Received: 18 November 2019 | Revised: 12 July 2020 | Accepted: 29 August 2020

DOI: 10.1111/csp2.283

CONTRIBUTED PAPER

Conservation Science and Practice
A journal of the Society for Conservation Biology
Open Access

WILEY

Community-based conservation strategies to end open access: The case of Fish Refuges in Mexico

Anastasia C.E. Quintana | **Xavier Basurto**

Duke University Marine Lab, Beaufort, North Carolina

Correspondence
Anastasia Quintana, Duke University Marine Lab, 135 Duke Marine Lab Rd, Beaufort NC 28512.
Email: anastasia.quintana@duke.edu

Funding information
Dynamics of Coupled Natural and Human Systems Program, National Science Foundation, Grant/Award Number: 1632648

Abstract

Secure property rights are often seen as a precondition of incentives for long-term sustainable use by communities dependent on natural resources. Securing formal property rights can be challenging in coastal small-scale fisheries, which often operate under open access conditions. We argue that insecure, informal rights can offer one pathway for property-rights regime change, and may also provide greater flexibility for developing sustainable fishing practices compatible with climate change adaptation, among other policy-relevant outcomes. The process of establishing short-term but renewable area-based conservation tools, such as the Fish Refuges of Baja California Sur, Mexico, offers the opportunity to examine how community-based strategies can generate incentives for conservation despite the lack of secure property rights. Using in-depth qualitative methods, socioeconomic surveys, and ecological data from 2009 to 2019, we studied the process of engagement among fishers, civil society, and government. We focused on understanding the emerging transition from a scenario of open access and limited withdrawal property rights, toward locals' attaining of insecure *defacto* management and exclusion property rights and longer-term visions of resource use and conservation. Altogether, this case illustrates the potential and limitations of Fish Refuges as an area-based fisheries and conservation tool.

KEYWORDS

climate change adaptation, commons, governance, institution, marine protected area, marine reserve, Mexico, property rights, small-scale fisheries

1 | INTRODUCTION

Developing climate change sensitive policies for marine ecosystems constitutes one of the biggest challenges currently facing marine policymakers for the long-term attainment of UN Sustainable Development Goals (IPCC, 2019). As the most globally widespread area-based conservation measures, protected areas are sure to play a prominent role (Pendleton et al., 2017; Tittensor et al., 2014). Yet, by being spatially delimited, protected areas offer an inherent tension between providing secure property rights over biologically significant marine areas, and being flexible and adaptable to the anticipated shifts in species ranges and their associated habitats (Maxwell, Gjerde, Conners, & Crowder, 2020; Roberts et al., 2017; Sumaila, Cheung, Cury, & Tai, 2017). The Mexican case

of Fish Refuges might offer insights as area-based fisheries and conservation tools adaptable to climate change (CONAPESCA, 2017). These temporary no-take zones aimed at rebuilding fish stocks in nearby fisheries can be renewed every 5 years during which it is possible for communities to propose changes in size or location. A crucial challenge remains as dominant theory predicts that the temporary nature of their property rights would create uncertainty about future benefits to stakeholders, leading to precarious incentives for costly management and long-term sustainability (Ostrom, 2003). However, this does not seem to be the case in Baja California Sur, Mexico. In this paper we study how fishers and their civil society advocates seem to have harnessed an opportunity for collaborative governance that has given them more control over their fishing areas, despite holding limited property rights over the resource. Our analysis, based on interviews, observation, social-science surveys, and ecological data, draws initial policy lessons of Fish Refuges' potential for grassroots governance and community-based strategies to build a climate-change resilient future, even though local stakeholders do not frame it as such. We contribute to a developing research agenda on emergent sustainability in systems with weakly defined property rights, like open access pastoral systems (Moritz et al., 2018; Querou, Tomini, & Costello, 2017) and systems with temporary property rights (Costello & Kaffine, 2008; Maxwell et al., 2020).

1.1 | Theoretical framework: Self-governance and property rights in community-based conservation

Community-based conservation has gained attention in recent years for its potential to avoid the failures of equity, legitimacy, and long-term social-ecological outcomes that have pervaded traditional approaches to conservation including command-and-control, but also increasingly market-based approaches (Armitage et al., 2009; Berkes, 2007). Critiques of community-based conservation point to its failure to really empower or include the interests of local resource users, who are often heterogeneous, as well as the manipulation of local "communities" for an agenda that is not their own (Blaikie, 2006; West, Igoe, & Brockington, 2006). One theoretical approach that places resource users and communities at the center of decision-making is self-governance, which emphasizes how users build and sustain institutions and property rights in management of the commons (McCay & Acheson, 1987; Ostrom, 1990). Scholarship on self-governance of the commons has developed insights about how communities and resource users can develop incentives increasing the likelihood for the long-term success of conservation initiatives (Ostrom et al., 2002). Some of the best-known insights are related to characteristics of the users and the resource that are important for the emergence of new rules structuring collective behavior, as well as design principles important for the sustainability of governance arrangements (Ostrom, 1990). While there is ongoing debate about their applicability and generalizability (Cox, Arnold, & Tomás, 2010; Fleischman et al., 2014), there is general agreement that property rights play an important role in long-term sustainable use (see Schlager, 2002 for a good summary). This literature associates well-defined, secure bundles of property rights with long-term sustainable outcomes (Ostrom, 2000; Schlager & Ostrom, 1992). The importance of property rights derives from their role in defining who captures which benefits from a resource, which structures the incentives resource users face for long-term sustainability (Commons, 1968; Demsetz, 1967).

While there is general agreement on the importance of property rights for sustainable use, there is disagreement about the particular "bundle" of rights that leads to long-term sustainable outcomes. There are arguments that resource users possessing a complete bundle (i.e., full privatization) will lead to efficient and optimal outcomes (Demsetz, 1967). However, evidence from the self-governance literature has found that certain incomplete bundles of property rights, if secure and recognized by the State, can lead to sustainable behavior (Schlager & Ostrom, 1992). Schlager and Ostrom (1992) developed a conceptual schema of five types of rights (access, withdrawal, management, exclusion, and alienation) to systematically analyze institutional change in property rights regimes. They argue that incentives for sustainability shift predictably with the accumulation of each new right, with three important jumps (Table 1):

In the nearly 30 years since this schema was published, it has been extensively used to analyze property rights regimes and sustainability (Mascia & Claus, 2009; Poteete, Janssen, & Ostrom, 2010; Ribot & Peluso, 2003) with strong interest in the mechanisms that drive changes in property rights regimes (Galik & Jagger, 2015; Ostrom, 2005). Yet it has not been sufficiently documented how or whether those who possess a limited bundle of rights are able to find incentives for sustainability. In this paper, we use the conceptual schema of Schlager and Ostrom (1992) to support our analysis of the evolution of engagement between fishers and their civil society allies, in which they have invested in resource maintenance despite not having the full bundle of property rights, effectively shifting the regime at play.

TABLE 1 Shifts in incentives for long-term sustainable management by cumulatively gaining the collective-choice rights of management, exclusion, and alienation, on top of the basic use rights of access and withdrawal, from Schlager and Ostrom (1992)

+ Management	Without management rights, users must follow rules that they did not make. Gaining management rights can lead to greater legitimacy of rules, better fit of rules to local context, and greater compliance.
+ Exclusion	Gaining exclusion rights assures users that they will capture the benefits of the management actions they undertake, which may be costly in terms of time, direct costs, or lost potential income.
+ Alienation	Gaining alienation rights completes the bundle. Alienation rights, associated with private property, may lead to sustainable behavior for some goods (Demsetz, 1967), but may lead to unsustainable behavior for commons, for example, when a forest is sold and cut down (Schlager & Ostrom, 1992).

2 | METHODS

2.1 | Study site: Fish Refuges of "El Corredor" San Cosme to Punta Coyote, Baja California Sur

Mexico's Fish Refuges (Zonas de Refugio Pesquero) are area-based tools (limited take or no-take zones) intended to protect or rebuild fisheries (DOF, 2014). Unlike most protected areas in Mexico, Fish Refuges are not governed by the ministry of conservation but by the Commission on Fisheries (Comisión Nacional de Acuacultura y Pesca, "CONAPESCA"). Most Fish Refuges have been designed and proposed by fishers, typically for 5 years at a time before they expire with the option of renewal. Since the first ones were established in 2012, 41 Fish Refuges have been established across Mexico covering 20,185 km^2 (CONAPESCA, 2017).

Fish Refuges were pioneered in Baja California Sur where fishing is of central economic importance (Leslie et al., 2015). Its hugely productive Gulf of California produces 71% of Mexico's total fisheries volume (OECD, 2006), yet there is evidence of decline (Saenz-Arroyo, Roberts, Torre, Cariño-Olvera, & Enríquez-Andrade, 2005; Sala, Aburto-Oropeza, Reza, Paredes, & López-Lemus, 2004). Such is the case in the "Corredor" San Cosme to Punta Coyote, a region with 150 km of coastline, 13 permanent towns, 659 residents, and 104 fishing vessels (Niparajá, 2016). Most livelihoods depend on fishing, with some ranching and tourism. Fishers in the region have noticed and been affected by fisheries decline (Niparajá, 2009; Figure 1).

Mexico's first Fish Refuges were established in the Corredor because of the confluence of declining fisheries and promotion by a civil society organization dedicated to regional conservation, Sociedad de Historia Natural Niparajá A.C. (hereafter, Niparajá). Niparajá's Sustainable Fishing program (Pesca Sustentable) is dedicated to fomenting social structures that create and maintain rules to support long-term fishing livelihoods. 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.

2.2 | Data collection and analysis

We conducted 6 months of ethnographic research between May 2016 and July 2018 (IRB permit #2018-0130) to understand the outcomes of changes in fisheries governance and property rights institutions. Data collection activities included a 10-day ecological cruise along the entire Corredor region, short field visits to three of the thirteen towns in the Corredor, 2 months of fieldwork in the state capital (La Paz), and 3 months of fieldwork in Agua Verde, the largest town in the Corredor. In order to learn about fishing traditions and local history before and after the Fish Refuges, we conducted 68 interviews, of which we recorded and transcribed 54 with consent (average length 58 min). Our respondents included fishers and their family members, fishing sector leaders, professionals (policemen, teachers), academic scientists, the State Secretary of Fishing (SEPADA), CONAPESCA staff, scientists from the National Institute of Fishing (Instituto Nacional de la Pesca, INAPESCA), and Niparajá staff. We coded interviews and all field notes for emergent themes like "informal rules," "relationship to Niparajá," and "status of fishery," iterating between data, theory, and conclusions (Charmaz, 2006). We also analyzed eight legal documents relevant to the Fish Refuges of the Corredor: the national fisheries law (DOF, 2007), the legal agreement that established the Fish Refuges in 2012 (DOF, 2012) and renewed them in 2017 (DOF, 2017), and the protocol for establishing Fish Refuges (DOF, 2014). In addition, we analyzed internal regulatory documents for each of

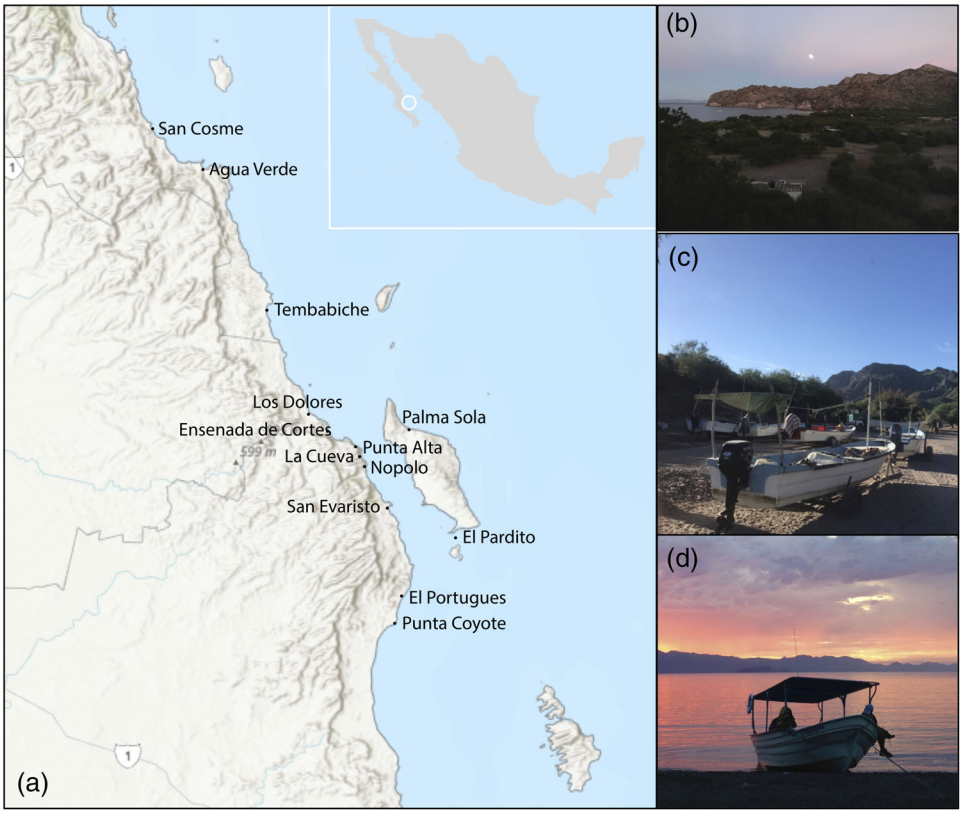

FIGURE 1 Map and photo panel of study site. (a) Map of Corredor (Baja California Sur, Mexico) with towns and permanent fishing camps labeled, from San Cosme (northernmost) to Punta Coyote (southernmost). Inlay on top right shows relative location in Mexico, on Gulf of California coast just north of La Paz, BCS, Mexico. (b) Photo from entrance to Agua Verde, largest town in the Corredor region (278 residents of 659 total), and primary site of data collection. (c) Photo of "pangas," fiberglass fishing boats with outboard motor typical of small-scale fisheries in Mexico. (d) Photo of panga moored at sunrise on beach at San Evaristo

the above regulations (Manifestación de Impacto Regulatorio, MIR). To contextualize interviews within broader social and ecological trends, we also gained access to two socioeconomic surveys conducted in 2009 and 2016 (before and after the Fish Refuges) with 51% (2009) and 57% (2016) of full-time fishers of the Corredor region, and continuous underwater monitoring data of 11 Fish Refuges and 11 control sites in the study area from 2012 to 2016 (1,174 transects total). The second author was involved in designing both surveys and training the enumerators that deployed it.

Our approach invites two sources of bias. First, Niparajá participated in the design and implementation of socioeconomic surveys and ecological data collection. We credit and thank them for sharing this data, and also acknowledge that this influences our analysis. Second, our ethnographic fieldwork was concentrated in the Corredor's largest town, Puerto de Agua Verde ("Agua Verde"), with 42% of Corredor's residents. Agua Verde has the largest fishing cooperatives and the longest relationship with Niparajá; its fishers proposed the largest Fish Refuge in 2012, and in 2017 were the only ones to expand their Fish Refuge. This study best reflects Agua Verde's opinions and experiences, although our interviews with government officials, university scientists, and Niparajá staff represent the entire Corredor region.

3 | RESULTS

3.1 | Few incentives for long-term sustainability before the Fish Refuges

In the years before the Fish Refuges' establishment, fishing in the Corredor was *de facto* open access. Despite living in the area for generations, local fishers lacked formal access, and withdrawal rights (e.g., fishing permits) and experienced confusion about who could fish and where. Formal management and exclusion rights legally rested with the State, but *de facto* were nonexistent given the lack of fisheries officials' monitoring and enforcement; a common complaint of Corredor fishers was that they were powerless to stop the illegal spearfishers ("pistoleros") from outside from "taking everything". Local fishers in the region blamed the decline in fishing on overharvest from poor management and lack of access controls. Fishers from the Corredor faced the same collective action dilemmas characteristic of Hardin's (1968) Tragedy of the Commons, which preclude fishers from finding incentives for long-term management. In Table 2, we represent the situation from a property-rights perspective, while acknowledging that property rights are only one factor affecting fishers' incentives and resulting behavior.

TABLE 2 Fisheries property rights in the Corredor before the establishment of the Fish Refuges, as *de facto* (rights in practice) and *de jure* (legal rights), based on interviews and Niparajá (2009)

Property rights	Actors with *de jure* rights	Actors with *de facto* rights
Access and withdrawal	• Half of Corredor fishers • Ensenada Blanca fishers (UMA)[a] • La Paz fishers[a] • Industrial shrimp boats[a]	• Almost all Corredor fishers • Many outsiders, including fishers from Ensenada Blanca, La Paz • Many shrimp boats, including from other states
Management	CONAPESCA	Corredor fishers, who developed norms about bait and gear types, although not respected by outsiders
Exclusion	CONAPESCA	Nonexistent
Alienation	The Mexican Federal Government on behalf of all Mexican citizens	

Note: Access is the right to be positioned to harvest a resource and withdrawal is the right to 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. Alienation is often misunderstood as the right to transfer withdrawal rights but is actually the right to transfer the decision-making rights of management or exclusion.

[a]Indicates overlapping and 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.

In the Corredor, like other rural coasts of Mexico, subsistence and small-scale commercial fishing preceded fishing regulations (Basurto and Garcia-Lozano, 2020). The legal implementation of a permit system placed traditional fishers outside the law until they could attain permits, a challenging process rendered more difficult by geographic, social, and political isolation. Fishers still struggle to keep up with fishing regulations created by the Mexican State. On one hand, there are high barriers to attain permits (costs, paperwork, uncertainty), and on the other, there is little enforcement of a poorly coordinated system with overlapping and conflicting access and withdrawal rights, both in rule-in-form (legal) and in rule-in-use.

By 2009 (before the Fish Refuges), only half of active fishing boats in the Corredor (47 of 104) had legal permits for finfish (Niparajá, 2009). Fishers without permits from neighboring states like Sinaloa and Sonora fished from temporary camps in the region, landing catch with permit-holding patrons (Niparajá, 2009). Some fishers from the capital city of La Paz (4 hr away by sea) claimed to have permits that provided access to the southern half of the Corredor. Industrial shrimping boats were frequent in the Corredor with an overlapping permit to harvest throughout the entire state. Fishers from the town of Ensenada Blanca, neighboring the Corredor to the north, exercised a spatially-delimited access and withdrawal permit called an "UMA" (Unidad de Conservación, Manejo y Aprovechamiento Sustentable de Vida Silvestre) which granted exclusive rights to harvest sea cucumbers in a large area overlapping the Corredor. Fishers from the Corredor complained that, rather than constrain themselves to sea cucumber, these fishers opportunistically fished all species using dive gear.

In contrast to the overlapping access and withdrawal rights granted to different groups of fishers described above, management and exclusion rights remained solely as the purview of the State, but were not exercised in practice. The nation's fisheries law grants CONAPESCA legal management rights, articulated as the duty of "regulating, fomenting, and administering the exploitation of fisheries and aquaculture resources" (DOF, 2007). Most fisheries are seemingly managed from the desks of CONAPESCA through fishing permits, which stakeholders view as insufficient: "In Mexico, there are very few fisheries that are managed... I don't believe that CONAPESCA is in the business of managing fisheries" (interview with NGO leader, 2017).

In the absence of government-led fisheries management in the Corredor, there was some evidence of self-governance practices before the Fish Refuges. Local fishers had developed norms regarding fishing areas, baiting, and gear restrictions, which are locally articulated as "the right way to fish" ("pescar bien"). The understanding of these practices varied across the 13 communities, but generally included a tacit agreement to respect one another's baited zones ("zonas cebadas"), use predominantly handlines (a low-efficiency fishing gear), and avoid using nets over rocky reefs or with a compressor (Niparajá, 2009). Outsiders tended not to respect these norms, often leading to conflict. The informal nature of these practices meant that authorities would not uphold them, frustrating the fishers in the Corredor, who felt

that the authorities unfairly punished local fishers rather than "badly behaved" outsiders (Niparajá, 2009).

CONAPESCA also formally holds exclusion rights, determining who can legally access and withdraw from the fishery, although our respondents accused this process of being opaque, random, or corrupt. In practice, there was little exclusion before the Fish Refuges. Occasionally, fishers from the Corredor would chase out fishers they perceived to be fishing wrongfully, but this exclusion was itself illegal, especially since many outsiders had some legal claims from the overlapping and complex permit system. Fishers from the Corredor described "caring for" the fish by limiting gear and letting areas "rest," while outsiders benefitted by "taking it all." (Table 2)

3.2 | Motivations for change: How to curb fisheries decline?

Overlapping and unclear access and withdrawal rights coupled with lack of management and enforcement likely contributed to fisheries decline and conflict in the study area. In the 2010 survey (n = 86 of 182), resident Corredor fishers expressed deep dissatisfaction with the property rights structure outlined above. 86% perceived that resources had declined, implicating overexploitation, harmful fishing techniques, and lack of fishing regulations. They wanted to restrict access and withdrawal: 62% agreed with prohibiting nets across the Corredor and 92% agreed with prohibiting nets and compressors together to target finfish. They were willing to engage in management: 79% said they would follow, monitor, and enforce no-fishing zones if they existed. They wanted to exclude outsiders: 67% thought that each community should have an exclusive fishing area and 95% wanted to exclude shrimp boats from the region. Also, Corredor fishers wanted to legalize their own withdrawal rights; even without enforcement, they feared prosecution and wanted to fish legally. Residents of one town, Ensenada de Cortés, partly blamed a 50% population decline on lack of permits. Fishers from the town of El Pardito expressed feeling like "delinquents" even though they had been fishing locally since 1916, before the first fisheries law in Mexico was established. In the entire study area 95% of fishers called for more legal permits. However, applying for permits was expensive and could take 40 days to 2 years, and often resulted in no permit. Furthermore, there were almost no mechanisms for fishers to gain management and exclusion rights.

Historically, fishers' role in management was to keep up with regulations that CONAPESCA imposed. A government staff member told us, "Restrictions on [the fishers] have always been top-down; they see it like this. We do scientific studies and see where we can pull the reins in or limit them, and the fishers never agree with these things. The fishers always scream and see it as a punishment" (interview, 2017). The only legal pathway for fishers to gain management and exclusion rights was a fishing concession granting access, withdrawal, management, and exclusion rights to an area, an extremely expensive and cumbersome process. However, in 2007, the new national fisheries law defined Fish Refuges as a newly available fisheries management tool: "[a]reas 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" (p. 6; DOF, 2007). Little direction was given on the role of fishers in management, but Niparajá saw an opportunity and presented the possibility of Fish Refuges to the fishers of the Corredor, ultimately precipitating a shift in the perception of ownership, *de facto* property rights, and behavior among local fishers.

3.3 | The mechanism leading to change: A collaborative process of establishing Fish Refuges, 2009–2012

Fish Refuges provided the opportunity to curb open access in the Corredor, but the legal tool of Fish Refuges do not necessarily lead to this result. Rather, it was through the collaborative process of establishing Fish Refuges that fishers of the Corredor positioned themselves as responsible managers deserving expanded rights. From a legal standpoint, Fish Refuges should seemingly have little effect on property rights and incentives for sustainability. Fishers may propose an area, but the management and exclusion rights ultimately lay with CONAPESCA, which approves or denies proposals based on a technical evaluation from its scientific branch, INAPESCA (Instituto Nacional de Pesca). Any individual or legal entity may submit a proposal, but CONAPESCA's intention is that only fishers with permits to the proposed area submit Fish Refuge proposals: "The one who asks for a Fish Refuge should be a fisher from that zone that has a permit" (interview with CONAPESCA official, 2017).

CONAPESCA strongly supported establishing Fish Refuges when they were first listed as an available tool in 2007. From 2008 to 2009, government officials, NGOs, and scientists held meetings about marine reserve science in the context of Mexican fisheries, and the potential of Fish Refuges. Working groups coalesced around several potential sites for the first Fish Refuges, including the

Corredor where Niparajá had been developing relationships for several years. One Niparajá staff member had lived intermittently in Agua Verde from 2007 to 2009, and was assisting their fishing cooperatives with paperwork and building leadership capacity. Seeing an opportunity to engage fishers with Fish Refuges, Niparajá decided to expand their geographic scope from Agua Verde to the whole Corredor; in 2009, they conducted a rapid appraisal of the needs, problems, and solutions across the Corredor, including interest in creating Fish Refuges. They conducted a census of all fishing activities in 2009 and a socioeconomic survey of 86 fishers in 2010. Seeing strong interest in permits, Niparajá interceded with CONAPESCA on behalf of the fishers to discuss the possibility of distributing permits, and at the same time asked for guidance on establishing Fish Refuges. In February of 2010, a top official of CONAPESCA went to the Corredor and invited the fishers to apply for permits, and also to submit a proposal for Fish Refuges. Niparajá staff told us that getting permits were not contingent on making Fish Refuges ("It wasn't a trade for Refuges," Niparajá, 2017a, 2017b) but the two processes happened at the same time.

Getting the permit applications in order was a Herculean task with layers of paperwork. Fish landings paperwork could only be filed with a unique identification number, which required a voter card and 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" (Niparajá, 2017a, 2017b). In easier cases, fishing cooperatives already had permits, but these permits had to be expanded to include more boats. By July 2010, all permit requests were submitted to CONAPESCA.

In 2010, Niparajá also facilitated the process of designing Fish Refuges in the Corredor. There was little legal guidance from either the fisheries law or CONAPESCA, so Niparajá based this process on other NGOs' experiences facilitating community-based marine reserves in Mexico. Niparajá hosted workshops in the Corredor on optimal design of Fish Refuges for ecological outcomes, based on marine reserve biology. In each town, fishers held meetings to suggest and edit maps for possible sites to ban fishing for 5 years. By September 2010, a map with 11 proposed Fish Refuge sites had been finalized. The areas were small (0.3–7.3 km^2) totaling 5% of the fishers' fishing areas (Niparajá, 2017a, 2017b). Niparajá circulated the final map throughout the Corredor, and 109 full-time resident fishers (of 182 total) signed a letter of support. In October 2010, Niparajá submitted the proposal and accompanying letter of support to CONAPESCA on behalf of the Corredor fishers.

CONAPESCA passed the proposal to INAPESCA for the technical opinion, creating a crisis because INAPESCA had no tools to evaluate the proposal. INAPESCA staff members told us, "There were certain doubts, certain reservations, about how they selected the areas... One thing was the quantity. Why 11? Why 11, and not 15? Why not 1?" and "The Institute doesn't have an official document with a methodology to use" (interviews with INAPESCA staff, 2017). Lacking the capacity to scientifically assess the proposal, INAPESCA simply ignored it. The proposal stagnated with INAPESCA for 2 years, during which Niparajá staff members put political pressure on CONAPESCA and INAPESCA through meetings and personal connections. At the end of 2011, the fishing permits were approved, doubling the number of permitted Corredor fishers (47–91), but INAPESCA still had not issued their technical opinion on the Fish Refuges. Niparajá staff told us, "What we really hoped as Niparajá was that the original proposal by the fishermen would be improved by INAPESCA" (interview, 2017). To that end, Niparajá invited INAPESCA to workshops with internationally renowned scientists in evaluating no-take zones, which INAPESCA never attended. Finally, in July 2012, nearly 2 years after the proposal was submitted, INAPESCA issued a technical opinion on the Fish Refuges of the Corredor.

According to INAPESCA staff, they issued a positive technical opinion for social and political reasons rather than ecological ones. They 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" (INAPESCA staff, 2017). Because the proposal was accepted on these social grounds, the Corredor fishers' proposal was unaltered by INAPESCA before it became law—contrary to the hopes of Niparajá. Since 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. One hundred and nine fishers had signed the letter in 2010; in 2012, 128 fishers signed the letter of support. Finally, on November 16, 2012, the Fish Refuges were published as a secretarial agreement, and thus became a legally backed instrument of fisheries management (DOF, 2012).

3.4 | Toward informal community-based management after the establishment of Fish Refuges

Although the process took 2 years, the locations and sizes of the fisher-designed Fish Refuges were directly

translated into federal law. Since the Fish Refuges are no-take zones, Corredor fishers lost *de jure* withdrawal rights in these areas for their 5-year duration, as have the shrimp trawlers and fishers from La Paz. In practice, some fishing still occurs inside the Fish Refuges. When asked in the 2016 survey about ongoing fishing inside the Fish Refuges, 45% reported some fishing by locals and 78% reported some fishing by outsiders. Confusion around overlapping rights continues. All activities outside CONAPESCA's purview are technically allowed inside Fish Refuges, including sea cucumber harvest under the independent UMA permit, frustrating fishers from the Corredor: "They say, no, if I am fishing for sea cucumber, I can fish in the Fish Refuge. You know that sea cucumber is more of a pretense... They pillage. They say they are fishing sea cucumber, and what a shame that they take everything there" (Corredor fisher, 2017). At the same time, in the broader region Corredor fishers have gained *de jure* withdrawal rights by doubling the number of permits held by local fishers. Although permits were not contingent on Fish Refuges, CONAPESCA officials discussed them together and Niparajá facilitated both processes.

Management and exclusion rights also changed through the collaborative process of establishing Fish Refuges, although mostly informally. Before, CONAPESCA had *de jure* management rights over resources in the area. *De facto*, there was no management. Fish Refuges have complicated these rights. The lack of evaluation protocols means that, in practice, INAPESCA has not edited or optimized Fish Refuge proposals. Because these proposals end up being approved as long as there is strong fisher support, fishers can use them to gain *de facto* management rights and establish legal no-fishing areas.

Furthermore, the process of designing a proposal has given Corredor fishers the opportunity to exclude shrimp trawlers and fishers from La Paz and other states from participating. Fishers in the Corredor advocate for their exclusive rights to design Fish Refuges in their fishing areas: "The community has the right to say, we want a Refuge here, and if we don't want it, then we won't have it... You put your Refuge in your fishing area... The one with the right is the community, nobody else. People from outside, they don't have the right" (Corredor fisher, 2017). This exclusion was particularly visible from 2013 to 2014 when fishers from La Paz opposed the Fish Refuges in the Corredor through demonstrations, rallies, and threats because they had not participated in their design. CONAPESCA ultimately quashed this opposition citing no legal records of catch landed in the Corredor by the La Paz fishers, irrespective that this was also true for many Corredor residents without permits who had never legally landed catch. However, in 2017 when Corredor fishers proposed a massive (5,640 km^2) Fish Refuge permitting all gears except trawling (effectively an industrial trawling restriction across the Corredor), CONAPESCA denied the proposal because shrimp trawlers had not participated. CONAPESCA was not willing to legalize that level of exclusive management by Corredor fishers. Thus, the *de facto* management and exclusion rights that the Corredor fishers have gained are not secure or formalized, but through the process they have positioned themselves as partners with civil society and the government to manage the resources they depend on (Table 3).

3.5 | How much has changed? Evidence of social-ecological impacts after the Fish Refuges

Ultimately, the Corredor fishers still face inherent uncertainties in the property rights they hold and the likelihood that they will be the long-term beneficiaries of present efforts; the Fish Refuges are temporary, and most

TABLE 3 Actors holding property rights to fisheries in the Corredor after the establishment of the Fish Refuges, separated as *de facto* (rights-in-use) and *de jure* (legal rights or rights-in-form)

Property rights	Rights within Fish Refuges		Rights in broader Corredor fishing area	
	De jure	**De facto**	***De jure***	**De facto**
Access and withdrawal	None (except UMA)	Small amount of ongoing fishing	All Corredor fishers, some fishers from La Paz and other municipalities	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	The Mexican Federal Government on behalf of all Mexican citizens			

decision-making processes are not codified. However, outcomes reported in the 2016 survey indicate changes in governance-related behavior and perception of Corredor fishers, as well as expectations of long-term ecological change. First, there is increasing participation in *de facto* management activities. In 2016, 63% of fishers were involved in some sort of informal management of the Fish Refuges with training and support from Niparajá, such as underwater monitoring, recording catch data, enforcement patrols, and reviewing security cameras. Second, there are strong indications of a closer relationship with the (formal) government. After the creation of the Fish Refuges, 53% of fishers said that government attention in the region increased (37% noticed no change). Sixty-eight percent of fishers said that fishing-related subsidies had increased. Twenty-nine percent of Corredor fishers had participated in formal fisheries governance like meetings and regional councils in 2016, a presumed increase from 0% in 2009 when the regional council did not exist and there was no Corredor fisher participation in CONAPESCA meetings to the authors' knowledge (the 2009 survey did not ask). This all coincided with an increase in legalized fishing: in 2009, only 50% of Corredor fishing boats had permits, compared to 88% by 2016. Yet mistrust in the government continues: in 2016, only 21% of fishers said they trust the government, while 48% disagreed or strongly disagreed. Forty-seven percent of fishers in 2016 said that authorities were unlikely to catch people fishing in the Fish Refuges.

Both fishers' perceptions and ecological monitoring data indicate moderate ecological benefits since the Fish Refuges were established. Sixty-three percent of fishers in the 2016 survey perceived that local fisheries would be worse or much worse without Fish Refuges. Underwater monitoring data showed a 30% increase in biomass and a significant increase in size inside the Fish Refuges compared to control sites from 2012 to 2016 (Niparajá, 2017a, 2017b). Sixty percent of species of commercial interest showed signs of recuperation of at least 10 kg per hectare, and half of species of commercial interest increased in average size (Niparajá, 2017a, 2017b). The small size of the Fish Refuges and the limited years of data from the ecological monitoring dictate caution on interpreting initial results but should encourage monitoring to continue. Moreover, regionally there are also signs of ecological and fisheries improvements. In the 2009 survey, 86% of fishers reported that fisheries had declined in the past 10 years, with 12% reporting no change. In 2016, only 4% reported decline, 41% reported no change, and 52% reported improvement. Underwater monitoring data show that biomass, richness, and diversity increased on average in both Fish Refuges and controls from 2012 to 2016 (Niparajá, 2017a, 2017b). Compared to reported decline prior to 2012, catch data collected by trained Corredor fishers ("Técnicos Pesqueros") show steady catches in almost all species from 2012 to 2016 (Niparajá, 2017a, 2017b). Changes in average individual size varied by species: in catch data from 2012 to 2016, average size of yellowtail (*Seriola lalandi*) and parrotfish (*Scarus ghobban*) decreased; red snapper (*Lutjanus peru*) was stable; and grouper (*Mycteroperca rosacea*) increased. Overall, there is initial evidence of improved ecological and fisheries health inside the Fish Refuges and also regionally in the Corredor since 2012, most notably in a transition from declining fisheries to stable or mildly improving fisheries (Figure 2).

4 | DISCUSSION

4.1 | Fish Refuges and the new shape of property rights

Before the Fish Refuges were implemented, local fishers had developed local traditions of self-governance that limited fishing effort. Yet, they suffered from a classic "tragedy of the commons" with uncontrolled access, overfishing, and fisheries decline, partly motivated by the lack of clarity in access, withdrawal, management, and exclusion property rights. Using Schlager and Ostrom (1992)'s framework, we classify this property rights structure as top-heavy: many actors exercised access and withdrawal rights, but few exercised any management or exclusion rights, creating few incentives for long-term management. Local fishers expressed concern over "caring for" their resources by "fishing well" while fishers from outside would "take everything." Local fishers wanted to limit gear for others, but the government could not support them because it lacked any tool that allowed fisher proposals for management to become law.

The Fish Refuges, made legally available in a new fisheries law in 2007, provided a tool where fishers could propose management arrangements for their fishing areas. The process of engagement outlined above allowed fishers to redefine their role in fisheries governance, engage in management activities, and appropriate *de facto* management and exclusion rights previously reserved to the State, under the tacit and explicit authorization of the State. Niparajá internalized many of the costs of this process like organizing numerous meetings in the Corredor and putting political pressure on fisheries officials. Altogether, this collaborative process between fishers, civil society and the State has shifted the property-rights structure affecting fishers from top-heavy toward a balanced one. Corredor fishers have moved from *de facto* open access toward greater

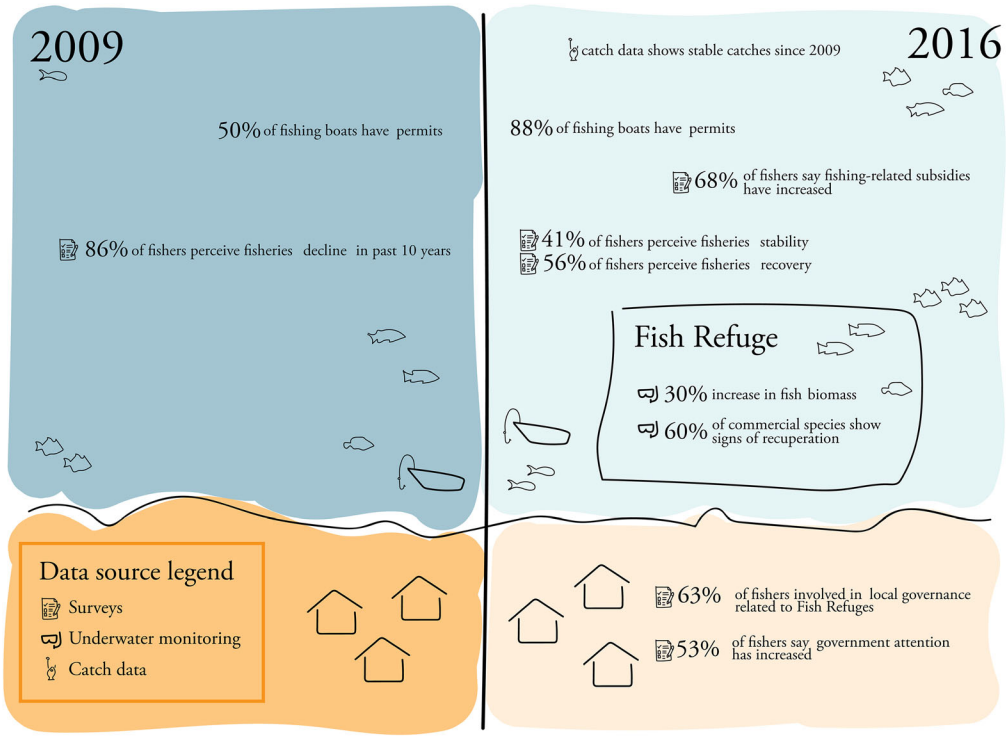

FIGURE 2 Lines of evidence of changes before Fish Refuges were implemented (2009) and after (2016) in the Corredor region. Figure draws on three sources of data: continuous underwater monitoring of Fish Refuges and control sites from 2012 to 2016; catch data recorded by fishers from 2012 to 2016; and socioeconomic surveys of fishers in 2009 and 2016. Fish Refuges were implemented in 2012

incentives for long-term management, albeit through informal and temporary management and exclusion rights (Figure 3).

4.2 | Tradeoffs of insecure property rights: Opportunity or risk?

The dilemma of the new property rights structure is that it is tenuous because it is not official. However, its unofficial nature seems to be precisely what allowed fishers to gain self-governance rights. On one hand, the lack of legal protocols meant that the fishers' proposal could not be technically evaluated, so was approved and translated to law without alteration. On the other hand, the Mexican State supported the informal exclusion of La Paz fishers from participating in the design of Fish Refuges, while rejecting the large Fish Refuge proposal that would have formally excluded shrimp trawlers. Perhaps the seed of opportunistic unofficial rights, watered by support from civil society allies, is one pathway for resource users to build toward sustainable institutions, although this hypothesis would need further examination and research.

One facet of this case most relevant to conservation practitioners is the importance of *who* drives the changes in property rights. Most property rights decentralization occurs when States decide to grant rights to resource users, but this has inherent problems (Larson & Soto, 2008). To keep real power, States often grant

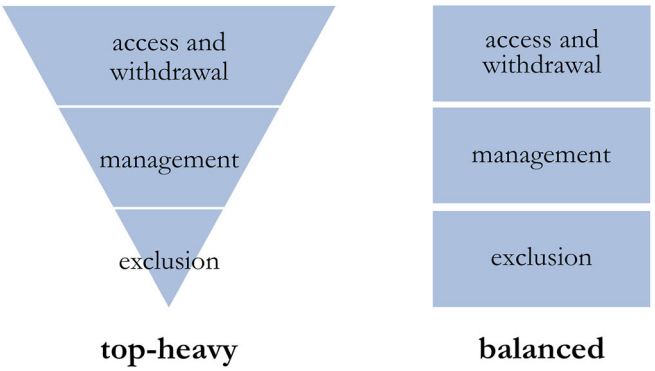

FIGURE 3 Conceptual diagram of two types of property rights regimes. Levels correspond to Schlager and Ostrom (1992)'s property rights framework. Width of each level represents number of fishers exercising rights at that level within a given property rights system. Left, a top-heavy property rights structure dominated by widespread access and withdrawal and less management or exclusion, as before the Fish Refuges were implemented. Right, a balanced structure, as after the Fish Refuges were implemented

responsibilities like enforcement without decision-making rights like management and exclusion, frequently resulting in poor conservation, and equity outcomes (Agrawal & Ostrom, 2001). Where there is a history of government appropriation, resource users may not trust rights granted by governments and continue to behave as though they do not have them (McCarthy, 2000; Meinzen-Dick & Knox, 1999). Furthermore, *de jure* rights often fail to change

behavior in practice because the ability to use rights (and associated incentives) depends on access to capital, labor, markets, legal know-how, and so on (Ribot & Peluso, 2003). In contrast to mediocre outcomes from State-granted rights, there is evidence that user-demanded rights may lead to greater likelihood of transformation (Larson et al., 2008; Larson & Soto, 2008; Pacheco et al., 2012).

This seems to be the case in the Corredor, where resource users have sparked a property rights regime change by proposing and defending their right to manage their coastal resources. Although the rights were largely informal, with legal rights retained by the State, Corredor fishers are increasingly involved in (co-)managing their fisheries. In 2015, a regional committee for fisheries management of the Corredor was formed, meeting several times a year, including representatives from INAPESCA and CONAPESCA, with the majority of seats held by Corredor fishers. In the 2016 survey, fishers reported receiving greater subsidies and attention from the government since the creation of the Fish Refuges. Since 2019, Corredor fishers have been engaged in discussions of long-term and formal management and exclusion rights in the form of fishing "concessions" granting 20-year exclusive harvest. And in 2020 during the COVID-19 pandemic, with demand fallen by 30–80% and half of Mexican small-scale fishers completely off the water (COBI, 2020), Niparajá has coordinated new local markets through a community-supported fishery to support Corredor fishers. The implication for conservation practitioners is that supporting grassroots demands by resource users for expanded property rights, even if informal, might precipitate broader changes than supporting State devolution of property rights.

4.3 | Potential of Fish Refuges as a policy tool for resilient fisheries

In the Corredor, there are initial signs of fisheries improvement since the Fish Refuges were established in 2012. Fishers surveyed in 2009 overwhelmingly reported regional fisheries decline, but by 2016 reported either stable or recovering fisheries. Fisheries-dependent data confirms stable catches since 2012 and monitoring data from 2012 to 2016 indicates increases in biomass and fish size within Fish Refuges. However, the regional effects of the Fish Refuges cannot be separated from the broader changes (e.g., increased enforcement, reduced illegal fishing, and reduced use of nets) associated with the evolution of governance in the Corredor since 2009. Focusing on the ecological and climate change potential of Fish Refuges in isolation from broader governance processes arguably misses the point. This may explain the paradox that Fish Refuges in other parts of Mexico have been supported and renewed by local fishers despite evidence that they have no ecological effect on either catches or in-water population density (Villaseñor-Derbez et al., 2019) and despite evidence of weak design according to ecological principles (e.g., inclusion of essential habitat and target species; likelihood of ecological improvements before expiration; Molina-Hernández et al., 2018).

These findings align with other studies suggesting that the effectiveness of area-based conservation measures and thus their potential for climate resilience, can only be understood when interpreted within their broader social fabric (Charnley et al., 2017; Fox et al., 2012; Mascia et al., 2017), particularly for small, voluntary, or temporary closures common in community-based conservation (Jupiter et al., 2014; Govan, 2009). For example, while both models (Gerber et al., 2003) and empirical evidence (Bartlett et al., 2009; Cinner et al., 2006; Cohen et al., 2013) show that temporary closures can bolster fisheries, the likelihood of success is best explained by strong cultural and historical institutions of collective tenure (e.g., Fijian "*taboo*"; Jupiter et al., 2012; Ruttan, 1998; Williams et al., 2006).

Evidently, Fish Refuges can serve as focal points for a process of engagement that gives fishers expanded rights (albeit informal), generating incentives to try community-based conservation with implications for climate resiliency. Engaging in community-based conservation is costly for communities of resource users in terms of time, energy, and money, with uncertain benefits. This is especially true for the creation of area-based conservation measures, which often fail to produce positive ecological outcomes (Gill et al., 2017) and may even attract poachers (Bergseth, Russ, & Cinner, 2015; Cudney-Bueno & Basurto, 2009), while being costly for community groups to establish and maintain. Evaluating property rights systematically using tools like Schlager and Ostrom (1992)'s schema may aid in understanding why fishers would engage in a costly, risky endeavor to make protected areas that might not work.

5 | CONCLUSION

Where resource users face poor incentives for long-term sustainable management, as in many *de facto* open-access fisheries, how can they find ways to transform their incentive structure? Policy tools like Fish Refuges where resource users generate their own management proposals could create opportunities to end open access through (initially) informal and insecure rights. Because informal rights—technically illegal—are beyond the state's jurisdiction, they depend upon engagement by resource users,

and thus may be well suited to community-based conservation. In the case of the Fish Refuges of the Corredor, informal and insecure rights have been a key step in the evolution of governance from *de facto* open access toward evidence of fisher engagement and increasingly sustainable fisheries. Insecure, temporary rights may be especially relevant for climate change adaptation, particularly in the context of protected areas, for which successful adaptation to ecosystem change and species distribution shifts might require redefining boundaries and conservation goals and renegotiation with local communities. Such changes imply the development of new property-rights regimes, in which one possibility is the establishment of more flexible but insecure property-rights arrangements like Fish Refuges.

ACKNOWLEDGMENTS

The authors gratefully acknowledge their research respondents from the towns of Puerto de Agua Verde, Tembabiche, San Evaristo, and Ensenada de Cortés; from Mexico's fisheries agencies (CONAPESCA and INAPESCA), and from the organization Niparajá A.C., especially Amy Hudson Weaver, Salvador Rodriguez Van Dyck, Ollín González, Tomás Plomozo, José Manuel Marrón, and Melisa Vázquez. Niparajá also provided ecological data for this paper. Mariana Walthers provided lodging, advice, and support that allowed this research to take place. Graduate student support was provided by Duke University's Graduate School through a James B. Duke International Research Fellowship and Anne Firor Scott Public Scholars Fellowship, and research funding was provided by NSF Coupled Natural Human Systems award #1632648.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Anastasia Quintana conceived of the original idea as part of her PhD dissertation. Anastasia Quintana conducted ethnographic research including analysis. Xavier Basurto was part of the team that designed and implemented the socioeconomic surveys. Anastasia Quintana designed the figures. Both authors wrote the manuscript and approve of the final version.

DATA AVAILABILITY STATEMENT

This paper draws on three sources of data. The first is qualitative data from interviews and observation, which will not be shared due to Internal Review Board restrictions and privacy rights of the participants. The second is ecological data on outcomes of the Fish Refuges. An analysis of this data can be found in a detailed report here (http://niparaja.org/wp-content/uploads/2015/06/Resultados-biologicos-ecologicos-de-las-Zonas-de-Refugio-del-Corredor-San-Cosme-a-Punta-Coyote-Monitoreo-submarino-2012-2016-DIGITAL.pdf). This data is owned by the NGO, Niparajá. The third is social science survey data from a survey in 2009 and 2016. Analyses of each of these surveys can be found here (2009: http://niparaja.org/wp-content/uploads/2015/06/Resultados_Entrevistas_Pescadores_MARZO_2010.pdf) and here (2016: http://niparaja.org/wp-content/uploads/2015/06/Reporte-Final-zonas-de-refugio-pesquero.pdf). Survey data is not publically released because of confidentiality of participants and impossibility of anonymity given the detailed nature of the survey and the smallness of the towns involved. Further data analyses and reports about the Fish Refuges can be found on Niparajá's website (http://niparaja.org/pesca-sustentable/).

ETHICS STATEMENT

This research was approved of by Duke University's Institutional Review Board (IRB permit # 2018-0130). All participants gave informed consent prior to participation in this study. Names have been kept anonymous to maintain confidentiality. All respondents were read a consent script and agreed to have their responses, including direct quotations, published anonymously.

ORCID

Anastasia C.E. Quintana https://orcid.org/0000-0003-2865-0825
Xavier Basurto https://orcid.org/0000-0002-5321-3654

REFERENCES

Agrawal, A., & Ostrom, E. (2001). Collective action, property rights, and decentralization in resource use in India and Nepal. *Politics and Society*, *29*(4), 485–514.

Armitage, D. R., Plummer, R., Berkes, F., Arthur, R. I., Charles, A. T., Davidson-Hunt, I. J., ... McConney, P. (2009). Adaptive co-management for social–ecological complexity. *Frontiers in Ecology and the Environment*. *7*(2), 95–102. http://dx.doi.org/10.1890/070089.

Basurto, X., & Garcia Lozano, A. (2020). Commoning and the commons as more-than-resources: A historical perspective on Comcáac or Seri Fishing. In P. K. Nayak (Ed.), *Making commons dynamic: Understanding change through commonisation and decommonisation*. UK: Routledge.

Bartlett, C., Manua, C., Cinner, J., Sutton, S., Jimmy, R., South, R., ... Raina, J. (2009). Comparison of outcomes of permanently closed and periodically harvested coral reef reserves. *Conservation Biology*, *23*(6),1475–1484.

Bergseth, B. J., Russ, G. R., & Cinner, J. E. (2015). Measuring and monitoring compliance in no-take marine reserves. *Fish and Fisheries*, *16*, 240–258. https://doi.org/10.1111/faf.12051

Berkes, F. (2007). Community-based conservation in a globalized world. *Proceedings of the National Academy of Sciences*, *104*, 15188–15193.

Blaikie, P. (2006). Is small really beautiful? Community-based natural resource management in Malawi and Botswana. *World Development*, *34*, 1942–1957.

Charmaz, K. (2006). *Constructing grounded theory: A practical guide through qualitative analysis*. London, England: SAGE Publications.

Charnley, S., Carothers, C., Satterfield, T., Levine, A., Poe, M. R., Norman, K., ... Levin, P. S. (2017). Evaluating the best available social science for natural resource management decision-making. *Environmental Science & Policy*, *73*, 80–88.

Cinner, J., Marnane, M. J., McClanahan., T. R., Almany, G.R. (2006). Periodic closures as adaptive coral reef management in the Indo-Pacific. Ecology and Society, 11(1).

COBI (2020). *Mexican fishing communities' resilience to COVID-19: Economic and social impacts*, Comunidad y Biodiversidad.

Cohen, P. J., Cinner, J.E., & Foale, S. (2013). Fishing dynamics associated with periodically harvested marine closures. *Global Environmental Change 23*(6), 1702–1713.

Commons, J. R. (1968). *Legal foundations of capitalism*. Madison: University of Wisconsin Press.

CONAPESCA (2017). CONAPESCA ZONAS DE REFUGIO PESQUERO EN México: Las Zonas de Refugio Pesquero (ZRP). Comisión Nacional de Acuacultura y Pesca.

Costello, C. J., & Kaffine, D. (2008). Natural resource use with limited-tenure property rights. *Journal of Environmental Economics and Management*, *55*(1), 20–36.

Cox, M., Arnold, G., & Tomás, S. V. (2010). A review of design principles for community-based natural resource management. *Ecology and Society*, *15*(4), 38.

Cudney-Bueno, R., & Basurto, X. (2009). Lack of cross-scale linkages reduces robustness of community-based fisheries management. *PLoS One*, *4*, e6253.

Demsetz, H. (1967). Toward a theory of property rights. *The American Economic Review*, *57*(2), 347–359.

DOF. (2007). Ley general de pesca y acuacultura sustentables. cámara de diputados del H. Congreso de la unión,

DOF. (2012). ACUERDO por el que se establece una red de zonas de refugio en aguas marinas de jurisdicción federal frente a la costa oriental del Estado de Baja California Sur, en el corredor marino de San Cosme a Punta Coyote.

DOF. (2014). NORMA Oficial Mexicana NOM-049-SAG/PESC-2014, Que determina el procedimiento para establecer zonas de refugio para los recursos pesqueros en aguas de jurisdicción federal de los Estados Unidos Mexicanos. Secretaria de Gobernacion,

DOF. (2017). ACUERDO por el que se modifica y se amplía la vigencia del similar que establece una Red de Zonas de Refugio en aguas marinas de jurisdicción federal frente a la costa oriental del Estado de Baja California Sur, en el corredor marino de San Cosme a Punta Coyote, publicado el 16 de noviembre de 2012.

Fleischman, F. D., Ban, N. C., Evans, L. S., Epstein, G., Garcia-Lopez, G., & Villamayor-Tomas, S. (2014). Governing large-scale social-ecological systems: Lessons from five cases. *International Journal of the Commons*, *8*, 428–456.

Fox, H. E., Mascia, M. B., Basurto, X., Costa, A., Glew, L., Heinemann, D., ... Recchia, C. A. (2012). Reexamining the science of marine protected areas: linking knowledge to action. *Conservation Letters*, *5*(1), 1–10.

Galik, C. S., & Jagger, P. (2015). Bundles, duties, and rights: A revised framework for analysis of natural resource property rights regimes. *Land Economics*, *91*, 76–90.

Gill, D. A., Mascia, M. B., Ahmadia, G. N., Glew, L., Lester, S. E., Barnes, M., ... Fox, H. E. (2017). Capacity shortfalls hinder the performance of marine protected areas globally. *Nature*, *543*, 665–669. https://doi.org/10.1038/nature21708

Govan, H. (2009). Achieving the potential of locally managed marine areas in the South Pacific. SPC Traditional Marine Resource Management and Knowledge Information Bulletin 25 (July).

Hardin, G. (1968). The tragedy of the Commons. *Science*, *162*(859), 1243–12248.

IPCC. (2019). *Special report on the ocean and cryosphere in a changing climate*. Intergovernmental Panel on Climate Change. https://www.ipcc.ch/srocc/.

Jupiter, S. D., Weeks, R., Jenkins, A. P., Egli, D. P., & Cakacaka, A. (2012). Effects of a single intensive harvest event on fish populations inside a customary marine closure. *Coral Reefs*, *31* (2), 321–334.

Jupiter, S. D., Cohen, P. J., Weeks, R., Tawake, A., & Govan, H. (2014). Locally-managed marine areas: multiple objectives and diverse strategies. *Pacific Conservation Biology*, *20*(2), 165–179.

Larson, A. M., Cronkleton, P., Barry, D., & Pacheco, P. (2008). *Tenure rights and beyond: Community access to forest resources in Latin America*. Bogor, Indonesia: CIFOR.

Larson, A. M., & Soto, F. (2008). Decentralization of natural resource governance regimes. *Annual Review of Environment and Resources*, *33*, 213–239.

Leslie, H. M., Basurto, X., Nenadovic, M., Sievanen, L., Cavanaugh, K. C., Cota-Nieto, J. J., ... Aburto-Oropeza, O. (2015). Operationalizing the social-ecological systems framework to assess sustainability. *Proceedings of the National Academy of Sciences of the United States of America*, *112*, 5979–5984. https://doi.org/10.1073/pnas.1414640112

Mascia, M. B., & Claus, C. A. (2009). A property rights approach to understanding human displacement from protected areas: The case of marine protected areas. *Conservation Biology*, *23*(1), 16–23.

Mascia, M. B., Fox, H. E., Glew, L., Ahmadia, G. N., Agrawal, A., Barnes, M., ... Gill, D. (2017). A novel framework for analyzing conservation impacts: evaluation, theory, and marine protected areas. *Annals of the New York Academy of Sciences*, *1399*, 93–115.

Molina-Hernández, A. L., Garza-Pérez, J. R., & Aranda-Fragoso, A. (2018). Identifying management challenges and implementation shortcomings of a new fishing refuge: Akumal reef, Mexico. *Ocean & Coastal Management*, *161*, 127–140.

Maxwell, S. M., Gjerde, K. M., Conners, M. G., & Crowder, L. B. (2020). Mobile protected areas for biodiversity on the high seas. *Science*, *367*(6475), 252–254.

McCarthy, J. (2000). The changing regime: Forest property and reformasi in Indonesia. *Development and Change*, *31*(1), 91–129.

McCay, B. J., & Acheson, J. M. (1987). *The question of the commons: The culture and ecology of communal resources*. Tucson, AZ: University of Arizona Press.

Meinzen-Dick, R. and A. Knox (1999). Collective action, property rights, and devolution of natural resource management: A conceptual framework. Draft paper for workshop.

Moritz, M., Behnke, R., Beitl, C. M., Bliege Bird, R., Chiaravalloti, R. M., Clark, J. K., ... Wilson, J. A. (2018). Emergent sustainability in open property regimes. *Proceedings of the National Academy of Sciences*, *115*, 12859–12867.

Niparajá (2009) Conociendo el Corredor: Una descripción de las comunidades pesqueras, su problemática y posibles soluciones.

Niparajá (2016) Corredor San Cosme - Punta Coyote: Infográfico (Geografía y estadística, Censo socio - económico, y Esfuerzo pesquero).

Niparajá (2017a). Estudio Justificativo de la Red de Zonas de Refugio Pesquero del Corredor San Cosme a Punta Coyote, B.C.S., México. T. Las comunidades de Agua Verde, Ensenada de Cortes, Los Dolores,, L. C. Punta Alta, Nopoló, San Evaristo, El Pardito, El Portugués y Punta, S. C. Coyote; La Federación de Sociedades Cooperativas Pesqueras Zona Centro B.C.Sur and A. C. de R.L. de C.V.; Con apoyo técnico de la Sociedad de Historia Natural Niparajá. La Paz, Baja California Sur, Mexico: 130.

Niparajá (2017b). Resultados Biológicos-Ecológicos de las Zonas de Refugio del Corredor San Cosme a Punta Coyote: Monitoreo Submarino 2012–2016.

OECD (2006) Agricultural and Fisheries Policies in Mexico. Recent Achievements, Continuing the Reform Agenda. Paris

Ostrom, E. (1990). *Governing the commons*. Cambridge, UK: Cambridge University Press. https://doi.org/10.1017/cbo9780511807763

Ostrom, E. (2000). Reformulating the commons. *Swiss Political Science Review*, *6*, 29–52.

Ostrom, E. (2003). How types of goods and property rights jointly affect collective action. *Journal of Theoretical Politics*, *15*, 239–270.

Ostrom, E. (2005). *Understanding institutional diversity* (Vol. 241). Princeton, NJ: Princeton University Press.

Ostrom, E., Dietz, T., Dolsak, N., Stern, P., Stonich, S., & Weber, E. (2002). *The Drama of the Commons*. Washington, D.C.: National Academies Press. https://doi.org/10.17226/10287

Pacheco, P., Barry, D., Cronkleton, P., & Larson, A. (2012). The recognition of forest rights in Latin America: Progress and shortcomings of forest tenure reforms. *Society & Natural Resources*, *25*(6), 556–571.

Pendleton, L. H., Ahmadia, G. N., Browman, H. I., Thurstan, R. H., Kaplan, D. M., & Bartolino, V. (2017). Debating the effectiveness of marine protected areas. *ICES Journal of Marine Science*, *75*(3), 1156–1159.

Poteete, A. R., Janssen, M. A., & Ostrom, E. (2010). *Working together: Collective action, the commons, and multiple methods in practice*. Princeton, NJ: Princeton University Press. https://doi.org/10.1515/9781400835157

Querou N, Tomini A, Costello C (2017) Spatial concessions with limited tenure

Ribot, J. C., Peluso, N. L. (2009). A Theory of Access*. *Rural Sociology*, *68*(2), 153–181. http://dx.doi.org/10.1111/j.1549-0831.2003.tb00133.x.

Roberts, C. M., O'Leary, B. C., McCauley, D. J., Cury, P. M., Duarte, C. M., Lubchenco, J., ... Castilla, J. C. (2017). Marine reserves can mitigate and promote adaptation to climate change. *Proceedings of the National Academy of Sciences*, *114*(24), 6167–6175. http://dx.doi.org/10.1073/pnas.1701262114.

Ruttan, L. M. (1998). Closing the commons: cooperation for gain or restraint?. *Human Ecology*, *26*(1), 43–66.

Saenz-Arroyo, A., Roberts, C., Torre, J., Cariño-Olvera, M., & Enríquez-Andrade, R. (2005). Rapidly shifting environmental baselines among fishers of the Gulf of California. *Proceedings of the Royal Society of London B: Biological Sciences*, *272*, 1957–1962.

Sala, E., Aburto-Oropeza, O., Reza, M., Paredes, G., & López-Lemus, L. G. (2004). Fishing down coastal food webs in the Gulf of California. *Fisheries*, *29*, 19–25.

Schlager, E. (2002). Rationality, cooperation, and common pool resources. *American Behavioral Scientist*, *45*, 801–819.

Schlager, E., & Ostrom, E. (1992). Property-rights regimes and natural resources: A conceptual analysis. *Land Economics*, *68*, 249–262.

Sumaila UR, Cheung WW, Cury PM, Tai T (2017) Climate change, marine ecosystems and global fisheries Building a climate resilient economy and society: Challenges and opportunities

Tittensor, D. P., Walpole, M., Hill, S. L. L., Boyce, D. G., Britten, G. L., Burgess, N. D., ... Ye, Y. (2014). A mid-term analysis of progress toward international biodiversity targets. *Science*, *346*, 241–244. https://doi.org/10.1126/science.1257484

Villaseñor-Derbez, J. C., Aceves-Bueno, E., Fulton, S., Suarez, A., Hernandez-Velasco, A., Torre, J., & Micheli, F. (2019). An interdisciplinary evaluation of community-based TURF-reserves. *PloS one 14*(8).

West, P., Igoe, J., & Brockington, D. (2006). Parks and peoples: The social impact of protected areas. *Annual Review of Anthropology*, *35*, 251–277. https://doi.org/10.1146/annurev.anthro.35.081705.123308

Williams, I., Walsh, W., Miyasaka, A., & Friedlander, A. (2006). Effects of rotational closure on coral reef fishes in Waikiki-Diamond head fishery management area, Oahu, Hawaii. *Marine Ecology Progress Series*, *310*, 139–149.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

How to cite this article: Quintana ACE, Basurto X. Community-based conservation strategies to end open access: The case of Fish Refuges in Mexico. *Conservation Science and Practice*. 2020;e283. https://doi.org/10.1111/csp2.283