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**Diagnosing collective action in Small-Scale Fisheries for the  
establishment and management of Marine Areas of Responsible Fishing  
(AMPR) in the Gulf of Nicoya, Costa Rica.**

By

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## **LIST OF ACRONYMS, ABBREVIATIONS AND UNITS**

AJDIP: Acuerdo Junta Directiva INCOPESCA

AMPR: Área Marina de Pesca Responsable (Marine Areas of Responsible Fishing)

BID: Banco Interamericano de Desarrollo (Inter-American Development Bank, IDB)

CA: Collective action

COLOPES: Comité Local de Pescadores (Local Fishers Committee)

CopeSoliDar R.L.: Cooperativa Autogestionaria de Servicios Profesionales para la Solidaridad Social R.L.

CPR: Common-Pool Resource

EEZ: Exclusive Economic Zone

IAD: Institutional Analysis and Development

IMAS: Instituto Mixto de Ayuda Social (Joint Institute of Social Assistance)

INA: Instituto Nacional de Aprendizaje (National Learning Institute)

INCOPESCA: Instituto Costarricense de Pesca y Acuicultura (Costa Rican Institute of Fisheries and Aquaculture)

INDER: Instituto Nacional de Desarrollo Rural (National Institute of Rural Development)

Km: kilometers

LOSO: Likelihood of Self-Organization

MAG: Ministerio de Agricultura y Ganadería de Costa Rica (Ministry of Agriculture and Livestock)

MINAE: Ministerio de Ambiente y Energía (Ministry of Environment and Energy)

MMA: Marine Management Areas

MPA: Marine Protected Areas

NGO: Non-Governmental Organization

POP: Plan de Ordenamiento Pesquero (Fisheries Management Plan)

SES: Social-Ecological System

SINAC: Sistema Nacional de Áreas de Conservación

SNG: Servicio Nacional de Guardacostas (National Coast Guard Service)

SSF: Small-Scale Fisheries

UNA: Universidad Nacional de Costa Rica (National University of Costa Rica)

## **Abstract**

Costa Rican institutional efforts for addressing fishing resource overexploitation have been diversified over the years, with the latest measures involving local communities in their management. Marine Areas of Responsible Fishing (AMPRs) were created under the vision of sustainable resource use through involvement of local coastal communities in decision making and management, together with governmental institutions.

Three AMPRs in the Gulf of Nicoya, Costa Rica, are examined in this thesis to understand factors that promoted their creation and to comprehend the factors that have facilitated or hindered collective efforts in coastal communities involved in AMPR management. The Social-Ecological System (SES) framework was applied in the analysis, to facilitate the identification and comparison of factors influencing collective action in the management of AMPRs.

Factors such as perception of fishing resources scarcity and high dependence on these resources were shown to influence self-organization and collective efforts for the creation of three AMPRs. Although some commonalities in factors were found to be influencing collective action positively or negatively in the management of the AMPRs, such as mistrust among actors and negative past experiences, lack of governmental support or resource mobility, differences were also found in the type of factor or in the intensity a factor was manifested, such as monitoring and graduated sanctioning mechanisms applied or the presence of leadership, which have made collective action characteristic in each AMPR. The importance of addressing problems with suitable strategies according to each context is mentioned, for the success of these measures over time.

**Key words:** Co-management, Social-Ecological System, Common-Pool Resources, governance.



## **Resumen**

Los esfuerzos institucionales de Costa Rica para abordar la sobreexplotación de recursos pesqueros se han ido diversificando a lo largo de los años, con las últimas medidas que involucran a las comunidades locales en la gestión. Las Áreas Marinas de Pesca Responsable (AMPR) se crearon bajo la visión del uso sostenible de los recursos a través de la participación de las comunidades costeras locales en la toma de decisiones y la gestión, junto con las instituciones gubernamentales.

En esta tesis se examinan tres AMPRs en el Golfo de Nicoya, Costa Rica, para comprender los factores que promovieron su creación y los factores que han facilitado u obstaculizado los esfuerzos colectivos en las comunidades costeras involucradas en la gestión de las AMPR. El marco del Sistema Socio-Ecológico (SES) se aplicó en análisis, para facilitar la identificación y comparación de los factores que influyen en la acción colectiva en su manejo.

Se ha demostrado que factores como la percepción de escasez de recursos pesqueros y la gran dependencia hacia estos recursos influyen en la autoorganización y los esfuerzos colectivos para la creación de tres AMPR. A pesar que se encontraron algunos factores comunes que influyen positivamente o negativamente en la gestión colectiva de las AMPR, como la desconfianza entre los actores, experiencias pasadas negativas, la falta de apoyo gubernamental o la movilidad de recursos, también se encontraron diferencias en el tipo de factor o en la intensidad con que se manifestó un factor, como el monitoreo y los mecanismos de sanción gradual aplicados o la presencia de liderazgo, que han hecho a la acción colectiva característica en cada AMPR. Se menciona la importancia de abordar los problemas con estrategias adecuadas de acuerdo con cada contexto, para el éxito de estas medidas a lo largo del tiempo.

# 1. Introduction and research synthesis

## 1.1 Introduction

Small-Scale Fisheries (SSF) represent half of fish captures in the world from coastal and freshwater ecosystems, mainly in developing countries. Ninety percent of all fishers worldwide are livelihood dependent on SSF, which provide an important food supply, economic incomes and support to local economies by trading in national or international markets (FAO 2015). In Costa Rica, about 94 percent of around 12,200 small-scale fishers<sup>1</sup> are on the Pacific coast (Beltrán Turriago 2013, FAO 2014), mainly settled in the Gulf of Nicoya. These fishers are dependent on coastal-marine fishing resources within this productive zone to sustain their livelihoods and obtain economic incomes (Monge and Garita 2013). However, fishing has been affected by different factors, such as overfishing and inadequate management strategies, leading to a decrease on fish stocks and threats to local livelihoods (Fernández Carvajal 2013, Monge and Garita 2013).

Before the 1980s, records revealed fishing resources were beginning to be overexploited. During the decade, this problem worsened, partly by the promotion of government incentives and facilities provided to fishers for enhancing fishing sector development, mainly the industrial sector for shrimp harvesting (Porras 1993, Monge and Garita 2013), leading to an overharvesting of high-valued fishing resources (García Lozano and Heinen 2016). Afterwards, it has been related to the use of illegal fishing gear (Monge and Garita 2013), increases in fishing effort, fishery industrialization, non-compliance with seasonal closures for fish reproduction and harvest of juvenile fish and endangered species, to satisfy the high demand for fishing resources (Palacios *et al.* 1996, Fonseca and Solis 2005, Beltrán Turriago 2013, Monge and Garita 2013, Pacheco Urpí *et al.* 2013). Conflicts have worsened among different types of small-scale fishers and fisheries, such as industrial and sport fishing, increasing resource scarcity and compromised sustainability (Beltrán Turriago 2013, FAO 2014, 2015). In addition, pollution and climate change effects are other factors negatively affecting their sustainability (Fonseca and Solis 2005, FAO 2015).

Different efforts have been carried out in Costa Rica to protect marine ecosystems from degradation over the last 50 years (Alvarado *et al.* 2012). Marine Protected Areas (MPAs) were established in the 1970s and they are currently managed through the National Conservation Area System (SINAC for its acronym in Spanish), a decentralized unit in the Ministry of Environment and Energy (MINAE for its acronym in Spanish). Even though MPAs have achieved resource conservation and development of tourism activities (Madrigal-Ballesteros *et al.* 2017), some negative results have been recognized such as not

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<sup>1</sup> SSF in Costa Rica are defined as fishing carried out in an artisanal manner by physical persons, with the use of non-mediated vessels in inland waters or in the coastal zone, or practiced on board a vessel with autonomy to fish up to three nautical miles from Costa Rican territorial seas, according to the Fish and Aquaculture Law of Costa Rica N° 8436 of 2005.

integrating local communities and their displacement in populated settlements. Conflicts for resource access and illegal fishing remain, and government institutions have not been able to follow every process (Alvarado *et al.* 2012, Solis Rivera *et al.* 2012, Weber de Morais 2017).

Other recent strategies allowing moderate resource extraction and involving local communities in management were developed by MINAE in 2008, such as the creation of Marine Management Areas (MMA) that include artisanal fishers in management design, the promotion of tourism and the allowance of certain fishing activities (Fargier *et al.* 2014). Afterwards, Marine Areas of Responsible Fishing (AMPR for its acronym in Spanish) were legally created in 2009 by the Costa Rican Institute of Fisheries and Aquaculture (INCOPECA for its acronym in Spanish), a decentralized unit of the Ministry of Agriculture and Livestock (MAG for its acronym in Spanish), in charge of regulating the Exclusive Economic Zone (EEZ) (Fargier *et al.* 2014).

AMPRs were created as a non-formalized co-management strategy (García Lozano and Heinen 2016) to minimize fishing resource overexploitation. Co-management is a governance system where communities and government authorities share functions in resource management (Jentoft 2000). In AMPRs, it has consisted of promoting the sustainable use of fishing resources over time, involving local communities in decision making for the restriction of fishing gear and activities with more impact on marine resources. Participation of communities in management, such as conducting their own monitoring and enforcement of rules, was attempted with complementary support from governmental institutions (Decree No. 35502 2009, Salas *et al.* 2012, Ayalez Cruz *et al.* 2013, Fargier *et al.* 2014, García Lozano and Heinen 2016, Weber de Morais 2017). Fishers and local communities are expected to self-organize into associations to request the creation of an AMPR and have an authorized function in resource management.

With the creation of AMPRs, some achievements in the recovery of fish stocks and some endangered species, less presence of illegal fishing gear, an increase in community advocacy and development of alternative livelihoods have been perceived by the local actors involved (Ayalez Cruz *et al.* 2013). However, some difficulties in achieving responsible fishing management have been identified. Low participation of fishers and communities, as well as lack of support and coordination with governmental organizations, has created challenges. Conflicts and competition among internal and external fishers, the use of illegal gear and local opposition to regulations remain (Salas *et al.* 2012, Ayalez Cruz *et al.* 2013, García Lozano and Heinen 2016, Weber de Morais 2017).

Although the AMPR model for governance is applied similarly across all cases, it is applied in different social-ecological contexts, where unique interactions in each community lead to different management outcomes for each case (Ostrom and Cox 2010).

This demonstrates the need to understand the factors could positively or negatively influence whether or not collective action is successful in the management of the AMPRs in their context and what could make them differ. This also relies on the importance of addressing problems according to each situation and avoiding strategies based on common solutions or panacea policy approaches, which have resulted in management failures (Ostrom 1990).

The research is focused on recognizing the unique Social-Ecological System (SES) components and their interactions in each case to identify their influence on self-organization, a key component of AMPR management. Some studies have been developed to comprehend the reasons why some systems are unstable due to failures of collective action, while others have succeeded and solved resource depletion due to individuals' ability to cooperate (Basurto and Ostrom 2009, Ostrom 2009). Some positive factors were related to effective conflict resolution, monitoring and sanction mechanisms, appropriate communication among group members and other organizations, rules and arrangements accomplishment (Ostrom 1990, Anderies *et al.* 2004, Cox 2014), and other factors. But factors such as low cost-benefit ratios (Acheson 2006), lack of leadership, conflicts, mistrust among actors and resource mobility were more likely to hinder collective action in a local context (Poteete and Ostrom 2004, Ostrom 2009).

A framework based on the work from Ostrom and other researchers has been developed and adapted as a diagnostic tool to analyze multiple types of SESs, through a set of variables potentially affecting collective action (Ostrom 2007, 2009, Ostrom and Cox 2010). Framework applications have been useful to identify specific factors that promote or weaken collective action in cases of irrigation systems (Cox 2014), fisheries (Basurto *et al.* 2013, García Lozano and Heinen 2016, Torres Guevara *et al.* 2016) and other diverse common-pool resource cases (Hinkel *et al.* 2015).

Therefore, an adapted version of the SES framework from McGinnis and Ostrom (2014) has been applied, to diagnose the main factors influencing collective action in each AMPR in the study. This study provides key information to comprehend the reasons why small-scale fishers have taken action collectively or not, in order to manage fishery resources sustainably in each AMPR, and to understand if collective action differs among AMPRs and the main reasons why. Data from this study could be useful for stakeholders, providing the knowledge needed to find solutions to better enable collective action (Hinkel *et al.* 2015), as well, for addressing future problems within each AMPR.

## **1.2 Research Objectives**

### **1.2.1 General objective**

Identify the main factors that influence collective action in Small-Scale Fisheries for the establishment and management of three AMPRs

## 1.2.2 Specific objectives

- Identify the main factors that promoted the establishment of the AMPRs
- Determine the main factors that facilitate or hinder collective action efforts in AMPR management
- Compare the main factors influencing collective action in the management of three AMPRs

## 1.3 Research questions

	Specific objectives	Research questions
1	Identify the main factors that promoted the establishment of three AMPRs	What main factors promoted the establishment of three AMPRs?
2	Determine the main factors that facilitate or hinder collective action efforts in AMPR management	Which main factors facilitate collective action efforts for the management of three AMPRs?
		Which main factors hinder collective action efforts for the management of three AMPRs?
3	Compare the main factors influencing collective action in the management of three AMPRs	Which are the main similarities of factors influencing collective action in the management of three AMPRs?
		Which are the main differences of factors influencing collective action in the management of three AMPRs?

## 1.4 Theoretical framework

Common-Pool Resources (CPR), such as forests or fisheries, face difficulties in excluding other users from harvesting (low excludability), where the extraction of one resource unit from one user affects the availability to other users (high subtractability) (Ostrom 1990, Anderies and Janssen 2013, Hinkel *et al.* 2015). Overexploitation of CPRs was assumed to occur when no clear property rights<sup>2</sup> were established (open access) or a centralized regulating mechanism was lacking (formal institutional rules) (Ostrom *et al.* 1994, Acheson 2006). This situation was explained under a hypothetical scenario, immersed in a social dilemma<sup>3</sup>. When individual harvesting interests were prioritized over the collective benefit (Hardin 1968, Ostrom 1990), the extraction of high quantities of resources would inevitably lead to depletion, known as the *tragedy of the commons* (Hardin 1968).

<sup>2</sup> Property rights refer to who owned the right to use or control determined resources (Meinzen-Dick and di Gregorio 2004)

<sup>3</sup> Social dilemma is referred as the conflict between short-term self-interest and longer-term collective interest (Van Lange *et al.* 2013).

Under this context, property rights systems such as private ownership or centralized management of CPRs were promoted to exclude users or regulate access (Hardin 1968, Acheson 2006), as a common solution to address resource depletion, assuming local users were not capable of self-organizing and creating institutions to avoid tragedy (Hardin 1968, Ostrom 1990, Anderies *et al.* 2004, Ostrom *et al.* 2007). However, Ostrom *et al.* (2007) refers to privatization and centralized state control as a panacea, a generic governance solution applied to all environmental problems, assuming problems, users and the system they are immersed in are similar. Studies revealed the failure of panaceas to sustainably manage CPRs in certain cases, e.g. when imposed government policies were not adapted to fit the system, which were not capable of excluding other users, increasing conflicts among them (Basurto *et al.* 2012, Alvarado *et al.* 2012). Other cases were related to overcapitalization and overexploitation of resources under private systems, showing that the application of these measures could not be suitable in every case (Acheson 2006).

Researchers such as Elinor Ostrom have studied different community-based CPR cases within irrigation systems, fisheries or forests in different countries, to show that communities were capable of avoiding tragedy and overexploitation by self-organizing. Communities that self-organized could resolve social dilemmas and manage CPRs sustainably, confronting Hardin's theory (Ostrom 1990, Anderies and Janssen 2012). Some other researchers have shown that collective CPR management can be effective in improving human wellbeing and in recovering, protecting and sustainably managing marine fishery resources (Basurto *et al.* 2012, 2013, Anderies and Janssen 2013, Méndez-Medina *et al.* 2015, Calvo-Ugarteburu 2016), overcoming CPR depletion and social dilemmas (Ostrom 1990, Agrawal 2001, Dietz *et al.* 2003, Dietz and Henry 2008).

However, different factors such as lack of communication and confidence among users, non-concerted rules, lack of monitoring and sanctioning mechanisms, resource mobility, high costs of self-monitoring, and others, were negatively influencing collective action (Ostrom 1990, 2009, Ostrom *et al.* 1994, Hinkel *et al.* 2015). Also, many individuals often do not participate in collective efforts and are difficult to exclude from benefitting from the work of others (Ostrom 1990). As a result, collective benefit is not achieved, leading to overharvesting and CPR depletion (Ostrom *et al.* 1994). On the other hand, overexploitation was diminished when factors such as clear rules, graduated sanctioning mechanisms, conflict resolution and participatory mechanisms were effective (Ostrom 1990, Ostrom *et al.* 1994, Cox 2014), and factors such as leadership (Vedeld 2000) or trust among actors (Cinner *et al.* 2012) were present.

Many of these factors are now included as variables in the Social-Ecological System (SES) framework, which was developed to analyze variables that may influence the successful management of CPRs that can be characterized more broadly as SESs (Agrawal 2001, Anderies *et al.* 2004, Anderies and Janssen 2012). SESs consist of linkages or

interactions between the ecological and social system. Specifically, it is related to the impact of human action (e.g. resource use) in *biophysical or non-human biological* components and their outcomes. They are characteristically complex and dynamic and could be affected by internal variations in social or ecological components, or external factors such as socioeconomic changes or natural disturbances, which generate changes in the system interaction (Anderies *et al.* 2004). To contextualize SES interactions, a framework was designed to orient and facilitate researcher comprehension when studying diverse and complex SESs (Ostrom 2009, Epstein *et al.* 2013). One of the forerunners for designing the SES framework was Ostrom's eight design principles for achieving self-organization, after studying community-based regimes cases (Ostrom 1990).

Ostrom in 2007 compiled sets of variables that were influencing SES interactions (I) and outcomes (O) considering four main attributes, composed of second interdependent variables which can be useful in analyzing a specific system unit. Also, external influences were considered to be social economic and political settings (S) and related ecosystem (ECO) (Ostrom 2007), which could affect or disrupt the four main attributes dynamic (Anderies *et al.* 2004). The SES framework has changed over time to more structured versions such as that of McGinnis and Ostrom (2014), which incorporates a larger number of variables to explain SES interactions with systems, subsystems and the outcomes that could be generated from interactions.

Ostrom in 2009 adjusted and included some second variables and selected ten of the variables influencing the Likelihood of Self-Organization (LOSO) for maintaining the sustainability of a resource system. Most recent framework modifications are from McGinnis and Ostrom in 2014, based on Ostrom's framework (2007, 2009). The proposal was a new scheme of interactions among the four main SES variables (Figure 1), considering interactions taking place in action situations that lead to certain outcomes. The possibility that a first-tier variable could be manifested in multiple forms was enlightening, and included suggestions of second variables to facilitate researcher analysis of any SES.

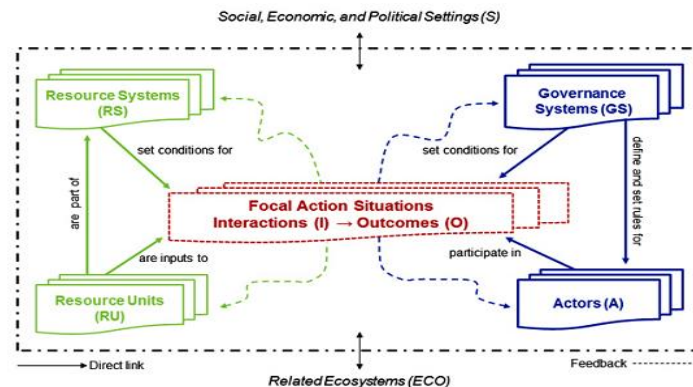


Figure 1. Social-ecological system framework. Source: McGinnis and Ostrom (2014).

The framework is considered a useful tool in facilitating comprehension of SES complexity through the analysis of the interactions among SES attributes and how they affect outcomes (Ostrom 2009, Ostrom and Cox 2010, Hinkel *et al.* 2015). It could be applicable in analyzing diverse SES types, and the research results could be a common language between scholars in different disciplines (Ostrom and Cox 2010, McGinnis and Ostrom 2014, Hinkel *et al.* 2015).

Diagnosing interactions in specific SESs provides information about prior variables affecting self-organization and challenges to achieve resource systems sustainability (Ostrom *et al.* 2007, Ostrom 2009). Moreover, it facilitates comparison of different SES cases with the use of first and more in-depth tier variables to build more precise theories, and to develop a diagnosis for designing suitable strategies to resource depletion problems (Ostrom and Cox 2010). Identifying sustainability and governance challenges and designing policies or strategies to minimize resource system overexploitation is relevant to proposing specific and effective solutions according to each SES situation (Hinkel *et al.* 2015, Partelow 2015), in order to achieve its sustainable management (Ostrom 2007) and avoid the prescription of a common solution, which could worsen SES situations (Ostrom *et al.* 2007, Ostrom and Cox 2010).

To some researchers, the SES framework reflects challenges for an integral evaluation of SES. The framework has been criticized because it emphasizes the role of social system variables over ecosystem variables (Epstein *et al.* 2013, Vogt *et al.* 2015). Also, some dynamics or interactions among main variables are not considered (Hinkel *et al.* 2015). Some variables are ambiguous and standardization for measuring is lacking (Schlüter and Madrigal 2012, Cox 2014). However, many study cases have been developed based on the SES framework to analyze sustainability and collective action in different SESs, demonstrating that it is a general framework for understanding SES processes and complexity (Ostrom 2009) and specifically variables affecting self-organization to manage resources sustainably in marine fisheries (Schlüter and Madrigal 2012, Basurto *et al.* 2013, Partelow and Boda 2015, García Lozano and Heinen 2016) and other contexts (Epstein *et al.* 2013, Cox 2014, Hinkel *et al.* 2015).

The SES framework has been applied and useful in continuing the building of the theory of collective action in fisheries, identifying factors enhancing the LOSO, such as the presence of local leaders, effective monitoring and graduated sanctioning mechanisms (Ostrom 1990, Pomeroy *et al.* 2001, Basurto *et al.* 2013), a high dependence on resources (Varughese and Ostrom 2001), and others. In addition, factors decreasing the LOSO and increasing conflicts among fishers have been related to high resource mobility (Basurto *et al.* 2013, Hinkel *et al.* 2015), low predictability of the resource system (Ostrom 2009), and low levels of trust and reciprocity between community members (Basurto *et al.* 2013), among others.



## 1.5 Results Synthesis

Factors influencing collective action were identified in three study cases. Information was coded according to SES framework variables, and their influence in each AMPR was described. AMPRs were created in Costa Rica to promote sustainable management of fishing resources, with the involvement of government institutions such as INCOPECSA in charge of fishery regulations, the National Coast Guard Service (SNG) in charge of patrolling Costa Rican waters, and local communities in different management roles, with possibilities for NGOs or research centers to participate (Ayalez Cruz *et al.* 2013, Fargier *et al.* 2014, García Lozano and Heinen 2016). Each AMPR was created in a different year and each has developed its own fisheries management plan with specific goals and rules.

Common purposes for AMPR creation were identified, such as the restriction of fishing gear or activities that have a significant impact on fishing grounds and fishing products availability, in order to make resource use sustainable over concerns about resource overexploitation in the gulf. Other common purposes were to certify fishing products from AMPRs to receive a higher market value for sustainably caught fish, controlled by community-managed collection centers promoted by NGOs such as MarViva. Development of alternative livelihoods such as tourism and aquaculture projects was also contemplated.

Nevertheless, area management has been distinctive at each site since their establishment. In Isla Caballo AMPR, the smallest AMPR by size, fishers are no longer active in area management. Motivations to self-organize were low, as physical area boundaries were not followed or enforced as agreed. Direct dependence on area resources was low related to fish mobility, rules were not respected and people were threatened during surveillance, and alternative projects were not developed for lack of basic services. Thus, goals have not been achieved and fishers have expressed that the AMPR is not functional.

Palito-Montero AMPR was created to exclude fishing gear other than hand-lines and to protect fishing grounds of economic importance. Efforts began in Palito before the AMPR was established, due to these reasons. Some factors enhancing collective action were identified such as self-organized night-time surveillance and informal sanction mechanisms to assure rule compliance and the availability of fish over time. Factors such as low trust among fishers from past experiences, disagreements with leaders or internal conflicts have hindered collective action. An increase in productivity has been achieved in the area with the measures taken, but it is constantly threatened by the high number of users, the presence of illegal gear and perception of the effects of climate change.

Distrito Paquera-Tambor AMPR is the largest AMPR in the gulf. Factors facilitating collective action were related to constant support by two non-fisher leaders as well as different types of support in funding and capacity-building from government agencies, NGOs and research centers, which have been more constant here than in other AMPRs.

Actors have developed participatory mechanisms for decision making, evaluation processes and constant communication using mobile phone applications for coordination. But low support in surveillance from authorities and local actors and conflicts among communities were some factors hindering collective efforts. Despite negative factors, fishers have expressed some changes in fish productivity, attributed to exclusion of certain gears and activities. Efforts have continued to achieve additional value for fishing products and promote tourism activities.

Key informants have expressed similarities in factors or situations negatively affecting AMPR management internally, finding some patterns or relationships in dependence on resource and resource mobility, negative past experiences, internal conflicts and mistrust. Some factors such as illegal fishing and the gulf overexploitation situation in general; fish mobility for migration; climate change; low support of government authorities in surveillance, enforcement and follow-up; fishing licenses not provided to fishers by INCOPECSA; and markets influencing price stability have been externally affecting collective action. But some factors have manifested differently in intensity, such as in leadership levels, frequency of monitoring activities, and conflictive relationships, factors that have made management characteristic at each site.

## **1.6 Conclusions and recommendations**

Factors such as high dependence on fisheries, the necessity to increase productivity and develop alternative livelihoods were some common issues that promoted the creation of AMPRs. However, factors influencing management of AMPRs were manifested in different manners according to each context, leading areas such as Isla Caballo AMPR to fail in its collective efforts. But areas such as Palito-Montero AMPR and Distrito Paquera-Tambor AMPR have continued collective efforts with varying ease and difficulty. Collective efforts have not been strongly influenced by group size, heterogeneity of actors or fishing gear in use.

Evaluating the capacity of institutions and local communities for organization or administration is important to strengthen human capacities and improve local conditions before implementation of management strategies or projects. This could be contemplated in the context of new AMPR creation proposals with different problems such as lack of capacity building and conflict resolution mechanisms, lack of financing for surveillance to assure exclusion of forbidden fishing gear, licenses denied to fishers as a requirement to fish in AMPRs or lack of property rights for land tenure to establish projects such as collection center, factors which have been negatively influencing collective efforts in management.

The failures of generic prescriptions to common resource management problems could be avoided by better understanding the complex and unique SES in each AMPR using a diagnostic approach. Governance could be better adjusted to context, increasing the

probability of achieving sustainability. Information obtained by diagnosis could be key for stakeholders in designing strategies and providing solutions more specific to each case as well as for future AMPR creation or other fishery programs.

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## **2. Diagnosing collective action in Small-Scale Fisheries for the establishment and management of Marine Areas of Responsible Fishing (AMPRs) in the Gulf of Nicoya, Costa Rica**

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### **Abstract**

Collective action theories have tried to explain factors affecting how and why actors work together to find sustainable solutions for resource management challenges. The Social-Ecological System (SES) framework is a set of variables shown to influence collective action for Common-Pool Resource (CPR) sustainability in the context of SESs. The framework has been applied in this research as a diagnostic tool to identify the main variables hindering or enabling collective action for the establishment of three Marine Areas of Responsible Fishing (AMPR for its acronym in Spanish) located in the Gulf of Nicoya, Costa Rica. The differences and similarities are compared between each of the three cases to advance our understanding of collective action theory in the context of Small-Scale Fisheries (SSFs) and to demonstrate how social-ecological differences between cases require contextually adapted policy approaches to increase the likelihood of fisheries success.

Results have shown that AMPR creation was promoted as a co-management regime among local communities and government agencies. High dependence on fishing resources and perception of resource scarcity were some main common variables influencing the actions for their establishment. However, differences were found in the type of factor or in the intensity a factor had on influencing collective action for AMPR management, as in the dependence on resources, the presence of effective monitoring and sanction mechanisms, and the presence of leadership. But factors such as mistrust among actors, internal conflicts, lack of governmental support and resource mobility were common factors more likely to hinder collective action. The importance of generating adequate governance strategies according to each context is mentioned, to ensure effective AMPR management over time.

**Key words:** Co-management, Social-Ecological System, Common-Pool Resources, governance.

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## 2.1 Introduction

Small-Scale Fisheries (SSF) represents the main livelihood for many marine-coastal communities around the world (FAO 2015). In Costa Rica, fishers and communities depend on this activity to obtain economic incomes and sustain their livelihoods, mainly in populated settlements along the Pacific Coast, such as the Gulf of Nicoya (Beltrán Turriago 2013). However, this activity has been threatened by decades of fishing resource overexploitation related to the development of different fishing sectors (Fernández Carvajal 2013) and promotion of some government incentives for their development (Porrás 1993). In addition, poverty and lack of alternative livelihoods, illegal fishing and low rule compliance, increases in fisher populations, high demand for commercial fishing resources (Pacheco Urpí *et al.* 2012) and harvest of under-sized fishing resources or breeding age individuals (Palacios *et al.* 1996), have been also associated with a decrease in fish stocks and the mature size of commercial species. Fishing efforts and conflicts among fishers have also been increasing (Pacheco Urpí *et al.* 2012, 2013, Fonseca and Solís 2005, Beltrán Turriago 2013).

Some governance systems based on co-management have been implemented by national government institutions to promote sustainable resource management and reduce overexploitation. Co-management consists of delegating different functions to communities and government agencies in resource management (Jentoft 2000). This governance system has decreased the cost of management by authorities, and local communities have shown more willingness to comply with the rules (Jentoft *et al.* 1998, Sutinen 1999) when being involved in decision making processes (Partelow 2015). In addition, more sustainable resource use has been noticed (Cinner *et al.* 2012).

In Costa Rica, regionalized AMPRs were recently promoted in 2009 as a co-management regime (Fargier *et al.* 2014, García Lozano and Heinen 2016b), wherein both state and community involvement in management is expected, in contrast to what is expected with top-down government regulation or private regimes (Carlsson and Berkes 2005). The Costa Rican Institute of Fishing and Aquaculture (INCOPECA, for its acronym in Spanish), a governmental institution in charge of regulating fishing activities, has promoted this measure to make sustainable use of fishing resources, in order to reduce overexploitation, conflicts among fishers and to promote alternative livelihoods (Decree N° 35502 -2009, Salas *et al.* 2012, Ayalez Cruz *et al.* 2013).

Fishers and local communities are requested to self-organize into a legal fisher association to participate in management, and to design a fishery management plan (POP for its acronym in Spanish) with an area proposal delimited by geographical coordinates, and the fishing gear and activities that they will allow under INCOPECA approval.

Fishing regulations are based on FAO guidelines for the code of ethics for Responsible Fishing (FAO 1995, Decree N° 35502 -2009). Associations must request financing for area maintenance and create a committee to follow processes in coordination with INCOPESCA. They must also guarantee rule compliance and report rule infractions, and create a surveillance committee for coordination with the National Coast Guard Service (SNG, for its acronym in Spanish) in enforcement, control and surveillance Decree N° 35502 -2009. Participation and support of other organizations is also considered (Decree N° 35502 -2009, Weber de Morais 2017).

Some coastal communities in Costa Rica have been organizing to create AMPRs and protect important fishing grounds (Pacheco Urpí *et al.* 2012). Some achievements in AMPRs have been perceived in the recovery of fish stocks and some endangered species, more community participation and development of alternative livelihoods, less presence of illegal fishing (Ayalez Cruz *et al.* 2013) and the banning of fishing activities such as shrimp trawling (Weber de Morais 2017). However, some difficulties in achieving responsible fishing and local management have not been exempted. Rule compliance and the use of legal fishing gear by both internal and external fishers is a challenge. Also, opposition of fishers to areas and their regulations, conflictive relationships and low coordination among fishers and communities, and lack of support and coordination with governmental organizations remain (Salas *et al.* 2012, Ayalez Cruz *et al.* 2013, García Lozano and Heinen 2016b, Weber de Morais 2017).

Existing literature has explained different factors influencing collective action to achieve sustainable resource management. Factors such as high to moderate levels of trust among users (Cinner *et al.* 2012), high dependence on resources (Varughese and Ostrom 2001, Ostrom 2009) effective monitoring and graduated sanctioning mechanisms (Pomeroy *et al.* 2001), clearly defined spatial and social boundaries (Ostrom 1990, Ostrom 1999, Pomeroy *et al.* 2001) and strong leadership (Vedeld 2000) increase the likelihood of collective action. But factors decreasing the likelihood of collective action were also identified. Larger groups with heterogeneity in interests (Vedeld 2000, Poteete and Ostrom 2004), low productivity of systems (Acheson 2006), high resource mobility (Ostrom 2009), erosion of social capital (Jentoft 2000), conflicts and rivalry among users (Poteete and Ostrom 2004), and lack of property rights regimes (Ostrom 2000, Anderies *et al.* 2004, Poteete and Ostrom 2004), led to failures in sustainable management and overexploitation was more likely to occur (Acheson 2006, Basurto and Ostrom 2009, Poteete and Ostrom 2004).

This paper aims to identify the potential factors influencing collective action for the establishment and management of three AMPRs (figure 2) in the Gulf of Nicoya, Costa Rica. Currently, there are seven AMPRs legally established in the gulf since 2009 (García Lozano and Heinen 2016b). The gulf is an estuary system located on the Pacific coast of Costa Rica, with an approximate area of 1550 km<sup>2</sup> (Pacheco Urpí *et al.* 2013). High value

fish, mollusks and crustacean species depend on this ecosystem to develop their life cycles (León 1973, Fernández Carvajal 2013). The inner gulf is surrounded by about 150 km<sup>2</sup> of mangrove forest (Gocke *et al.* 2001, Fernández Carvajal 2013). Islands such as Chira, Venado, Bejuco, Pan de Azucar and Caballo are distributed inside the gulf. It is subject to a dry season from December to April and a rainy season from May to November (Alvarado Sánchez *et al.* 2011).

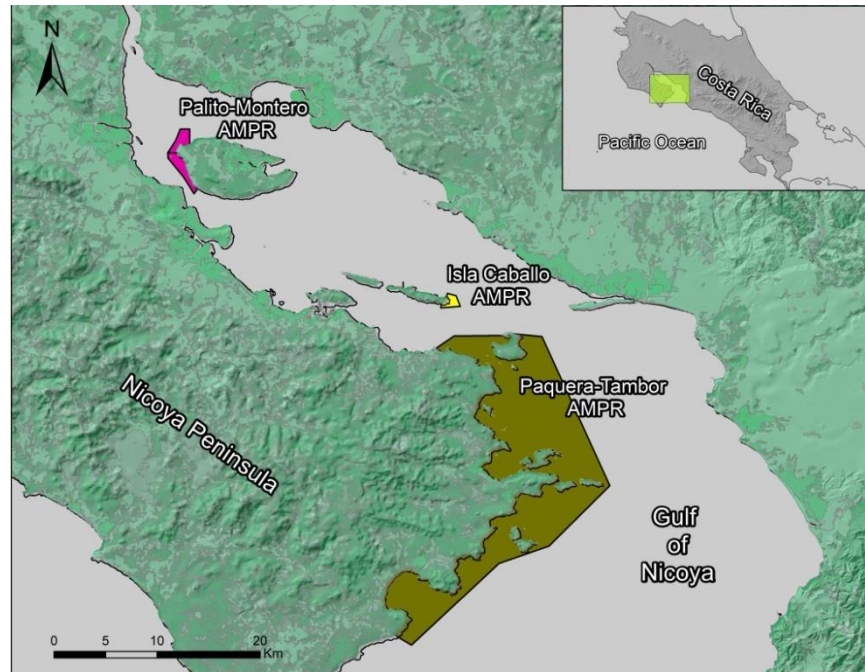


Figure 2. Map of AMPRs in study in the Gulf of Nicoya, Costa Rica. Source: this study.

The main economic activities of the coastal inhabitants are based on high-value fish, shrimp and mollusk harvesting, and aquaculture to a smaller extent (Alvarado Sánchez *et al.* 2011). The gulf, located on the Pacific Coast, is the main coastal-marine fishery zone of the country, with a high population of around 22 fishing communities and 11,000 fishers who depend on this activity to sustain their livelihoods. However, fishing resources have decreased due to overexploitation, affecting socioeconomic conditions of fishers and marine ecosystems (Pacheco Urpí *et al.* 2013). The importance of this research is immersed in the national context of promoting governance systems based on co-management such as AMPRs, to overcome fishing resource depletion and promote sustainable fishing practices. The role of local fishing communities in management is examined, to have a more in-depth understanding of the potential factors that could have been influencing self-organization positively or negatively for the management of the AMPRs. The Social-Ecological System (SES) framework was applied in this research as a tool to understand these factors.

The SES framework was proposed by Ostrom in 2007 to facilitate comprehension of complex interrelations between ecological and social variables and how they affect

outcomes in the context of self-organization (Ostrom 2009, Ostrom and Cox 2010, Hinkel *et al.* 2015). It provides information about prior variables affecting self-organization to achieve sustainability in resource management (Ostrom *et al.* 2007, Ostrom 2009). The SES framework is composed of four main variables: resource system (RS), resource unit (RU), governance system (GS), and actors (A), which could influence and be influenced by social, economic and political settings (S) or related ecosystems (ECO). An updated version of McGinnis and Ostrom (2014) was applied in this research (figure 3). Each main variable could be derived into second-tier variables and these could also be derived into more in-depth variables, in order have greater comprehension of the SES context and to answer research questions (Ostrom *et al.* 2007, Ostrom 2009).

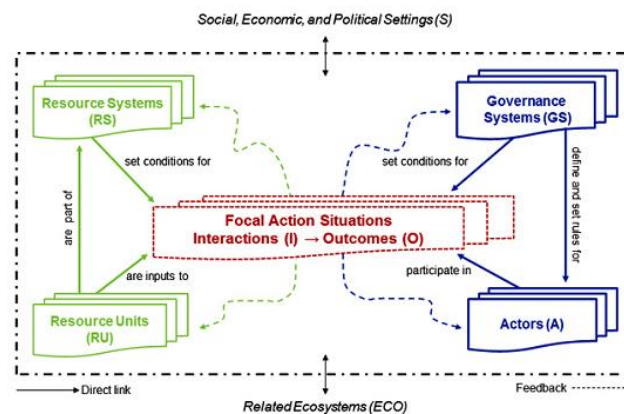


Figure 3. Social-Ecological System framework. Source: McGinnis and Ostrom (2014).

Diagnostic research through the application of the SES framework provides specific information on the main variables affecting collective action and sustainable resource management in a context (Ostrom *et al.* 2007, Ostrom 2009). During a diagnosis, general questions are developed based on higher levels of the framework and more specific questions could be developed at lower levels of the framework to detect and consider the relevant variables and their influence. Diagnosis allows specifying how information is structured from general to specific levels and formalizes this knowledge into ontologies (Frey and Cox 2015). This is useful in understanding governance challenges, in order to design suitable strategies to target resource depletion problems according to a specific SES context (Ostrom and Cox 2010, Hinkel *et al.* 2015, Partelow 2015). This contributes to avoiding the prescription of common solutions, known as *panaceas*, which could hasten resource depletion (Ostrom *et al.* 2007, Cox 2011).

On the other hand, some researchers have noted some problems in the use of the framework, such as ambiguity and a lack of standardized variable measurement (Schlüter and Madrigal 2012). Also, the development of more in-depth variables is lacking in formalization, which reduces possibilities for comparisons between study cases (Frey and Cox 2015). Moreover, the framework has been criticized for being focused mainly on social system variables (Vogt *et al.* 2015). Despite some difficulties in its application, it has

been useful to analyze diverse SES types, and the research results have been useful in building more precise theories of collective action, to be shared in a common language between scholars in different disciplines (Ostrom and Cox 2010, McGinnis and Ostrom 2014, Hinkel *et al.* 2015).

SES frameworks have been applied in coastal and marine ecosystem research to continue building collective action theory and to determine factors affecting sustainable management in fisheries. Basurto *et al.* (2013) found that low trust among actors, low leadership and internal conflicts are negatively influencing collective action for benthic resource management in Chile and Mexico. Torres Guevara *et al.* (2016) found that mistrust, violence and low economic development were factors decreasing collective action efforts in the Colombian Caribbean, mentioning the relevance of more consideration of socioeconomic and political settings variables in research. London *et al.* (2017) also found that internal conflicts and heterogeneity of interests were negative influences, but the presence of leadership and high dependence on resources were factors enhancing collective action in SSF in Argentina. Furthermore, government support in enforcement, effective monitoring and sanctioning mechanisms have been relevant for resource management (London *et al.* 2017)

With this research, we intend to apply the SES framework to continue testing hypotheses related to collective action theories in SSF, determining factors influencing collective action for co-management in the AMPRs with an emphasis on the role of local communities in management. Thus, this thesis is guided by three research questions: 1) Identify the factors that led local communities to organize and create an AMPR, 2) identify the main factors facilitating or hindering efforts for co-management, and 3) compare the main differences and similarities of influencing factors among the three AMPRs. Second and third-tier variables were developed. McGinnis and Ostrom (2014) argued researchers would keep modifying the SES framework, adding elements for applying the framework to different contexts, as adapted by other researchers (Epstein *et al.* 2013, Partelow and Boda 2015, Vogt *et al.* 2015) to give responses to research questions.

## **2.2 Methods**

### **2.2.1 Exploratory research to guide case selection**

Field research was developed from November 2016 to May 2017 in the Gulf of Nicoya. Three of seven AMPRs in the gulf were selected after exploratory research in all seven sites for appropriate cases. The AMPRs selected are Palito-Montero AMPR and Isla Caballo AMPR, located around islands; Distrito Paquera-Tambor AMPR, located by the mainland, as seen in Figure 2. Study cases were selected based on the most different cases method (Seawright and Gerring 2008), according to information obtained in preliminary open-ended interviews (Annex1) developed with main local key informants, in order to

have an overview of potential factors influencing collective action. Observation protocols were also developed as a guide to visually identify and record the potential factors (Annex 1) (Newing 2011, Creswell 2014). Qualitative documents were reviewed (Newing 2011), to have a brief overview of AMPRs' context, history and current situation.

Cases with a larger number of differences were selected based on their social and ecological diversity, in order to test collective action theory related to the variables that could potentially influence collective action, such as group size, homogenous or heterogeneous groups, resource system size, and others. Also, to give response to research question making a comparison of the similarities and differences of factors having an influence in the three AMPRs. Annex 2 shows some of the aspects considered in the selection of cases in more detail.

### **2.2.2 Data collection**

A diagnostic approach was used with the development of broader general questions from the first approach in the field, to more in-depth questions in later approaches, for identifying the main variables and situations affecting collective action in each area (Cox 2011). Semi-structured interview protocols were designed for key informants and local actors, based on SES framework variables as a guide for diagnosing collective action. Standardized questions were considered in more general questions to assure comparison among the AMPRs. Snow-ball sampling was selected as a methodology for targeting informants, considering different multiple entry points into the social network of individuals (Newing 2011, Soares and Gutiérrez 2011). The information gathering stopped when sample saturation was reached, meaning that no new information was added or referred people were repeated. Free, prior and informed consent was done before conducting interviews (Newing 2011).

Governmental institutions such as INCOPECA and SNG were asked about their functions related to fishery context and AMPR management. These and other institutions such as the National Learning Institute (INA, for its acronym in Spanish), the National Institute of Rural Development (INDER, for its acronym in Spanish), and the Joint Institute of Social Assistance (IMAS, for its acronyms in Spanish) were also asked about their participation and knowledge of the AMPR situation. Non-governmental institutions such as MarViva, CoopeSoliDar R.L. and the research center at the National University of Costa Rica (UNA, for its acronym in Spanish) were asked about their influence on or support to AMPRs and their perception of the management situation.

Association leaders within AMPRs were asked about organization history and progress, the purpose of AMPR creation, and the ease or difficulty of management it, among other aspects. Fishers were asked about their participation and organization in AMPR management, perspectives of AMPR situation and fishing activities held in the AMPR. Fishers and leaders were mostly targeted as individuals and not as a group, due to

the conflict cases mentioned or the distance between them. Other entities that could provide information were also considered, such as development associations or fish collection centers. More in-detail interview protocols are shown in Annex 3. A total of 126 semi-structured interviews were conducted with different informants approached as seen in Table 2. More detailed information on informants is provided in Annex 4.

Table 1. Semi- structured interviews conducted during field research.

Informant Sector	Total Semi- structured interview	Association / <u>local</u> leaders	Fishers	Other associations/ institution	Collection centers
Isla Caballo AMPR	24	3	16	3	2
Palito-Montero AMPR	38	15	19	2	2
Distrito Paquera -Tambor AMPR	48	13	31	2	2*
External institutions, NGOs, research centers, others	13				
External collection centers	3				
<b>Total</b>	126				

Qualitative observations were also made, which consisted of recording information observed on activities conducted by individuals or groups (Newing 2011, Creswell 2014) throughout the fieldwork, such as surveillance, meetings or fishing activities. Informal interviews (Newing 2011) were also held with local fishers during fishing or management activities, to have a complementary understanding of each AMPR situation. Qualitative documents were also reviewed (Creswell 2014), which included published articles, institutional research, laws and decrees, and grey literature, to obtain more complete information for the study case and to contrast it with qualitative interviews.

### 2.2.3 Data analysis

Data was triangulated with different information sources specified previously to validate their context (Creswell 2014). Data from different sources was coded according to the SES framework with first and second tier-variables. Third tier-variables were developed according to AMPR context in cases where second-tier variables manifested multiple dimensions (McGinnis and Ostrom 2014), to differentiate or be more specific on the influence of certain more in-depth variables (Frey and Cox 2015). As an example, the third-tier variable ‘surveillance’ was developed and named in the context of the second-tier variable ‘Monitoring and sanctioning rules’, to reflect that the influence of the ‘surveillance’ variable differed from ‘sanctioning’ variable. Also, the word ‘monitoring’ was replaced with ‘surveillance’, which was more likely to be understood and related to

patrolling and control by informants. Codes were cross-checked with ones developed in other research (Creswell 2014) with coded SES framework variables (Basurto *et al.* 2013, McGinnis and Ostrom 2014, Partelow and Boda 2015, London *et al.* 2017). The adapted variables are specified in Annex 5.

Comparison tables were developed based on the main variables that positively or negatively influenced collective action in three AMPRs. Indicators were developed during comparison data analysis based on informant perceptions recorded in the interviews (Newing 2011), to categorize the value of each variable and determine its influence on collective action. The values were interpreted in ordinary categories as low-medium-high. For example, a value of 'low' was attributed when informants expressed a negative answer to a situation affecting collective efforts for management. More in-depth indicators are shown in Annex 6.

In order to make cases comparable in this research, collective action influence was determined in decreasing-increasing categories, depending on the value of the variable for each AMPR. When a variable had a positive influence on collective action it was designated 'increasing' while a variable representing a negative influence was designated 'decreasing'. The values to determine collective action were contrasted with measurements suggested in different case studies examining collective action (Ostrom 1990, Ostrom 2009), the Social-Ecological Systems Meta-Analysis Database (SESMAD) (Cox 2014), and fisheries research (Pomeroy *et al.* 2001, Cinner *et al.* 2012, Basurto *et al.* 2013).

### **2.3 Results**

Three AMPRs were selected as study cases. Isla Caballo AMPR is the smallest AMPR located around an island in the gulf. The group size of actors is small, and the population is highly dependent on fishing. Paquera-Tambor is the biggest AMPR in the gulf and it contains a heterogeneous and large group of actors involved in creation and management efforts. Palito-Montero AMPR is the oldest legally created AMPR in the gulf and actors have developed own self-organized surveillance activities, which are characteristic of this AMPR. The results of the exploratory research to select study cases are shown in Table 2. More in-depth criteria are shown in Annex 2.



Table 2. Three study sites in the Gulf of Nicoya. Source: this study.

Description	Isla Caballo AMPR	Palito-Montero AMPR	Distrito Paquera-Tambor AMPR
<b>Year of creation</b>	2012	2009, extension in 2012	2014
<b>AMPR extension (km<sup>2</sup>)</b>	1.48	6.12	200
<b>Main sectors involved</b>	1 (Playa Torres Sector)	2 (Palito, Montero)	3 (Playa Blanca, Paquera, Tambor)
<b>Associations / cooperatives involved</b>	1 association (ASCOLOPES)	2 associations (ASOPECUPACHI, ASOMM)	5 associations (ABUZPA, ASOTAMBOR, Asopesplayablanca, APEP, ASPARMAR)
<b>Estimated number of fishers</b>	70-90 (on island)	120 (In AMPR zone)	1 cooperative (COOPEPROMAR) More than 150 (in AMPR zone)
<b>Estimated population</b>	350 (In island)	3000 (in island)	Unknown
<b>Environment characteristics</b>	Rocky beach, island	Rocky reefs, Mangroves Mudflats, island	Coral reefs, Mangroves, estuaries, Rivers, Islets, Bay, Rocky shore, mudflats, sandy beach
<b>Main livelihood</b>	Artisanal fishery	Artisanal fishery	Artisanal fishery
<b>Other livelihoods</b>	None	Aquaculture (in AMPR), farmhand in Livestock, Rural tourism, Family stores	Tourism/ hotels, agriculture, Construction, Sport and recreational fishing, aquaculture.
<b>Main gear in use</b>	Gillnet, artisanal surrounding net	Hand-line	Bottom longline. Gillnet
<b>AMPR status</b>	Collective action efforts no longer taken. Conflicts	Self-organized surveillance and informal sanction mechanisms Internal conflicts	Support from organizations and private sector in funding and management Own collection centers

The following results explain how these and other factors do or do not influence collective action in each AMPR. Results are divided according to each research question. Factors which have promoted collective action in the establishment of three AMPRs are shown in section one. Factors facilitating or hindering collective action in management are shown in section two. A comparison of factors influencing collective action is shown in section three.

### 2.3.1 Influencing factors for the creation of AMPRs

The section provides an overview of the organization process in local coastal communities and the motivations for creating each AMPR, based on key informant responses. A brief comparison of common factors promoting AMPR creation is also explained.

**Palito-Montero AMPR.** Palito was the first AMPR created in the country in 2009 and extended to the Montero community in 2012. Palito's hand-line fishers started to organize in 1995, in order to protect fishing grounds and assure harvests over time (Babeu *et al.* 2012), by excluding mainly gillnet fishers associated with a decrease of fish stocks in the area (RS5, A7b) that represented an important resource for many families in obtaining daily income (A8a). The Hand-line Fishers Association of Palito, Chira Island (Asociación de

Pescadores Cuaderos de Palito, Isla Chira, ASOPECUPACHI) was formed with 32 hand-line fishers in 2004 (Ayales Cruz *et al.* 2013) to request support from governmental organizations for protecting a conservation area, and funding from non-governmental organizations such as the Small Grant Program (SGP-UNDP-GEF) to delimit the area with buoys and to acquire surveillance equipment. “Let’s Save the Gulf” (Salvemos al Golfo) association was later self-organized in the Palito community by fishers with gear other than hand-lines, who were not included in the AMPR creation process.

With AMPR creation in 2009, informal rules for area delimitations and restrictions were legally recognized (García Lozano and Heinen 2016b). The Mixed Association of Montero (Asociación Mixta de Montero, ASOMM) was also created in 2009 with around 40 fishers and community members, as a requirement to creating a Palito area extension for similar purposes, as suggested by INCOPECA to hasten creation procedures. Projects, such as collection centers were requested by both sectors to reduce intermediaries and to get their own products to markets in Puntarenas (S5b), promoted by MarViva-IDB funding. Aquaculture projects have also been promoted by UNA as alternative livelihoods to obtain income and to reduce dependence on fisheries (A8). Both ASOPECUPACHI and ASOMM agreed to manage the area together and share funding. Surveillance systems such as patrolling in pairs every night (GS8a) were established and fishers agreed to report the presence of illegal fishers to SNG and INCOPECA.

**Isla Caballo AMPR.** Fishers were previously organized into a Local Fisher Committee (COLOPES); these committees were promoted in the country to facilitate communication between INCOPECA and fishers (Fernández Carvajal 2013). The Local COLOPES was transformed into a COLOPES Association, to comply with AMPR requirements. Efforts began in 2007 to create an area for protecting fishing grounds and reproduction sites, due to concern over the decrease in fish amounts (RS5). Restriction of fishing gear other than hand-lines was imposed, based on Palito’s AMPR previous experience. Moreover, income was expected to improve with the construction of its own collection center, also promoted by MarViva-IDB funding, to give fish additional value and sell directly to markets. It was also expected to generate alternative incomes (A2a) and reduce dependence on fishing as a livelihood (A8). A majority of fishers said that the AMPR idea was proposed by the main island leader and they were requested to sign an agreement with the proposal. Fishers committed to night-time surveillance and the application of informal sanction mechanisms (GS8c) as in Palito. The AMPR was approved in 2012, described by a leader as a delayed process with spatial boundaries that differed from those in the initial proposal.

**Distrito Paquera-Tambor AMPR.** Area creation efforts began in 2011 that weren’t legally approved until 2014. Different local actors with support from external institutions organized in three sectors for its creation: Tambor, Paquera and Playa Blanca, with 14 subsectors distributed among them. Associations involving different types of fishers and

divers, local communities, tourism chambers, industrial fisheries, governmental and non-governmental organizations, reached agreements in participatory meetings to restrict or forbid different types of gear, equipment or activities in each area sector (GS4) that had effects on fisheries and tourism. Participants also agreed to manage and look after their own sector.

With this measure, fish stocks were expected to increase in the area (RS5) for future harvest (A8) and alternative sources of income such as ecotourism and aquaculture would be promoted (A2). Moreover, MarViva-IDB funds would be used to build collection centers in each sector for fishers to sell products locally and in external markets, reduce traveling costs and intermediaries (S5b), to obtain better incomes and improve their livelihoods (A2a). A processing plant has also been promoted to process and trade added value fishing products from the area (RU4a).

**2.3.1.1 Comparison of common factors promoting AMPR creation**

Although each AMPR has developed a specific fishing management plan (Plan de Ordenamiento Pesquero, POP) with its own operational rules and collective choice rules, fishers and other actors have organized under similar purposes to have the right to restrict and control access to fishing gear (GS4). Moreover, fish productivity was expected to recover and increase (RS5, RU5), to assure harvest over time due to high dependence (A8), to improve incomes through the creation and self-organized management of association collection centers (A5), and trade in AMPR products with added value (RU4a) while directly accessing markets (S5b). The development of alternative livelihoods was also expected (A8a). From top to bottom, Figure 4 summarizes the main common factors that motivated local people to organize for the creation of the three AMPRs, based on tendencies in key informant responses.

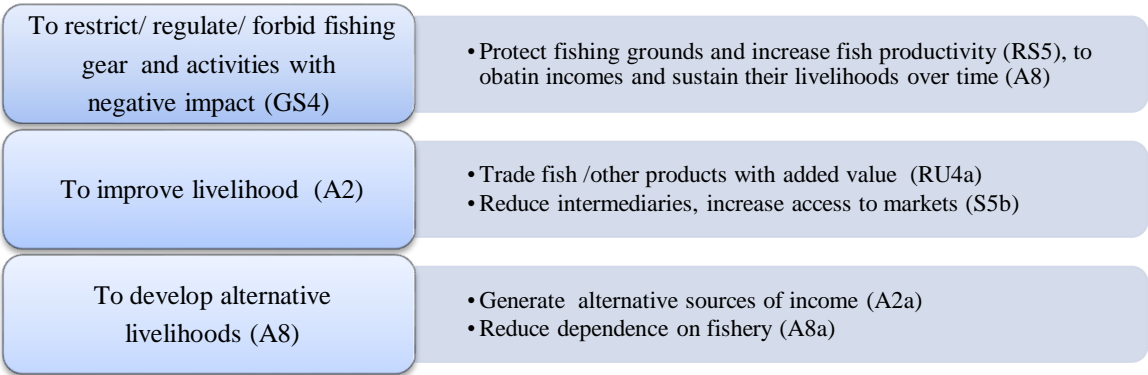


Figure 4. Main common factors that promoted collective actions for the creation of the three AMPRs

### 2.3.2 Collective action in AMPR management

The main factors influencing fishers and local communities to take action collectively in AMPR management were identified, according to key informant responses.

**Palito-Montero AMPR.** Initial support from organizations was said to be key in motivating fishers to enroll in the process. INCOPECSA provided support to hasten creation procedures initially (GS1c). Capacity building was provided by other governmental organizations, including INA (GS1b). Different NGOs initially supported surveillance training and funding for equipment, payment for fishers during the night shifts (GS2a), and construction of collection centers (GS2a). Biological monitoring by UNA of fish productivity in the AMPR is often done (GS8b). Although NGO funding support has concluded, private collection centers and associations have been investing in surveillance and buoy maintenance (I5). However, some fishers stopped doing night surveillance once payment was no longer provided.

Self-organized nocturnal surveillance (I7) and informal sanction mechanisms are frequent (GS8c), as a necessary effort to assure rule compliance and harvesting over time (A8a), related to the high dependence on AMPR resources (A8). Violent conflicts (I4a) between gillnet and hand-line fishers for their exclusion occurred in Palito at the beginning but diminished over time when fishers raised awareness about the area's benefits (A7c) and adopted hand-lines as the main gear (A9a). A majority of fishers in both sectors mentioned an increase in fish abundance (RS5, A7b), relating it to the surveillance measures taken. However, mistrust among fishers (A6) has been related to past experiences with conflict (A3), and has led to the expulsion of some fishers from the association (GS8c) or their exclusion from management processes. Moreover, fishers have complained and disagreed with current leaders in management, causing some fishers to remove themselves from the association (A5). Difficulties in coordination and disagreements between the Palito and Montero sectors have also occurred (I4a). A lack of coordination and the distant relationship with INCOPECSA was another common response, as also found by Babeu *et al.* (2012).

Collection centers are not functioning (Figure 5) due to the lack of operational permits (S4a) and the existence of landlord-client relationships among private collection centers that pay slightly higher prices. Furthermore, the AMPR is perceived as overharvested, related to the presence of a large number of fishers from the island or beyond. Management costs have been assumed by a few fishers, but most are benefiting without supporting management (García Lozano and Heinen 2016b). These different situations have discouraged fishers from participating in management, although some fishers remain organized to take care of AMPR resources (Salas *et al.* 2012). An oyster culture was developed by women in the Palito sector as one of the AMPR's alternative projects, but

some women withdrew when the shared benefits acquired were low for a large group or because they felt excluded by association women leaders and their families, who remain in the project with UNA support.



Figure 5. Non-functional collection center in Montero (left). Oyster culture developed by women in Palito (right).

**Isla Caballo AMPR.** Diverse difficulties for management have been mentioned by various informants targeted. Initially, support from INCOPESCA was given to measure and delimit the area (GS1c) in collaboration with UNA (GS2c). But some buoys delimiting spatial boundaries were placed in spots that differed from what was in the initial proposal and were damaged or not respected by internal and external fishers in disagreement with the AMPR establishment. In addition, conflictive relationships among fishers and local families occurred in the process (I4a) when rules were not respected by fishers (GS5). Some mistrust of leaders was expressed for ones who had not sanctioned their own family members when they disobeyed rules (A5). A few fishers and leaders who took on self-organized surveillance and enforcing activities were threatened by fishers (I4a) and abandoned surveillance efforts. Furthermore, surveillance support from the Coast Guard was considered inconstant (GS8a).

Moreover, there was low motivation among fishers in the AMPR to take care of and harvest inside the area, when fishing resources are mostly targeted outside the AMPR (RU1) with illegal gear such as artisanal surrounding nets, which provide more income than harvesting with hand-lines, obtaining around 400 kg valued at approximately 1700 USD in a working day. On the other hand, donations to build the collection center were not provided by MarViva-IDB due to the lack of water and electricity services (A2b); water has to be brought in from Puntarenas in gallon bottles (figure 6), and electricity is provided by solar panels or a small gasoline-powered plant. Furthermore, construction is not allowed on the island (S4a) due to state control of the property. Activities for area management are no

longer implemented (I7), and only maintenance activities have been developed as a requirement during closed seasons for community work, but some fishers thwarted spatial boundaries afterwards.



Figure 6. Landing fish harvested using illegal artisanal surrounding nets (left). Potable water brought from Puntarenas to the island (right).

**Distrito Paquera - Tambor AMPR.** Different factors have motivated fishers to participate in different area activities. AMPR creation and management has been facilitated by two main non-fisher leaders with professional skills in biology and administration, who have supported area creation by organizing sectors and requesting institutional support (A5). Different governmental institutions and NGOs have supported in advisory, capacity building (GS2b) and financing (GS2a). Research centers have also supported biological monitoring (GS8b). Investment from the fishing associations, cooperatives and the tourism sector is provided to organize different activities related to the AMPR (I5).

Communication by mobile cellphone applications like WhatsApp (S7a) have facilitated coordination among different working groups such as associations, committees and the cooperative, to share information on the different activities to develop such as meetings (I2). Constant participatory meetings among actors are held for decision making (I7, GS6) and to evaluate AMPR progress (I10) (Figure 7). Moreover, a governance committee was self-created (I7) for decision making among different local representatives including the tourism chambers, fishers, divers and the municipality, to inform INCOPECSA of the results and decisions taken, as it is replicating this governance strategy in other AMPRs. Furthermore, it was said that the area has managed to decrease illegal fishing and unsustainable practices such as shrimp trawlers, which was associated with an increase in productivity in the sectors (RS5, A7).





Figure 7. Meetings for decision making in a cooperative assembly (left). Cooperative project to deliver AMPR fishing products in containers (right).

However, some difficulties have been mentioned in creation or management processes. Rivalry and disagreements among fishers, leaders and/or communities (I4a), creates a fear of participating in meetings due to illegal fishing (A6) or disagreement with the area proposal (GS6). Moreover, rules have not been respected mainly at night or during closed seasons (GS5), mentioning infrequent surveillance by SNG (GS8a). Self-organized surveillance in the area has decreased, related to threats received by other fishers (I4a) or the fear of capture by SNG for lack of a fishing license (GS5). In addition, fishers and other actors are physically located and living in communities that are distant from one another (A4a), making it difficult to meet in person and coordinate.

Fishers do not depend solely on area resources to obtain income (A8a) related to targeting fish according to mobility or going to the open sea (RU1) and other alternative livelihoods available such as tourism or jobs on the mainland. Although association collection centers are working, they still depend on external markets to set prices (S5a) and some fishers have been searching for better prices and new landlord-client relationships. Cooperative infrastructure is not yet built and even though some initial efforts have been made (Figure 7), fishers are discouraged due to the time the project has taken to be executed. Table 3 and Annexes 7 to 9 show a summary of the main influencing factors for the three AMPRs in study.

Table 3. Factors influencing collective action in the three AMPRs of the study

	Isla Caballo AMPR	Palito-Montero AMPR	Distrito Paquera –Tambor AMPR
Enabling conditions	<ul style="list-style-type: none"> <li>• Support from government institutions and research centers in creation process (GS1c, GS2c)</li> </ul>	<ul style="list-style-type: none"> <li>• Initial support from INCOPESCA to hasten creation procedures (GS1c).</li> <li>• Initial support from NGOs in funding (GS2a), capacity building (GS1b).</li> <li>• Frequent support from authorities in enforcement (GS1d).</li> <li>• Biological monitoring from research institutions (GS8b)</li> <li>• Own investment and from private collection centers for surveillance and area maintenance (I5).</li> <li>• Continual self-organized surveillance and informal sanctioning mechanism (GS8a, c)</li> <li>• High dependence on area resources (A8a). Fish are usually targeted inside (RU1).</li> <li>• Homogeneity of gear in use (A9a).</li> </ul>	<ul style="list-style-type: none"> <li>• Support of two non-fisher leaders in creation and requesting funding (A5).</li> <li>• Support from governmental and non-governmental institutions in funding administrative procedures, capacity building, research (GS1, 2), biological monitoring (GS8b).</li> <li>• Own association, cooperative and private sector investment (I5)</li> <li>• Regular meetings for decision making (I7, GS6).</li> <li>• Creation of governance committee for decision making with different representatives (GS3b)</li> <li>• Communication through cellphone applications (S7a) for coordination (I2).</li> </ul>
Hindering conditions	<ul style="list-style-type: none"> <li>• Unclear spatial boundaries (RS2)</li> <li>• Lack of water, electricity services (A2b), and land tenure rights (S4a) to develop projects</li> <li>• Rules not respected (GS5)</li> <li>• Low surveillance and support from government authorities (GS8a)</li> <li>• Threats to fishers in self-organized surveillance (I4a)</li> <li>• Conflictive relationship among internal and external fishers (I4a)</li> <li>• Not solely dependent on area resources (A8). Mobility of high-value fish targeted is high (RU1). Majority of fishing gear in use are not types allowed in area (A9a).</li> <li>• Low leadership (A5)</li> </ul>	<ul style="list-style-type: none"> <li>• NGO funding for surveillance concluded (I5)</li> <li>• High number of fishers harvesting without supporting management (A1)</li> <li>• Low coordination and disagreements in/between sectors (A6, I4a)</li> <li>• Changes in board members, disagreement with leaders (A5)</li> <li>• Mistrust among fishers (A6) related to past experiences (A3) and expulsion of members (GS8c)</li> <li>• Association collection centers not working (S4). Patron-client relationship of fishers and leaders with private collection centers</li> </ul>	<ul style="list-style-type: none"> <li>• Not solely dependent on area resources (A8), related to fish mobility (RU1)</li> <li>• Mistrust among fishers (A6), related to conflicts in some communities, negative past experiences (A3, I4a)</li> <li>• Fishers without license (GS5)</li> <li>• Disagreements for area creation remain (GS6)</li> <li>• Association collection centers depend on external markets to set prices (S5a)</li> <li>• Difficulties in coordinating with widely spaced fishers (A4)</li> <li>• Inconstant support from authorities in surveillance (GS8a). Threats during self-organized surveillance (I4a)</li> <li>• Patrolling the entire area is complex (RS3)</li> <li>• Processing plant not yet developed (S4a)</li> </ul>

### 2.3.3 Comparative analysis of collective action in AMPRs

This section compares how factors have been influencing collective action among the three AMPRs. Common factors have been identified but some of them have differed in the way they are manifested in each area in relation to organizational support, dependence, self-organized surveillance or presence of leadership. Comparison of some of the top main factors influencing collective action is shown in Table 4. Variable values are measured as high-medium-low, based on information provided by informants. Collective action influence was categorized as decreasing-increasing. Arrows pointing up mean that a variable has a positive influence on collective action (increasing) and arrows pointing down represent a negative influence (decreasing). The table shows how most of the factors have been negatively influencing collective action in CAB, compared with PAL or PAQ, where



some of the factors have been influencing fishers positively to take action in AMPR management or to develop different activities.

Table 4. Comparison of variables affecting collective action in AMPRs

Variable	Theoretical statement of collective action (CA)	CAB*		PAL		PAQ	
		Value	CA	Value	CA	Value	CA
Trust- reciprocity (A6)	High to moderate levels of confidence and close relationship among local actors is likely to increase CA	Low	↓	Low	↓	Medium	↑
Leadership / entrepreneurship (A5)	Likelihood of CA increase when actors possess entrepreneurial skills, are respected and followed as local leaders by other actors	Low	↓	Low	↓	High	↑
Monitoring and sanctioning mechanisms (GS 8a)	Likelihood of CA increase when effective monitoring and graduated sanctioning mechanisms are applied, assuring rules compliance	Low	↓	High	↑	Low	↓
Importance of AMPR resource (dependence) (A8)	High dependence on AMPR resources to obtain incomes and sustain livelihoods increase the likelihood of CA	Low	↓	High	↑	Medium	↑
Resource unit mobility (RU1)	CA is less likely with highly mobile resource units	High	↓	Medium	↑	High	↓

\* CAB: Isla Caballo AMPR; PAL: Palito-Montero AMPR; PAQ: Distrito Paquera-Tambor AMPR.

In general, multiple factors influencing collective actions were found at the same time. Common factors enhancing efforts to self-organize have been identified, as the presence or support of organizations and perception of an increase in fish stocks after area creation or when monitoring mechanisms were effective. But common factors hindering efforts for collective action were also identified, such as rule non-compliance or internal conflicts. However, these have differed in the manner factors are manifested in each area. Table 5 summarizes the main similarities and differences of factors affecting collective action, based on the perspectives of key informants.

Table 5. Main similarities and differences of factors affecting collective action on three AMPRs

Description	
	Hindering CA
	Enhancing CA
Similarities	<ul style="list-style-type: none"> <li>▪ Rule non-compliance (GS5); inconstant surveillance and enforcement from authorities (GS1d, GS8a).</li> <li>▪ Conflicts and low coordination with authorities (I4b) (Babeu <i>et al.</i> 2012). Conflictive experiences (A3, I4a), mistrust (A6) among local actors.</li> <li>▪ Majority of fishers without license (GS5), not being provided by INCOPESCA (GS7)</li> <li>▪ Some buoys are damaged (RS2) (<b>Figure 8</b>), lack of financing to repair them.</li> <li>▪ Resource mobility (RU1) and variable productivity (RS5) related to environmental patterns, migration, (RS7, RU7, A7a), rainy-dry season and climate change (ECO1, A7c).</li> </ul>
	<ul style="list-style-type: none"> <li>▪ Presence and support from governmental and non-governmental agencies in advisory, financing or surveillance actions (GS1,2)</li> <li>▪ Perception of an increase in fish productivity (A7c), also found in Ayales Cruz <i>et al.</i> 2013, Weber de Morais 2017.</li> </ul>

	<ul style="list-style-type: none"> <li>High dependence on fishing resources (A8a, b), but not limited to AMPRs (García Lozano and Heinen 2016b) <b>(Figure 8)</b>.</li> <li>Perception of fishers as individualists (A7c). Not everyone enrolled in an association (A1).</li> <li>Low rated or no added value to AMPR fishing products (S5a, RU4a)</li> </ul>	
<b>Differences</b>	<ul style="list-style-type: none"> <li>More difficulties in PAQ* to coordinate a variety of actors (A1, A4)</li> <li>More complex surveillance throughout each area sector and division in PAQ (RS3)</li> <li>Socioeconomic conditions in CAB are more precarious than other areas (A2). Less presence and support from governmental and non-governmental organizations (GS1, 2)</li> </ul>	<ul style="list-style-type: none"> <li>More constant support in PAQ with funding, capacity building, research (GS1, GS2)</li> <li>Functional collection centers in PAQ</li> <li>More constant self-organized surveillance and informal sanctioning mechanisms in PAL (GS8a, c), related to high dependence on local resources (A8, A2a).</li> <li>Leaders in PAQ have acquired more skills to request support and organize actors (A5).</li> <li>More participatory network dynamic for decision making in PAQ (GS6).</li> </ul>

\* CAB: Isla Caballo AMPR; PAL: Palito-Montero AMPR; PAQ: Distrito Paquera-Tambor AMPR



Figure 8. Buoys damaged in Palito-Montero AMPR (left); Fishermen from Isla Caballo harvested *Cynoscion albus* species (queen croaker) (right) in AMPR Distrito Paquera-Tambor.

In a general context, fishers have said that changes in fishing regulations over time have been negatively influencing traditional fishing practices adopted over generations (A8c) and hindering sector development. As an example, a significant proportion of fishers are excluded from subsidy benefits given by IMAS in closed seasons, due to lack of fishing permits or the obligatory insurance requested. Some fishers have expressed the need to harvest illegally inside or outside the AMPRs to obtain economic income or feed their families (A2, A8a, and b).

On the other hand, an increase in the number of fishers has been perceived over the years, related to population growth (S2a) and unemployment on the mainland (Salazar Araya 2012), which have increased rivalry and conflicts among fishers inside and outside the AMPRs (I4a). Moreover, institutional financing and human resources assigned to government agencies for monitoring and patrolling is lacking (Pacheco Urpí *et al.* 2013),

specifically for AMPRs. Less enforcement was mentioned since INCOPECSA lost surveillance power to SNG, which prioritizes drug trafficking but at a low frequency in the AMPRs (GS8).

## **2.4 Discussion**

### **2.4.1 Collective action implications**

Factors influencing collective action in AMPRs have been identified with the application of the SES framework. Motivations to organize for the creation of AMPRs have been related to the context of the Gulf overexploitation situation, to protect resources and increase fish productivity, and to generate alternative livelihoods in response to fishing resource scarcity. Some fisheries research has shown local actors taking action collectively in similar situations to protect and ensure availability over time, due to high dependence on resources to sustain livelihoods (Varughese and Ostrom 2001, Basurto *et al.* 2013).

In addition, different factors have been influencing collective action for AMPR co-management. At Isla Caballo, homogeneous and small group characteristics do not ensure resource management or the achievement of a collective good, contrasting with findings in other cases (Vedeld 2000, Agrawal and Goyal 2001) and showing more of a negative influence. Internal conflicts related to rule non-compliance have discouraged some fishers from continuing with efforts in surveillance activities. Jentoft (2000) and Ostrom (2000) explain that collective action is less likely when a social network is eroded and conflicts are occurring, aligning with the analysis at Caballo. Unclear spatial boundaries also discouraged collective action and disagreements with authorities. The need for clear and mutually accepted boundaries, similar to other findings (Ostrom 1990, Gutierrez *et al.* 2011), would likely reduce conflicts, the ease of compliance with rules, and reductions in monitoring costs. Direct dependence on resources within the AMPR was low, because the target species at Caballo are highly mobile, moving in and out of the area. The AMPR is static and very small in size, which does not account for species mobility. Fishers need to fish outside the AMPR and therefore are not directly dependent on it. However, they are highly dependent on fishing in general. Thus, the likelihood to self-organize was low due to a lack of motivation or incentives that the AMPR will benefit the conservation of mobile species, similar to what was seen in the case study of Torres Guevara *et al.* (2016), but when the fish stock was abundant. Illegal fishing and overharvesting still represent a continual problem.

At Palito-Montero AMPR, a high dependence on local resources to obtain incomes has been determinant in the taking of collective action to ensure resource availability over time, as seen in other study cases (Varughese and Ostrom 2001, Schlüter and Madrigal 2012, García Lozano and Heinen 2016a). Thus, fishers have developed apparently effective self-organized surveillance and informal sanctioning mechanisms, for example, to assure fishing

resources, as seen in similar study cases (Ostrom 1990, Pomeroy *et al.* 2001, Ostrom 2007, Gutierrez *et al.* 2011). However, there is difficulty in excluding fishers using hand-lines as the allowable gear type. Thus, a high number of fishers from different communities in the gulf and in the island harvest in this AMPR that is perceived as productive, is facing a subtractability problem when there is no control of harvesting limits. Fleischman *et al.* (2014) explain how high economic dependence on a resource could enhance overexploitation problems, as local informants in the area have perceived. On the other hand, low levels of trust among actors have decreased collective efforts, as also stated by some researchers (Ostrom 2009, Cinner *et al.* 2012, Trimble and Berkes 2015).

In Distrito Paquera -Tambor AMPR, many actors with heterogeneous interests and using different types of gear have not hindered collective action, compared to findings in other cases (Jentoft 2000, Poteete and Ostrom 2004). Moreover, wealthy actors in this heterogeneous group have assumed some transaction costs to develop different activities, as also seen in other similar cases (Vedeld 2000, Poteete and Ostrom 2004, Ostrom 2009). The literature states that strong leadership has been relevant in motivating self-organization (Poteete and Ostrom 2004, Ostrom 2009, Gutierrez *et al.* 2011, Basurto *et al.* 2013), In the AMPR, the presence of leadership was related to leaders' capacity in administration, in requesting support and in coordinating different activities. Technological communication mechanisms such as mobile applications and the internet, have facilitated coordination among different groups, showing the important role of technology in enhancing collective action (Postmes and Brunsting 2002). However, there are still difficulties in adopting effective surveillance mechanisms to exclude illegal fishing in a large AMPR, where threats of overexploitation are still apparent.

In general, some main variables such as trust among actors, dependence on local resources, leadership and monitoring mechanisms have been some common factors influencing collective action in the AMPRs, factors that Basurto *et al.* (2013) also found to be influencing self-governance. However, these and other factors have been manifesting differently according to each study site. Low capacity for building in communities, individualism and low government support has been found by Pacheco Urpí *et al.* (2012, 2013) to be affecting sustainable management and governance in coastal communities in the Gulf of Nicoya.

#### **2.4.2 Co-management implications as governance strategy**

In the context of promoting co-management as a new governance strategy, the NGOs and government agencies involved did not consider different local conditions. History and past experiences and precarious socioeconomic conditions, such as on Isla Caballo, have been influencing the ability of local fishers to work together. Furthermore, government support was mentioned as insufficient in all three AMPRs. Existing studies have shown that management can be more effective when government support is provided continuously at different stages of implementation (Berkes and Folke 1994, Torres Guevara *et al.* 2016).

Moreover, successful organization over time is more likely when some conditions are met or are already in hand, such as previous capacity building in organization and management (Jentoft 2000, Carlsson and Berkes 2005), strengthened leadership and the ingraining of the importance of sustainable resource use (Pomeroy *et al.* 2001), as developed to some extent in Distrito Paquera-Tambor AMPR.

### **2.4.3 SES framework application**

The SES framework has proven to be a general tool which could be suitable to different types of SESs, such as fisheries, since it shows a compilation of variables that have the potential to influence collective action and sustainable management. For this research, it has facilitated the identification and comprehension of which set of variables were mainly influencing collective action in each AMPR through diagnosis, considered a method potentially applicable to understanding collective action in other SESs and promoting the comparison of cases (McGinnis and Ostrom 2014). It was also identified that a set of variables could be related or influencing collective action together, but further research is needed to comprehend the interactions between them. Understanding the complexity of SESs is important for knowing how to adjust management in a way that fits local conditions by recognizing how variables constantly interact, leading to different results over time and influencing management.

Difficulties in measuring variables occurred due to a lack of standardized variable measurement, similar to challenges presented in other cases (Schlüter and Madrigal 2012, Cox 2014). Variables such as ‘social capital’ or ‘constitutional rules’ may not be interpreted as ‘variables’ when they are representing concepts or theories, thus, it has been difficult to define a value for its measurement. Also, some problems of ambiguity presented during coding, since it was difficult to determine whether a situation was related to one or two variables, e.g. when coding socioeconomic attributes and importance of resource, a problem also seen in Schlüter and Madrigal (2012). Other challenges were detected in the development of more in-depth variables. McGinnis and Ostrom (2014) have argued that researchers would keep modifying the SES framework and adding variables to give responses to research questions, but researchers need to be cautious in the development of more suitable and measurable in-depth variables and distinguish them from concepts or indicators, otherwise it may present a problem for comparison across cases or misunderstandings in measurement. Some in-depth variables were developed with information provided in interviews, contrasted with others developed by other researchers. Cox (2014) has mentioned that when adapting variables or indicators developed by other researchers, some may not be adapted to other SESs if they were developed for a particular context. It is necessary to orient the framework application to reduce the number of complications in the research.

## 2.5 Conclusion

Organization for AMPR creation was mainly promoted by a high dependence on fishing resources, to find strategies for sustainable harvest and ensure incomes over time, improve livelihoods and generate alternative livelihoods to reduce dependence on resources, under an overharvesting situation.

Multiple factors were found to be influencing management in AMPRs. Factors such as high dependence on resources, presence of effective monitoring and sanction mechanisms, and presence of leadership were more likely to enhance collective action. But factors such as mistrust among actors, internal conflicts, lack of governmental support and high resource mobility were more likely to hinder collective action. Although some factors were found to be similarly influencing collective action in the AMPRs, differences in the intensity they were manifested or differences in other types of factors identified, have made management challenges unique in each AMPR. Factors such as group size and heterogeneity or resource system size have not been so relevant in influencing collective action, compared to variables mentioned above.

In the AMPR co-management context, fishers are requested to self-organize for participation in management, in some cases with no basis in administration, little capacity or low education levels. Also, difficulties in implementing surveillance actions have occurred, when there is high resource mobility, low support from authorities and a lack of legal power for sanctioning and excluding fishers with illegal gear or practices. Precarious socioeconomic conditions, lack of financing sources to afford activities such as surveillance, buoy maintenance or meeting organization, and INCOPECA not providing fishing permits, have also had a negative influence on actions. Attribution of some property rights to communities as in management or control rights, have not ensured adequate management and user exclusion. Moreover, the possibilities for establishing collective choice rules have not ensured rule compliance or that actors will work together.

The AMPRs' situation has reflected that co-management may not be the suitable governance system to address overfishing problems in all contexts. Some local conditions as mentioned above could represent a limitation for fishers and communities to take efforts collectively in resource management. Diagnosing organization level and/or improving and better preparing local conditions before applying this type of governance system could increase the likelihood that communities would make commitments to sustainable management in the long term, as explained by Ostrom (2000) and Pomeroy and Berkes (1997). The need to formulate strategies with governance systems suitable to each socioeconomic, political or environmental context in which SESs are immersed could avoid future failures in these types of initiatives, as has been mentioned by different researchers (Pomeroy and Berkes 1997, Ostrom 2007, Frey and Cox 2015, Hinkel *et al.* 2015).

Finally, although the SES framework has been useful as a diagnostic tool, challenges still occur in the coding and measurement of variables. Some researchers suggest standardizing variable measurements to make comparisons across cases (Schlüter and Madrigal 2012, Cox 2014). However, trying to code the information into standardized variables might not be suitable for categorizing a specific situation, but this reduces the possibility of making comparisons if variable measurements are too specific to a context, as mentioned by Frey and Cox (2015). It may be proper to orient the application of the framework with a set of variable measurement proposals that could be formalized and adapted to different study cases, but to consider that some specific or new in-depth variables could always be developed to describe a specific variable influencing a particular situation.

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# Annex

## Annex 1. Open-ended interview and observation protocol

OBSERVATION PROTOCOL				
GENERAL DATA				
Date:				Time:
Location:				
Community:				
Observer:				
Name of AMPR:				
Communities involved:				
Area:				
Accessibility and transportation:				
Airplane <input type="checkbox"/>	Boat <input type="checkbox"/>	Bus <input type="checkbox"/>	Cars <input type="checkbox"/>	Trucks <input type="checkbox"/> Train <input type="checkbox"/> Others <input type="checkbox"/>
Access:				
Infrastructure:				
Banks <input type="checkbox"/>	Community center <input type="checkbox"/>	Market <input type="checkbox"/>	Parks <input type="checkbox"/>	School <input type="checkbox"/> Shops <input type="checkbox"/>
hospital/health center <input type="checkbox"/>	Hotels <input type="checkbox"/>	Others <input type="checkbox"/>		
Comments:				
RESOURCE SYSTEM				
Type of ecosystem				
Archipelago (Small island) <input type="checkbox"/>		Intertidal <input type="checkbox"/>	Beach <input type="checkbox"/>	Lagoon <input type="checkbox"/>
Coastal <input type="checkbox"/>		Coral reef <input type="checkbox"/>	Mangrove <input type="checkbox"/>	Deep sea <input type="checkbox"/>
Open ocean <input type="checkbox"/>		Estuary <input type="checkbox"/>	River <input type="checkbox"/>	Salt marsh <input type="checkbox"/>
Mud flats <input type="checkbox"/>		Others <input type="checkbox"/>		
Comments:				
Pollution				
Garbage:	0-10% <input type="checkbox"/>	11-30% <input type="checkbox"/>	31-50% <input type="checkbox"/>	51-70% <input type="checkbox"/> 71-100 <input type="checkbox"/>
Sewage:	Industrial <input type="checkbox"/>	Households <input type="checkbox"/>	Agriculture <input type="checkbox"/>	Shipping <input type="checkbox"/>
	Others <input type="checkbox"/>			
Others: Noise (traffic, people, industries,...) <input type="checkbox"/>		Light <input type="checkbox"/>		
Waste type:	Organic <input type="checkbox"/>	Plastic <input type="checkbox"/>	Electronic <input type="checkbox"/>	Glass <input type="checkbox"/>
	Paper <input type="checkbox"/>	Others <input type="checkbox"/>		
Land use:	Agriculture <input type="checkbox"/>	Industries <input type="checkbox"/>	Recreation <input type="checkbox"/>	
	Conservation <input type="checkbox"/>			
	Settlement <input type="checkbox"/>	Forestry <input type="checkbox"/>	Others <input type="checkbox"/>	
Comments:				

**Fishing sector**

Artisanal  Subsistence  Industrial  Recreational  Aquaculture   
 Others

Comments:

**Other economic sectors**

Agriculture  Tourism  Industries  Forestry   
 Others

Comments:

**Facilities**

Landing site  Harbor  Cooling   
 Storage  Processing  Collection center   
 Selling point  Others

Comments:

**RESOURCE UNIT**

Mollusks  Crustacean  Fish  Others   
 targeted species (valuable species, by catch):

**Economic value**

Price of main species:

Products:

canned  dried  fresh  packed  salted  smoked  others

Certificates: yes  which:  
 no   
 unknown

Comments:

**ACTORS****Size of community**

Number of fishers:

Total residents in involved community:

Number of people involved in cooperation:

Comments:

**Socio-economic attributes**

Living conditions (house characteristics, access to basic services etc.):

Comments:

**Services**

Water supply  Electricity  Internet  Telephone  Sewers   
 Sewage plant  Others

Comments:

**Culture**

Religion:





**PRELIMINARY KEY INFORMANT INTERVIEW PROTOCOL**

Interviewed person:	
Why is informant key?	
Name of interviewers:	
Date:                    /        /	Time:        _____ to _____
Location:	AMPR:

**Presentation and prior consent informant**

My name is \_\_\_\_\_ and my partner is \_\_\_\_\_. We are researchers from \_\_\_\_\_; our objective is to gather preliminary information about the current situation of the AMPR and the organization of fishers and communities to manage it. This interview could last between 30-45 minutes.

Your participation in this interview is voluntary; if you feel uncomfortable participating, answering a question or continuing with the interview you can tell me. Your responses are confidential and they will not be analyzed specifically. In the event that my question is not clear, you can ask me and I will explain it to you.

Would you allow us to take some notes and photographs in order to record all the information provided and facilitate its analysis?

We want to be sure that you agree to participate in this interview voluntarily.

**Questions**

**Statistical data/documents:**

- How many people live in this community?
- How many communities are there and what are their locations and names?
- How many fishers are there? How many of them are in an association?
- How many fisheries associations are there, what are their locations and names, and which communities do they belong to? (See map)
- How is the collaboration with other organizations? (NGOs, cooperatives, network)

**Characteristics of AMPRs:**

- What are the codes, norms, rules and formal documents for the area?
- What are the property rights? (state-owned, community-owned)
- When and why was it established? Which communities were involved in the AMPR creation process?
- Which communities are involved in AMPR resource usage?
- What are the participatory mechanisms? In which processes are fishers involved and how?
- Who might be key informants?

\*Show the map to refer to the communities involved, key points (landing sites, fishing grounds) and

boundaries of AMPRs

**Community properties:**

- What are the property rights? (collectively owned facilities such as boats, collection center)
- How are efforts, benefits, resources, responsibility-sharing going?
- What is the history of self-organization? (when and why)
- What are the dynamics of changes in the cooperatives? (Conflict generation? Involvement in tourism?)

**Main target species:**

- When are the closed seasons?
- Where are the fishing grounds? (map)
- What is the market chain like?
- What are the sale values of products?
- Which are the best days/times for finding fishers?

**Additional comments:**

## Annex 2. Characteristics of seven AMPRs in the gulf of Nicoya, considered for case selection

AMPR	Isla Caballo AJDIP/169-2012	Puerto Níspero AJDIP/160-2012	Palito-Montero, Isla Chira AJDIP/154-2012	Isla Venado AJDIP/456-2013	Costa de Pájaros AJDIP/182-2014	Tárcoles AJDIP/193-2011	Distrito Paquera-Tambor AJDIP/099-2014
Year of creation	2012	2012	2009 Extended in 2012	2014	2014	2011	2014
Area extension (km <sup>2</sup> )	1.48	2.6	6.12	~7	10.5	108.8	200
Estimated population	350	280	>3000	>900	>2000	unknown	unknown
Number of fishers	70-90 (island)	60 (around area)	120 (around area)	400 (island)	120-150 (around area)	100(around area)	>150 (around area)
Main association/ cooperative involved	1	1	2	1	1	1	6
Main communities involved	1	1	2	3	3	>5	>10
Main livelihood	Fishery	fishery	fishery	fishery	fishery	fishery	fishery
Alternative livelihoods	No	Familiar farms, agriculture, industry	Aquaculture (in area), farmhand in Livestock, Rural tourism, Family stores	Rural tourism Family stores	Family stores, agriculture	Tourism recreational fishing agriculture other jobs on land	Tourism/ hotels Agriculture Construction Sport and recreational fishing Aquaculture Other jobs on land
Basic services	No water and light service No garbage disposal, No sewage service	Water and electricity service No garbage disposal	Water and electricity service No garbage disposal	Water and electricity service No garbage disposal	Water and electricity service	Water and electricity service	Water and electricity service Some communities without transportation service
Accessibility	By boat	By boat, land	By boat, small ferry service Internal roads	By boat Internal roads	By boat, land	By boat, land	By land, by boat, ferry service and port, by airplane
Type of ecosystems	Rocky shore, beach	Beach, Mangrove, Rivers, Mudflats, estuary	Rocky reefs, Mangroves Mudflats, islet	Mangrove, mudflats, islets	Beach, Mangrove, Rivers, Mudflats, estuary, islets	Coastal, beach, river	Coral reefs, Mangroves, estuaries, Rivers, Islets, Bay Rocky shore, mudflats, beach
Gear in use	Mainly gillnet or artisanal surrounding net	Hand-line, seine net gillnet	Mainly hand-line Seine net Gillnet	Artisanal surrounding net artisanal trawler gillnet hand-line	Mainly gillnet Hand-line	Gillnet Hand-line Some small trawlers	Bottom longline Gillnet Hand-line Diving equipment
Main species targeted	Croaker species,	Croaker species, sea	Croaker, snapper,	Croaker species, bass,	Mollusk, shrimp;	Pacific sierra,	Croaker, snapper,

	bass, snapper, shrimp	bass, shrimp	catfish species. Grouper, bass Mollusks, shrimp	snapper, shrimp	Croaker, snapper, catfish, grouper species.	Croaker, snapper, groupers and catfish species, shrimp	groupers and catfish species; bass, mahi mahi, tuna, Mollusks, lobster, shrimp
Positive aspects	Refuge site for fish	Some presence of governmental and NGO institutions	Self-organized surveillance and sanction mechanism active from before area legalization	Support from research centers	Productive fishing grounds	Fishing Products with labeling through cooperative Presence of NGOs	Support from authorities, NGOs, research centers, private sector Functional association collection centers
Negative aspects	No surveillance Violent conflicts among fishers, including family members Missing support from authorities Efforts no longer taken Rule non-compliance	Low monitoring from authorities Conflict among communities Rule non-compliance	Conflict among fishers	Conflict among fishers Rule non-compliance	Low monitoring from authorities Rule non-compliance	Illegal fishing	Sectoral conflicts Little processing of their own fishing products, processing plant
Other	Strong family relationships	*National wildlife refuge nearby				*Pollution	*MPA involved

\*Information from observation protocol and open-ended interviews, literature review: Salas *et al.* 2012, Ayales Cruz *et al.* 2013; national decrees)

\*\*Sites selected highlighted in green; differences considered highlighted in blue

### Annex 3. Semi-structured interviews protocol developed with key informants

#### KEY INFORMANT SEMI-STRUCTURED INTERVIEW

##### Standard model:

Interviewed person:	Age:	Gender:
Why is informant key?		
Name of interviewers:		
Date:                    /     /	Time:        _____ to _____	
Location:		
<b>Presentation and Free, Prior and Informed Consent</b>		
<p>My name is _____ and my partner is _____. We are researchers from _____, I am developing my master's thesis and my objective is to gather information about how people of the communities organized to create the AMPR, how they are organized to manage it and the current situation of the AMPR.</p> <p>This interview could last between 30-45 minutes. Your participation in this interview is voluntary; if you feel uncomfortable in participating, answering a question or continuing with the interview, you can tell me. Your responses are confidential and they will not be analyzed specifically. In the event that my question is not clear, you can ask me and I will explain it to you.</p> <p>Would you allow us to take some notes (and photographs) in order to record all the information provided and facilitate its analysis?</p> <p>We want to be sure that you agree to participate in this interview voluntarily.</p>		

## ASSOCIATION/ COOPERATIVE LEADERS

### Role:

N°	Questions
1	What was the purpose for creating the association/ cooperative? (benefits)
2	What are the functions of the association/cooperative?
3	What are the requirements for adding a new member? (license)
4	How often does the association/cooperative have meetings?
5	How are decisions in the association/cooperative made? (representatives) Who can participate?
6	Were fishers organized before the creation of the AMPR?
7	How were fishers organized for the establishment of the AMPR? (backgrounds)
7.1	Did the majority of fishers participate? Why?
8	What was your role/the role of the association in the establishment of the AMPR?
9	How do you inform fishers about decisions made/ issues related to the AMPR?
10	What was the purpose for the creation of the AMPR?
11	What was easy or difficult in creating the AMPR?
12	How did organizations support the establishment of the AMPR? (govt. agencies/NGOs)
12.1	Do you think the support of the organizations was key to the establishment of the AMPR? Why?
13	How were boundaries for the AMPR established? (design, selection)
14	Are they clear to fishers inside/outside the communities involved? Why?
15	Who can fish in the AMPR?
16	What are the rules for fishing inside the AMPR?
17	How were the rules for the AMPR decided? Who participated in the rules decisions?
18	Is there a management plan for the AMPR? If yes, who participated in its development?
19	Who agreed with the rules/management plan? Did the majority of fishers agree with the rules/management plan? Why? Do they still agree with the rules/ management plan now?
20	Which surveillance activities were established? Why? How was this decided?
21	Who is in charge of the AMPR management? (Communities, NGOs, government, other associations).
21.1	How are they carrying out their functions?
22	Which ones invest in AMPR management? (maintenance, surveillance) Is there a specific budget for the AMPR management? If not why
23	How do you participate in the management of the AMPR?
24	Do you think the support of fishers/organizations is key to maintaining the AMPR? Why?
25	How is your relationship with fishers /community/ organizations in managing the AMPR? (assoc/govt, non-govt agencies/others AMPR) If a negative answer: How do you think you can improve your relationship with them?
26	Who is participating in surveillance activities?
27	Who is in charge of enforcing rules?
28	How are fishers following the rules in the AMPR? (closed seasons)
29	What kind of sanction is imposed on fishers if they do not obey the rules?
30	Are there conflicts between fishers inside/outside the AMPR? If yes, How are these conflicts managed?
31	Are fishers competing for fish resources inside/outside the AMPR? Why?
32	What changes have you noticed in amounts or sizes of fish caught in the AMPR since its establishment?
33	What are the difficulties/facilities you have to manage in the AMPR?
34	What is motivating/discouraging fishers/organizations in participating in AMPR management?
35	How are the objectives/goals of the AMPR being accomplished?
36	What are the main achievements of the AMPR you have obtained since its establishment?

37	What are the biggest challenges you have for this AMPR now / in the future?
38	Are there any other fishery-related issues to address? What are they? Do you think there are issues other than AMPR management that need addressing in your community? What are they?
39	What do you think the fishing situation in the gulf will be like in the future?
40	Do you think the community is organized to address different issues? --- How are the fisher's communities around the AMPR organized?

*We appreciate your help in this research; do you have any additional comments?*

## FISHERS

### Questions

*	Age:	Gender:	Years fishing:
1	Are you a member of a fisher association or cooperative? (Yes/No) Why?		
	What are the requirements for being in an association?		
	What do you think are the benefits of being in an association?		
2	If yes (1), How often do you participate in association activities? (meetings/decision making)		
2.1	Do you feel the association represents you? Do you think other fishers feel represented? Why?		
3	How is your <u>relationship/confidence</u> with other fishers / association leaders or community leaders?		
4	What documents must a fisher have to go fishing? (license, permits, courses) Is it difficult to obtain them? Why?		
	Do you know how not having those documents affects a fisher? (license, permits)		
5	What was the purpose for the creation of the AMPR?		
6	Who participated in the creation of the AMPR? (fishers/NGOs/govt) How did you participate in the creation of the AMPR? Did most of the fishers participate? Why?		
7	What was easy or difficult in creating the AMPR?		
8	What are the AMPR rules/agreements? Who participated in setting the rules? (NGOs/govt/fishers). Did you participate? Why? Who agreed with the rules? Did you/most fishers agree? Why?		
9	How were the boundaries of the AMPR decided? How clear are the boundaries of the AMPR for you/other fishers inside/outside the AMPRs?		
10	Who can fish in the AMPR? Is there a special license for fishing inside the AMPR?		
11	How often-do you/other fishers participate in activities related to the AMPR? (surveillance/ meetings/ decision making) Why?		
11.1	How have you participated in surveillance activities? Why? If not, will you participate in the future?		
12	Do you know how surveillance mechanisms were arranged?		
13	How is your <u>relationship</u> with other fishers/organizations in managing the AMPR? (Other assoc./govt/ NGOs/ research inst.) If a negative answer: How do you think you can improve your relationship with them?		
14	Do you think the support of fishers/organizations is key to the management of the AMPR? (surveillance, maintenance) Why?		
15	What motivates/discourages you/other fishers to participate in the management of the AMPR?		
16	Are fishers obeying the rules in the AMPR? Why? If not, how are you trying to promote/incentivize them to follow the rules? What kind of sanction is imposed on fishers who do not obey the rules?		
17	How often do you have conflicts with other fishers inside/outside the AMPR? Why/ why not? Do you compete/ have rivalry for fish resources inside/outside the AMPR? Why?		
18	What is your main source of income? What other sources of income do you have? Does your income satisfy your own/ family needs?		



	What do you do with money that you can save?
	What activities do you do during closed seasons to earn money?
	Do fishers respect the rules inside/outside the AMPR in closed seasons?
19	Who supports you when you need help? (loan/equipment)
20	What do you do with the fish/other after capture? (store/sell/eat)
21	Is there a different price for fish caught inside the AMPR? Why/why not? How does it benefit/affect you that there is a different price? (Future?)
22	How far do you have to travel to catch fish/shrimp/others? Which is the main fishing gear you use? Why did you select this gear?
23	Which are the main species you catch? Can you catch the majority of these inside the AMPR? Why/why not?
24	What changes have you noticed in the amount or size of fish/other in the AMPR since its establishment?
25	Do you think the amount of fish available in the AMPR is enough for all the fishers of these communities/ other sites? Why?
26	What do you think makes AMPR management difficult/easy?
27	What do you think are the main achievements/challenges of the AMPR?
28	Are there any other fishery-related issues to address? What are they? Do you think there are issues in your community other than AMPR management to address? What are they?
29	What do you think the fishing situation in the gulf will be like in the future? What action would you take if you cannot obtain income from fishing in the future?
30	Did you finish grade school/high school? Why? How does it benefit/affect you? (find job)
31	Why did you become a fisher? Are your sons becoming fishers? Are younger generations becoming fishers? Why/why not?

## INCOPESCA Questions

*	What are the functions of the institution?
1	What are the main reasons for promoting the creation of the AMPRs? What is the purpose of the AMPRs?
2	What do you expect from the AMPRs?
3	How are you benefiting from the creation of the AMPR?
4	What was your role in the establishment of the AMPRs? (design/ research/rules)
5	Is there a management plan for each AMPR? Who participated in their preparation?
6	What is the procedure for establishing an AMPR? What are the requirements?
7	How is the AMPR managed?
8	What is your role in the management of AMPRs? (finance/monitor/surveillance/rules enforcement)
9	Who is in charge of the management of the AMPR? What are their functions?
10	Who invests in the activities of the AMPR? (buoys maintenance/ surveillance) Is there a budget for AMPR management?
11	What is your relationship with fisher/associations/organizations like for managing the AMPR? (Coast Guard, NGOs). If a negative answer: How do you think you can improve your relationship with them?
12	Do you have frequent meetings with associations or organizations related to the AMPRs?
13	Do you share information related to AMPRs with associations or other organizations?
14	What are the fishing regulations for the AMPRs? Are they the same for every area? Who participated in the decision making?
15	Is there a written document stating the rules and regulations for the AMPRs? <u>Which?</u>

	Who established the rules?
16	Are the rules of the AMPR being enforced? How?
	Has the enforcement of rules been done by Coast Guard since the beginning?
17	Do you know if fishers are following the rules?
18	Was the certification of the fish considered in the purpose of the AMPRs?
	Are there markets for responsible fishing? If yes, how are they working?
19	Do you support some AMPRs more than others?
20	Do you think some AMPRs are being more successful than others?
21	Are you supporting the creation of a new AMPR? Why?
22	How do you support fishers/ comm. leaders in training related to the AMPR? (education/)
23	How often do you have conflicts among fishers in managing the AMPR?
24	What is the procedure for fishers to obtain a license? Are you giving more licenses? Why?
25	How did you establish closed seasons?
	Are all types of fishing resources reproducing during this time period? Why?
26	How was the amount of subsidies to be given to fishers in closed seasons determined?
27	Are the objectives/goals of AMPRs being accomplished?
	Are you achieving your proposed goals?
28	What are the biggest challenges for AMPRs in the Gulf of Nicoya now and in the future?
	What is the current situation of fishery resources in the gulf? (overexploitation/stock)
29	Which types of fishing gear cause most/least impact on fishery resources in the gulf? (selective gear)
30	Are you conducting frequent monitoring activities in the AMPRs?
31	What is your relationship with collection centers?
	Have you supported them with software/ equipment /training?
32	What are the requirements you request for their operation?
	Are you promoting them to acquire responsible fishing products?

*We appreciate your help in this research; do you have any additional comments?*

Secondary approach questions:

33	How fishers are being affected for not having permits?
	What alternatives are you promoting for this situation? (livelihoods)
	How do you know if every fisher is active?
34	How were AMPRs created according to fisher's proposals?
35	Are you considering establishing a governance committee in every AMPR?
	What results are you expecting for this measure?
	How will it be adapted according to each AMPR?
36	What is the role of the institutions with the AMPRs?
37	How is the fish trade being regulated -from capture to consumer? (Illegal collection centers/ catch/ equipment)
38	How is the use /catch of live bait being regulated?
	How could this affect long-line and hand-line fishers?
39	How are consumers being informed about responsible fishing?
40	How often do you follow up on the progress of the AMPRs?
41	What are the plans for closing the area 201?
	What results are you expecting for this measure?
	What alternative livelihoods are you promoting with this measure?
42	Are you training fishers to quit using illegal fishing gear/practices?

## COAST GUARD

*	What are the functions of the institution?
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1	What do you know about the AMPRs? What is the purpose of the AMPR?
2	What was your role in the establishment of the AMPRs?
3	Do you know about the rules each AMPR has? How were rules of the AMPR decided?
4	Do you know who is involved in the management of the AMPR? (communities, NGOs, government, associations) What is your role in the management of AMPRs? (finance/monitor/surveillance/rules enforcement) Who is in charge of surveillance activities? Is there a legal document establishing who has to patrol AMPRs? Who decided?
5	How often do you receive calls reporting illegal fishing inside/ outside the AMPRs? What actions do you take when you receive these types of calls?
6	How often do you patrol for illegal fishing inside/ outside the AMPRs? How often are illegal fishers/ illegal fishing gear present inside/outside the AMPRs? How often do conflicts occur with fishers during patrolling activities in the AMPRs/gulf? How do you think these conflicts can be solved? What sanction mechanisms do you apply to fishers in these cases? If you confiscate illegal fishing gear, what do you do with it?
7	Do you know which organizations invest in the management of the AMPR? (surveillance/ maintenance) Do you have a specific budget for patrolling AMPRs/ the gulf? Do you have enough resources to patrol AMPRs / the gulf? (materials/ equipment/ crew) What difficulties occur in patrolling AMPRs? (Location/size) the gulf?
8	What activities do you attend to most frequently in the gulf?
9	How is your relationship with fishers and organizations in managing the AMPR? (Associations/ INCOPESCA/ NGOs/govt. agencies). If a negative answer: How do you think you can improve your relationship with them?
10	What would be easier or more difficult in managing the AMPRs together? How do you think the creation of a new station at Nispero will help in addressing different situations related to the fishery in the gulf?
11	What do you think about the fishery situation currently and in the future?
12	What action could fishers take if they are being threatened by other fishers during surveillance?

*We appreciate your help in this research; do you have any additional comment?*

#### **Other government agencies, research institutions / NGOs, other associations**

1	What are the functions of the institution?
2	What kind of activities/projects do you develop with fishers/ fishery communities in the Gulf of Nicoya? How do you oversee the projects you implement? How do they implement oversight?
3	How is your relationship with associations/ fishers / other institutions for developing different activities in communities?
4	What do you know about the AMPR? Do you know what the purpose of the AMPRs is?
5	Did you participate in or support the creation of the AMPRs? If yes, How? (Design/ research/rules) Why? If yes (5), What was easy or difficult in creating the AMPR?
6	What kind of activities/ research do you develop in the AMPRs?
7	Do you participate in or support the management of the AMPRs? If yes, How? (training/ projects/ research) How often do you participate? What benefits do you gain from supporting fishers/ associations?
8	How is your relationship with fisher/associations/organizations for managing AMPRs?
9	Do you think the support of organizations is key to managing the AMPR? Why?

10	Do you share information related to AMPRs/research in the gulf with associations or other organizations?
11	What do you think are the main achievements/challenges of the AMPRs?
12	What are the socioeconomic and environmental conditions of fishery communities (spec. in AMPRs in the study)?
	What are the main problems of fishery communities (spec. in AMPRs in the study)?
13	How do you perceive the organization of fishers/fishery community? (spec. in AMPRs in the study)?
14	What is easy or difficult in working with fishers/fishery communities?
15	What do you think about the current and future fishery situation in the AMPRs/the gulf?

Specific questions:

For governance committee	What was the purpose for creating the Gov. committee? What are its functions?
For ADI	Asked: 1, 2, 4, 12, 13 What institutions support ADI? What kind of support do you give to fishers? How do perceive the relationship among fishers?
For INA (To confirm with audio)	Asked: What kind of training do you give people? To whom (individual/ group)? What kind of training/courses do you give fishers? (topics) Do people have to make a request or do you offer training? What is the purpose of these training events/courses? How do you think training events/courses benefit fishers? How often do you give training events/courses for fishers? Do you give training to fisher communities on topics other than fisheries? How is your relationship with fishers? Do the majority of fishers attend the training events/courses? Why?
For IMAS	Asked: 1, 2, 4, 5, 7, 12, 13 How do you support fishers during closed seasons? How was the amount of money to give them decided? How do you evaluate whether it is enough to satisfy fisher's needs? Do you support the creation of projects in the AMPRs?
For INDER	Mostly all
For CoopeSoliDar R.L.	Mostly all
For UNA	Mostly all
For MarViva	Mostly all

### Collection center /Intermediaries

1	What are the main fish/shrimp/ species you receive?
2	Who sets the price for fish/shrimp/others?
3	Which market addresses the fish you sell?
4	Do you support fishers? How? (Loan/equipment)? How do you benefit from supporting them?
5	How is your relationship with the fishers?
6	What do you know about the AMPR? Do you know what the purpose of the AMPR is?
7	Do you pay a different price to fishers if fish is from the AMPR? Why? If not, would you pay a different price in the future?
8	Where does the fish you buy come from?

	Do you know if some fish comes from an AMPR?
9	Are you involved in activities of the AMPR? Why?
10	Have you noticed a change in the amount or size of the fish you receive?
	Do you ask for a specific size or quality of fish you want to receive?
	Do you notice differences when fish is caught with different types of gear?
11	How is your relationship with other collective centers? Do you compete with them?
12	How is your relationship with organizations/govt. agencies (INCOPECSA)?
	How often do they give you training?
	Have you received training about responsible fishing?
13	What is required to establish a collection center?
14	Who is in charge of inspecting collection centers? How often are inspections done?

#### Annex 4. Key informants approached in fieldwork

Informants	Semi-structured		Open-ended	
<b>Isla Caballo AMPR</b>				
Association leaders	2 (M)	1 (F)		1 (group 1 M and 2 F)
Fishers	15 (M)	1 (F)		
Development association		1		
EBAIS (mobile staff in Venado, Chira, Caballo)		1		
High school director		1		
Collecting center (private)		2		
<b>Palito-Montero AMPR</b>				
Association leaders and ex-leaders	12 (M)	3 (F)		2 (M)
Fishers	16 (M)	3 (F)		
Development association		1		
Island syndic		1		
Collecting center (private)		2		
<b>Distrito Paquera -Tambor AMPR</b>				
Association leaders	12 (M)	1 (F)		2 (F)
Fishers	29 (M)	2 (F)		
CAPATUR (governance committee)		1		
Cobano municipality (governance committee)		1		
Collecting center (associations)		2		
<b>External to AMPR</b>				
INCOPECA		3		
Servicio Nacional de Guardacosta		2		
INDER		1		
IMAS		1		
INA		1		
UNA		2		
CoopeSoliDar		1		
MarViva		1		
ASOPAPU		1		
Collecting centers (Puntarenas)		3		
<b>Total</b>		<b>126</b>		<b>5</b>

\*(M) Male; (F) Female

**Annex 5. Adapted Social-Ecological System Framework. Source: McGinnis and Ostrom 2014.**

<p><b>Social, economic, and political settings (S)</b>  S1 – Economic development  S2 – Demographic trends      S2a - Population tendency (*L)  S3 – Political stability  S4 – Other governance systems      S4a- Regulations at national/local level  S5 – Markets      S5a- Market stability      S5b- Market access (*L)  S6 – Media organizations  S7 – Technology      S7a- Communication</p>	
<p><b>Resource systems (RS)</b>  RS1 – Sector (AMPR resources)  RS2 – Clarity of system boundaries  RS3 – Size of resource system  RS4 – Human-constructed facilities  RS5 – Productivity of system  RS6 – Equilibrium properties  RS7 – Predictability of system dynamics  RS8 – Storage characteristics  RS9 – Location</p>	<p><b>Governance systems (GS)</b>  GS1 – Government organizations      GS1a- Support in funding (*P)      GS1b- capacity building      GS1c- support in legal procedures      GS1d- support in enforcement (*P)  GS2 – Nongovernment organizations      GS2a- Support in funding      GS2b- Capacity building (*B)      GS2c- support in legal procedures  GS3 – Network structure      GS3a vertical (*P) (*L)      GS3b horizontal (*P) (*L)  GS4 – Property-rights systems      GS4a- Formal      GS4b- Informal  GS5 – Operational-choice rules      GS5a- formal      GS5b- informal  GS6 – Collective-choice rules  GS7 – Constitutional-choice rules  GS8 – Monitoring and sanctioning rules      GS8a- surveillance      GS8b- biophysical monitoring      GS8c- graduated sanctions (*P)</p>
<p><b>Resource units (RU)</b>  RU1 – Resource unit mobility  RU2 – Growth or replacement rate  RU3 – Interaction among resource units</p>	<p><b>Actors (A)</b>  A1- Number of actors  A2 – Socioeconomic attributes      A2a- source of incomes (*L)</p>

<p>RU4 – Economic value  RU4a- Market value (*L)  RU5 – Number of units  RU6 – Distinctive characteristics  RU7 – Spatial and temporal distribution</p>	<p>A2b- access to basic services (*L)  A3 – History or past experiences  A4 – Location  A5 – Leadership/entrepreneurship  A6 – Norms (trust-reciprocity)/social capital  A7 – Knowledge of SES/mental models  A7a- traditional knowledge  A7b- system dynamic knowledge  A7c- social behavior knowledge (*L)  A8 – Importance of resource (dependence)  A8a- Economic dependence (*L)(*B)  A8b- Subsistence dependence  A8c- Cultural dependence (*L)(*B)  A9 – Technologies available  A9a- Homogeneity (*B)(*P)</p>
<p><b>Action situations: Interactions (I) → Outcomes (O)</b></p>	
<p>I1 – Harvesting  I2 – Information sharing  I3 – Deliberation processes  I4 – Conflicts  I4a-Internal conflicts (*L)  I4b- External conflicts (*L)  I5 – Investment activities  I6 – Lobbying activities  I7 – Self-organizing activities  I8 – Networking activities  I9 – Monitoring activities  I10 – Evaluative activities</p>	<p>O1- Social performance measures (e.g., efficiency, equity, accountability, sustainability)  O2- Ecological performance measures (e.g., overharvested, resilience, biodiversity, sustainability)  O3- Externalities to other SESs</p>
<p><b>Related ecosystems (ECO)</b>  ECO1 – Climate patterns  ECO2 – Pollution patterns  ECO3 – Flows into and out of focal SES</p>	

Crossed-checked with: (\*L) London *et al.* (2007), (\*B) Basurto *et al.* (2013), (P\*) Partelow and Boda (2015)



## Annex 6. Indicators to determine the influence of factors on collective action in AMPRs

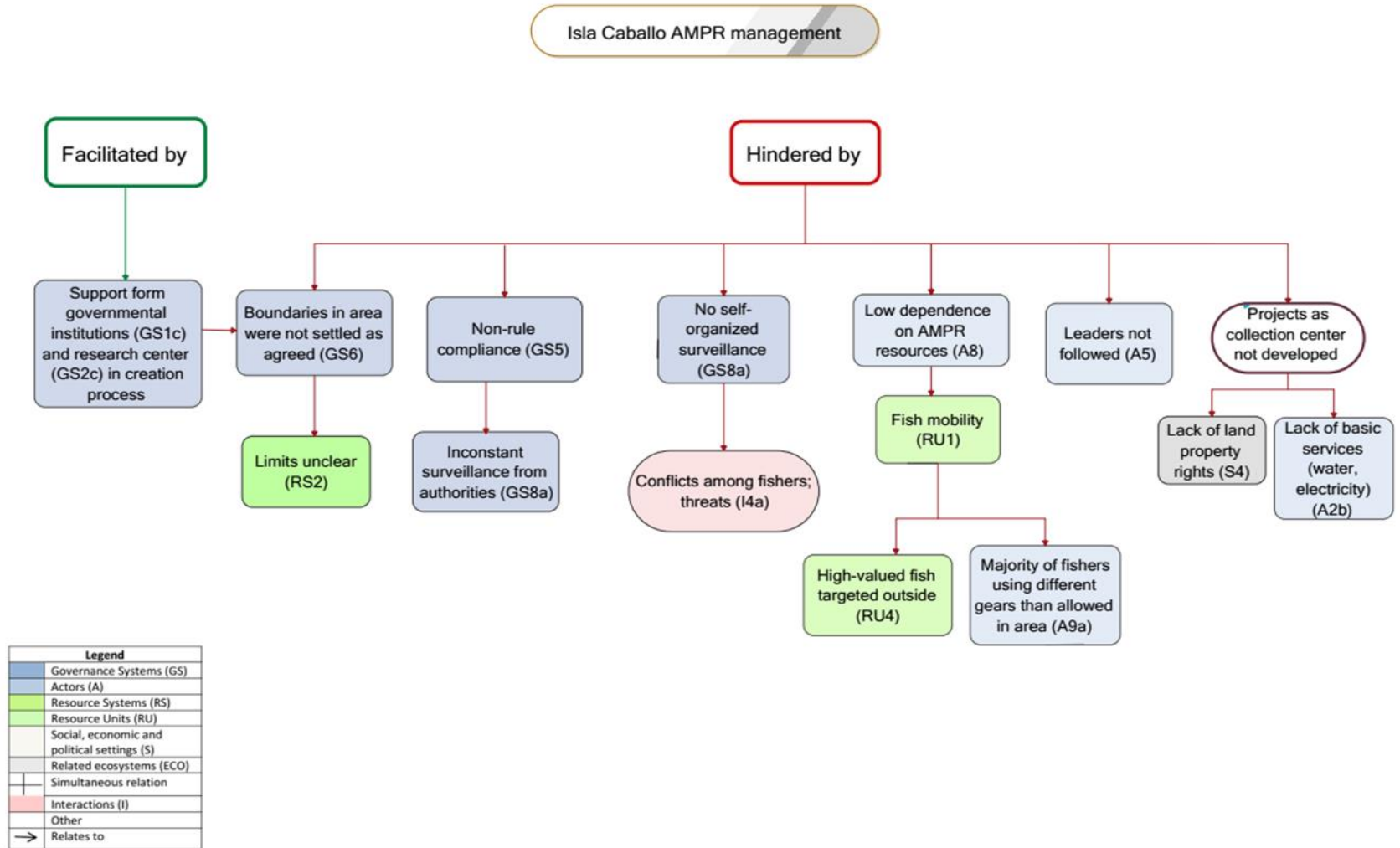
Variable	Theoretical statement of CA	Source	Indicator	Examples of key informant perceptions*
Trust- reciprocity (A6)	High to moderate levels of confidence and close relationship among local actors is likely to increase CA	Cinner <i>et al.</i> 2012, Basurto <i>et al.</i> 2013	Low: Negative or conflictive relationship and little confidence and among actors	-“Not much relationship...” (Isla Caballo fisher) -“Not much communication” (Isla Caballo fisher) -“There is no confidence with board members” (Palito fisher) -“There are many problems among fishers” (Playa Blanca sector fisher) -“they fight among family” (Paquera sector fisher)
			Medium: Confidence and relationship among actors is intermediate or not strong among some actors	-“Relationship...not bad, not good” (Palito fisher) -“Not everyone good” (Playa Blanca sector fisher)
			High: Positive confidence or close relationship among actors	-“everyone knows each other” (Palito fisher) -“good relationship”(Tambor sector fisher) -“Work fine with everyone” (Tambor sector fisher)
Leadership/ entrepreneurs hip (A5)	Likelihood of CA increases when actors possess entrepreneurial skills, are respected and followed as local leaders by other actors	Olson 1965, Ostrom 1999, Ostrom 2009, Vedeld 2000, Pomeroy <i>et al.</i> 2001, Gutiérrez <i>et al.</i> 2011	Low: Lack of leadership skills, disagreement with leader actions or actors neglecting to follow leaders	-“There is no communication of decisions taken” (Isla Caballo fisher) -(Association) “...is taken by a family group and others are not taken into account” (Isla Caballo fisher) -(Association) “...do not take me into account” (Isla Caballo female fisher) - “...There is bad management from board members” (Palito fisher) -“Do not feel represented, also other fishers feel the same” (Palito fisher) -“Do not trust in leaders...”(Palito fisher)
			Medium: Leadership is taking place but still missing skills and acceptance of leaders to be followed	-“More or less, board members have changed recently” (Montero fisher)
			High: Presence of leadership skills had positive effect on requesting institutional support and being followed and respected by actors	-“...trust in them...have achieved things in short time” (Tambor sector fisher) -“organized people and organizations of the area... asked for support from institutions and municipality” (Paquera sector leader) - (Leader) “provides important support...” (university researcher)
Monitoring and graduated sanctioning mechanisms (GS8a)	Likelihood of CA increases when effective monitoring and graduated sanctioning mechanisms are applied, assuring rules compliance	Ostrom 1990, Pomeroy <i>et al.</i> 2001, Gutiérrez <i>et al.</i> 2011	Low: Lack of efforts to patrol illegal activities in AMPRs and apply graduated sanctions, to assure rule compliance	-“...authorities and fishers do not help...” (Isla Caballo fisher) -“call coast guard... but they do not come” (Paquera sector fisher) -“coast guard should come constantly; there is no support” (Isla Caballo fisher) -“...do not denounce because they are family” (Isla Caballo fisher) -“No sanction...” (Tambor sector fisher)
			Medium: Patrolling efforts are not often developed to assure rule compliance and sanctions are not often or only partially applied to actors that disrespect rules in the	-“...not everyone taking care” (Palito fisher) -“When we go through the area” (Tambor sector fisher) -“When illegal fishing is seen, report it to the navy” (Tambor sector fisher) -“...more presence from authorities is needed” (Isla Caballo fisher)

			AMPRs	-“CG has been watching over” (Tambor sector fisher) -No sanctions for hand-line fishers using illegal gear but for gillnet fishers (Montero fisher)
			High: Patrolling efforts are constant to assure rules compliance. Enforcement and sanctions are effective with actors that disrespect rules in the AMPRs	-“Surveillance during nights” (Palito fisher) -“Usually; we have a group for surveillance; went out last night to patrol” (Montero fisher) -“There is a group in charge of surveillance...” (Palito fisher) -“Coast guard is called, fishers lose their license” (Palito fisher) -“If the equipment is not allowed, they (Coast Guard) takes equipment and boat” (Tambor sector fisher)
Importance of AMPR resource (dependence) (A8)	High dependence on AMPR resources to obtain income and sustain livelihoods increases the likelihood of CA	Varughese and Ostrom 2000, Ostrom 2009, Basurto <i>et al.</i> 2013	Low: Negative or little dependence on AMPR fishing resources	-“I work outside the area” (Isla Caballo fisher) -“Most fish is caught outside the area” (Tambor sector fisher)
			Medium: Intermediate dependence on AMPR fishing resources	-“It depends, it varies according to where the fish are” (Paquera sector fisher) -Sometimes inside or outside, depending on species (Tambor sector fisher)
			High: Positive or strong dependence on AMPR fishing resources	-“Take care, it provides food” (Montero fisher) -“...only depend on the area to fish” (Palito fisher) -To obtain “...daily income” (Palito fisher)
Resource unit mobility (RU1)	CA is less likely with highly mobile resource units	Ostrom 2009	Low: Resource units of interest present little mobility and could usually be found and harvested inside the AMPR.	-“fish mostly in area” (Palito fisher)
			Medium: Resource units of interest are often found or harvested inside the AMPR but displace due to different patterns	-“Sometimes (fish) get inside, it is during some period of time” (Isla Caballo fisher) -“Fishing is variable; sometimes good in good tides “ (Palito fisher) -“Depends on the moon, tides...” (Paquera sector fisher) -According to tides; can be caught inside or outside (Playa Blanca sector fisher)
			High: Resource units displace and migrate and are rarely found or harvested in the AMPR	-“Fish do not stay in the area” (Isla Caballo leader) -“...fish migrate...” (Tambor sector fisher) -“...resource is mobile...” (NGO member)

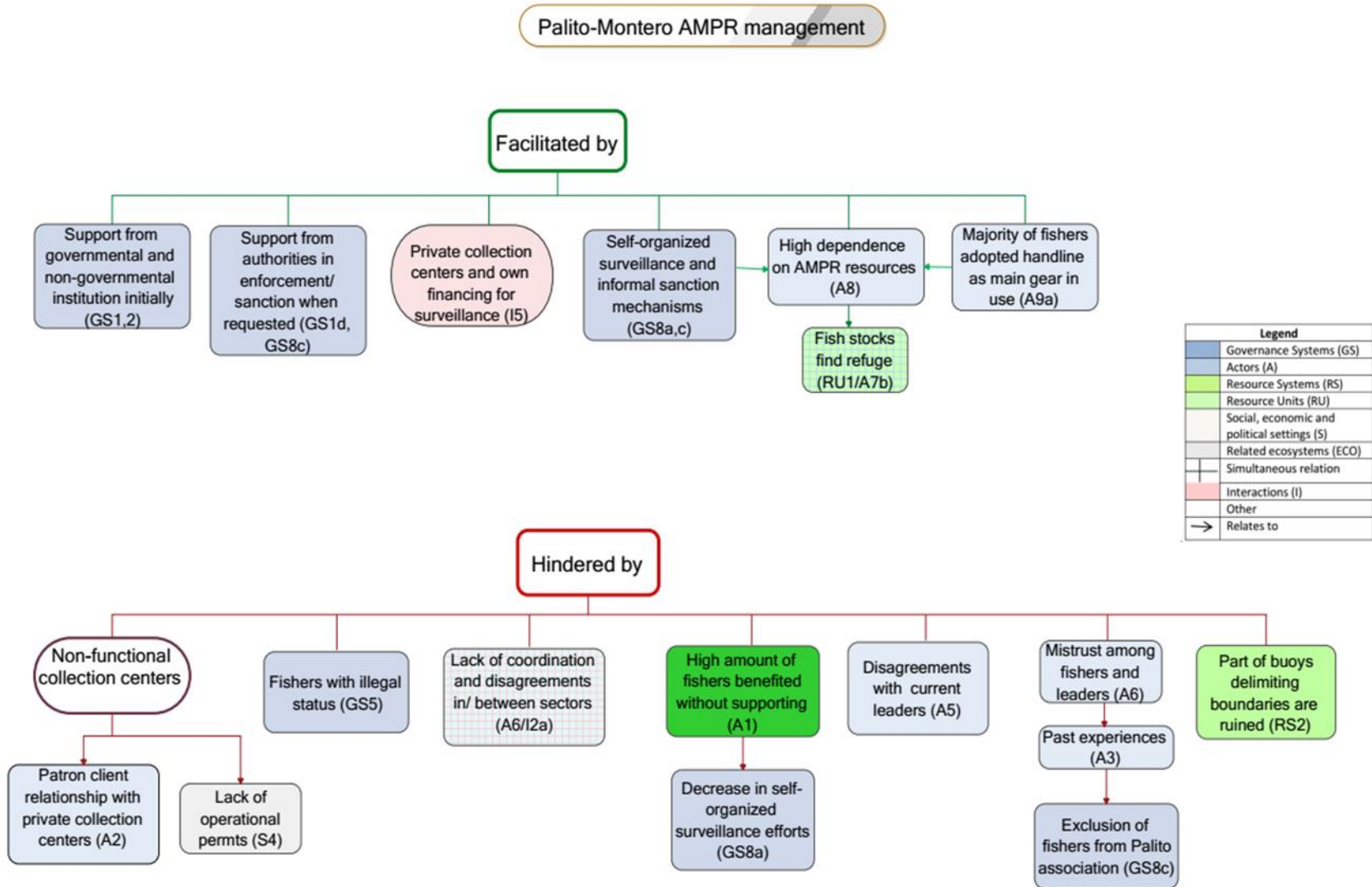
\* Key informant perceptions were translated from English to Spanish for research purpose

Influence on collective action (CA)			
Increasing: A variable has a positive influence on CA	↑	Decreasing: A variable has a negative influence on CA	↓

## Annex 7. Factors influencing collective action for Isla Caballo AMPR



## Annex 8. Factors influencing collective action for Palito-Montero AMPR management



## Annex 9. Factors influencing collective action for Distrito Paquera-Tambor AMPR management

