Unbundling and trading property rights in a fishing commons

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Abstract

Property rights structure incentives for long-term sustainability. Here we investigated how area-based policy tools that can adapt to climate change create trade-offs in terms of property rights. There is tension between property rights theory (long-term secure rights associated with sustainability) and resilient, adaptive tools where rights are temporary. Schlager and Ostrom have useful a conceptual schema for thinking about property rights of commons (Schlager & Ostrom, 1992); we use this tool to analyze trade-offs. Fish Refuges are adaptive and temporary area-based tools in Mexico that were established to solve fisheries decline. They are one of the few (but growing number of) adaptive area-based conservation tools, and have restructured property rights. We qualitatively analyzed how these Fish Refuges restructured property rights, thus creating different trade-offs for different actors. Fish Refuges were made legally available from a new fisheries law in 2007, and were first established in 2012. By 2017, there were 40 Fish Refuges in Mexico accounting for 20,000 km^2. Before the Fish Refuges, there were overlapping and unclear legal harvest rights in the Corredor region. In practice (de facto rights), local communities harvested fish with no limits, as did outsiders. Management and exclusion rights legally rested with the state, but de facto were nonexistent. Thus there were few incentives for long-term management, beyond local dependence upon the fishery. Fishing was going down, and local fishers in the region blamed this on overharvest from poor management and lack of exclusion. Fish Refuges are created when fishers submit a proposal (assisted by a non-governmental organization), which is assessed and edited by the state fisheries research agency, then established by the state fisheries enforcement agency. The process of these first Fish Refuges has led to fishers gaining de facto management and exclusion rights by giving up harvest rights. Outsiders have lost harvest rights and have been excluded from management. Adaptive area-based conservation tools create unstable and temporary property rights, but here have allowed local resource users to give up shaky harvest rights and gain shaky management and exclusion rights. They have led to new opportunities for negotiating management and rights with the state, some of which may be formalized into legal management and exclusion rights in the future.

Introduction

In marine systems, there is a challenge to develop resource and environmental policies that can adapt to climate change (D. R. Armitage et al., 2009; Perry, Ommer, Barange, & Werner, 2010; West et al., 2009). Perhaps the fastest growing marine resource policies are area-based tools like Marine Spatial Planning and Marine Protected Areas (Tittensor et al., 2014), which are a form of holistic ecosystem-based management, considered necessary by ecologists for complex coastal ecosystems (Crowder & Norse, 2008; Levin & Lubchenco, 2008). However, there is a tension between the need for adaptation and resilience on one hand, and existing area-based approaches, which are often permanent and struggle to be adaptive to climate change (Green et al., 2014; McLeod, Salm, Green, & Almany, 2009). One policy tool available in Mexico that is both area-based and potentially adaptive is the temporary no-fishing area called a Fish Refuge (CONAPESCA, 2017). By prohibiting fishing within their borders, Fish Refuges aim to rebuild fish stocks in nearby

fisheries. These Fish Refuges must be renewed every 5 years, thus creating the opportunity for adaptation to climate change. In this paper, we present the trade-offs in incentives for long-term sustainability created by short-term Fish Refuges in one region of Mexico, using a property rights framework.

Property rights – rights to derive benefits from things – are important because they structure incentives for managing resources, which in turn influences social and environmental outcomes (Commons, 1968; Demsetz, 1974; E. Ostrom, 2003; Schlager & Ostrom, 1992). The property rights associated with long-term resource sustainability for marine commons like fisheries are well known: secure management and exclusion rights are associated with sustainable management (Agrawal & Ostrom, 2001; E. Ostrom, 2003). However, Mexico's temporary no-fishing areas, while potentially adaptive, threaten the security of property rights by creating temporary property rights structures. This policy goes against the grain of secure long-term property rights, which is usually argued to be necessary for sustainable resource management. However, because policies like Fish Refuges are new, this has not been empirically examined. We address this gap by addressing the research question: *What is the property rights structure created by an area-based management tool that has the potential to adapt to climate change*?

We use the case of 11 Fish Refuges in the San Cosme to Punta Coyote Corredor in Baja California Sur, Mexico to explore this question. This paper makes three major scholarly contributions. First, we find that insecure tenure does not preclude incentives for long-term sustainability. This contributes to literature on climate change and resilience, using property rights theory as a lens to empirically and theoretically explore the tension between adaptability and sustainability. Second, we find that *who* changes property rights regimes is very important. In this case, the process of establishing Fish Refuges allowed local fishers to negotiate and informally claim new property rights (management, exclusion), in part by relinquishing rights of access and withdrawal. We show how a classical property rights framework (Schlager & Ostrom, 1992) can be used to analyze the unbundling and trading of property rights through the policy process, and reveal the agency of resource users to claim expanded rights with expanded incentives for long-term sustainability. Indeed, here we describe a case where resource users were able to move from an unsustainable pathway to a sustainable one by strengthening their incentives for long-term resource management. Especially of interest, this occurred in a system lacking the usual characteristics of successful collective action and resource sustainability. Third, this paper contributes to literature on social outcomes of area-based conservation tools by exploring how such a tool creates new incentive structures via property rights. This paper describes the social outcomes of a new type of area-based management that has the potential to adapt to climate change.

Property rights theory and resource management

Given a system with actors making decisions, such as a fishery, a property rights framework is useful for predicting behavior that is primarily driven by incentives. Thus, a property rights framework can be used to analyze whether actors have incentives for long-term sustainability in such cases. Property rights are defined as particular actions that are authorized in respect to a specific domain (Commons, 1968; V. Ostrom, 1976). Property rights convey the right to benefit or harm oneself or others, and a commensurate duty to respect that right (Demsetz, 1974). The reason that property rights have interested theorists is because they define who captures which benefits from a resource, thus shaping incentives and decision-making around resources (Demsetz, 1974; V. Ostrom & Ostrom, 1977) (see Figure 1, below).

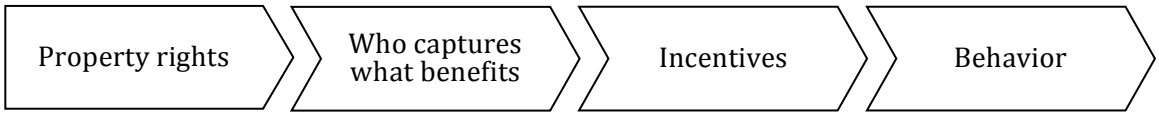

Figure 1. Classical view of property rights mediating how rules affect behavior amalgamated from (Commons, 1968; Demsetz, 1974; E. Ostrom, 1986; Schlager & Ostrom, 1992)

Early resource economists were interested in property rights because they align personal incentives with societal incentives (Demsetz, 1974). Classical property rights theory suggested that well-defined property rights improve resource outcomes through three mechanisms: first, by ensuring that those who sow are those who reap (positive externalities); second, by reducing perverse incentives to compete for limited resources and eliminate the resource stock (negative externalities; often labeled the "tragedy of the commons"); and third, by reducing the number of parties that must negotiate unintended consequences (transaction costs) (Coase, 1960; Demsetz, 1974). In other words, property rights are theorized to internalize both positive and negative externalities, and thus incentivize efficient resource management and the greater good (Demsetz, 1974). The actual outcomes of different property rights regimes are highly varied, however (E. Ostrom, 2005) which has led to property rights being defined on a finer resolution. Rather than binary (have/have not), it is widely accepted that property rights are plural, often called a "bundle of sticks" or a "bundle of rights", including use but also exclusion of others and transference rights (Becker, 1977; Epstein, 1985).

Differentiating between rights is especially important for explaining outcomes in common-pool resources: resources that are limited, competitive, and accessible to many (E. Ostrom, Gardner, & Walker, 1994). Many marine resources like fisheries, biodiversity, and deep-sea minerals in the high seas can be analyzed as common-pool resources (Berkes, Feeny, McCay, & Acheson, 1989). Certain rights, or, more exactly, certain bundles of rights, incentivize sustainable behavior towards these common-pool resources (Schlager & Ostrom, 1992). In 1992, Schlager and Ostrom provided theoretical and empirical evidence that overthrew previous assumptions (Demsetz, 1974) that only a complete bundle of rights (i.e., full ownership) would lead to sustainable management of a resource by internalizing all externalities (Schlager & Ostrom, 1992). Instead, they demonstrated that an incomplete bundle, such as proprietorship, could predict sustainable behavior – indeed, in some cases could lead to more sustainable outcomes because the resource system could not be sold (Table 1). Schlager and Ostrom (1992) developed a conceptual schema to analyze property right regimes for common-pool resources, which has since been used in thousands of analyses including cases of area-based management (Ban, Evans, Nenadovic, & Schoon, 2015; Mascia & Claus, 2009) and climate change adaptation (Coleman, 2011).

In their now-classical conceptual schema, Schlager and Ostrom distinguish between five types of rights: access and withdrawal, management, exclusion, and alienation (Schlager & Ostrom, 1992). Access is the right to be positioned to harvest a resource and withdrawal is the right to actually harvest (often a particular quantity of) the resource, so Schlager and Ostrom combine these two. Management is the right to regulate internal use and transform the resource; exclusion is the right to determine who has access rights and how those rights are transferred; and alienation is the right to sell or lease either or both management and exclusion rights (Schlager & Ostrom, 1992). Alienation is often misunderstood (Ban et al., 2015) as the right to sell withdrawal rights (e.g., to sell fishing permits in an estuary), but it is actually the right to sell the decision-making rights of management or exclusion (e.g., to sell the whole estuary to a hotel for development). The careful

distinction between use (access and withdrawal), regulating how (management), regulating who (exclusion), and controlling the process (alienation) is important for understanding the implications of Schlager and Ostrom's conceptual schema, which bundles different combinations rights. This conceptual schema, linking positions to bundles of rights, is shown below in Table 1.

	Authorized user	Claimant	Proprietor	Owner
Access and Withdrawal	X	X	X	X
Management		X	X	X
Exclusion			X	X
Alienation				X

Table 1. The Schlager and Ostrom (1992) conceptual schema of property rights. Bundles of rights (left column) are associated with different positions (top row). An X in a column marks a right associated with that column's position.

A major contribution of Schalger and Ostrom's schema is that there are many different rights, and full ownership (i.e., all rights) is not required to have strong incentives to sustain a resource; proprietors have sufficient rights to make decisions that promote long-term investment and harvesting from a resource. However, Ostrom and Schlager do connect rights like exclusion and management with stronger incentives to sustain than just possessing withdrawal rights. They argue that the incentives shift predictably with the accumulation of each new right, with three important jumps in incentives as described below.

Access and withdrawal	→	Management:	Without management rights, users are forced to follow rules that are not of their own making. Gaining management rights can thus lead to greater legitimacy and compliance.
Management	→	Exclusion	Gaining exclusion rights provides the assurance that users will capture the benefits of the management actions they undertake, which may be costly in terms of time, direct costs, or lost potential income.
Exclusion	→	Alienation:	Originally alienation rights were assumed to be of critical importance for sustainable behavior (Demsetz, 1974), but Schlager and Ostrom refuted this (1992). Indeed, sometimes alienation rights resulted in less sustainable outcomes, for example when owners sell forests to oil companies that cut it down (CITATION).

In the nearly 30 years since this schema was published, it has been used to analyze property rights in thousands of cases of common-pool resources. Two insights emerge from this literature. First, bundles of rights are typically cumulative for common-pool resources. The cumulative nature of these bundles of rights is important because it establishes a clear hierarchy of positions with respect to the resource. Rights are not always cumulative for all resources; Ostrom and Hess have developed a set of 7 types of rights that apply specifically to internet resources, which are not necessarily cumulative (E. Ostrom & Hess, 2007, 2010). Galik and Jagger propose an alternative schema with 6 types of rights (adding "alteration" above management) with added distinctions between rights and powers, although they still conceptualize these as cumulative (Galik & Jagger, 2015). Ban et al. argue that bundles of rights are highly complex with overlapping rights, using the

case of marine area management in Australia (Ban et al., 2015). Yet their complexity and overlapping rights pertain to different goods rather than complexity of rights around a single good (Ban et al., 2015). However, nothing in the conceptual schema requires bundles of rights to be cumulative (Schlager & Ostrom, 1992).

Second, although there is strong interest in the mechanisms that drive changes in property rights regimes (Agrawal & Ostrom, 2001; Galik & Jagger, 2015; E. Ostrom, 2005), it is unclear how or whether those who possess a limited bundle of rights (use, withdrawal) are able to upgrade to fight for, negotiate, or claim an expanded bundle of rights – rights that are typically associated with strong incentives for sustainability. How are resource users who are dependent on a resource, but who do not have management rights, to gain such rights? How might they move from an unsustainable pathway to a sustainable one? Much work on property rights around the commons has focused on static property rights systems rather than dynamic ones. In this paper, we use the conceptual schema of Schlager and Ostrom (1992) to analyze how resource users unbundle and trade withdrawal rights to gain management and exclusion rights in a dynamic process of property rights regime shift, focusing especially on tradeoffs in terms of property rights. We describe how rights change, who drives this change, and what specific negotiations during the policy process allow for certain rights to be altered.

Fish Refuges as an empirical case

Fish Refuges (Zonas de Refugio) are area-based tools intended to protect or rebuild fisheries in Mexico, typically through no-take zones (DOF, 2014). Fish Refuges are governed differently than other area-based resource management tools in Mexico. While the majority of these are implemented by the National Commission on Protected Areas (Comisión Nacional de Áreas Naturales Protegidas, CONANP) in the Ministry of the Environment and Natural Resources (Secretaria de Medio Ambiente y Recursos Naturales, SEMARNAT), Fish Refuges are implemented by the Commission on Fishing (Comisión Nacional de Acuacultura y Pesca, CONAPESCA) in the Ministry of Agriculture and Rural Development (Secretaría de Agricultura y Desarrollo Rural, SADER; until 2019, SAGARPA). Also, Fish Refuges are typically implemented by CONAPESCA in response to demand (in the form of a formal, written proposal) from fishing organizations or fishers coordinated by non-governmental organizations. Thus, the process of creating Fish Refuges typically reflects greater power sharing and co-management than other area-based tools. Finally, Fish Refuges are typically (but not necessarily) established for 5 years at a time before they expire, while most other area-based tools in Mexico are permanent.

While they are governed differently in many aspects, Fish Refuges share some characteristics with other marine area-based tools in Mexico, which we compare below. Mexico's Protected Areas (Areas Naturales Protegidas, ANPs) are the most prevalent area-based management tool, and aim to preserve or restore ecosystems (Koch, 2015). Their legal definition as far as what is permitted within their boundaries is very vague, with the result that many Protected Areas allow extractive activities in much of their area. For example, in the Loreto Bay National Park (Parque Nacional Bahia de Loreto), fishing was allowed in more than 99% of the park until this year (Rife et al., 2013). However, resource users like fishers often view Protected Areas as threats to their long-term livelihoods, based on cases of Protected Areas that have completely banned resource harvest, or certain types of harvest, with the stated objective to restore or protect biodiversity. Contrast Protected Areas with Fishing Concessions, an area-based form of fisheries management where exclusive harvest over an area is granted to a particular fishing entity, often a fishing cooperative. The aim of Fishing Concessions is much more similar to Fish Refuges: to

maintain long-term sustainable fisheries harvest. However, the mechanism of a Fishing Concession is different from a Fish Refuge: rather than using no-take zones to restore Fish Stocks, Fishing Concessions incentivize sustainable harvest through medium-term harvest and exclusion rights in a designated area, where a given fishing entity is expected to establish its own rules to maintain a sustainable fishery. Fishing Concessions have been considered a type of Territorial Use Right in Fisheries (TURF) (McCay, 2017). Fish Refuges are thus tools that look and act like Protected Areas as far as the mechanism they use to accomplish their goal, but which serve an objective that is more similar to a Fishing Concession.

	Protected Area	**Fish Refuge**	**Fishing Concession**
Area-based tool	✓	✓	✓
Size (typical)	Large	Very small	Small
Duration (typical)	Permanent	5 years	20 years
Adaptive capacity	Low	High	Medium
Secretary	Ministry of the Environment and Natural Resources (SEMARNAT)	Ministry of Agriculture and Rural Development (SADER)	Ministry of Agriculture and Rural Development (SADER)
Legal management unit	Commission on Protected Areas (CONANP)	Commission on Fishing (CONAPESCA)	Commission on Fishing (CONAPESCA)
Legal focus	Ecosystem protection and restoration	Fisheries exploitation	Fisheries exploitation
Mechanism	Ecological: Restricted harvest; No-take areas	Ecological: No-take areas	Economic/incentives: Long-term exclusive access rights
Enforced by	CONANP	Self	Self
First legal example (contemporary form)	1917	2012	1933

Table 2. Comparison of three area-based resource management tools in Mexico: the Protected Area (Area Natural Protegida), the Fish Refuge (Zona de Refugio), and the Fishing Concession (Concesión). Fish Refuges, the focus of this paper, use similar mechanisms as Protected Areas (i.e., ecological mechanism of no-take zones), but share objectives (fisheries exploitation) and legal structure (Commission on Fishing) with Fishing Concessions. (Crespo-Guerrero & Jiménez-Pelcastre, 2018; DOF, 2012, 2014)

Fish Refuges were first established as a legal tool for fisheries management in the national fisheries law of 2007 ("Ley General de Pesca y Acuacultura Sustentables") (DOF, 2007). The law defined Fish Refuges as "Areas delimited in federal waters, with the primary aim of conserving and contributing, naturally or artificially, to the development of fishing resources through reproduction, growth, or recruitment, as well as preserving and protecting the surrounding environment" (page 6) (DOF, 2007). Beyond this, the law gave little direction, mentioning Fish Refuges three times in 71 pages. This left great latitude, and great onus to demonstrate their utility, to the first Fish Refuges, which were established in 2012. Since 2012, more than 40 Fish Refuges have been established, accounting for more than 20,000 km^2. Not all Fish Refuges are equivalent. It was not until 2014 that the federal government published a 4,400-word protocol defining the purpose, mechanisms, and legal steps of Fish Refuges in Mexico. While most Fish Refuges were proposed by fishing organizations or non-governmental organizations on behalf of fishers, there are exceptions (e.g., the Gulf of Ulloa Fish Refuge). Also, while most Fish Refuges are temporary, and expire after a

designated period (usually 5 years), some are permanent. Finally, while most Fish Refuges are no-take zones which prohibit all fishing activities, some are partial-take zones, allowing limited fishing activity (for example, allowing hand line fishing but no other forms). Some of these Fish Refuges were established together as a network in a single piece of legislation, as in the case we examine in this paper. A table of all official, currently existing Fish Refuges (not including expired ones) is below.

State	Name (Distinct Legal Framework)	# Refuges (if network)	Total Km²	Date established	Type
Baja California Sur	Punta Coyote to San Cosme	12	69.66	15/11/2017	11 Total Temporal 1 Partial Temporal
	Gulf of Ulloa	1	19932.29	6/25/18	Partial Temporal
	Isla Natividad	2	2.00	7/6/18	Partial Permanent
Quintana Roo	Espiritu Santo	8	10.49	30/11/17	Total Temporal
	Banco Chinchorro	1	122.57	31/5/19	Total Temporal
	Akumal	1	9.88	13/4/15	Partial Temporal
	Canal Nizuk	1	0.08	24/4/18	Total Permanent
	Bahia Ascension	2	32.11	23/9/16	Total Temporal
Sinaloa	Teacapan	7	3.49	3/12/14	Partial Permanent
	Bahía de Altata-Ensenada del Pabellón	1	0.02	24/4/18	Total Permanent
Sonora	Isla San Pedro Nolasco	3	1.38	12/7/17	Total Temporal
	Puerto Libertad	1	0.74	12/7/17	Total Temporal
	Bahía Jitzamuri-Agiabampo	1	0.03	24/4/18	Total Permanent

Table 3. Fish Refuges in Mexico. Table includes sizes, types, and names of all legally established Fish Refuges in Mexico, as of May 2019, to the authors' knowledge. The name listed is the name of the distinct legal framework, many of which create networks of various Fish Refuges. Types: Fish Refuges may be total (complete no-take) or partial (limited fishing gear types or harvest); and they may be permanent (no expiration) or temporal (set expiration date, usually after 5 years). There are a total of 41 individual Fish Refuges established by 13 distinct legal frameworks, in 4 states. The total area covered by Fish Refuges is 20,185 km². The First Fish Refuge was established on November 16, 2012, and the most recent, on May 31, 2019. 26 Fish Refuges are of type Total Temporal; 9 are Partial Permanent; 3 are Total Permanent; and 3 are Partial Temporal.

Temporary Fish Refuges have the potential to adapt to climate change by requiring the full process of renegotiation, reassessment, and reapproval every time they expire, creating the opportunity for adaptation and resilience (D. Armitage, Berkes, & Doubleday, 2010; D. R. Armitage et al., 2009; Olsson, Folke, & Berkes, 2004; Plummer, Armitage, & de Loë, 2013). They are arguably the only area-based tool in Mexico that does have a high potential to adapt to climate change. Fish Refuges thus create the opportunity to answer our research question about the property rights structure created by an area-based management tool that has the potential to adapt to climate change, within the context of Mexican fisheries. Along many indicators, Mexico is in the middle of small-scale fisheries management globally, comparable to other middle-development countries like Malaysia, the Philippines, Peru, Ecuador, and Brazil (Pitcher, Kalikoski, Short, Varkey, & Pramod, 2009). Similar to these countries, the vast majority (97%) of fishing boats in Mexico are small-scale, less than 36 feet with an outboard motor (FAO, 2003). Fisheries management is a challenge in Mexico; fisheries are in decline, poorly managed, and largely de-facto open access (Cinti, Shaw, Cudney-Bueno, & Rojo, 2010; Finkbeiner, Ayers, Kittinger, & Crowder, 2015; Giron‐Nava, Johnson, Cisneros‐Montemayor, & Aburto‐Oropeza, 2018; Sala, Aburto‐Oropeza, Reza, Paredes, & López‐Lemus, 2004). Fisheries rights accumulate in the wealthy and powerful (Basurto et al., 2012). High uncertainty caused by violence from the narcotic trade, volatility of prices, economic crises, and climate change (Micheli et al., 2012) exacerbates the management challenges created by multi-specific, data-poor, and notoriously complex fisheries (Salas, Chuenpagdee, Seijo, & Charles, 2007). Managers from other countries where rule of law is low, fishing is poorly controlled by central governments, and fishing is in decline are likely to be interested in the findings from this case.

Study Site: El Corredor San Cosme to Punta Coyote, Baja California Sur

The case of Fish Refuges that we use to answer our research question is the first-ever network of Fish Refuges created in November 2012. They were established in the northwestern Mexican state of Baja California Sur in the "Corridor" region between San Cosme and Punto Coyote on the Gulf of California coast, north of the capital of La Paz. A map of the study region is below.

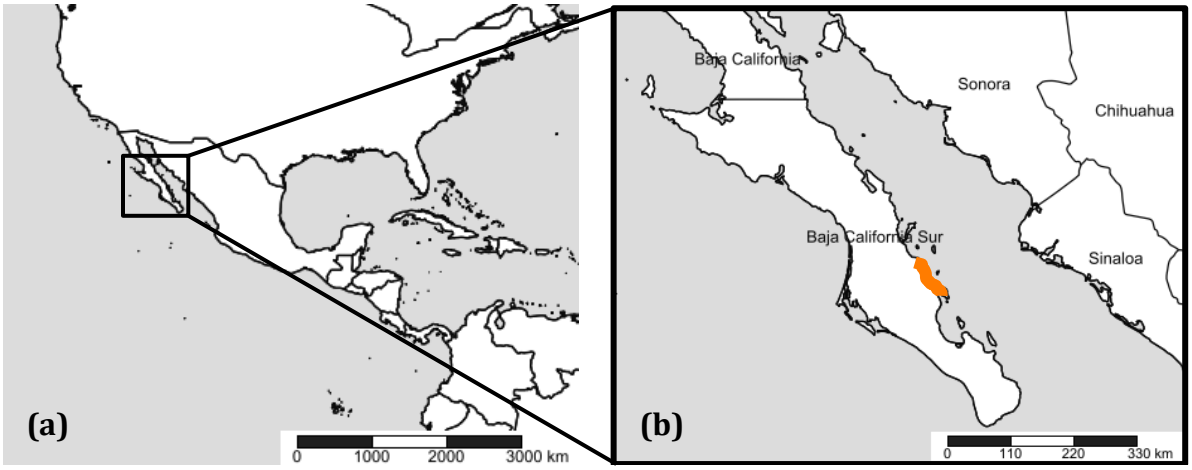

Figure 1. Map of study site. Figure (b) is an inlay of Figure (a). The Corridor San Cosme to Punto Coyote, Baja California Sur (hereafter, "the Corridor") where the study took place is shown in orange in (b). Map created by A. Quintana using SimpleMappr.

The Gulf of California is the inland body of water that separates the Baja California peninsula from mainland Mexico, and produces 71% of Mexico's total fisheries volume (OECD, 2006). The reason it is so productive is because of upwelling, which supports huge primary productivity. Adaptation in this region is crucial, as oceanographic conditions like El Niño Southern Oscillation cause extreme fluctuations in productivity (Pérez-Brunius, López, & Pineda, 2006). In response, fishers distribute risk through mobility and diversification of gear, targeted species, and livelihoods (Sievanen, 2014). There exists the widespread perception that fishing is in decline, with evidence of "fishing down food webs" (Basurto, 2005; Sala et al., 2004) and rapidly shifting baselines in fishers (Saenz-Arroyo, Roberts, Torre, Cariño-Olvera, & Enríquez-Andrade, 2005). Such is the case within the Corredor San Cosme to Punta Coyote where this study takes place, a region with 150km of coastline, 13 permanent towns, 659 residents, and 104 fishing vessels (Niparajá, 2016). No paved roads serve the area, although there are some dirt roads; 40% of towns are only accessible by sea. No centralized water or electricity serves these towns, but most houses have solar panels and some towns have wells, springs, or both. Most people are dependent on fishing for their livelihoods, although there is some ranching and tourism. 91% of fishers only fish, and 95% of fishers have lived in the same place for more than 10 years (Niparajá, 2015). Fishers in the region have noticed and been affected by the decline in fishing (Niparajá, 2009).

Figure 2. Photo panel of the Corredor region. Left, a "panga", the fiberglass fishing boat with outboard motor typical of small-scale fisheries in Mexico. Middle, a cooperative president processing catch just landed on the beach at Puerto de Agua Verde (also pictured in right). Right, the largest town in the Corredor region, Puerto de Agua Verde, with 260 residents; the natural port can be seen on the left.

The reason that the first Fish Refuges came to be established in the Corredor is because of the confluence of fisher support and strong promotion by the non-governmental organization (NGO), Sociedad de Historia Natural Niparajá A.C. (hereafter, Niparajá). Niparajá is an NGO based in Baja California Sur's capital of La Paz dedicated to regional conservation within the state; it has four programs, one of which is Sustainable Fishing (Pesca Sustentable). The mission of this program is to foment social structures that can create and maintain rules that support long-term survival of fishing livelihoods and their associated cultural, social, and economic values. While they have some broader projects, much of their work is concentrated in the Corredor region. In 2009, Niparajá started systematic data collection on problems and proposed solutions within fisheries of the Corredor. Through a process which spanned 3 years, described below, a network of 11 Fish Refuges were finally established in 2012 in the Corredor, with a 5-year duration. In 2017, the Fish Refuges were reinstituted and expanded for another 5 years.

Data collection and analysis

To understand how the Fish Refuges of the Corredor restructured property rights and the implications for long-term sustainability, we conducted qualitative primary data collection including 6 months of ethnographic research over 3 years (2016-2018), 68 interviews, and document analysis. This qualitative data was contextualized in and interpreted alongside socioeconomic surveys conducted in 2009 and 2016, as well as fisheries-dependent and fisheries-independent ecological data collection from 2012-2017. Because we did not collect primary data before 2016, all data from 2009-2016 is from secondary sources. The sources we draw heavily on in this paper include the 2009 socioeconomic survey and a series of qualitative focus groups conducted in 2009, with detailed notes assembled in a 60-page document called, "Conociendo el Corredor". While we collected the primary data used in this paper, we want to make it clear that the secondary data, including the socioeconomic surveys, the ecological data, and Conociendo el Corredor, was collected by Niparajá and their colleagues. We want to recognize and give them due credit for the extensive work they have done to collect data in this region, and to also acknowledge that this is a source of bias for the conclusions we may draw from this data.

Our primary data collection consisted of 6 months of ethnographic research conducted from May 2016 to July 2018. This work was approved in advance by Duke University's Institutional Review Board (permit #2018-0130). Data collection activities included: a 10-day ecological cruise along the entire Corredor region; short field visits to 3 of the 13 towns in the Corredor (Tembabiche: 3 days; San Evaristo: 6 days; and Agua Verde: 14 days); 2 months of fieldwork in the capital, La Paz, where the Commission of Fisheries (CONAPESCA), Niparajá, and two universities are located; 10 days in Loreto, a city to the north of the Corredor; and 3 months (2 continuous) of fieldwork in Agua Verde, the largest town in the Corredor. We conducted 68 interviews, of which 54 were recorded with permission. These were transcribed in full, and averaged 58 minutes in length. Respondents included: fishers from the Corredor and their family members; fishing cooperative leaders from within the Corredor; professionals (policemen, teachers) from the Corredor; state-level fishing sector leaders; academic scientists; the State Secretary of Fishing (SEPADA); the Commission on Fishing (CONAPESCA) and their research branch, the National Institute of Fishing (Instituto Nacional de la Pesca, INAPESCA); and staff of Niparajá. We analyzed these interviews and all field notes using thematic coding to identify emergent themes, and we iteratively returned between data and existing theory (Charmaz, 2006). We also analyzed all legal documents connected with the Fish Refuges of the Corredor, including: the 2007 general law of fishing (DOF, 2007); the legal documents which established the Fish Refuges in the Corredor in 2012 (DOF, 2012) and renewed them in 2017 (DOF, 2017); and the protocol that specified the implementation of Fish Refuges from 2014 (DOF, 2014). In addition, we analyzed the regulatory impact documents (Manifestación de Impacto Regulatorio, MIR) for each of the above legal documents, internal government documents that calculate the predicted costs, benefits, and impacts of proposed regulations and must be published before the regulations may be passed.

The majority of our fieldwork (observation, field notes, formal interviews, and informal interviews) within the Corredor took place in the town of Agua Verde, the northernmost town in the Corredor. Although there are 13 total towns, Agua Verde alone accounts for 42% (278 of 659) of the residents of the Corredor region. Agua Verde shares many characteristics (dependence on fishing; no centralized electricity or water system) and is well connected with the other towns in the Corredor. However, it has the largest and best-developed fishing cooperatives and also has the longest formal relationship with Niparajá. The fishers of Agua Verde proposed the largest Fish Refuge established in 2012, and eventually were the only ones to expand their Fish Refuges in

2017. Our interviews about the Fish Refuges with government officials, university scientists, and Niparajá staff represent the entire Corredor region. However, our interviews that took place within the Corredor best reflect the opinions and experiences of residents of Agua Verde rather than the entire Corredor.

Property rights before the Fish Refuges

Before the Fish Refuges (leading up to 2009), there were overlapping and unclear legal harvest rights in the Corredor region. In practice (de facto rights), local communities harvested fish with no limits, as did outsiders. Management and exclusion rights legally rested with the state, but de facto were nonexistent. Thus there were few incentives for long-term management, beyond local dependence upon the fishery. Fishing was in decline, and local fishers in the region blamed this on overharvest from poor management and lack of exclusion. Below we summarize the property rights structure, in terms of withdrawal and access, management, exclusion, and alienation (Schlager & Ostrom, 1992), before the Fish Refuges were implemented. Note that we differentiate between *de jure* rights (legal rights) and *de facto* rights (rights in practice).

	De jure rights	De facto rights
Access and Withdrawal	~½ of Corredor fishers Ensenada Blanca (UMA) (?) La Paz fishers (?) Shrimp boats (?)	All Corredor fishers Many outsiders, including Ensenada Blanca, La Paz, shrimp boats
Management	CONAPESCA	Informal local rules within Corredor (bait, gear), often not respected by outsiders
Exclusion	CONAPESCA	Nonexistent
Alienation	Nation of Mexico	

Table 4. Table listing who had possession of property rights to fisheries in the Corredor before the establishment of the Fish Refuges, separated as *de facto* (rights in practice) and *de jure* (legal rights). A (?) indicates blurry or partial *de jure* rights, usually where an actor uses some *de jure* rights to engage in a much broader suite of technically illegal harvesting activities.

Withdrawal and access to fisheries in Mexico is controlled by the Commission on Fishing (CONAPESCA), mostly through fishing permits (DOF, 2007). A typical permit specifies the species that may be fished, gear, and location, and is granted either to an individual ("permisionario") or to a fishing cooperative. For many invertebrates, permits specify a single species, but many permits are multispecific, most notoriously for shark ("tiburon") and finfish ("escama"), encompassing dozens to hundreds of species. The permit system is ineffective at limiting harvest or access, as both permisionarios and cooperatives often serve as patrons who land and "legalize" catch from illegal fishers (Basurto, Bennett, Weaver, Rodriguez-Van Dyck, & Aceves-Bueno, 2013). The result is de facto open(ish) access in most coastal regions of Mexico.

In the Corredor in 2009, local resident fishers had limited legal access and withdrawal rights, although they had de facto access and withdrawal rights. Fishers primarily fished finfish and

shark (46 species) (Niparajá, 2015). In 2009, only half (47 of 104 active boats) of the fishers had permits for finfish (Niparajá, 2009, 2015). Even fewer had permits for shark: in Agua Verde, 7-10 boats fished for shark and none had permits. Fishers from the region still harvested without formal rights; more than 100 boats actively fished. Enforcement was hardly ever a problem. Fishers from the town of Tembabiche (where there were 11 actively fishing boats and only 1 with a permit) said that one time the military came and said they needed permits to fish, but left after one day, and thus they could continue fishing without a permit as normal (Niparajá, 2009). However, the lack of formal access and withdrawal rights did affect people in the Corredor. Residents of one town, Ensenada de Cortes, blamed the population decline from about 100 to almost 50 on the lack of permits combined with the decline in fishing. In another town, El Pardito, the lack of permits for shark made fishers who had been fishing shark since 1916 now feel like "delinquents" who had to hide in the shadows (Niparajá, 2009). However, many fishers in the Corredor had failed when they attempted to get permits. They complained that getting permits could take 40 days to 2 years, expensive and time-consuming paperwork and signatures (especially as this required trips to the city of La Paz 6 hours away), and often resulted in no permit.

Outsiders also had access to the fishery, in some cases legal and other cases de facto, and commonly at some blurry line between. For example, fishers from a town to the north, Ensenada Blanca, had obtained a special management permit to harvest sea cucumber through an "UMA" (Unidad de Conservación, Manejo y Aprovechamiento Sustentable de Vida Silvestre), a special kind of permit awarded by the Ministry of the Environment (SEMARNAT) for the management and sustainable use of protected species within a designated area. The designated area for Ensenada Blanca's sea cucumber harvest overlapped with the Corredor. Although the fishers from Ensenada Blanca thus have legal access and withdrawal of sea cucumber in the region, fishers from the Corredor complained that they abused their UMA, and would fish any species they found. The even greater source of complaint was that the Ensenada Blanca fishers would use a compressor to spearfish, often at night; while they legally can use a compressor to collect sea cucumber, commercial spearfishing for fish with a compressor is illegal across Mexico. Thus, while the Ensenada Blanca fishers had some legal access and withdrawal rights (for sea cucumber only), they had much broader de facto access and withdrawal of finfish and other species.

Another form of blurry access and withdrawal rights in the Corredor by outsiders were fishers from La Paz and industrial shrimp boats. The southern half of the Corredor region is within the municipality of La Paz. While many permits specify specific areas for fishing, some permits only name the broader municipality where fishing activities are allowed. Thus, some fishers from the capital city of La Paz have legal rights to access and fish anywhere off the coast of the municipality of La Paz, including the southern half of the Corredor. Indeed, there are several season fishing camps in the Corredor for fishers from outside. This had led to conflict because some permanent residents of the Corredor feel like the La Paz fishers are encroaching on their traditional fishing grounds. Similarly, industrial shrimp boats have legal access to fish shrimp, but fishers from the Corredor report that they often intentionally use nets over rocky areas to target finfish. Finally, some fishers illegally fish in the Corredor region, coming from across the Gulf of California (Sinaloa), and because of the general lack of enforcement are de facto able to access the fishery.

Management rights for fisheries in Mexico are legally held by the Commission on Fisheries (CONAPESCA). Article 8o of the fisheries law charges CONAPESCA with "Regulating, fomenting, and administering the exploitation of fisheries and aquaculture resources" (DOF, 2007). However, NGO leaders working in sustainable fisheries in the state are cynical about whether there is, in practice, any management activity: "In Mexico, there are very few fisheries that are managed… I don't believe that CONAPESCA is in the business of managing fisheries. They have interest in developing

fisheries, they have interest in promoting fisheries… but they have no interest in managing fisheries" (interview December 2017). In the Corredor before the Fish Refuges, with the exception of some self-management, very little formal management activities (such as monitoring, size limits, catch limits, gear limits, or any other type of fisheries management rule) was taking place by CONAPESCA or anyone else. However, the residents of the Corredor had a complicated system of self-imposed rules regarding fishing areas, baiting, and gear, and identified themselves as "fishing well" ("pescar bien"). These rules were never formalized and varied across the 13 towns of the Corredor. However, they generally included respecting baited zones ("zonas cebadas") and gear restrictions like using only handlines, or allowing nets but not over rocky areas and not in baited zones, or not using a net with a compressor, or not spearfishing with a compressor (Niparajá, 2009). These rules were often not respected by outsiders, leading to conflict. A particular complaint of Corredor fishers was that outsiders did not know the area, and thus they "do more harm" because they did not know the appropriate place and times for using nets (Niparajá, 2009). The informal nature of these rules meant that authorities would not uphold them, frustrating the fishers in the Corredor, who felt that the authorities often punished the traditional fishers of the zone, rather than people actually doing bad things (Niparajá, 2009).

Like management rights, legal exclusion rights for fisheries in Mexico are held by CONAPESCA, who has the power to determine who can access and withdraw from the fishery. Who is granted access and who is excluded is an opaque process, and is perceived by fishers in the Corredor as either random or corrupt. In practice, before the Fish Refuges, few were excluded from the fisheries of the Corredor. Some fishers from the Corredor felt that fishers in La Paz had illegally arranged with CONAPESCA to be able to fish in the Corredor. Occasionally, fishers from the Corredor would attempt to take exclusion rights into their own hands and chase out fishers they perceived to be fishing wrongfully. Fishers from one town in the Corredor reported having "run out of town" outsiders, but that these outsiders had actually had permits and thus the Corredor fishers recognized that they had no legal basis for this action. Fishers in the Corredor expressed a strong desire for exclusion rights: many reported feeling that they were caring for the fish (using limited gear, letting areas "rest", not using nets, etc.) so that outsiders could fish them.

Fisheries, as all natural resources in Mexico, ultimately belong to the nation, and cannot be alienated by anyone. Mexico's Constitution of 1917 decrees: "In the Nation is vested the direct ownership of all natural resources of the continental shelf… In those cases to which the two preceding paragraphs refer, ownership by the Nation is inalienable and imprescriptible, and the exploitation, use, or appropriation of the resources concerned, by private persons or by companies organized according to Mexican laws, may not be undertaken except through concessions granted by the Federal Executive, in accordance with rules and conditions established by law" (DOF, 1917). The unalienable nature of fisheries in Mexico means that they cannot be fully privatized; in the case of alienation, de jure and de facto rights are the same. The structure of alienation rights was unchanged by the Fish Refuges; we do not discuss alienation further in this paper.

The fishers of the Corredor expressed deep dissatisfaction with the property rights structure outlined above, before the Fish Refuges. From the survey of 86 (of 182 total) fishers in the Corredor conducted in 2010 by Niparajá and colleagues, both the pressing problems and suggested solutions were heavily centered around property rights. 86% of fishers said that resources had declined, and they identified overexploitation, harmful fishing techniques, and lack of fishing regulations as the cause. These they linked to excess harvest from fishers from La Paz, Ensenada Blanca, and Sinaloa, as well as shrimp trawlers (access and withdrawal issues); lack of regulations about gear, so that fishers were using nets, spearfishing, and other gears perceived as destructive, as well as lack of respect for local rules (management issues); and the lack of exclusion rights, so

that any positive management of local resources by Corredor fishers would not be captured by them (exclusion issues). The solutions that the fishers from the Corredor proposed in the 2009 survey reflected these concerns. 95% of fishers called for more permits. 62% agreed with prohibiting nets across the Corredor, and 92% agreed with prohibiting the use of nets and compressor together to target finfish. 95% of fishers wanted to exclude shrimp boats from the region, and 67% thought that each community should have an exclusive fishing area (79% would share their fishing area with other communities of the Corredor). 79% said they would follow, monitor, and enforce no-fishing zones.

The process of establishing Fish Refuges

"It wasn't a trade for Refugia" (interview with Niparajá staff, December 2017), but two major changes happened between 2009 and 2012 in the Corredor: permits, and Fish Refuges. Niparajá facilitated the dual process of helping fishers in the Corredor apply for permits and design Fish Refuges ("Refugia"). By the end of the process, the number of permits in the Corredor had doubled (47 to 91 permits), and a network of 11 Fish Refuges had been established – the first ever Fish Refuges in Mexico. The details of the process were critical in determining the final property rights structure after the establishment of the Fish Refuges. Through the process that Niparajá has created in collaboration with the fishers in the Corredor, these fishers have been able to position themselves as the legitimate recipients of tenure through parallel processes of excluding common enemy (shrimpers, divers), gaining de jure access and withdrawal rights and de facto management and enforcement rights, where before they had only partial access and withdrawal rights.

The legal process to establish a Fish Refuge is as follows (DOF, 2014). First, a formal written proposal must be sent to the headquarters of CONAPESCA (Dirección General de Ordenamiento Pesquero y Acuícola). Any individual or legal entity may submit a proposal, but the intention is that it is submitted on behalf of fishers with permits to fish the area where the Fish Refuge is proposed: "The one who asks for a Fish Refuge, is because he is a fisher from that zone and has a permit" (retired Director de Ordenamiento, CONAPESCA). This written proposal must be accompanied by a supporting document detailing the justification for the proposal, including 24 categories of ecological and social information (DOF, 2014). CONAPESCA then has 10 business days to send this proposal to its research branch, the National Institute for Fishing (Instituto Nacional de Pesca, INAPESCA) to be evaluated on its merit, based on these 24 categories of indicators. INAPESCA has 60 business days to give its technical opinion on the proposal. Once CONAPESCA receives INAPESCA's technical opinion, CONAPESCA has 15 business days to make a decision about implementing the Fish Refuge (DOF, 2014). Before the Fish Refuge can be implemented, it must undergo internal review within the secretary, including a cost-benefit assessment of regulatory impact (the Manifestación de Impacto Regulatorio, MIR). If the Secretary (SADER) through CONAPESCA does decide to implement the Fish Refuges, it must publish a formal Agreement in the Diario Oficial de la Federacion, where all regulations and laws for Mexico are published and thus made legal. Finally, after a Fish Refuge has been implemented, CONAPESCA is charged with determining whether the Fish Refuges should be modified, maintained, or eliminated, based on the technical opinion of INAPESCA, which in turn should be based on their studies of the Fish Refuges (DOF, 2014).

In this theoretical legal process, fishers may propose an area, but the management rights ultimately lie with CONAPESCA, based on INAPESCA's scientific evaluation. CONAPESCA also has the ultimate exclusion rights by deciding whose proposal shall be entertained and whose will be

rejected. Thus, in theory, a Fish Refuge should not restructure property rights around fisheries in Mexico.

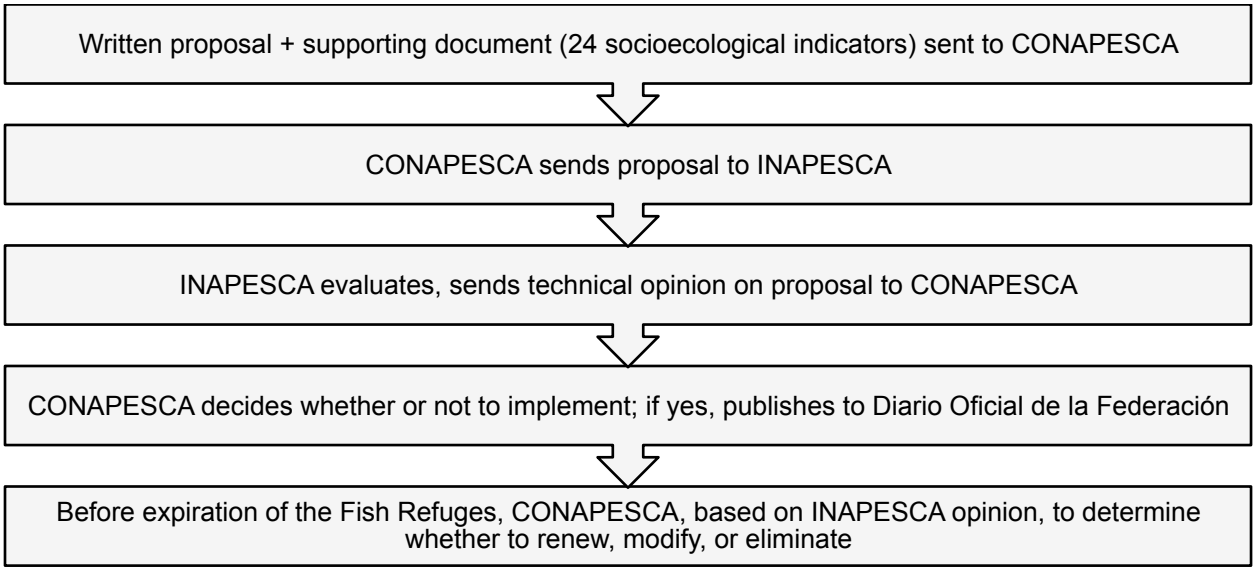

Figure 3. Legal process to establish a Fish Refuge in Mexico, from (DOF, 2014)

However, at the time that the Fish Refuges were being planned and processed (2010-2012), the legal process had not been established. The formal protocol for establishing Fish Refuges was not published until 2014. As a result, the process of establishing Fish Refuges in the Corredor took much longer than the legal process outlined above, and also was the primary experience that informed the process above. In the Corredor, the process of creating Fish Refuges was part of two parallel processes that have fundamentally restructured property rights in the region's fisheries. Those two processes were the application for permits, and the actual creation of the Fish Refuges. As Niparajá staff stated (beginning of this section), receiving permits was not a trade for making Fish Refuges, but the two processes happened at the same time. The reason that Fish Refuges restructured property rights in the Corredor (when in theory they should not) is because of the absence of a strong property rights structure to begin with, the lack of formal protocols to evaluate Fish Refuges, and the perseverance of Niparajá staff.

After the general fisheries law made Fish Refuges an available legal tool in 2007, there were a series of meetings about the ecological science of using marine reserves for fisheries management in Mexico, and how Fish Refuges could serve as such. These meetings, which took place in 2008 and 2009, involved NGOs and government officials working in fisheries across Mexico. During a meeting in November 2008, CONAPESCA officials expressed interest in establishing Fish Refuges, precipitating a number of working group meetings on possible areas for the first Fish Refuges, including the Corredor and Bahía Magdalena in Baja California Sur and sites in Quintana Roo. Supported by this political will, in 2009, Niparajá conducted a rapid appraisal of the problems, solutions, and needs in the Corredor, which they wrote up in the document, Conociendo el Corredor, to see whether there was interest in creating Fish Refuges. They also conducted a census on fishing activities and a socioeconomic survey of fishers in the Corredor in 2009. As described in detail above, there was general discontentment with fisheries management, desire to manage better, and interest in Fish Refuges; 79% of fishers said they would follow, monitor, and enforce no-fishing zones. There was also strong concern about lack of permits, and getting legal access to the

fishery. CONAPESCA was still interested in moving the process of the Fish Refuges along, and was also willing to facilitate permits for the Corredor fishers. In February of 2010, Martin Botello, the Director of Ordenamiento Pesquero for CONAPESCA, went to the Corredor to invite the fishers there to apply for fishing permits, and to submit a proposal for Fish Refuges. From February to July of 2010, Niparajá and the fishers of the Corredor had numerous meetings and pushed forward the permits and the proposal. Getting the permit applications in order was in many cases a Herculean task. "For the people who never had permits before, you had to get a bunch of stuff to be able to have a permit. So you had to have a registro de pesca, you had to have your CURP. And to have a CURP, you need your IFE. And to get your IFE, you need a birth certificate. And there were people in the Corredor who didn't have any of those things. They didn't have birth certificates. And so we had their parents, who were 70 years old come and register their child, who was 40 years old" (interview with Niparajá staff, December 2017). In easier cases, fishing cooperatives already had permits, but these permits had to be expanded to include more boats. After a reiteration of the invitation by Martin Botello in May 2010, all permit requests were turned into CONAPESCA by July.

Meanwhile, in April-May 2010, Niparajá was also facilitating the process of designing Fish Refuges in the Corredor. They hosted workshops in the Corredor on optimal design of Fish Refuges for ecological outcomes, based in ecological and biological science of marine reserves. In each town, fishers held meetings to suggest and edit maps for possible Fish Refuge sites. By September, a map with 11 proposed sites for Fish Refuges had been finalized. Niparajá circulated the final map throughout the Corredor, and 109 fishers from the Corredor (of 182 total fishers in the zone) signed a letter of support for the final proposal. In October 2010, Niparajá submitted the full proposal and accompanying letter of support to CONAPESCA on behalf of the fishers of the Corredor. This proposal was passed from CONAPESCA to INAPESCA for the technical opinion. "And it came to a big crisis. INAPESCA for many months, and I'd say years, was still questioning the validity of using Zonas de Refugio as a fisheries management tool… inside, they didn't have the technical ability to evaluate it. And they said, if you want us to give you the technical opinion, our technical opinion is that we don't have enough information to evaluate it" (Interview with Niparajá staff, 2017). In interviews, INAPESCA staff members told us, "There were certain doubts, certain reservations, about how they defined the areas… One thing was the number. Why 11? Why 11, and not 15? Why not 1?... We didn't have more information" (interview November 2017). INAPESCA's inability to give a technical opinion coincided with the drying up of political will at CONAPESCA. The result was that INAPESCA did not administer a technical opinion for nearly 2 years, until summer of 2012.

Between October 2010 and June 2012, Niparajá staff members kept pressure on CONAPESCA and INAPESCA to keep the proposal alive, and the process moving. They brought up Fish Refuges at meetings with the Secretary of SAGARPA (now, SADER), who gave nominal support for the Fish Refuges. They went to a meeting in Cancún with the heads of INAPESCA and CONAPESCA so they could ask about Fish Refuges. They brought fishers from the Corredor to visit the headquarters of CONAPESCA in the state of Sinaloa and ask what was happening with the Fish Refuges, as well as the fishing permits. They held trainings, inviting scientists and experts from around the world, with INAPESCA to train them in evaluating something like a Fish Refuge. "What we really hoped as Niparajá was that the original proposal by the fishermen would be improved by INAPESCA" (interview with Amy Hudson Weaver, Niparajá, November 2017). At the end of 2011, the fishing permits were approved. And finally, in July 2012, INAPESCA issued the technical opinion for the Fish Refuges.

The reason that INAPESCA finally issued a technical opinion was partly political. "In the end, we just give advice, an opinion, but who finishes deciding is CONAPESCA. There was certain

political support" (interview with INAPESCA staff, November 2017). However, INAPESCA also saw opportunity in working with fishers. "The proposal had a deficiency of technical information, but it had the backing of its own community; it was something that was born from them," one INAPESCA staff member told us. Another INAPESCA staff member echoed this: "Since the beginning the fishers agreed with having [the Fish Refuges]. And this influenced INAPESCA's decision a lot, to give a positive decision" (interviews November 2017). Finally, INAPESCA staff emphasized the precautionary principle as a reason for their technical opinion: "If the baseline does not exist, if there is not a lot of information about this ecosystem, that is no reason not do something. If the proposal is good, it will generate a baseline. And so that is where we started to say, yes, here we have to use the precautionary principle" (interview November 2017).

Because it had been 2 years since the Fish Refuges were proposed, in August of 2012, CONAPESCA requested another signed letter from the fishers of the Corredor to make sure they still supported the proposal. 109 fishers had signed the letter in 2010; this time, 128 fishers signed the letter in support of the proposal for the Fish Refuges. Finally, on November 16, 2012, the Fish Refuges were published in the Diario Oficial de la Federacion as a secretarial agreement, and thus became law.

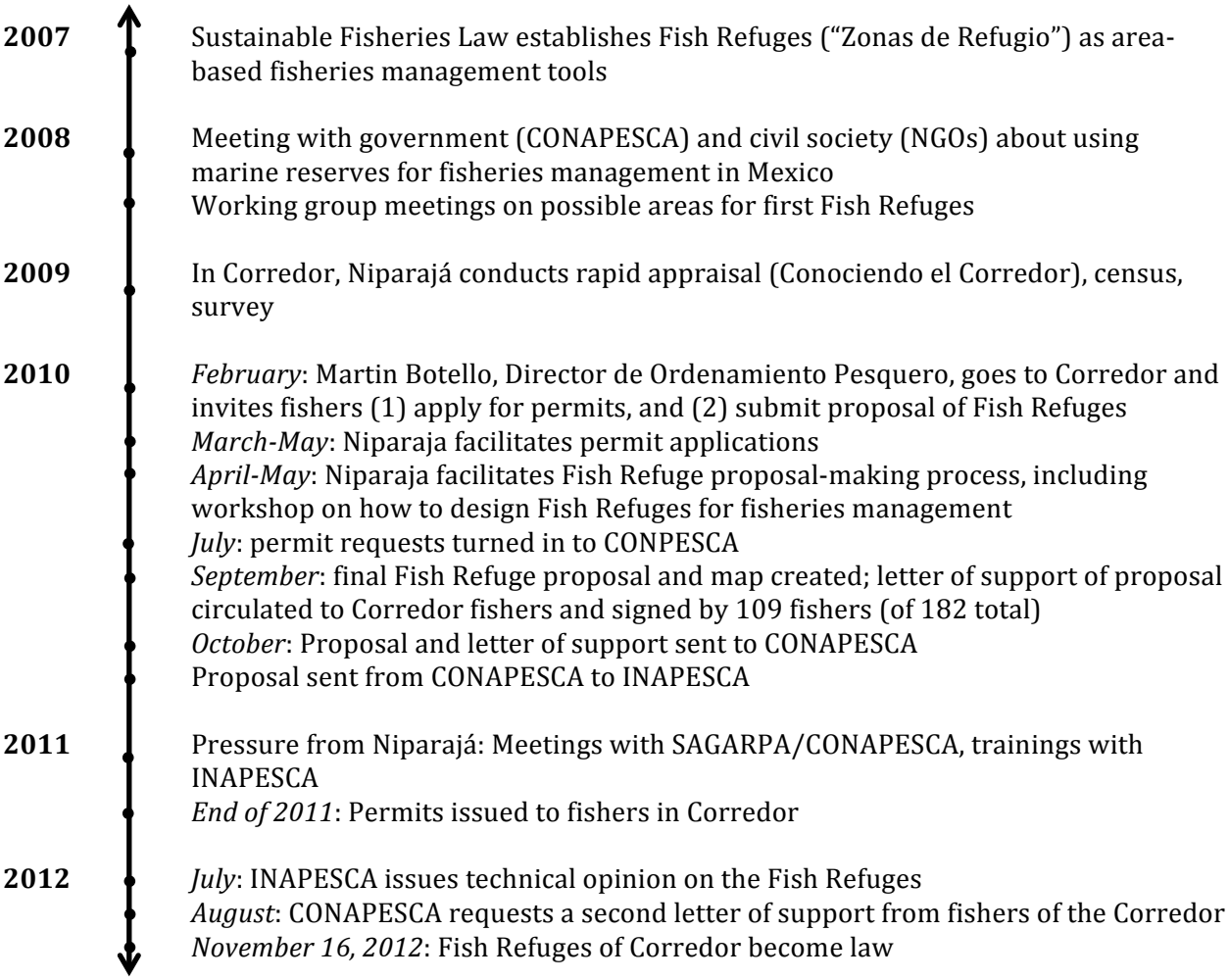

Figure 4. Timeline of the establishment of Fish Refuges in the Corredor

Property rights structure after the establishment of Fish Refuges

Although the process took 2 years, the locations and sizes of the Fish Refuges designed by fishers in the Corredor (facilitated by Niparajá) were directly translated into fisheries law. Through this process, the fishers agreed to respect the no-fishing zones, where their access and withdrawal rights were given up. However, they had now gained de facto management and exclusion rights over their coastal seas. These management and exclusion rights are not secure or formalized. However, these informal rights have been a first step in gaining greater tenure over coastal resources. Through the creation of the Fish Refuges, fishers in the Corredor had positioned themselves as partners with civil society and the government in managing their resources sustainably.

The new distribution of rights is as follows. Within the Fish Refuges, CONAPESCA prohibits commercial harvesting; the Corredor fishers have lost their *de jure* withdrawal rights in those areas. So too have the shrimp trawlers and fishers from La Paz. The original lifespan of the Fish Refuges was 5 years, and after they were renewed, another 5 years. In practice, some fishing still does occur inside the Fish Refuges. In a survey in 2016, while 54% of fishers reported that nobody from their community fishes inside the Fish Refuges, 45% of fishers reported that some fishers from their community do fish inside the Fish Refuges. Regarding people from outside the Corredor, 48% of fishers reported that outsiders sometimes fish in the Fish Refuges, and 30% reported that they "always" do. In all areas around the Fish Refuges, withdrawal is still permitted. In this case, fishers have actually gained *de jure* rights of withdrawal outside the Fish Refuges by gaining fishing permits. As described above, the permits and the Fish Refuges were not explicitly or formally tied together. However, CONAPESCA officials like Martin Botello discussed both the permits and the Fish Refuges together, and Niparaja facilitated both processes. After the creation of the Fish Refuges, 53% of fishers said that government attention in the region increased (37% noticed no change). 68% of fishers said that fishing-related subsidies had increased.

The withdrawal rights inside the Fish Refuges have the one complication of the UMA. All activities not managed by CONAPESCA are still allowed within the Fish Refuges. This includes the sea cucumber harvesting under the UMA held by the fishers from Ensenada Blanca, which is managed by a different secretary, SEMARNAT. The "outsiders" from Ensenada Blanca are thus still permitted to use compressors to dive for sea cucumber in the Fish Refuges. This is a source of frustration for fishers from the Corredor. "Now, we have had the problem of the UMA for sea cucumber. Why? Because, supposedly, SEMARNAT doesn't restrict your fishing of sea cucumber…You know that the sea cucumber is more of a pretense. Because if they go to fish, they are fishing lobster, snail, finfish. But they say, no, if I am fishing for sea cucumber, I can fish in the Fish Refuge. Because the UMA goes from Punta Aguja to here, to Berrendo, that is where the UMA is. And SEMARNAT doesn't restrict you: you can fish sea cucumber anywhere, Refuge, or whatever it is. The pepineros [sea cucumber fishers], they pillage. They say, I am fishing sea cucumber, and what a shame that they take out everything that is there" (interview with fisher from the Corredor, October 2017).

Management rights have also shifted because of the Fish Refuges. Before, CONAPESCA had de jure management rights over resources in the area. De facto, there was no management. Fish Refuges have complicated these rights in a number of ways. The lack of a clear evaluation protocol for INAPESCA to assess any proposal and give its technical opinion means that, in practice, Fish Refuges are not altered by INAPESCA. As an INAPESCA staff member told us, "In the interior of the Institute, we don't have a document about how to do various things… the Institute doesn't have an

official document that says, "this is the methodology that we use"" (interview 11/30/17). Because proposals in practice end up being accepted as long as there is strong fisher support, fishers can use them to gain de facto management rights. Indeed, anyone could in theory. In the official protocol for establishing Fish Refuges, anybody can propose a Fish Refuge and thus gain management rights (DOF, 2014). However, Hilario Perez, ex-Director de Ordenamiento for CONAPESCA, told us that the intention of a Fish Refuge is for fishers to propose them in their own (legal) fishing areas: "the one who asks for a Refugia, is because he is a fisher from that zone and has a permit" (Interview 12/1/17). Fish Refuges are thus one way for fishers to gain management rights over their fishing resources, and thus create greater long-term incentives for sustainability. While these type of management rights are small – closing off fishing in designated areas – they have, in the Corredor, served as a foot in the door for fishers to work with CONAPESCA.

Exclusion rights have also been restructured in the process of establishing Fish Refuges in the Corredor. Before, the waters of the Corredor were fished (often illegally) by a number of people from other places: fishers from La Paz, Ensenada Blanca, and Sinaloa, and shrimp trawlers. However, these people were not included in the process of designing Fish Refuges in the Corredor. Indeed, fishers from La Paz put up strong opposition to the Fish Refuges after they had been established, in 2013 and 2014. CONAPESCA argued that they did not have legitimate claims to participation in establishing Fish Refuges because they had not legally landed catch from the Corredor – although this was also true for many residents of the Corredor, who had not had permits before they proposed the Fish Refuge sites, and who had never landed catch legally anywhere. The perception that local fishers have the right to exclude outsiders was strongly felt by fishers in the Corredor. When we asked who has the right to establish a Fish Refuge, a fisher told us, "Who has the right? Well, the community has the right. Well, the government also, because if the government wants to implement something, it does it. But the community has the right. The right to say, we want a Refuge here, and if we don't want it, then we won't have it… You can put in a Refuge, but only in your fishing area. We can't say, "we are going to put in a Refuge in Las Animas", because it corresponds more to San Evaristo, over there. Each one puts in its area of Refuge in their fishing area. The community is the one with the power… Generally, the one with the right, is the community, nobody else. People from outside, they don't have the right" (Interview 12/7/17). These exclusion rights are informal, however. When fishers from the Corredor tried to formalize these exclusion rights by proposing a large area in 2017 that banned trawling, CONAPESCA did not implement the no-trawling area, arguing that shrimp trawlers had not participated in the proposal.

	Within Fish Refuges		Broader Corredor fishing area	
	De jure	*De facto*	*De jure*	*De facto*
Access and Withdrawal	None (except UMA)	Small amount of fishing ongoing	All Corredor fishers	For now, same as in 2009: All Corredor fishers Many outsiders, including Ensenada Blanca, La Paz, shrimp boats
Management	CONAPESCA	Fishers from Corredor	CONAPESCA	Increasingly, fishers from Corredor
Exclusion	CONAPESCA	Fishers from Corredor	CONAPESCA	Increasingly, fishers from Corredor
Alienation	Nation of Mexico			

Table 5. Table listing who had possession of property rights to fisheries in the Corredor after the establishment of the Fish Refuges, separated as *de facto* (rights in practice) and *de jure* (legal rights).

Conclusion

In summary, property rights structure incentives for long-term sustainability. Here we investigated how area-based policy tools that can adapt to climate change create trade-offs in terms of property rights. There is tension between property rights theory (long-term secure rights associated with sustainability) and resilient, adaptive tools where rights are temporary. Schlager and Ostrom have useful a conceptual schema for thinking about property rights of commons (Schlager & Ostrom, 1992); we use this tool to analyze trade-offs. Fish Refuges are adaptive and temporary area-based tools in Mexico that were established to solve fisheries decline. They are one of the few (but growing number of) adaptive area-based conservation tools, and have restructured property rights. We qualitatively analyzed how these Fish Refuges restructured property rights, thus creating different trade-offs for different actors. Fish Refuges were made legally available from a new fisheries law in 2007, and were first established in 2012. By 2017, there were 40 Fish Refuges in Mexico accounting for 20,000 km^2. Before the Fish Refuges, there were overlapping and unclear legal harvest rights in the Corredor region. In practice (de facto rights), local communities harvested fish with no limits, as did outsiders. Management and exclusion rights legally rested with the state, but de facto were nonexistent. Thus there were few incentives for long-term management, beyond local dependence upon the fishery. Fishing was going down, and local fishers in the region blamed this on overharvest from poor management and lack of exclusion. Fish Refuges are created when fishers submit a proposal (assisted by a non-governmental organization), which is assessed and edited by the state fisheries research agency, then established by the state fisheries enforcement agency. The process of these first Fish Refuges has led to fishers gaining de facto management and exclusion rights by giving up harvest rights. Outsiders have lost harvest rights and have been excluded from management. Adaptive area-based conservation tools create unstable and temporary property rights, but here have allowed local resource users to give up shaky harvest rights and gain shaky management and exclusion rights. They have led to new opportunities for negotiating management and rights with the state, some of which may be formalized into legal management and exclusion rights in the future.

An important conclusion of this work is that Fish Refuges, in this case, have provided a mechanism for fishers to actively restructure their own property rights to the resource they depend on, thus creating greater incentives for long-term sustainability. One aspect that has received less attention in the literature of property rights is who restructures property rights systems. Often, rights are "given" to resource users. Here, rights were taken – and although the rights were largely informal, with legal rights retained by the state, fishers have received greater subsidies and attention from the government because of their participation in this project. Now, in 2019, these fishers are engaged in discussions of long-term and formal management and exclusion rights. Again facilitated by Niparajá, these fishers are creating Fisheries Management Plans and starting the process of applying for fishing concessions – 20-year exclusive management rights to a designated fishing area. And CONAPESCA is on board with the push for greater rights: ex-Director of Ordenamiento told us, "I am convinced that the scheme of concessions is a tool that will permit greater security to fishers, and more responsible fishing".

Furthermore, these fishers have engaged in a process to restructure their property rights in a place where the socioecological characteristics that predict strong collective action are absent. Unlike the Pacífico Norte, another region in Baja California Sur where strong collective action has led to healthy, resilient fisheries and is now an internationally famous co-managed fishery, the Corredor does not have commercial access to high-value benthic invertebrates with low mobility (McCay et al., 2014). This case thus serves as an example of incentive-shifting under circumstances that are not the ideal ones for collective action. In the end, Fish Refuges are simply a tool: as a leader of the fishing sector in the state of Baja California Sur told us, "In the end, it isn't Fish Refuges that we want, it is conscientiousness" (Interview November 2017).

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