul>
Non-Governmental Organizations (NGOs), research centers	<ul style="list-style-type: none"> <li>• Participation in area delimitation</li> <li>• Possibility of projects financing; capacity building</li> </ul>

Source: Decree N° 35502-MAG 2009, Weber de Morais 2017.

at the same time to provide alternative livelihoods to fishing in the communities (Salas et al. 2012; Ayales Cruz et al. 2013).

AMPRs require communities to have a formal fishing association and fishing management plan (Plan de Ordenamiento Pesquero, POP) to apply. They need to self-organize the creation of this association and build social momentum to select representatives into leadership positions. Thus, the AMPR governance model requires a 'first step' of collective action from participating communities to get started. The management plan should outline the geographical extent of the AMPR, argue the ecological and social significance of the marine area, as well as propose harvesting rules that align with national fisheries legislation<sup>2</sup> (García Lozano and Heinen 2016b) and the FAO code of conduct for responsible fishing (FAO 1995). The main roles of each responsible entity for AMPR activities are summarized in Table 1.

While the AMPR model is based on legitimizing small-scale fishers in management, not all fishers and community members have been included or are motivated to participate. There is a large heterogeneity in the types of fishers and gears used in the AMPRs, which often creates conflicts for developing mutually accepted fishing regulations, rule compliance and enforcement mechanisms. Furthermore, not all local actors are trained or have the necessary resources to manage the AMPRs (Ayales Cruz et al. 2013). Shifting

<sup>2</sup> Decree N° 35502. 2009. Regulation for the establishment of Marine Areas of Responsible Fishing. Diario La Gaceta. Costa Rica.

perceptions over who should take more responsibility, government agencies or fishers themselves, has hindered progress. Thus, the aim of the research is to analyze the similarities and differences in the drivers influencing collective action in three AMPRs. For this general purpose, we conduct a qualitative comparative analysis of the three AMPRs by applying the social-ecological systems framework (SESF) (Partelow 2018) adapted from McGinnis and Ostrom (2014). The SESF is a diagnostic conceptual framework comprised of eight first-tier variables, and nested second-tier variables within each first-tier (Table 3).

The main objectives of this paper are:

- (1) Identify the social and ecological variables that have promoted the emergence of AMPRs in the Gulf of Nicoya;
- (2) Examine the main drivers of collective action that led to the establishment of each AMPR;
- (3) Analyze and compare the main facilities and challenges for co-management between cases.

## 2. Methods

### 2.1. Study case selection

The Gulf of Nicoya is located on the Pacific coast of Costa Rica and represents the largest tropical estuary in Central America (1550 km<sup>2</sup>) (Pacheco Urpí et al. 2013) and ~150 km<sup>2</sup> of mangrove forest (Gocke et al. 2001). Three out of the seven total AMPRs in the Gulf of Nicoya were selected. The process of case selection was guided by exploratory research in all seven sites. Each AMPR was visited and assessed with an observation schedule (Newing 2011; Creswell 2014) to systematically observe and compare the broad social and ecological similarities and differences between them. To guide site selection, open-ended interviews were conducted in each AMPR through largely opportunistic random sampling encounters with local fishers and fishing association leaders. Existing literature on fishing and AMPRs in the region was used to better understand the social and ecological context of the gulf. We selected the AMPRs Palito-Montero on Isla de Chira and Isla Caballo (both located on islands), and Paquera-Tambor on the mainland peninsula (Figure 1). The ‘most different case’ selection method (Seawright and Gerring 2008) was chosen to select cases because they represent the AMPRs with the largest differences in terms of number and type of actors and social groups, fishing gears used, resource system size and location, among other variables perceived to be influential during site selection (see Table 4).

### 2.2. Data collection

This study conducted qualitative diagnostic research guided by the SESF. All primary data was collected between November 2016 and May 2017 through



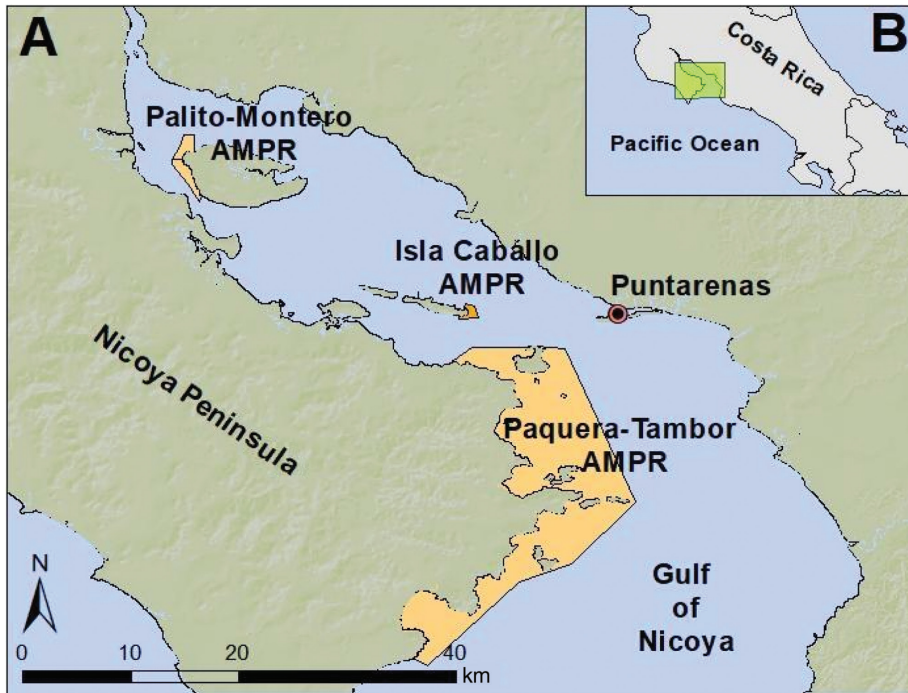


Figure 1: (A) Location of AMPRs examined in the Gulf of Nicoya [orange]. (B) Location of Costa Rica in Central America. Source: Generated by authors.

127 semi-structured interviews in Spanish. Key informants included government officials, researchers and non-governmental organizations (NGOs). They were selected due to their direct experience or position in the fishing associations, leadership and historical involvement with fishing and the development of the AMPR (Table 2). In addition, fisheries and community members were also interviewed to assess general perceptions on and involvement with the AMPR. Snowball sampling was used to target all interviewees, considering multiple entry points into the social network of individuals (Newing 2011; Soares and Gutiérrez 2011). Information from interviews was cross-checked with other individuals until saturation or consensus in relation to that specific topic was reached (e.g. if the majority of interviewees expressed that one of the main difficulties was lack of monitoring, the answer was considered as a main influential variable. Informed consent was obtained from all individuals before each interview (Newing 2011). Participant observations also provided a mean of data collection through author's moderate participation in community meetings, fishing activities, alternative livelihood activities. Observation of patron-client interactions, Coast Guard enforcement and illegal fishing events, as well as living in each community with local families for numerous weeks provided an in-depth perception of the daily real-

Table 2: Semi-structured interviews conducted during field research.

Case	Informants	Actor group	Semi-structured interviews
Isla Caballo	Association leaders	Community	2 (M), 1(F)
	Fishers		15 (M), 1 (F)
	Development association	Civil society/NGO	1 (M)
	Equipos Básicos de Atención Integral en Salud (EBAIS) (Mobile staff in Venado, Chira, Caballo)	Public sector	1 (M)
	High school director		1 (M)
	Collection center <sup>a</sup> (private)	Private sector	1 (M), 1 (F)
Palito-Montero	Association leaders and ex-leaders	Community	12 (M), 3 (F)
	Fishers		16 (M), 3(F)
	Development association	Civil society/NGO	1 (M)
	Island syndic		1 (M)
Paquera-Tambor	Collection center (private)	Private sector	2 (M)
	Association leaders	Community	12 (M), 1 (F)
	Fishers		29 (M), 2 (F)
	Cámara Paqueraña de Turismo (CAPATUR) (governance committee)	Civil society/NGO	1 (F)
	Cobano municipality (governance committee)	Public sector	1 (M)
Governmental agencies	Collection center (association)	Community	2 (F)
	Fishery and Aquaculture Costa Rican Institute (INCOPECSA)	Public sector	3 (M)
	National Coastguard Service (SNG)		2 (M)
	National Institute of Rural Development (INDER)		1 (M)
	Joint Institute of Social Assistance (IMAS)		1 (M)
NGO/research centers/other	National Learning Institute (INA)		1 (M)
	National University of Costa Rica (UNA)	Civil society/NGO	1 (M), 1 (F)
	Cooperativa Autogestionaria de Servicios Profesionales para la Solidaridad Social (CoopeSoliDar)		1 (F)
	MarViva		1 (M)
	Asociación de Pescadores Pangueros Artesanales de Puntarenas (ASOPAPU)		1 (M)
Collection centers (Puntarenas)	Private	3 (M)	
<b>Total</b>			<b>127</b>

The affiliation and actor group of each interviewee is shown in relation to each AMPR case. The gender of each individual is shown i.e. (M) Male; (F) Female.

<sup>a</sup>Collection centers are known as places to store the fish captured and sold by fishers. The collection center owners distribute and sell seafood products to the markets.

ity of each community and their AMPRs. As a complement, official documents related to each AMPR were obtained when available, including fishing management plans, lists of association members, legal documents, as well as articles and reports from local universities in relation to ecological monitoring and health.

The interviews followed a diagnostic procedure (Ostrom 2007; Cox 2011; Partelow 2016), which consisted of broad semi-structured questionnaires developed for various key informants and fishers. The same questionnaires were the



starting point in each case, but the diagnostic process led to the development of questions that were specific to each case over time. Starting questions were initially broad and structured around the first-tier variables of the SESF, standardized across all cases. Initial interview responses led to a continual refinement of our research questions. Subsequent interviews were guided by the second-tier variables of the SESF. This process of continued refinement of research questions continued over multiple phases of interviews as more detailed information was collected within each case on the different variables. Questions became more specific to each case and we relied on the variables of the SESF as the common set of variables to ensure that the information between cases was comparable during analysis.

### 2.3. Data analysis

Qualitative interview data from each AMPR were coded using the second-tier variables of the SESF from McGinnis and Ostrom (2014) as a content analysis tool following similar methods in other SSF and SESF studies (Basurto et al. 2013; Partelow and Boda 2015; García Lozano and Heinen 2016a; London et al. 2017). If necessary, third-tier variables were incorporated which were previously developed by mentioned authors above and suited for our research context, and also new variables were developed to sort data into more nuanced categories adapted for our research, following an ontological logic of “categorizing data into hierarchies of classes and subclasses....specifying the important attributes that each class has; and specifying other important relationships between classes...,” (Frey and Cox 2015, 13) linked and organized by the SESF variables. Added third-tier variables specific to this analysis are shown in Table 3. Third-tier variables developed by other authors are marked with an asterisk (\*); added third-tier variables are shown in italic format.

The data coded to each variable was analyzed in relation to current theories of collective action. First, however, it was used to describe the SES and the characteristics of SSF in the Gulf of Nicoya in general, as other researchers such as Delgado-Serrano and Ramos (2015) and London et al. (2017) have applied the SESF. Second, data were coded and analyzed with a collective action theory lens in each case to identify the role it may play in influencing governance outcomes (e.g. Ostrom 1990, 2009; Poteete and Ostrom 2004; Poteete et al. 2010), additionally informed by the Social-Ecological Systems Meta-Analysis Database (SESMAD) (Cox 2014), studies applying the SESF in fisheries (e.g. Basurto et al. 2013, Torres Guevara et al. 2016, London et al. 2017) and other specific studies on SSF (e.g. Gutiérrez et al. 2011; Cinner et al. 2012).

To conduct our comparative analysis, first, indicators were defined to determine the influence of each variable in each case after an initial first round of data coding with each second-tier variable (see Appendix 1). Most variables cannot be measured on a simple scale; therefore, specific ordinal values were determined to measure each variable (e.g. high-medium-low) (see Appendix 1). Analyzed values for each variable for each case were attributed based on qualitative data

Table 3: Social-ecological system framework adapted from McGinnis and Ostrom (2014) to fisheries management in the Gulf of Nicoya.

<b>Social, economic, and political settings (S)</b>		
S1 – Economic development		
S2 – Demographic trends		
S2a – population tendency*		
S3 – Political stability		
S4 – Other governance systems		
S4a – Regulations at national/local level		
S5 – Markets		
S5a – Market stability		
S5b – Access to markets*		
S6 – Media organizations		
S7 – Technology		
S7a – Communication devices/programs		
<b>Resource systems (RS)</b>	<b>Actors (A)</b>	<b>Governance systems (GS)</b>
RS1 – Sector (AMPR resources)	A1 – Number of actors	GS1 – Government organizations
RS2 – Clarity of system boundaries	A1a – Heterogeneity	GS1a – Support in funding*
RS3 – Size of resource system	A2 – Socioeconomic attributes	GS1b – capacity building
RS4 – Human-constructed facilities	A2a – source of incomes*	GS1c – support in legal procedures
RS5 – Productivity of system	A2b – access to basic services	GS2 – Nongovernment organizations
RS6 – Equilibrium properties	A3 – History or past experiences	GS2a – Support in funding
RS7 – Predictability of system dynamics	A4 – Location	GS2b – Capacity building*
RS8 – Storage characteristics	A5 – Leadership/entrepreneurship	GS2c – support in legal procedures
RS9 – Location	A6 – Norms (trust-reciprocity)/social capital	GS3 – Network structure
<b>Resource units (RU)</b>	A7 – Knowledge of SES/mental models	GS3a – vertical*
RU1 – Resource unit mobility	A8 – Importance of resource (dependence)	GS3b – horizontal*
RU2 – Growth or replacement rate	A8a – Economic dependence*	GS4 – Property-rights systems
RU3 – Interaction among resource units	A8b – Subsistence dependence	GS4a – Formal
RU4 – Economic value	A9 – Technologies available	GS4b – Informal
RU4a – Market value*	A9a – Heterogeneity (e.g. gears/equipment)	GS5 – Operational-choice rules
RU5 – Number of units		GS5a – formal
RU6 – Distinctive characteristics		GS5b – informal
RU7 – Spatial and temporal distribution		GS6 – Collective-choice rules
<b>Interactions (I)</b>	<b>Outcomes (O)</b>	GS7 – Constitutional-choice rules
I1 – Harvesting	O1 – Social performance measures	GS8 – Monitoring and sanctioning rules
I2 – Information sharing	O2 – Ecological performance measures	GS8a – social monitoring*
I3 – Deliberation processes	O3 – Externalities to other SESs	GS8b – biophysical monitoring*
I4 – Conflicts		GS8c – graduated sanctions*
I4a – Conflicts among direct users*		
I4b – Conflicts with externals*		
I5 – Investment activities		
I6 – Lobbying activities		
I7 – Self-organizing activities		
I8 – Networking activities		
I9 – Monitoring activities		
I10 – Evaluative activities		
<b>Related ecosystems (ECO)</b>		
ECO1 – Climate patterns	ECO2 – Pollution patterns	ECO3 – Flows into and out of focal SES

obtained from informants. For example, a measure of ‘absence’ was attributed to Monitoring and Sanctioning (GS8) when a consensus on informants’ responses expressed null or low monitoring efforts (Basurto et al. 2013; Epstein et al. 2014; Partelow et al. 2018). This allowed relative comparisons of variables within a case (see Table 6). These values are relative to our study. However, to determine the appropriate measurement of the values and assess their influence on collective action, they were contrasted with measurements in similar studies (e.g. Ostrom 2009; Basurto et al. 2013; Cox 2014; Trimble and Berkes 2015; London et al. 2017). Moreover, a value of positive, negative or minimal influence on collective action was determined for each variable based on our analysis of interviews. Our findings contradicting collective action hypotheses from the literature were indicated with an asterisk (\*). These findings allowed us to make further comparison about the differences and similarities of variables influencing collective action between the three cases. A qualitative between-case comparison was developed in the discussion section.

### 3. Results

#### 3.1. Social-ecological characteristics influencing the emergence of AMPRs in the Gulf of Nicoya

In this section, we characterize the Gulf of Nicoya as an overarching social-ecological system, providing context to examine the three AMPRs within the gulf, which are all embedded in the same broader system, facing some similar challenges. Highly productive fisheries in the gulf (RS5) supported by nutrient rich upwelling and large freshwater river inputs (RS7) (Kappelle 2016) have led to the establishment of more than 20 small-scale fishing communities (Pacheco Urpí et al. 2013) (S1) and a culture of coastal resource dependent livelihoods (A8). Our study sites are mainly located in Puntarenas municipality; the Human Development Indicators for this municipality (HDI) are ranked 54th out of 81 in Costa Rica for 2013, dropping to 59th in 2014 (UNDP and UCR 2016). According to the Social Development Indicator (SDI), one of our study sites in the Chira district had the lowest social development score in the Central Pacific Region in 2017 (MIDEPLAN 2018). Poverty in these fishing communities mostly affects youth and women (A2) (Sánchez 2018).

The port city of Puntarenas has grown from a small fishing village in the 1970s into the regional hub for seafood markets (S5). Most of the fish caught in the region goes through Puntarenas markets for local sale or is transported to the Costa Rican metropolitan area. In general, networks of patron-client systems have been established locally and play an important role in fish markets and community social security but also show substantial power asymmetries among actors. Few predominant fishing collection centers are found in most communities, which set fish prices and buy fish from local fishers. Their owners often provide monetary and equipment loan to fishers, often acting as the local bank in rural communities. This makes fishers dependent on one specific collection center owner as fishers

have to repay debts, as most fishers do not have sufficient means to transport fish themselves to further markets, or as owners offer better prices than other collection centers. Some fishers own their boats or equipment. In these cases, fishers typically employ other fishers for wage labor to help with fishing activities.

The fishing sector has also expanded due to a growing coastal population (S2a), or human migration from neighboring regions and countries like Nicaragua (Salazar Araya 2013). In response to growth in the region and migration into the fisheries sector, competition and overcrowding have created conflicts between small-scale and industrial fishers (I4) (García Lozano and Heinen 2016a), where historical policies for fisheries commercialization have largely favored the industrial sector, marginalizing artisanal communities (Salazar Araya 2013). Because of an increasing fishing sector (I1), many consider fisheries in the gulf to be severely overexploited and on the verge of collapse (O2) (Fonseca and Solis 2005; Tabash Blanco 2007; Fernández Carvajal 2013), threatening local livelihoods (O1). Furthermore, the Gulf of Nicoya faces similar challenges as many coastal areas worldwide, including illegal fishing (GS5) and lack of authorities' enforcement (GS1; 8) (Pacheco Urpí et al. 2012; Salazar Araya 2013), and, erosion from sea-level rise (ECO1) and pollution from land-based sources of regional watersheds (ECO2).

In recent years, a tourism industry has been expanding. Ecotourism and recreational fisheries have influenced transitions for some fishery dependent communities to tourism, such as in zones of Tambor (Herrera-Ulloa et al. 2011). Some communities have explored aquaculture and rural tourism as viable alternatives to fishing, but many projects remain small-scale and exploratory.

Cooperativism has been part of the social and political discourse in Costa Rica since the 1970s, supported by tax exemptions and education policy that have spread roots into the artisanal fisheries sector (García Lozano and Heinen 2016a). SSF cooperatives (GS2) can help establish fair prices, collectively fund community projects, provide micro loans to fishers and sell their own products independently. Not all communities have well established cooperatives, but those few have played a large role in managing fishery activities, as well as fisher associations. Such associations are non-profit business models that provide legal representation to fishers, but mostly during seasonal closures. However, not every fisher belongs to an association as there is often the perception that the associations are not useful, as past conflicts have occurred among association members or leaders. Also, many fishers do not possess a fishing license to legally join.

From the state, AMPRs and fisheries are overseen by INCOPESCA, but enforcement responsibilities were transferred to the National Coast Guard Service in 2000<sup>3</sup> (Pacheco Urpí et al. 2013) (GS1). However, the Coast Guard does not prioritize fisheries enforcement over drug trafficking and other national security issues, as expressed by different informants including two Coast Guard

<sup>3</sup> Law N° 8000. 2000. Law of National Coast Guard Service creation. Costa Rica.

members, and as a challenge expressed in MIDEPLAN (2014). This creates the perception of insufficient enforcement (GS8) and lack of responsibility in the eyes of many fishers who observe regular local roving banditry fishing behavior inside and outside the AMPRs, who do not possess legal enforcement authority, and who are constantly threatened if they try to monitor and report illegal practices. The situation is worsened by lack of financing and human resources for the Coast Guard. Lastly, fishers perceive more frequent activity from them with the establishment of a new station in the inner gulf. However, a Coast Guard member expressed the difficulties in reaching every AMPR and the entire gulf with limited resources. Reflecting this sentiment, an INCOPEPESCA member expressed that one of the biggest challenges for the AMPRs is “*to improve control and surveillance*”. This shows the contradicting perceptions of what the solution to fisheries governance in the gulf should be. On one hand, AMPRs as a policy model reflect the importance of bottom-up community driven self-organization and empowerment to change fishing behavior, while on the other hand, many point to insufficient top-down enforcement from national agencies to resolve the situation.

INCOPEPESCA is in charge of implementing regulations for all fisheries (GS5). Fishers are required to have a license, provided by INCOPEPESCA, which is also necessary to receive subsidy benefits during fishery closures and for gasoline. However, INCOPEPESCA is no longer providing new fishing licenses. Fishers are also required to have life insurance, to take a survival course (*‘zafarrancho’*), purchase boat safety equipment, and to acquire a navigation certificate authorized by port authorities after periodic boat and equipment inspections. These requirements are often difficult to afford for small-scale fishers due to generally poor socioeconomic conditions (A2). These conditions are worse for fishers who are dependent and hired as employees for other fishers, as they often do not have their own boat and equipment, fishing permits, life insurance nor subsidy benefits, and receive lower incomes than their boss. Thus, perceptions of fishing as a secure livelihood is heterogeneous among fishers, with expressions such as: “*sometimes fishing is good, sometimes it is not*”, “*it is education, it depends how people manage income*”, “*Satisfied, I am my own boss... it is enough to sustain my family*”, or “*Barely to survive...*”, “*Sometimes difficult, because I have a loan for the motor*”. Seasonal closures are perceived as the hardest period for fishers. Some have stated they fish illegally during these periods to feed their families. Other fishers who receive subsidies have expressed that they are not enough to cover their expenses.

In addition, numerous gear restrictions apply throughout the gulf and more specifically to all AMPRs, such as a minimum size for mesh nets and hooks (GS5). These restrictions are difficult for hand-line and long-line fishers who typically rely on catching smaller fish for live bait, mostly sardines or shrimp with artisanal purse-seine nets (*‘chinchorro’*), an activity which is no longer allowed. An INCOPEPESCA member explained that different regulations have been established based on biological studies, to regulate overfishing and promote sustainable

practices. However, some informants have expressed that regulations are mostly affecting small-scale fisheries in comparison to bigger fishing sectors. Also, some informants have expressed that money for fisheries development has not reached communities due to corruption. Many fishers have expressed dissatisfaction with their work and have perceived institutional abandonment.

Many fishers have small 3–4-meter boats with outboard motors that can easily reach any part of the gulf for a day of fishing, with slight differences according to target species. Social relationships are more frequent among fishers who use the same gear types. This provides them social identity, e.g. when hand-line fishers identify themselves as “*real fishers*” in comparison to others with gears that were introduced later in the gulf or with fishers that use mixed gears. Many hand-line fishers harvest in their local waters, but a large percentage of fishers who use artisanal gillnets, seine nets and long-lines are highly mobile throughout the gulf. This is in part due to target species that are mobile (RU1) with varying spatial and temporal distributions (RU7), related to changes in water temperature, reproduction cycles, tidal cycles or stages of biological development. Fishers expressed their local knowledge, which can be interpreted as their perceptions motivating behavior: “*Sometimes fish is good...it depends on gear in use, tides...*”, or “*it (fish) diminishes in March–April*”. Furthermore, open-access rights to fish throughout much of the gulf has created local roving banditry, where fishers ‘follow the fish’ beyond imposed borders like AMPRs and local Marine Protected Areas (MPAs), mostly where enforcement is likely to be lower. This sometimes includes fishers who already have an AMPR in their communities. AMPR network members and leaders lack needed coordination and communication between themselves in general, particularly on the topic of ‘fishing across borders’.

Despite the commonalities in the gulf described above, in which all AMPRs are immersed, each AMPR faces unique challenges for establishing effective governance to deal with those challenges. Table 4 summarizes some of the main characteristics of each AMPR, distinguishing them from each other in the gulf. How these different characteristics influence collective action in each case is examined in section 3.2.

### **3.2. Three AMPRs: a brief history of common drivers for establishment**

Our results show that the motivations for fishers and other actors to initiate the process of establishing the AMPR, i.e. taking the initial steps of collective action, was driven by some common factors across cases (Table 5), including the influence of NGOs (e.g. MarViva, Conservation International) and government agencies (e.g. INCOPESCA). The motivations and influences on each case is specified below. Fishers in all cases wanted to have exclusion and management rights to restrict and control the access of fishers with certain types of fishing gears (GS4), as a common property regime. This was driven by a common mental model (A7) that certain gear types in use were destructive or enabled overharvesting, which was perceived as a threat to their livelihood due to high

Table 4: The main social and ecological characteristics of the three AMPRs examined, organized by the second-tier variables of the SESF (McGinnis and Ostrom 2014).

SESF	Indicator	Palito-Montero	Isla Caballo	Paquera-Tambor
RS3 – Size	AMPR size (km <sup>2</sup> ) Number of AMPR spatial divisions	6.12 2 divisions	1.48 1 division	200 14 Zones distributed in 3 divisions
RS9 – Location	Location of AMPR in Gulf	Large island; inner gulf	Small island; middle gulf	Mainland; outer gulf
GS1 – Government organizations	Number and type with more presence	INDER, INA, IMAS	IMAS, INAMU	INCOPESCA, SNG, INDER, IMAS, SINAC-MINAE, INA, INFOCOOP
GS2 – NGOs	Number of fisher associations	ASOPECUPACHI (hand-liners Palito) Save the Gulf (non-hand-liners) ASOMM (hand-liners Montero)	ASCOLOPES (fisher association)	ABUZPA (divers in Paquera) ASOTAMBOR (fishers in Tambor) Asoplayablanca (fishers in Playa Blanca) APEP (fishers in Paquera) ASPARMAR (AMPR association) CATUCO (Cobano Tourism) CAPATUR (Paquera Tourism) COOPEPROMAR (AMPR cooperative)
GS5 – Operational rules	Other user associations Fisher cooperatives Other	Asociación Ecoturística Damas de Chirra No Development association (AD)	No No Development association (AD)	MarViva, Pretoma
GS5 – Operational rules	AMPR rules	Hand-line only Three-pronged hook forbidden Aquaculture allowed	Hand-lines Fishing traps Seine nets Aquaculture in the future	Shrimp gillnets 3–3.5', fin fish gillnet 3.5–8', lobster gillnet 5 1/8" with restricted length and height Hand-line with hook size #10, #9 and #12 and with live bait Bottom longline with 500 hooks and size #7 and #8 Fishing traps Recreational diving Commercial diving with equipment restrictions Sport fishing (fishing rod) No fishing zones Other (Gears restrictions depending on zones)



Table 4: (continued)

SESF	Indicator	Palitio-Montero	Isla Caballo	Paquera-Tambor
A1 – Number of actors	Actors groups	Fishers, community, researchers	Fishers, community	Fishers, divers, tourism sector, community, researchers, municipality
	Estimated community population	3000 (on island)	350 (on island)	Undetermined but more than others
A2 – Socioeconomic attributes	Number of local fishers	120 (In AMPR zone)	70–90 (on island)	More than 150 (in AMPR zone)
	Level of heterogeneity between actors/groups	Little social and economic heterogeneity between actors (i.e. some wealthy actors)	More social and economic homogeneity between fishers	Economic and social heterogeneity between actor (i.e. different wealthy actors)
	Access to basic services	Presence of basic services, including freshwater, electricity, education. Irregular health service	Absence of most services including electricity, freshwater and waste disposal. Irregular health service	Presence of basic services including freshwater, electricity and education
A3 – History	Initial efforts	Efforts since 1995. First AMPR legally created in 2009; extended in 2012	Initial conservation efforts in 2007; created in 2012	Efforts began in Paquera sector. Initial proposal in 2011. AMPR created in 2014
A5 – Leadership/Entrepreneurship	Leadership in local associations	Some local leaders self-organizing	Few local leaders self-organizing	Different local leaders self-organizing, self-creation of a governance committee
	Own cooperative/collection centers	two non-functional collection centers	No	Yes, own cooperative
A8 – Dependence	Alternative livelihood options	Aquaculture (in AMPR) Livestock Rural tourism Familiar stores	Minimal rural tourism	Three functional collection centers Tourism Agriculture/livestock Construction Recreational fishing Aquaculture
A9 – Technology	Fishing gear with more use	Hand-line (main) Gillnets Long-line	Artisanal seine nets; gillnets (main) Longline and hand-line	Bottom longline Gillnet

Table 5: Common drivers motivating collective action to establish all three AMPRs.

Common drivers to establish AMPRs across cases	Desired outcome
Want to restrict fishing gears and activities (GS4; GS5) with negative impact	<ul style="list-style-type: none"> <li>• Protect fishing grounds to increase fish population (RS5), to secure income and sustain their livelihoods over time (A8a; b)</li> </ul>
Want to improve livelihoods (A2)	<ul style="list-style-type: none"> <li>• Trade fish/other products with an additional value (RU4a).</li> <li>• Reduce intermediaries, increase access to markets (S5b) (Collection centers construction promoted by the NGO MarViva through funding from Interamerican Development Bank (IDB) for this purpose)</li> </ul>
Want to develop alternative livelihoods (A8)	<ul style="list-style-type: none"> <li>• Generate alternative source of incomes (A2a), such as aquaculture or tourism projects</li> <li>• Reduce dependence on fishery (A8a)</li> </ul>

dependence on fishing (A8a; b). The AMPR in Palito constituted a model to be promoted by INCOPECA and adopted by other fishing communities. Fishers also in all cases wanted to increase market prices through the creation and self-organized management of a collection center owned by the local association (A5). This would facilitate direct trade to markets (S5b) by avoiding private patron-client systems (RU4a). A final common motivation was the expectation for the development of alternative livelihood opportunities in the community (A8a), mostly from aquaculture or tourism, ultimately due to perceived fish scarcity. AMPRs do not exclude external fishers, as long as they comply with local rules. Infractions must be reported to the Coast Guard and sanctions must be enforced by INCOPECA (see Table 1).

### 3.2.1. Palito-Montero AMPR on Isla Chira

Palito's handline fishers started to organize in 1995, with the goal to protect the area and assure harvests over time (Babeu et al. 2012) to maintain local livelihoods (A8a). Early efforts were made to exclude gillnet fishers from inside and outside the community, who were perceived as local roving bandits (I10), and who were blamed for decreasing fish populations (RS5; A7). Self-organized surveillance during nights (I7) and informal sanctioning mechanisms such as gear confiscation and/or destruction were developed for this purpose, which remain today (GS8c). In 2003, the Handline Fishers Association of Palito (ASOPECUPACHI) was formed by 32 fishers (I7) (Ayales Cruz et al. 2013). The association requested government support to establish a local conservation area and applied for funding (I5) from the United Nations Small Grant Program (SGP-UNDP-GEF) to mark the area with buoys and acquire surveillance equipment. Another fisher association was created a few years later called "Let's save the gulf" (Salvemos al Golfo) by non-handline fishers (I7), who were not included in the AMPR creation process and disagreed with its exclusionary approach for non-hand liners. Violent

conflicts (I4a) between gillnet and handline fishers occurred in Palito early due to exclusion but diminished over time as rules became increasingly accepted (A7) and when the majority of local fishers adopted hand-lines as their main gear (A9a). This process increased recognition for the AMPR as an important governance approach to maintain their livelihoods and for family subsistence (A8).

Palito was the first AMPR created in Costa Rica in 2009 (A3). INCOPECA created the AMPR model from inspiration and by learning from Palito's self-organized efforts. The only difference from Palito's original effort being that responsibilities in the formal AMPRs were to be shared with government agencies through co-management. The previous informal rules and regulations (GS4b; GS5b) of the area were now legally recognized (García Lozano and Heinen 2016b). Palito was extended to include the neighboring Montero sector in 2012. A fishing association from Montero (ASOMM) was created in 2009 with around 40 fishers and community members (I7), as a requirement to create the Palito area extension with a few different rules. The extension was suggested by INCOPECA to hasten creation procedures (GS1c). Also, other government agencies such as IMAS, NGOs and research institutes (INA, MarViva, UNA) have supported capacity building, surveillance equipment and/or general funding for AMPR functioning (GS1a; b; GS2a; b), and actions influencing fishers to keep enrolled. In addition, UNA provided information about potential fishing areas to protect within the AMPR and supported the development of aquaculture projects.

Collection centers were requested by both ASOPECUPACHI and ASOMM associations (I5) to directly trade their own products to markets in Puntarenas (S5b). Both associations also agreed to manage the area together (A6; I3) and share funding. Each association agreed to establish a surveillance system, consisting of patrolling the area in pairs every night (GS8a) and reporting the presence of illegal activity to Coast Guard and INCOPECA (GS3a). The perception of the majority of fishers in both sectors was an increase in fish abundance (RS5; A7) (Fargier et al. 2014), attributing it to surveillance measures taken (GS8a; c), which motivated further management efforts.

### **3.2.2. Isla Caballo AMPR**

Prior to the AMPR on Isla Caballo, fishers were organized (I7) into a Committee of Local Fishers (COLOPES), who was transformed into an association under the same name to comply with legal requirements. These committees historically (A3) promoted communication and coordination between INCOPECA and fishers (Fernández Carvajal 2013). Initial efforts to protect the fishing grounds near the island began in 2007 as a community marine conservation area, motivated by fisher perceptions (A7) of decreasing fish populations (RS5). Isla Caballo followed the experience of Palito-Montero and Tárcoles (I8) to increase conservation efforts and assure fishing areas. The initiative was adopted by the main local leader (A5) within COLOPES, and the association organized the establishment of a fish collection center (I7).

The Isla Caballo AMPR was approved in 2012. The AMPR application was pushed forward by a few strong community leaders (A5; I7), supported by UNA and INCOPECA (GS1c) to design the area boundaries. Local fishers were mostly involved only in the approval process, requesting a signature if they agreed. This helped get the AMPR established when most of them agreed, but also left some fishers in disagreement. Fishers in COLOPES also agreed to self-organize surveillance during nights (I7; I9) and apply their own informal sanctioning mechanisms (GS8c), such as taking out illegal gears (i.e. gillnets) and destroying them, similar to Palito.

However, the area has faced major management challenges since the establishment process. The process was referred to by leaders and fishers as delayed, with some spatial boundaries established by INCOPECA different than the initial proposal (RS2). This discouraged further participation from many interested local fishers from the start, decreasing the acceptability of the AMPR as a legitimate form of governance (A3; A6). Also, some fishers have removed or destroyed the buoys who felt it did not comply with the original area design, and for presenting an obstacle for gillnet fishers.

### **3.2.3. Paquera-Tambor AMPR**

The process to establish the Paquera-Tambor AMPR began in 2011 and was legally approved in 2014. Paquera-Tambor has a diversity of actor groups involved (A1a), including fishers, a free divers' association, non-fisher communities, tourism chambers, industrial fishers, governmental agencies and NGOs. The purpose of initial participatory meetings was to discuss the types of gear restrictions organized by zones within the AMPR, and the types of activities allowed within each zone (GS4) (i.e. which actor group could conduct activities in each zone). The AMPR was marked with buoys, and was divided into three sectors: Tambor, Paquera and Playa Blanca, with 14 zones distributed among them (GS4a). Local actors agreed to manage and look after their own sectors (I3). Moreover, plans were included to build collection centers in each of the three sectors (I5). In addition to the collection centers, a processing plant was planned, to be built and managed by the AMPR cooperative to process their own seafood products to add additional value (RU4a). The cooperative was also created to manage a common fund to be given as a form of loan to fishers in case of emergency, as a form of social insurance (I5), or to sell equipment to fishers at lower prices.

The creation of the AMPR and its management has been facilitated by two non-fisher leaders (A5) with professional skills in biology and administration (A2). The tourism sector has been participating in management due to the importance of the AMPR for recreational fishing, free diving and boat cruises (A8a). These leaders have organized the different actor groups together and requested government support (A5; I6). Different governmental organizations and NGOs have supported the development of the AMPR legally (GS2c), through capacity building (GS1b; GS2b; I5) and financing (GS1a; GS2a; I5). Research centers, such as UNA, have also supported biological monitoring (GS8b; I9). Investment from the fishing associations, cooperatives and the tourism sector has been provided

to organize activities related to AMPR meetings (I5). A governance committee was created (I7), integrated by different local representatives of tourism chambers, fishers, divers and the municipality, in response to the inadequate functioning of surveillance and associated committees, as has happened with the other two AMPRs. The governance committee was proposed as a participative strategy to take decisions (I3) related to AMPR functioning and inform the results to INCOPECSA (I7; GS3b; GS6), which has since adopted the approach of developing a governance committee for other AMPRs (I10).

### **3.3. Analysis and comparison of facilities and challenges for continued collective action in the AMPRs**

Self-organized collective action has played a substantial role in the establishment of all three AMPRs, but initial efforts are not enough for continued progress. Thus, continued collective action is a necessary foundation to achieve the goals of the AMPRs over time. This section presents a brief overview of the current outcomes (O1; O2; O3), current challenges, and comparison of the hindering and enabling conditions influencing continued collective action. Table 6 shows the key variables influencing collective action from the SESF and their ordinal value which indicates how each variable is most likely playing a role in each case. Green 'up' arrows indicate a positive influence and red 'down' arrows indicate a negative influence. A horizontal line (–) indicates no observed or minimal direct influence on collective action. An asterisk (\*) indicates an influence on collective action contradicting a theory/hypothesis claimed from the general literature.

#### **3.3.1. Palito-Montero: initial progress followed by challenges**

The Palito-Montero AMPR achieved important advances towards a model for community-based collective action for fisheries governance. However, initially successful efforts are, today, followed by continuing challenges. A lack of coordination and a contentious relationship with INCOPECSA is perceived by fishers (I4b) (Babeu et al. 2012). Association collection centers are not functioning due to a lack of operational permits (S4a), and for the existence of strong dependent relationships between private collection centers owners and association leaders and fishers. Owners pay them slightly higher prices, and some association leaders and fishers owe them loans or rent equipment, a situation that does not allow them to quit and organize on their own. Some fishers stopped doing night surveillance when compensation payment was no longer provided by NGOs. Although funding support was over, private collection centers and associations have been investing in surveillance materials (I5) but obtaining enough funding to repair boundary buoys is difficult (Figure 2). Marking the AMPR boundaries is still a challenge after nearly 10 years.

The resources in the AMPR are still perceived by many fishers as overharvested (A7) due to high numbers of fishers within the area, who often do not follow the rules (e.g. using a three-pronged hook), exacerbated by difficulties with

Table 6. Key variables influencing collective action in each AMPR.

SESF variable	Collective action (CA) hypothesis of variable influence	Palito-Montero		Isla Caballo		Paquera-Tambor	
		Ordinal value	Influence on CA	Ordinal value	Influence on CA	Ordinal value	Influence on CA
Clarity of system boundaries (RS2)	Clear spatial boundaries increase likelihood of CA. Easier to tell who is in or out, and to monitor	Partially	→	Unclear	→	Partially	→
Size of resource system (RS3)	Larger areas provide enough resource availability, increasing the likelihood of CA	Small	→	Small	→	Large	←
	Smaller areas are easier to monitor as transaction costs decrease, increasing the likelihood of CA. Very large areas are difficult to monitor as transaction costs increase, decreasing the likelihood of CA	Small	→*	Small	→*	Large	→
Operational rules (GS5)	Formal rules chosen by local actors are implemented, increasing the likelihood of CA	Partially	→	Absent	→	Partially	→
Collective-choice rules (GS6)	Allowance of local actors (i.e. fishers using multiple gear types) to participate in designing or modifying rules increases the likelihood of CA	Low	→	Low	→	Medium	←
Monitoring and sanctioning (GS8)	Presence of monitoring and graduated sanctioning mechanisms facilitate rule compliances and increases the likelihood of CA.	Presence	←	Absence	→	Absence	→
Number of actors (A1)	As the number of actor groups increases, it is more likely that they have heterogeneous interests and practices, making it more difficult to create consensus and agreements. This decreases the likelihood of CA.	Small	←	Small	-	Large	→
	As the number of actor groups increase, transaction costs (i.e. monitoring, communication and coordination) increase. This decreases the likelihood of CA.	Small	→*	Small	→*	Large	→

Table 6: (continued)

SESF variable	Collective action (CA) hypothesis of variable influence	Palito-Montero		Isla Caballo		Paquera-Tambor	
		Ordinal value	Influence on CA	Ordinal value	Influence on CA	Ordinal value	Influence on CA
Socioeconomic attributes (A2)	Economic heterogeneity increases the likelihood of CA (i.e. Wealthy actors can afford transaction costs or invest).	Medium	↑	Low	↓	High	↑
History and past experiences (A3)	High frequency of negative experiences with management affects actor's behavior, decreasing the likelihood of CA.	High	↓	High	↓	Medium	↑
Location (A4)	Actors located far apart increases transaction costs (e.g. monitoring, getting together), decreasing the likelihood of CA.	Close	↑	Close	-	Far	↓
Leadership/ entrepreneurship (A5)	Strong leadership and entrepreneurial skills increase the likelihood of CA.	Weak	↓	Weak	↓	Strong	↑
Trust/social capital (A6)	High to moderate levels of confidence and close relationship among local actors is likely to increase CA.	Low	↓	Low	↓	Medium	↑
Dependence (A8)	High dependence on AMPR resources to obtain incomes and sustain livelihoods increases the likelihood of CA.	High	↑	Low	↓	Medium	↑





Figure 2: Buoys damaged in Palito-Montero AMPR (left); oyster aquaculture developed by women in Palito (right).

excludability and high subtractability. Mistrust among the same hand-line fishers (A6) has been related to past experiences comprising conflicts for allowing fishers with illegal fishing gears to access during surveillance rotations in exchange of money (A3), leading to their exclusion in management processes or the expulsion of fishers from the Palito association (GS8c). Moreover, fishers have complained and disagreed (I3) with current leadership, motivating some fishers to leave the association (A5).

Difficulties in coordination and disagreements between both communities, Palito and Montero, is frequent. The Montero community claims Palito's fishers for not taking care of their sector, and instead fishing in Montero without supporting them in surveillance activities (GS8a). This has led many fishers to be discouraged from participating in management, but a small minority of fishers (including fishers with own boats and/or their employees) are remain organized and still carrying management tasks and costs (Salas et al. 2012; García Lozano and Heinen 2016b). Furthermore, oyster aquaculture was developed by women in Palito as a part of AMPR alternative projects (Figure 2), but some women stopped participating when shared benefits were low due to the large group size or due to feeling excluded by women's association leaders and their families who took the project's control, and who remain in the project with external support e.g. from UNA. Some ecotourism activities within the AMPR have been developed such as boat trips by Asociación Ecoturística Damas de Chira but are infrequent. It seems clear that alternative livelihood opportunities have not yet materialized as hoped but some efforts are still made.

### 3.3.2. Isla Caballo: minimal progress and continuous difficulties

Collective action on Isla Caballo has largely been a failure, in part influenced by the initial conflict about boundary establishment. As described in the above section, despite the fact that the majority of fishers signed the agreement to exclude

all gears except hand-lines, many local fishers did not respect the boundaries of the AMPR or its rules (GS4, GS5). A lack of monitoring and sanctioning (GS8), coupled with the perceived illegitimacy of rules by gillnet users led to business as usual. Enforcement from the Coast Guard was perceived as inconsistent and largely ineffective (GS8a). The few fishers and leaders who initiated self-organized surveillance and enforcement (GS8c) were threatened by other fishers which were using illegal gears (I4a) to target the high-valued fish. Leaders have been criticized for not imposing sanctions on family members known to be fishing illegally (A5; GS8c) despite living on the same island. Overall, conflictive relationships among local fishers and between local and external fishers (I4) have stagnated motivation to work together and find mutually accepted rules among fishers using different gear types.

The spatial size of the AMPR on Isla Caballo is too small (RS3) and does not fit the ecological distribution of target species or fishing behavior on the island (RU7). Although targeted fish species around Caballo have a high value (RU4), these species are highly mobile throughout the Gulf (RU1) (Figure 3). Thus, most fishers are not directly dependent on resources from within the small spatial area of the AMPR (A8), leaving little motivation to face the high transactions costs of management (e.g. surveillance). Moreover, most fishers in the community use other gear types than those allowed in the AMPR, and many young fishers use illegal gillnets with the potential to harvest up to 400 kg per day valued around 1700 USD. These fishers have little interest in fishing with hand-lines or motivations to protect the area when there is opportunity to gain more profit with illegal gear outside the area.



Figure 3: A fisher from Isla Caballo displaced to AMPR Distrito Paquera-Tambor and harvested two 'queen croaker' (*Cynoscion albus*) with hand-line gear (left). Water distribution from Puntarenas city to the island (right).

Funding from MarViva-IDB was not provided to build a collection center; different reasons hindered this process, such as perceptions that the AMPR has been largely ineffective from the start and the island's state-controlled property (GS4) that forbids construction (S4a), poor socioeconomic conditions and lack of basic services needed to build the center such as water and electricity (A2b). Freshwater is imported by boat from Puntarenas (Figure 3) and electricity is provided by solar panels or private gasoline generators. Collective action such as meetings and self-organized surveillance for the AMPR are no longer being done (I7). Only the maintenance of buoys is continued as a requirement during seasonal closures as mandatory community work to receive closure compensation (a form of subsidy) from the government, but this has not increased rule compliance.

### 3.3.3. Paquera-Tambor: Many challenges but making progress

Despite the overall success in establishing the Paquera-Tambor AMPR, difficulties remain for continued functioning. Disagreements and conflicts have been held among fishers, leaders and/or communities mainly in the Playa Blanca sector (I4a), or with those who still disagree with the AMPR proposal (GS6). Some fishers do not participate in meetings or in self-organized surveillance for fear of being discovered by the authorities due to their illegal fishing status (GS5). Self-organized surveillance has also been inconsistent due to threats during patrolling (I4a), mostly from external fishers with illegal gears. Fishing regulations are often not respected at night or during seasonal closures (GS5), which has led to perceptions (A7) of inadequate surveillance by the Coast Guard. Furthermore, spatial boundaries for the 14 zones are not clear enough (RS2), increasing surveillance challenges. Fishers and other actors are physically located in communities that are far apart from each other compared to other AMPRs (A4), making it difficult to meet in person and coordinate due to increased transaction costs (e.g. travel time and planning ahead). Also, surveillance has been limited to zones located closer to communities and not in further zones because of the large size of the whole AMPR (200 sq km) (RS3). Fishers do not depend only on fish within the AMPR for their livelihoods (A8a), they often travel by boat outside the area or to the open sea for more highly mobile pelagic species like 'dorado' (*Coryphaena hippurus*) (RU1; RU7). Moreover, fishing is not the only livelihood opportunity in Paquera-Tambor. Tourism has provided new opportunities in the service sector (A8a), and other alternative livelihoods are available because it is connected to the mainland.

Despite these challenges, Paquera-Tambor is making progress, arguably the most stable of the three cases. Local informants have perceived an overall decrease in the presence of illegal fishing and unsustainable practices like shrimp trawlers in the AMPR, which was also related to perceptions of increasing fish populations (A7; RS5). Strong leadership (A5) from two non-fishers (A1), one in the tourism and one in the research sector has been crucial for bringing needed capital from the government and NGOs, for having facilitated formal administrative organization and provided continuous motivation to keep management moving forward, in addition to different local actors' own invested money (A2).



*Figure 4: Association collection center in Playa Blanca sector delivering fish to Puntarenas (left). Meetings for decision-making in Paquera-Tambor, led by the president of the cooperative (standing right).*

This capital also enabled the establishment of three collection centers and one cooperative. Although they still depend on external markets to set prices and trade (S5a) (Figure 4), collection centers and cooperatives provide incentives and direct trade of seafood to local tourism restaurants and hotels. Research and biological monitoring are sometimes active in the area to support decisions and progress (GS8b). Formal organizational meetings held every 1–2 months for decision making (I7, GS6), have helped to bring actors located throughout the area together (Figure 4) and to evaluate progress of the AMPR and nested projects (I10). Coordination among different working groups from associations, committees and the cooperative has been aided using mobile phones and online communication platforms like ‘WhatsApp’ (S7a). All these factors such as leadership, institutional support and participatory decision making have motivated different actors to continue efforts together.

#### 4. Discussion

AMPRs are a new and institutionally unique model for small-scale fisheries governance in Costa Rica. They follow a global shift towards providing common property rights to local communities (TURFS) (Gallier et al. 2016) and promote collaborative community-based governance that aims to include local people in decision-making processes (Glaser et al. 2010; Boda 2015). AMPRs have evolved in response to largely failed ‘nature without people’ conservation models (Folke 2006; Mace 2014) in many coastal areas, many of which are exclusionary or designed after terrestrial conservation models that are not adapted to coastal social-ecological contexts (Weber de Morais 2017). Exclusionary and misfit governance models can marginalize small-scale fishers who are highly dependent on local natural resources with few alternative livelihood opportunities, because they do not consider local system dynamics or account for the motivations or goals of local people (Bromley 2016).

AMPRs also fit Costa Rica's ambition to adopt the FAO SSF guidelines (FAO 2015b), but despite praised efforts to do so (Sabau 2017), the reality of implementation in specific fisheries around the world will require further adaptive capacity and greater attention by national governments to provide the support and resources that local communities need for success. Nonetheless, it is evident that momentum to support AMPRs reflects Costa Rica's effort to try to avoid marginalization, to reduce overfishing, unsustainable and/or illegal fishing practices, and to develop the coastal economy by reducing high dependence on extractivism towards tourism and aquaculture. From this perspective, the social-economic setting (S) outside the SES focused on, is of central importance for its diagnosis, as has been found in other studies (Torres Guevara et al. 2016; Partelow et al. 2018).

The initial model of AMPR governance (from Palito) has been largely adopted as the generic co-management approach in most AMPRs. However, replication of the Palito model to other communities is problematic. Rural fishing communities in the Gulf of Nicoya may seem to have similar socioeconomic and ecological conditions, challenges and goals, but our findings suggest that there are substantial and meaningful differences in numerous social and ecological characteristics (i.e. resource system size, fishing gears in use, target species, heterogeneous actor groups, socioeconomic conditions of actors) in each AMPR, reflecting on the importance to adapt the AMPR model for each case.

#### **4.1. Linking our results to collective action theory**

The results of our study, and many others, tend to first emphasize the role of single variables in collective action rather than analyzing the interdependent interactions between variables or their relationships to each other (Leslie et al. 2015; Partelow et al. 2018). However, we discuss below how the interaction of some key variables are positively and negatively influencing collective action. The emergence of collective efforts taken to establish the AMPRs is strongly linked to the dependence on local fishing grounds perceived as scarce, and poor socioeconomic conditions of actors who were looking to protect and restrict access to their main source of incomes.

In relation to the continual collective efforts taken for the management, Palito-Montero shows that although the AMPR is achieving some goals, challenges for management are constant. There appears to be strong links between high dependence on resources and monitoring and sanctioning activities in the fishing grounds, increasing user groups and increased transaction costs (e.g. monitoring and control efforts), weak leadership and negative experiences with existing local management processes or with state organizations tasked with monitoring and enforcement. On Isla Caballo, strong links exist between fishing gears in use different than allowed in the AMPR and low dependence on AMPR resources, lack of deliberative processes for management, weak leadership, mistrust and negative past experiences, lack of monitoring and sanctioning, low rule compliance, different mental models, the small size of the AMPR and the unclear boundaries.



Lastly, in Paquera-Tambor, highly interrelated variables include the large number of actors, the economic heterogeneity of actors, strong leadership, actors' dispersed location, the large resource system size, the heterogeneous gear types used, mental models (i.e. perceptions), the unclear boundaries, infrequent monitoring and sanctioning activities, high transaction costs (e.g. to mobilize actors, develop meetings, and set agreements) and often deliberative processes for management held. These variable interactions make the Paquera-Tambor AMPR unique and complex. There is not one variable which explains why Paquera-Tambor has progressed more than the others, it is the unique interactions between all variables.

We also discuss the congruence of our findings in relation to existing literature on collective action, mostly related to SSF. Overall, most of our findings support hypotheses proclaimed by existing literature (see Table 6). Some influential enabling conditions were unique or similar between some AMPRs, and similar to other SSF and SESF studies. Enabling conditions include strong leadership (Gutierrez et al. 2011; Basurto et al. 2013) such as in Paquera-Tambor AMPR, high dependence on area resources (García Lozano and Heinen 2016a) and monitoring and sanctioning mechanisms implemented (Pomeroy et al. 2001; Gutierrez et al. 2011; London et al. 2017) such as in Palito-Montero. Hindering conditions were also similar across AMPRs and with the existing literature, including the lack of external support for enforcement (Torres Guevara et al. 2016), mistrust and conflictive or negative past experiences among actors (Torres Guevara et al. 2016; Partelow et al. 2018) and unclear spatial boundaries (Trimble and Berkes 2015; Torres Guevara et al. 2016). Few variables in our analysis were found to be contradicting expected hypotheses. Instead, we find that some variables seem to have no effect despite the expectation that they should. One such exception is that we would expect transaction costs for monitoring to decrease on Isla Caballo and in Palito-Montero due to their small size and proximity of actors, but the opposite effect was observed. This is most likely explained by interactive effects with other variables, like poor socioeconomic conditions of actors, or high mobility of species. This indicates the need for the continued analysis of collective action if we aim to consider complexity and interactive effects beyond the examination of single variable influences (Leslie et al. 2015; Partelow et al. 2018). It also indicates the need for in-depth qualitative case studies, which are better suited to hypothesize interaction effects through detailed observational research than, for example, linear statistical approaches (Poteete et al. 2010; Partelow et al. 2018).

It is clear that many variables interact simultaneously to influence outcomes. Many of the relevant variables are the same in the three AMPRs, but they tend to have different importance and interact in different ways. This supports the need to understand each AMPR as unique, and that each will require contextually appropriate governance within the co-management model to avoid viewing co-management as generic solution (Jentoft 2000; Ostrom 2007). Many variable interactions are combinations of enabling and hindering conditions that in some ways counterbalance each other. One could assume that more hindering conditions would likely undermine success in the long term, and more enabling condi-

tions would suggest a greater capacity to achieve collective action. However, this is not such a simple equation in reality. Some enabling conditions may compensate for hindering conditions and some may not. Which variables can compensate, or counterbalance others is difficult to generalize.

Isla Caballo has more hindering conditions (e.g. low rule compliance, unclear boundaries, absence of monitoring and sanctioning mechanisms) than Palito-Montero and Paquera-Tambor which generally helps to explain why they struggle to work together and why solutions seem complex and out of reach. Paquera-Tambor has a delicate balance of equal hindering and enabling conditions, which is seemingly enough to slowly move things forward without overwhelming barriers. For example, transaction costs (e.g. monitoring, get actors together) seem to be mitigated by wealth actors and very strong leadership that motivates fishers to self-organize and participate. The heterogeneity among actors, both economic and in relation to business skills, can enable collective action (Poteete and Ostrom 2004), because it can bring needed knowledge about how to formally organize management processes and needed capital that fishers would otherwise not have. These few variables seem to overcome many other hindering conditions in a positive but asymmetric way, suggesting that the balance between hindering and enabling conditions is relative to the importance of particular variables in a context. In Palito-Montero, the balance of hindering and enabling conditions seems to be a little less symmetric. However, a group of hindering conditions (i.e. mistrust and negative past experiences) are in some ways counterbalanced by a group of enabling conditions (i.e. private collection centers support and user-driven enforcement).

In all three AMPRs, increasing transaction costs (e.g. building trust, establishing clear communication, monitoring efforts and cost, arranging meetings) are hindering collective action, and although they are sometimes mitigated by some enabling conditions for collective action in the individual cases (e.g. small group size, resource dependence or strong leadership), they are difficult to deal with institutionally, where individual costs and benefits have to be weighed against group progress when many choose to be non-compliant, differ, or even undermine collective efforts. It is in these processes that the reality of the social dilemma in CPR management plays out in daily life.

#### **4.2. AMPR policy challenges**

Many fishers and community members simply do not have the institutional capacity to self-organize to solve the challenges they face. This is a familiar challenge for many SSF (Salas et al. 2007; Torres Guevara et al. 2016; Wallner-Hahn et al. 2016; Partelow et al. 2018). Many realize the necessity for AMPRs and how they could bring potential benefits. However, there is minimal capacity and experience in self-organization, communicating effectively, resolving conflicts and capacity building that can help shift the perception of what AMPR management is designed to be (i.e. a collective and empowering process built on the contributions of all



individuals), rather than the perception that solutions for management should come from the outside. Resolving these issues requires institution building which takes time and investments from supporting organizations like INCOPECA and the Coast Guard. Responsibility for dealing with transaction costs and investments cannot be entirely assumed or expected to be resolved by local actors, many of whom are living in precarious socioeconomic conditions. However, it is also evident that government agencies also lack financing, human resources and capacity themselves. It is also evident that monitoring and enforcement represent main challenges to make rules legitimate and SSF guidelines effective.

In addition, there is a clear necessity to promote more inclusive decision-making processes for fisheries governance that can empower local communities to develop and enforce responsible fishing areas that align with their own interests and goals, as these mechanisms have worked in cases such as Paquera-Tambor, or notably in Tárcoles AMPR (Rivera et al. 2017). It is also necessary to consider strategies that link together networks of AMPR to govern mobile species because they may not always be confined within a spatial area. In addition, it seems necessary to analyze if the real aim of the AMPRs is to assure fishing grounds for communities or exclude competitors, and not necessarily to regulate catches amount, apparently such as in Palito-Montero. Reflection is needed on whether small AMPRs such as Isla Caballo may not motivate behavior change when incentives are not substantial. While the AMPRs aim to empower local communities, it is obvious that they are not able to achieve many of the goals on their own, without external government or NGO aid. It is also necessary to evaluate how the promotion of alternative livelihoods may impact SSFs as it may represent a risk for their existence and for their identity in the long term. Anyhow, financial, technical knowledge and organizational capacity are needed to advance projects like aquaculture and tourism, and to extend it including different community members.

## 5. Conclusion

### 5.1. AMPR context

Each AMPR can be thought of as a unique nested system for management. Common goals have motivated collective action to establish AMPRs, mainly influenced by the perception of fish scarcity and to protect local fishing grounds for local livelihoods. However, some achievements and challenges have differed between AMPRs. In general, hindering and enabling variables influencing collective action in our study were similar to other SSF study cases. Variables such as monitoring and enforcement mechanisms from all involved actors, strong and transparent leadership, high dependence on marine resources, wealthy actors who can afford transaction costs, inclusion of different actors in decision making are more likely to enable continued collective action. However, variables such as mistrust among actors, negative past experiences or internal conflicts, non-rule compliance, lack of governmental or institutional support and continual resource unit mobility are more likely to hinder collective action, undermining AMPR success.

The size of resource system, number and heterogeneity of actors, was not as influential as expected. However, variables cannot be analyzed in isolation as they are constantly interacting with each other, with aggregate effects on collective action.

We observe that although AMPRs have been promoted as a generic co-management model, it seems necessary to adapt the model to the social-ecological conditions of each community to increase the likelihood of continual progress. There are also common features and challenges facing all AMPRs, which makes the comparison of similarities and differences a useful methodological approach for understanding how co-management can be adapted by learning between cases. The most common and foundational feature of AMPR co-management is the necessity for collective action amongst fishing communities and other actors. The AMPR concept proposes a simple idea, to empower local people to govern themselves. However, this is not so easy in practice. We argue that AMPRs are a step in the right direction, because they represent a shift towards more inclusive, participatory and collaborative environmental governance for small-scale fisheries in Costa Rica and has contributed to the implementation of responsible fishing practices based on the FAO Code of Conduct and SSF guidelines. Nonetheless, persistent efforts are still needed to make collective action a social process that is truly inclusive of all actors and motivated by a belief that it will bring desired outcomes.

Numerous policy changes can be considered for continued AMPR implementation. Despite the National Development Plan (2015–2018) promoting the creation of additional AMPRs, continuous investment is needed from all actors, but especially from government agencies. More support is needed for capacity building to support administration, leadership, conflict resolution mechanisms, and in educating fishers, together with monitoring and enforcement activities to assure rule compliance. More coordination among different government agencies is necessary to join efforts and provide more effective solutions. Inclusive decision-making processes are needed among different actors (e.g. fishers with different gear types, community members, local tourism sector) to increase the likelihood that rules are acceptable and practically functional. In general, it is important to develop more periodical assessment by responsible agencies on the progress of the AMPRs and their challenges to decide if more AMPRs should be created or to better address the problems of the existent ones.

With the existing AMPRs, supporting clear boundaries markings and the creation of deliberative spaces for communities to discuss challenges would likely be beneficial. Looking forward, serious efforts to reduce ambiguity of boundaries and advance the responsible fishing governance should consider making the entire Gulf of Nicoya a single large AMPR. However, it would be necessary to assure that fishers are not further marginalized due to gear restrictions that result in smaller catches, lower incomes and conflicts. It is firstly important to analyze the impact of these types of policy decisions in the livelihoods of fishing communities and if government agencies in charge would have enough resources to comply with management tasks (e.g. social and biological monitoring, enforcement). More biological monitoring is also needed to analyze the impact of the

AMPRs on conservation related to sustainable fish catches overtime, as well as socioeconomic changes and the role of growing demand for fish products and higher prices on fishing behavior.

## 5.2. SES framework application

The application of the SESF has been useful as a diagnostic tool for structuring data collection and conducting a content analysis. In line with other studies, it is particularly useful for small-scale fisheries, and for guiding data collection for observational research and the analysis of qualitative data (Partelow et al. 2018). However, many challenges remain for its application (Partelow 2018). One challenge is analyzing the interactions between variables. It is important to recognize that many variables interact, often in complex, nonlinear and unpredictable ways (Liu et al. 2007), but focusing on their interactions is relevant for unpacking SES dynamics and a key next step for future research. Another challenge is that there are still many methodological steps and gaps that make comparison difficult such as how each variable is defined, the indicators used for measurement, or observation methods for data collection and how data is analyzed and transformed or coded (Partelow 2018). Similar challenges have been presented in other studies in relation to a lack of standardization to measure the influence of variables (Schlüter and Madrigal 2012; Cox 2014). Nevertheless, this is what makes the SESF useful, its ability to be an adaptable tool. There is a methodological tradeoff between its adaptability and its ability to provide a common set of variables for systematic comparison. It is true that numerous methodological challenges exist for future applications of the SESF, however, exploring new methods and to convey these methods as transparently as possible will help learning and help to build a tool box of methods for its continued application.

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## Appendix

## Appendix 1: Indicators developed for the measurement of the variables.

Variable	Theoretical statement of CA	Source: adapted from	Ordinal value description
Clarity of system boundaries (RS2)	Clear spatial boundaries increase likelihood of CA. Easier to tell who is in or out, and to monitor	Ostrom 1990; Cox et al. 2010; Basurto et al 2013; Trimble and Berkes 2015; London et al. 2017	<b>Clear:</b> geographic and social boundaries are well-defined, making feasible to identify who is in or out <b>Partially:</b> geographic and social boundaries are not clear enough, but some structures (e.g. buoys) and limitations remain identifying who is in or out <b>Unclear:</b> unclear geographical and social boundaries make infeasible to identify who is in or out
Size of resource system (RS3)	Larger areas provide enough resource availability, increasing the likelihood of CA  Smaller areas are easier to monitor as transaction costs decrease, increasing the likelihood of CA.  Larger areas are difficult to monitor as transaction costs increase, decreasing the likelihood of CA	Ostrom 2009  Ostrom 2009	<b>Small:</b> Perception of a small-size resource system <b>Medium:</b> Perception of a medium-size resource system <b>Large:</b> Perception of a large-size resource system  <b>Small:</b> Perception of a small-size resource system <b>Medium:</b> Perception of a medium-size resource system <b>Large:</b> Perception of a large-size resource system
Operational rules (GS5)	Formal rules chosen by local actors are implemented, increasing the likelihood of CA	Basurto et al. 2013	<b>Present:</b> Rules are operating in a maximum or total degree <b>Partially:</b> Rules are still operating at certain degree <b>Absent:</b> Rules are operating in a minimum or null degree
Collective-choice rules (GS6)	Allowance of local actors (i.e. fishers using multiple gear types) to participate in designing or modifying rules increases the likelihood of CA	Ostrom 1990; Cox et al. 2010	<b>Low:</b> Participation of local actors in decision making is minimal or null <b>Medium:</b> Participation of local actors in decision making is moderate <b>High:</b> Participation of local actors in decision making is maximal

Appendix 1: (continued)

Variable	Theoretical statement of CA	Source: adapted from	Ordinal value description
Monitoring and sanctioning (GS8)	Presence of monitoring and graduated sanctioning mechanisms facilitate rule compliances and increases the likelihood of CA	Ostrom 1990; Pomeroy <i>et al.</i> 2001	<b>Absence:</b> Minimal efforts are taken to patrol illegal activities within the AMPR, and to apply graduated sanctions for assuring rule compliance. <b>Partially:</b> Efforts are taken but not enough to patrol illegal activities within the AMPR. Enforcement and gradual sanctions mechanisms are sometimes applied with actors that disrespect rules. <b>Presence:</b> Constant efforts are taken to patrol illegal activities within the AMPR. Enforcement and gradual sanctions mechanisms are applied with actors that disrespect rules.
Number of actors (A1)	As the number of actor groups increases, it is more likely that they have heterogeneous interests and practices, making it more difficult to create consensus and agreements. This decreases the likelihood of CA	Vedeld 2000; Ostrom 2009; SESMAD 2014	<b>Small:</b> Description of reduced group size with common interests <b>Medium:</b> Description of moderate-size group with some common interests <b>Large:</b> Description of an extensive group size with different interests
Socioeconomic attributes (A2)	As the number of actor groups increase, transaction costs (i.e. monitoring, communication and coordination) increase. This decreases the likelihood of CA  Economic heterogeneity increases the likelihood of CA (i.e. Wealthy actors can afford transaction costs or invest)	Ostrom 2009  Poteete and Ostrom 2004	<b>Small:</b> Description of reduced group <b>Medium:</b> Description of moderate-size group <b>Large:</b> Description of an extensive group size  <b>Low:</b> Economic wealth is very similar among actors <b>Medium:</b> Economic wealth is more or less similar <b>High:</b> Economic wealth of actors is different among actors

## Appendix 1: (continued)

Variable	Theoretical statement of CA	Source: adapted from	Ordinal value description
History and past experiences (A3)	High frequency of negative experiences with management affects actors' behavior, decreasing the likelihood of CA	Torres Guevara et al. 2016; London et al. 2017	<b>Low:</b> negative experiences among actors have rarely occurred and have not significantly affected actors' behavior <b>Medium:</b> negative experiences among actors have often occurred and has affected actors' behavior but not significantly <b>High:</b> negative experiences among actors have occurred more frequently and have significantly affected actors' behavior
Location (A4)	Actors located far apart increases transaction costs (e.g. monitoring, getting together, access to markets), decreasing the likelihood of CA	Ostrom 2009	<b>Close:</b> Description that location of actors is proximate to each other <b>Far:</b> Description that location of actors is distant from each other
Leadership/ entrepreneurship (A5)	Strong leadership and entrepreneurial skills increase the likelihood of CA	Vedeld 2000; Pomeroy et al. 2001; Ostrom 2009; Gutiérrez et al. 2011	<b>Weak:</b> Lack of leadership skills, disagreement with leader actions or actors neglecting to follow leaders <b>Strong:</b> Presence of leadership skills has positive effect on requesting institutional support and being followed and respected by actors
Trust/social capital (A6)	High to moderate levels of confidence and close relationship among local actors is likely to increase CA	Cinner et al. 2012; Basurto et al. 2013	<b>Low:</b> Negative or little confidence, and/or conflictive relationship among actors <b>Medium:</b> Confidence and relationship among actors is intermediate <b>High:</b> Positive confidence or close relationship among actors
Dependence (A8)	High dependence on AMPR resources to obtain income and sustain livelihoods increases the likelihood of CA	Ostrom 2009; Basurto et al. 2013	<b>Low:</b> Negative or little dependence on AMPR fishing resources <b>Medium:</b> Intermediate dependence on AMPR fishing resources <b>High:</b> Positive or strong dependence on AMPR fishing resources