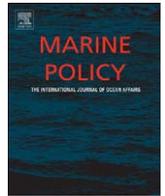




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# The unintended consequences of formal fisheries policies: Social disparities and resource overuse in a major fishing community in the Gulf of California, Mexico

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## ABSTRACT

This study investigates the local social and fisheries impact of formal fisheries policies in Bahía de Kino, one of the most important fishing villages in terms of extraction of benthic resources in the Northern Gulf of California, Mexico. The paper focuses on cross-scale institutional interactions, describing how existing formal policies are functioning on the ground, how these policies interact with local arrangements, and how this interaction may affect the incentives of different actors towards sustainable fisheries. Besides providing lessons on how the performance of a local fishery could be improved, this paper addresses the question of whether the formal institutional structure of Mexican fishing regulations is effective in promoting responsible behavior by small-scale fishery stakeholders. It is argued that the design of the most widely used management tool to regulate access to marine resources throughout Mexico -the permit (licensing) system- provides the wrong incentives for sustainable-use. Granting secure rights to resources to those actively involved in the fishery is a necessary step for promoting sustainable fishing practices.

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“We claim respect of our own fishing grounds, just like fishers from other villages from which we have been expelled do” (Bahía de Kino’s fishers, in petition to authorities in March 2007).

## 1. Introduction

Institutions<sup>1</sup> are widely regarded as important factors influencing the outcome of natural resources use by humans, whether it involves overuse or sustainable management [1,2]. Given a set of ecological, social and institutional constraints, people consider the costs and benefits of various behaviors and act according to their perceived incentives [2,3]. Institutions are particularly important in common-pool resources (CPRs), resources from which excluding users is difficult (the exclusion problem), and one person’s

harvest of the resource makes this resource unavailable to others (the subtractability problem) [4].

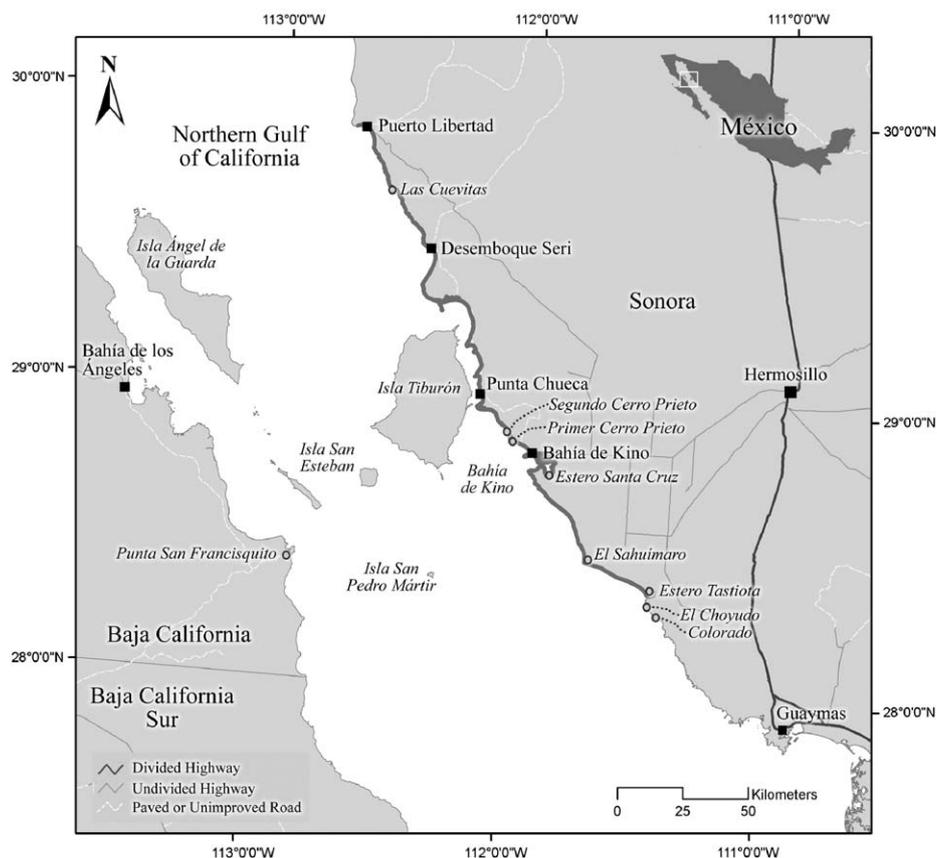
In fisheries, controlling who accesses a fishing ground and how the resource is harvested by those entering the fishery are critical for limiting exploitation to sustainable levels. Open-access to fisheries has had disastrous social and ecological consequences worldwide, even when resource-use rules were in place. On the other hand, decades of observation of traditional and *de novo* management practices have shown us that sustainability is achievable when the right mechanisms for controlling access and use, and for providing incentives for fishery stakeholders to pursue sustainable outcomes, are in place [4–11]. Whether developed by users themselves, by governments or other agencies, or a mix of both, some of the elements present in successful management institutions include granting of secure rights to resource users, stakeholder’s meaningful participation in the full range of management (planning, science, legislation, and implementation), government recognition and consideration of locally developed institutions and initiatives, and government support for management [5,11,12].

However, rules and regulations are seldom implemented and used exactly the way they are stated. The rules and practices that

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<sup>1</sup> We refer to ‘institutions’ as the rules, norms and strategies adopted by individuals to organize their social interactions and resource extraction [2].



**Fig. 1.** Map of the study area within the northern Gulf of California (NGC). The NGC is the area extending north of Punta San Francisquito in Baja California and north of Bahía de Kino in Sonora. The thick gray line on the Sonoran coastline indicates the geographic jurisdiction of fishing permits for diving products in Bahía de Kino, extending from Puerto Libertad to Estero Tastiota. Square markers indicate the main towns or cities. Hermosillo is the capital city of Sonora. Cartographic design: Marcia Moreno-Báez and Erika Koltenuk.

are actually used in field settings are called working rules or rules-in-use and they may or may not closely resemble the formal laws expressed in legislation, administrative regulation [4], or local formal agreements. Sometimes, rules in use may differ considerably—or even contradict—the existing formal rules. Rules-in-use are also different from laws or formal rules in that they are not easily observable [13]. This may lead to erroneous assumptions by analysts and managers who may believe that formal rules and rules-in-use are always the same, and/or that there are no other rules in place than formal rules [13,14]. If managers assume that users automatically learn, comprehend, and make use of the government rules in place, management strategies may be based on administrative assumptions rather than on what is really happening in the field [2,14]. Unfortunately, this issue is seldom addressed in studies of fishing communities, leaving us without an understanding of how government rules are functioning on the ground, and therefore how their implementation could be improved.

This paper presents the results of a study designed to describe the local social and fisheries impacts of formal fisheries policies in Bahía de Kino, one of the most important fishing villages in terms of extraction of benthic resources<sup>2</sup> in the Northern Gulf of California (NGC), Mexico (Fig. 1) [15]. The Gulf of California (GC) is a region internationally known for its biological richness [16]. It is Mexico's chief supplier of fishery resources for national and international markets, and provides food and labor opportunities

<sup>2</sup> Benthic species spend most of their life cycle in association with the sea bottom (i.e. mollusks, crustaceans). In Bahía de Kino, they are harvested primarily by commercial divers.

to thousands of people at a local level [17]. Fishing activities (large and small-scale) in the GC generate over 50,000 jobs, produce about 50% of the national fishery production, and involve around 26,000 fishing boats of which about 90% are small-scale boats<sup>3</sup> locally called 'pangas' [18].

Besides providing lessons on how the performance of a local fishery could be improved, this paper addresses the question of whether the formal institutional structure of Mexican fishing regulations is effective in promoting responsible behavior by small-scale fishery stakeholders. A number of studies of governance of marine resources by fishing communities have been developed in the Gulf of California [16,19–23]. However, none has specifically addressed the on-the-ground performance of the main management tools for fisheries regulation and their consequences for fisheries sustainability. This study argues that the design of the permit (licensing) system, the most widely used tool to regulate access to marine resources throughout Mexico, provides the wrong incentives for sustainable management. It is suggested that granting secure rights to resources to those actively involved in the fishery is a necessary step for promoting sustainable fishing practices.

## 2. Methods

The Institutional Analysis and Development Framework (IAD) [24] was used to help frame this research and identify relevant variables to explore. In this framework, three basic categories of

<sup>3</sup> Usually fiberglass boats less than 10m long, equipped with outboard motors.

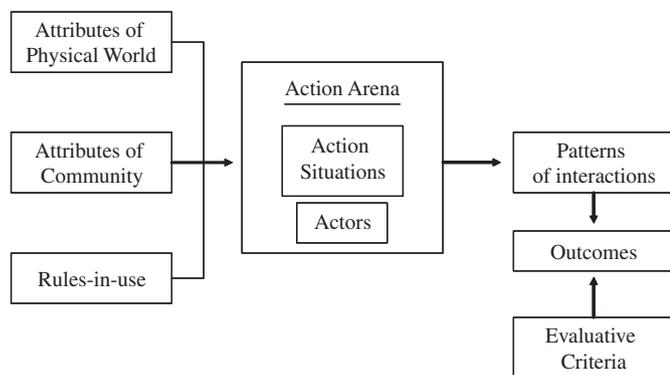


Fig. 2. A framework for institutional analysis [4].

variables are thought to influence the patterns of interaction among individuals in any given setting: (1) the rules used by participants to order their social interactions (i.e. local and government rules-in-use); (2) attributes of the biophysical world (i.e. resource characteristics); and (3) attributes of the community (i.e. socio-cultural attributes) [24] (Fig. 2).

Research in Bahía de Kino (Fig. 1) was conducted from April to August 2007, focusing on the small-scale fisheries sector of commercial divers. Information on the local performance of formal and informal rules regulating access and use was gathered through participant observation, examination of secondary sources, and semi-structured and structured interviews (including open and closed-ended questions) [25,26]. The first phase of the research was devoted to getting used to the setting, building trust and having informal and semi-structured talks with fishers, participating in a few fishing trips ( $n = 4$ ) and recording observations at the beach. During the final phase of the research, a structured interview was designed based on what was learned in previous months.

The structured interview was applied to fishers belonging to the major groups of divers in town that were active in 2007 (6 groups). Even though the selection of interviewees was not random due to lack of updated information on these groups' members, whenever possible the number of interviews was distributed among groups more or less in proportion to an estimate of the number of boats working for each group at the time interviews were performed. A total of 45 interviews were conducted (about 19% of the fishers believed to be directly involved in this activity).<sup>4</sup> Eighty nine percent of interviewees were panga captains (in charge of the boat) ( $n = 40$ ), of which 33 were also divers and the rest ( $n = 7$ ) were captains and divers' assistants (the person who assists the divers on board). One or two crew members from 40 pangas were interviewed, out of approximately 80 active pangas involved in commercial diving in town (COBI,<sup>5</sup> unpublished).

In addition to interviewing fishers, interviews were performed with a local authority and a local leader of the permit holders' sector to obtain information about issues of access to fishery resources within local fishing grounds. Secondary data were reviewed, including bylaws of cooperatives, official statistics on catch for the main target species of commercial divers, and

additional catch and effort data collected through a voluntary logbook program implemented by an interdisciplinary project on small-scale fisheries called PANGAS, taking place in the Northern Gulf of California (<http://pangas.arizona.edu>).

### 3. Bahía de Kino's fisheries: social and resource characteristics

Bahía de Kino is a rural coastal community of about 5000 inhabitants [27] situated in the state of Sonora, Mexico, where fishing is the most important human activity [28]. About 800 fishers and 200 active pangas are locally involved in small-scale fisheries (COBI, unpublished). A total of 66 species are harvested by these small-scale fishers, of which 35 are regarded as the primary targets of fishing trips (project PANGAS 2007, unpublished). Species extracted are an important source of marine products at the local and regional level. A number of these species are also internationally commercialized [15,29].

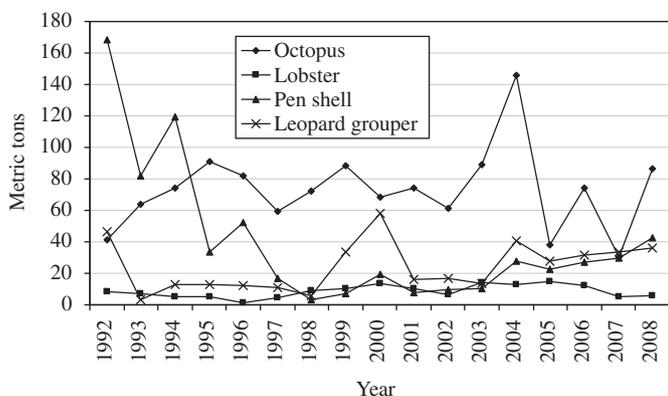
About 80 pangas are currently active in commercial diving in Bahía de Kino (COBI, unpublished), harvesting pen shells (mostly *Atrina tuberculosa*, and occasionally *Atrina Maura* and *Pinna rugosa*), octopus (*Octopus* spp.), lobsters (*Panulirus inflatus*), and fishes [mainly groupers (*Mycteroperca rosacea* and *M. jordani*) and snappers (*Hoplopagrus guentherii* and *Lutjanus novemfasciatus*)]. Sea cucumber (*Isostichopus fuscus*) is also an important diving fishery, though clandestine because no authorization to harvest this species has been granted in the area. Pangas are 8–9 m long, equipped with 55–115 hp outboard motors. To breathe underwater, divers use a 'hookah', which is fabricated locally using a modified paint sprayer as the air compressor, connected to a modified beer keg as the reserve air tank [30]. One or two 100 m hoses are attached to this tank with air regulators at the end. The diving crew may include the operator or 'popero' (who operates the boat), one or two divers, and a divers' assistant (who controls the air supply for the divers). However, 'poperos' usually act as divers' assistants too, to increase the economic efficiency of the fishing trip (earnings are divided among less people). One of these crew members is also the person in charge of the boat or captain, who is responsible for its maintenance and for responding to the owner<sup>6</sup> in case anything may happen to it. Fishers working in commercial diving may at times also work in other fishing activities, using gillnets (for fish and shrimp) or traps (for swimming crabs, *Callinectes* spp.). Nonetheless, based on fishers' declarations, diving is the primary source of income for 93% of the fishers interviewed and fishing (of any kind) is the only source of income for 71% of interviewees.

The state of fishery resources is not being evaluated by the federal government for any target species of commercial diving in Bahía de Kino. The only information available is landings statistics, and sometimes independent studies conducted by NGOs or other non-governmental institutions. Official historical landings in Bahía de Kino indicate a marked decrease in catches of pen shells from 1992 to 1998 (from 168 to 3 metric tons), with a tendency to a slight increase in recent years (Fig. 3). A slight increase in landing trends is also evidenced for leopard grouper and octopus in the last few years, though octopus catch has been quite variable over time (Fig. 3). Table 1 shows the average, maximum and minimum catch for octopus, lobster, pen shell and leopard grouper between 1992 and 2008. Nonetheless, official statistics should be interpreted with caution and may only be useful to show trends. Illegal fishing is likely high because of unreported catch, catch captured outside local port's jurisdiction

<sup>4</sup> The exact number of fishers involved in this activity is actually unknown. An estimation was used based on the number of pangas dedicated to commercial diving in town and the number of people generally involved in any diving trip ( $n = 3$ ), accounting for 240 people. However, because small-scale fishing is highly dynamic, actual number of fishers actively participating in fishing activities can vary greatly.

<sup>5</sup> A local NGO, Comunidad y Biodiversidad (COBI), [www.cobi.org.mx](http://www.cobi.org.mx).

<sup>6</sup> Usually when a crew member owns the fishing equipment, he or she is the person in charge. Otherwise, the captain is appointed by an owner external to the crew.



**Fig. 3.** Unpublished official landings (MT) for octopus, lobster, pen shell and leopard grouper declared at the regional office of CONAPESCA in Bahía de Kino. Weight of entire individuals for all species but pen shells (adductor muscle weight) is reported. Markers indicate where there is data. Lines do not imply real data. Courtesy: Personnel of the Regional Office of CONAPESCA in Bahía de Kino.

**Table 1**

Average, maximum and minimum catch (MT) for octopus, lobster, pen shell and leopard grouper between 1992 and 2008.

Species	Average annual catch (MT) (1992–2008)	Maximum annual catch (MT) (1992–2008)	Minimum annual catch (MT) (1992–2008)
Octopus: <i>Octopus</i> spp.	72.9	145.9	30.3
Pen shell: <i>Atrina</i> spp.	40.0	168.4	3.4
Lobster: <i>Panulirus inflatus</i>	8.6	14.9	1.5
Leopard grouper: <i>Mycteroperca rosacea</i>	24.2	58.2	3.5

Weight of entire individuals for all species but pen shells (adductor muscle weight) is reported. Source: regional office of CONAPESCA in Bahía de Kino.

that is declared as if it was captured inside (i.e. in another state's jurisdiction), and misidentification of species, among other factors. In Sonora, estimations by the Navy in 2006 suggested that half of the small-scale boats fishing in state waters were illegal (4000 boats officially registered and about 8000 actually fishing) (newspaper El Imparcial, August 2006).

For one of the species of interest, Moreno et al. [31] provided the first reliable estimation on the condition of pen shell populations in the fishing grounds of Bahía de Kino. These authors found densities of less than 5 individuals per 300 m<sup>2</sup> in most fishing grounds, suggesting severe overfishing. Also, additional catch and effort data collected through a logbook program indicates lower average annual catch per unit effort (CPUE) for the 2007 pen shell fishing season in an important fishing ground for Bahía de Kino's divers (1.1 kg of adductor muscle/hour diving<sup>7</sup>) compared with neighboring fishing grounds [2 kg of adductor muscle/hour diving<sup>8</sup> inside the Infiernillo Channel (Fig. 1); and 7.3 kg/h diving<sup>9</sup> in a fishing bed in the southern state of Sinaloa] (project PANGAS, logbook program, <http://pangas.arizona.edu>).

#### 4. The formal institutional setting for fisheries in Mexico and Bahía de Kino

Fisheries administration in Mexico has been traditionally centralized [32]. Nonetheless, a new fisheries Law was enacted

in October of 2007, the 'Ley General de Pesca y Acuicultura Sustentables', introducing decentralization<sup>10</sup> as one of its primary goals (see [www.conapesca.sagarpa.gob.mx](http://www.conapesca.sagarpa.gob.mx)). Hereafter, the formal institutional setting in place at the time this study was conducted (before the new law was enacted) will be described. In addition, the changes as they appear in the new law, when there was any, will be also described.

Fisheries regulation in Mexico is shared by two federal agencies, the Secretary of Fisheries and Agriculture (SAGARPA), and the Secretary of the Environment and Natural Resources (SEMARNAT) (Fig. 4). SAGARPA, via its National Fisheries Commission (CONAPESCA), is the primary agency in charge of fisheries regulation, issuing licenses in the form of fishing permits, authorizations or concessions (Fig. 4). CONAPESCA is also in charge of enforcing regulations related to fishery resources that fall under SAGARPA's jurisdiction. SEMARNAT, on the other hand, regulates the use of species listed 'under special protection',<sup>11</sup> and, in the case of benthic resources listed in this category (i.e. sea cucumber, rock scallop *Spondylus* spp.) may authorize their harvest through a species-specific permit<sup>12</sup> that grants exclusive use rights within a specified polygon following the guidelines of a management plan. SEMARNAT is also in charge of the establishment and management of marine protected areas throughout Mexico via the National Commission of Natural Protected Areas (CONANP). PROFEPA, the Federal Agency for the Protection of the Environment, is SEMARNAT's enforcement body (Fig. 4). The Navy is also entitled to provide enforcement support to both CONAPESCA and PROFEPA if needed.

Throughout Mexico, fishing permits (granted by CONAPESCA) are the most widely used management tool to regulate access to marine resources. To date, fishing concessions have been granted only for a few benthic resources of high commercial value (i.e. abalone, lobster) on the west coast of Baja California Peninsula and the Caribbean Sea [20].

Fishing permits may be granted to any corporate entity (typically a cooperative) or individual for 4 years or less (2–5 years in the new law), and they are renewable upon compliance with regulations. The core requirements to access fishing permits include (a) presenting personal documentation, (b) specifying the species, fishing area, landing port, and duration of the right to be solicited, (c) specifying and certifying technical information of boat(s), motor(s) and fishing gear(s) as registered in the Secretariat of Communication and Transportation (d) certifying the legal possession of boat(s), motor(s) and fishing gear(s), (e) certifying the legal constitution and membership of corporate entities, (f) certifying inscription at the Federal Taxpayers' Registry (Secretariat of Economy), and (g) paying the required fees.<sup>13</sup>

The permit specifies the particular species (i.e. octopus permit, lobster permit) or group of species<sup>14</sup> to be harvested within a

<sup>10</sup> This law establishes that states and municipalities will have participation in decision making through the creation of State Fisheries Laws and State Fisheries and Aquaculture Councils.

<sup>11</sup> Species included in the norm NOM-059-ECOL-1994 and subsequent modifications.

<sup>12</sup> Called 'Predios Federales Sujetos a Manejo para la Conservación y Aprovechamiento Sustentable de Vida Silvestre' (Federal Polygons for the Conservation and Sustainable Use of Wildlife). This tool and CONAPESCA's fishing concessions provide exclusive use-rights over one species within a specified area. This implies that other fishers may access the same area to harvest other species.

<sup>13</sup> The processing fee for a fishing permit was about US\$50 in 2008 (Ley Federal de Derechos, Art 191A, inciso IIa), but the actual cost of the permit varies according to the species (i.e. permits for abalone, lobster or species included in the category 'almejas' (clams) range between US\$150 and 400 each, SAGARPA's personnel, personal communication).

<sup>14</sup> Some permits are issued for several species under a generic category, i.e. the escama (fish with scales) permit allows fishing about 200 species of fish, or the shark permit which includes several species of elasmobranchs.

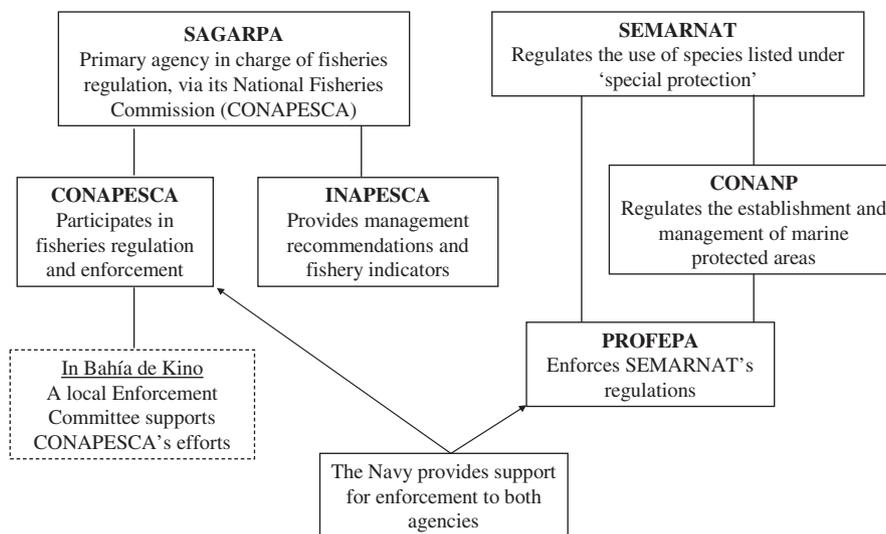


Fig. 4. Federal agencies involved in fisheries regulation in Mexico and their main attributes as they relate to fisheries management.

broadly specified region [20]. Each fishing permit specifies the number of boats (referred as 'número de espacios') that are permitted for use to harvest the species authorized in the permit, together with technical specifications of the fishing equipment(s) (boat, motor and fishing gear). Even though the number of permits to be issued per species or group of species is not formally fixed (as in limited entry systems), the tendency has been to restrict or put on hold the allocation of new permits in most small-scale fisheries in the GC because of stock decline or lack of information on the status of populations. However, there is no restriction on the number of permits each corporate entity or individual can hold, besides the cited restrictions on the allocation of new permits. Also, a boat that belongs to a permit holder can be registered in more than one permit. That is, the same boat can be entitled to fish several species, depending on the amount of permits registered to a specific boat.

When this study was conducted, fishing permits were transferable from person to person with authorities' supervision (under the new law, an existing permit has to be first rescinded by its holder or removed,<sup>15</sup> and authorities decide who to allocate it to).

Fishing permits provide a number of benefits to their holders. Permit holders are the only ones who can legally land the catch and declare it at a Regional Office of CONAPESCA [20]. They are also the only ones who can provide legal invoices (or 'facturas') for the catch. These invoices certify legal ownership of the harvest, and are necessary to sell and transport the catch to regional or international markets. Note that permit holders are only allowed to harvest and sell resources that have been caught using the fishing equipment(s) (boat, motor and fishing gear) registered in their permits. Since permit holders are the only ones who can issue legal invoices necessary to commercialize the catch, they might be tempted to buy and sell resources caught with boats other than the ones registered in the permits. This practice is locally called 'amparo' (sheltering catch from other sources using one's permit) and is prohibited by law. Nevertheless, as it will be later shown, it is widely practiced.

Table 2 shows the permit holders that have declared catch in 2007 (active permits) for each of the four main target species of

commercial divers at the regional office of CONAPESCA in Bahía de Kino, together with the number of boats allowed to operate per permit and species, and the spatial jurisdiction of each permit (see Fig. 1 for geographical reference). Note that the total number of permits (19) exceeds the total number of permit holders (12) since one person or corporate entity can hold several permits. Also, since the same boat may be entitled to fish several species depending on the number of permits allotted to each boat, the total number of boats allowed to operate (50) does not match the sum of subtotals for the four species analyzed (97). In addition, the spatial jurisdiction of permits for the same and different species tend to overlap with one another.

On the other hand, specific regulations for resource use are defined within 'Normas Oficiales Mexicanas' (norms) published in the Federal Registry. Closures (temporal or permanent) and gear or size restrictions are the most common management measures in the existing norms. Generally there are no quota limits. In addition to fishery norms, the National Institute of Fisheries (INAPESCA), the scientific 'backbone' of CONAPESCA, develops the 'Carta Nacional Pesquera' (CNP) (National Fisheries Chart), which summarizes the status, management recommendations and indicators for all Mexican fishery resources. Table 3 shows the norms that apply to the target species of commercial divers in Bahía de Kino (also applicable to the entire Gulf of California and other regions within Mexico) and the main recommendations as they appear in the CNP for the same species. Note that there is an absence of legally binding norms and knowledge of these species' population status for most of these species.

It should also be noted that the use of marine protected areas has only recently been implemented in the Bahía de Kino region. Isla San Pedro Mártir is an important fishing destination, especially for commercial divers, and in 2002, a large area surrounding this island was designated as a Biosphere Reserve [16]. Even though the area involved constitutes a small portion of local divers' fishing grounds, this is a new fisheries management strategy for this region and studies are currently underway to monitor its effectiveness in promoting sustainable populations of marine organisms targeted by small-scale fishers [16].

These regulations (access and resource-use rules) are enforced by the federal agencies cited above (Fig. 4). In Bahía de Kino, two officials from CONAPESCA are in charge of monitoring and enforcing regulations concerning fishing permits and resource-use

<sup>15</sup> A permit can be removed if the holder does not comply with regulations, i.e. if he or she does not initiate fishing activities when expected, suspends fishing for over 90 days without justified cause, or does not provide the required information.

**Table 2**  
Permit holders that showed catch declarations in 2007 (active permits) at the regional office of CONAPESCA in Bahía de Kino for four main target species of commercial divers, and features of each fishing permit.

Species	Fishing permits	Permit holders	Geographic jurisdiction	Number of authorized boats	Declared catch 07 (MT)	Average annual catch per boat (declared catch/number of authorized boats) (MT)	Average annual catch per boat (logbooks) (MT)	Ratio average annual catch per boat (declared/logbooks)
Octopus	1	CPH 1	El Sahuímaro–Las Cuevitas	5	4.1	0.8	–	–
	1	CPH 2	El Colorado–Puerto Libertad	12	5.4	0.4		
	1	CPH 3	El Colorado–Puerto Libertad	8	1.3	0.2		
	1	IPH 1	El Sahuímaro–San Esteban	3	6.5	2.2		
	1	IPH 2	Bahía de Kino–Las Cuevitas	2	7.9	3.9		
	1	IPH 3	El Choyudo–Puerto Libertad	2	2.6	1.3		
	1	IPH 4	El Colorado–Puerto Libertad	6	0.3	0.1		
Subtotal	7			38	28.1			
Pen shell	1	CPH 2	El Colorado–Puerto Libertad	12	2.0	0.2	0.28	0.6
	1	CPH 4	Estero Santa Cruz	4	9.0	2.3	0.28	8.0
	1	CPH 5	Puerto Libertad–Tastiota	3	4.6	1.5	0.28	5.5
	1	IPH 1	El Sahuímaro–San Esteban	7	8.2	1.2	0.28	4.2
	1	IPH 5	Cerro Prieto–El Colorado	5	6.8	1.4	0.28	4.9
Subtotal	5			31	30.6			
Lobster	1	CPH 1	El Sahuímaro–Las Cuevitas	5	4.4	0.9	–	–
	1	IPH 3	El Choyudo–Puerto Libertad	2	0.5	0.2		
	1	IPH 6	Segundo Cerro Prieto	3	1.5	0.5		
Subtotal	3			10	6.4			
Escama permit <sup>a</sup>	1	CPH 1	El Sahuímaro–Las Cuevitas	5	14.8	3.0	–	–
	1	CPH 3	El Colorado–Puerto Libertad	8	1.1	0.1		
	1	IPH 1	El Sahuímaro–San Esteban	3	0.4	0.1		
	1	IPH 2	Bahía de Kino–Las Cuevitas	2	10.9	5.4		
Subtotal	4			18	27.2			
Total	19	12						

Weight of entire individuals (eviscerated) for all species but pen shells (adductor muscle weight) is reported. Logbook data is used for comparison with official landings. The average annual catch per boat estimated from logbooks was 0.28 MT, for which 5 logbooks were used. CPH: corporate permit holder (i.e. a fishing cooperative or other form of association) and IPH: individual permit holder.

<sup>a</sup> Only includes escama permits that were used for leopard grouper caught through diving.

**Table 3**  
Management recommendations as they appear in the National Fisheries Chart for the main target species of commercial divers in Bahía de Kino and fishery norms regulating the harvest of these species.

Species	CNP management recommendations	Existing regulations by species
Sea cucumber <i>Iostichopus fuscus</i>	Population status in Sonora, undetermined. There are no recommendations for Sonoran sea cucumber populations. SEMARNAT may authorize use. No authorization for exploitation has been granted in Sonora	NOM-059-ECOL-1994  Enforced by PROFEPA and the Navy Permanent closure throughout México
Rock scallop <i>Spondylus calcifer</i>	Lumped with other 15 species under the category 'almejas' (clams). Population status in Sonora, undetermined. There are no recommendations for Sonoran rock scallop populations. SEMARNAT may authorize use. Only one authorization has been granted in Sonora, though not in Bahía de Kino	NOM-059-ECOL-1994 (see above)
Lobster <i>Panulirus inflatus</i>	Population status in Sonora, undetermined. A gradual increase in fishing effort may be allowed if supported by technical studies. Recommends assessing the resource in Sonora and other states, and regularizing the use of commercial diving. This fishing gear is used in the Gulf of California, even though it is prohibited for lobster	NOM-006-PESC-1993  Enforced by CONAPESCA and the Navy Applies to Federal jurisdiction of Gulf of México and the Caribbean Sea, Pacific Ocean including Gulf of California (GC) Gear restrictions: traps, unless other gear is authorized by SAGARPA Size restrictions: 82.5 mm (cephalothorax length) No breeding females Land entire specimen to enable control Temporary closure (GC): July 1st to October 30th
Groupers, <i>Mycteroperca</i> spp. and Snappers, <i>Hoplosternus guentherii</i>	Lumped with other 200 species under the category 'peces marinos de escama' (marine fishes with scales). Commercial diving does not appear in the list of fishing gear used to capture these species. Population status in Sonora, undetermined. General recommendations include not increasing fishing effort in any of the species within the category, and modifying current categorization to allow administration by groups of related species (smaller groups)	None

Table 3 (continued)

Species	CNP management recommendations	Existing regulations by species
Pen shell <i>Atrina</i> spp.	Lumped with other 15 species under the category 'almejas' (clams). Recommends not increasing fishing effort in Sonora and other states, and implementing the use of quotas in Sonora and Sinaloa	None
Black murex snail <i>Hexaplex nigritus</i>	Population status in Sonora, undetermined. Recommends assessing the resource in Sonora every 2 years. General recommendations include not increasing fishing effort in any of the states where it is fished, and implementing reproductive closures	None
Octopus <i>Octopus</i> spp.	Under a general category 'pulpo' (octopus) including identified and unidentified species captured in Mexico. Population status in Sonora, undetermined. Recommends taking measures in Sonora if catches are lower than 100 MT. General recommendations for all octopus species include not increasing fishing effort, and reinforcing biological and fisheries studies to better regulate these fisheries	None

norms under CONAPESCA's jurisdiction. The area they oversee spans over 200 km of coastline (from Puerto Libertad to Estero Tastiota; Fig. 1), and inspections are usually performed by land. There is no permanent presence of PROFEPA (in charge of enforcing regulations concerning MPAs and species under special protection) in town. However PROFEPA's officials may arrive upon demand by members of the community, the Navy, or CONAPESCA's officials. The navy provides support for enforcement to both agencies at sea, when solicited. Resources and personnel are often in short supply, and officials are frequently unable to cover the entire area in a timely and effective manner. Also, CONAPESCA's available resources and control efforts are often invested on species subject to official norms and with the most economic importance to the federal government like shrimp. Since CONAPESCA's officials are federal agents, from time to time they are required to provide support to other communities where additional help is needed, leaving local fishing grounds without enforcement. CONAPESCA's efforts are supported locally by a committee comprised of local permit holders, the 'Comité de Inspección y Vigilancia de Bahía de Kino' or CIV (Local Enforcement Committee). Its goal is to provide support to help prevent illegal fishing in any fishery taking place in local fishing grounds (Fig. 4). However, as it will be later discussed, the performance of this committee is rather controversial.

## 5. De facto institutional setting in Bahía de Kino

In the following section, a description on how the formal institutions described above perform in practice in Bahía de Kino will be provided, particularly concerning the performance of the permit system and local cooperatives as it relates to issues of access control and enforcement.

### 5.1. Buyers as right holders and fishers with no rights

Generally, in Bahía de Kino marine resources targeted by commercial divers are captured by fishers who do not own a fishing permit and do not belong (as members), to any cooperative holding permits. These fishers are locally called 'pescadores libres' or independent fishers and they are the labor force of the permit holders (individual or corporate). They possess the fishing expertise and experience, and gain legal access to resources by entering into a working relationship with the holder of a permit. In this study, 82% of respondents were independent fishers, none was an individual permit holder, and 18% were members of cooperatives holding fishing permits. In reality, most permit holders are the buyers of the product. It should also be noted that

most<sup>16</sup> of the local corporate permit holders (principally cooperatives) that were active in 2007 (Table 2) function in practice as individual permit holders (locally referred as 'permisionarios'). Cooperatives are usually constituted by a mixture of family members, others not related to the fishing activity, and a few fishers that were requested to sign at the time the cooperatives were formed. However, in practice, these 'cooperatives' are seldom 'cooperatively managed'. Generally, only one person administers the business and concentrates most of the power.

The disparate social structure of local diving fisheries is somehow reinforced by existing requirements to obtain fishing permits and the socio-economic context in which these fisheries take place. Generally, the people who directly harvest marine resources in the Gulf of California, as is generally the case worldwide, have low educational and economic backgrounds, with few or no chances to access alternative, highly remunerated, and less risky, jobs. It is estimated that only 25% of the population in the state of Sonora between 15 and 130<sup>17</sup> years of age has reached an educational level higher than the third year of middle school [27]. Obtaining fishing permits requires possession and certification of ownership of fishing equipments and conducting exhaustive and time consuming paperwork, requisites that are difficult to accomplish by fulltime fishers who often lack the time, the capacity, or the means to compete with people who are more prepared, influential, and economically well positioned. There is also the issue of people needing to bribe officials to obtain permits (or to avoid being punished for not having permits), as has been pointed out in previous works [33]. In addition, since there are no restrictions on the number of boats that can be registered as users of a fishing permit, it is common that people requesting fishing permits do so for several boats. Given this, individual permit holders or corporate permit holders whose members are not fishers, necessarily have to 'hire' fishers (without contract and social provisions such as pension or insurance) to put their equipments to work. Permit holders tend to distance themselves physically from the fishing activity and become businessmen.

Although the formal system does not allow ownership of fishing equipments (boat, motor, and fishing gear), by others than permit holders, 24% of interviewees declared that they own the fishing equipment with which they worked, 47% said it was permit holder's ownership, and 29% were in the process of buying

<sup>16</sup> The only exception at the time this study was conducted was a cooperative entirely integrated and managed by fishers (not buyers). However, they had major administrative problems. We interviewed 5 out of 12 members from this group.

<sup>17</sup> The Instituto Nacional de Estadística y Geografía (INEGI) (National Institute of Statistics and Geography) uses 130 years of age as the highest age value in statistical reports.

equipment from permit holders. This practice, where permit holders encourage fishers to buy their own equipment with their help, is becoming increasingly common as a way for permit holders to get rid of equipment maintenance responsibilities. The fishing equipment is bought by the permit holder, and the fisher starts paying for the equipment with each fishing trip, using the portion of the earnings that is retained by the boat owner for equipment repairs (1/4 of net earnings if three crew members went fishing). This practice tends to increase fishers' dependency on permit holders because as long as the fisher is in debt with the permit holder, the fisher is obliged to sell the product to the permit holder at the price he chooses. This process of fishers buying equipment from permit holders who also buy the fishing products may take years to complete. Once fishers own the equipment, they could choose to sell their product to other buyers. However, since these fishers do not hold fishing permits associated with their boat, this action would still be illegal unless they secure a fishing permit under their name.

Regardless of who owns the fishing equipment, permit holders almost always provide in advance the funds to cover the costs of the fishing trips (for gas, food, ice). This also obliges fishers to sell the product to the permit holder that provides these funds. Ninety one percent of interviewees rely on permit holders or independent buyers (with no fishing permits) to cover the cost of fishing trips, while only 9% cover these costs on their own. These fishers also rely on permit holders or independent buyers to loan them funds for other personal expenditures. Although at times a personal and respectful bond is formed between both parties, fishers are usually in debt to these permit holders.

## 5.2. De facto open-access in the presence of regulatory tools

### 5.2.1. Fishing permits are used to launder illegal harvest

As suggested by our observations in the field and previous works [15,20] the on-the-ground performance of current fisheries tools has been clearly ineffective in Bahía de Kino. Implementation and enforcement of current rules is also difficult in practice given the characteristics of the fleet and the coastal environment. Illegal practices as defined in legislation are known to be locally widespread. These practices may include (a) using one's permits to sell resources caught with fishing equipments other than the ones registered in the permits, known locally as 'amparar' or to shelter illegal catch, (b) buying or selling invoices<sup>18</sup> ('facturas') to legitimize the commercialization of products caught without a permit, (c) not complying with the species that each boat is allowed to capture, (d) unreported catch by permit holders or illegal fishing by people not holding any permission to fish in the area, (e) the use of fishing equipments not owned by the permit holder (i.e. usually the boat's name as registered in the permit is painted over the original one), and (f) the use of altered invoices to shelter catch harvested during closures.

One of the most widely prevalent illegal practices throughout the region is sheltering illegal catch under someone else's permit or 'amparo' (point (a) above) [15,20]. This practice is relatively easy to perform and hard to detect in part because there are no quota limits associated with permits. Since permit holders are the only ones who can provide legal invoices for the product extracted directly from sea,<sup>19</sup> they are generally perceived in the community

as buyers simply because that is what they generally do, they buy product from people willing to sell their catch to them, and 'legitimize' this catch under their permits. To illustrate this, the average annual catch of pen shells (the species for which there was the most data) per boat declared in 2007 by permit holder (official data) was compared with the average annual catch per boat using logbook data for the same year (Table 2). Five logbooks were used, 2 from Bahía de Kino's fishers (fishing grounds surrounding Bahía de Kino) and 3 from Punta Chueca's fishers (fishing grounds inside the Infiernillo Channel) (Fig. 1). Punta Chueca was included because often the catch from the Infiernillo Channel is sold to permit holders or independent buyers from Bahía de Kino and declared (at least part of it) at the local office of CONAPESCA. Results show that one corporate permit holder (#4) has apparently fished (and declared) as much as 8 times more pen shells per authorized boat than the average annual catch per boat as estimated from logbooks (Table 2). This excess catch might potentially come from boats not registered in his permits or from outside the jurisdiction of Bahía de Kino's or Punta Chueca's fishing grounds. Although declaring a high amount of catch implies that permit holders would have to pay more taxes, the amount they get by selling so much product would counteract this cost.

### 5.2.2. Invasions of pangas in other communities' jurisdictions: what role for right holders and fishers?

Illegal access to other permit holders' jurisdictions is also common in the Gulf of California and triggers disputes between stakeholders from different fishing communities. In Bahía de Kino, access to local fishing grounds by outsider pangas is a major source of internal conflict, involving local fishers (independent or in cooperatives), permit holders and authorities. The 'invasión de pangas de fuera' (invasion of outsider pangas), as local fishers refer to it, takes place almost every year during the fishing season of the most valuable and/or abundant resources in Bahía de Kino's fishing grounds. These pangas usually arrive from fishing communities within the state, south of Bahía de Kino (i.e. Guaymas, Fig. 1), and from southern states (mainly Sinaloa and Nayarit). Most of the invasions take place during the fishing season for fish species (mostly Sierra, *Scomberomorus* spp.; rays and sharks) and shrimp (blue shrimp, *Litopenaeus stylirostris*). However, outsider pangas may also invade local territory during the fishing seasons for benthic species like pen shell, lobster, and octopus. The number of outsider pangas arriving to town varies. The last intrusion involved about 150 pangas from Sinaloa (Sierra fishing season 2007; source: newspaper El Imparcial; March 10, 2007). According to local fishers this number may escalate to about 500 pangas during the shrimp season (as of last invasion in 2006).

In Bahía de Kino, local fishers and some permit holders react to these intrusions organizing protests (locally referred to as 'grillas') at the Regional Office of CONAPESCA or blocking the main and only paved road to town with their pangas. It should be noted that people not directly depending on the affected fisheries (villagers in general, friends and family members of fishers and permit holders) frequently participate in these 'grillas', fearing that outsider fishers may settle and begin working in other resources too. Outsiders would be competing with local fishers of any kind, thus threatening everyone's livelihoods.

Some local permit holders are involved in these intrusions, bringing the outsider pangas to work for them with the understanding that they sell their product only to them. This arrangement can offer the newcomers 'legal' protection under the fishing permits of local permit holders. However, if these pangas arrive from outside, they are not the same pangas registered in local

<sup>18</sup> Usually in exchange for a monetary compensation per kg of product sheltered in each invoice.

<sup>19</sup> Buyers without a fishing permit are allowed to buy product from permit holders, or from other buyers without a fishing permit and resell it. However, they have to carry on with them a document that certifies the legal possession of the catch, which specifies the fishing permit under which the product in question was harvested.

permit holders' permits. Even if the outsider pangas would bring a permit that allows them to fish in the area of Bahía de Kino (which is the case of many escama (fish with scales) permits), these fishers usually sell the product to local permit holders and not to the owner of the permit they are bringing with them.

These intrusions can also generate conflicts between permit holders. While some permit holders may participate in bringing in outsider pangas to work for them, other permit holders see invasions as a threat to their own business and may join local fishers in protest. Permit holders compete for fishing products and for fishers willing to sell these products to them.

Access conflicts are mediated by CONAPESCA's officials and a local committee integrated by local permit holders, 'Comité de Inspección y Vigilancia de Bahía de Kino' or CIV (Local Enforcement Committee). This committee was formed in 2004 to provide support to local authorities in preventing intrusions of outsider pangas and reducing illegal fishing. Its members are to provide support for surveillance activities, supplying gas, vehicles and/or pangas for officials to make the rounds, and informing authorities about illegal activities when detected. However, this committee is in some way controversial since it is integrated by the only legal actors in the fishery, local permit holders, some of whom are locally known to participate in promoting the intrusion of outsider pangas in town. In addition, because independent fishers are not allowed to participate in this committee, its actions are generally perceived as illegitimate by these fishers. This reduces the transparency of the process and makes fishers believe that access conflicts are 'negotiated' between permit holders and authorities, decreasing the credibility of local authorities as law enforcers.

Access conflicts are certainly not limited to Bahía de Kino [34]. Bahía de Kino's fishers also move to other communities to harvest resources when these are scarce or less convenient in local fishing grounds. Local divers usually move south of Bahía de Kino (Guaymas in Sonora, Nayarit, and Sinaloa), or west, crossing the gulf to fish in islands and along the coast of the Baja California Peninsula. One of these movements took place in the summer of 2007 (while this study was taking place), when divers from Bahía de Kino moved to Guaymas (Sonora) and other southern states (Sinaloa and Nayarit) to harvest pen shells after large beds of this species were found (productions of 80–150 kg/panga/day, compared to 15–20 kg/panga/day in Bahía de Kino's fishing grounds; summer 2007).

In contrast to movements of pangas promoted by permit holders, Bahía de Kino's fishers tend to tolerate the movement of individual fishers (without pangas) between fishing communities. Local fishers are in general willing to accept people from outside the community if these fishers work with local pangas. Likewise, local fishers have more chances to be accepted in other communities (i.e. in Guaymas) if they move without their panga and work in a panga from the village they are visiting. In these movements, divers are allowed to carry their fishing gear (compressor, hose, diving suit) and crew with them. They have to prearrange this movement with fishers or permit holders from the village they are heading to and use the pangas and fishing permits (when they exist) of the locals. This informal agreement matches the formal legislation concerning access rights as granted by fishing permits (people can move from panga to panga, but pangas must be used within a jurisdiction as specified in the permits).

However, these tacit arrangements are often relaxed if fishers have family bonds or close friendship with people in other villages, in which case they are allowed to take their pangas with them. Furthermore, regardless of fishers' discontent, movements of pangas to other communities' jurisdictions with no previous arrangements with locals are frequent in the Gulf of

California region, particularly due to the absence of strong official control.

## 6. Is sustainability achievable under current institutions?

To a large extent, the informal world of independent fishers is not visible to the federal government which only recognizes permit holders as the sole legal actors in the fishery. Independent fishers are perceived as illegal actors by authorities and even by permit holders themselves (who depend on fishers' labor to make their living). This lack of recognition of the people who actually perform fishing activities results in exclusion of these fishers from formal decision-making processes concerning their fisheries. These fishers are also unable to access government benefits. In addition, since the permit holders who have access to regulatory agencies have little direct involvement with the harvested resources, a great deal of fishers' knowledge useful for management never reaches government agencies. Furthermore, the co-existence of unrecognized fishers and permit holders that are often powerful businessmen, gives way to the development of incentives that discourage responsible fishing practices.

As a result, Bahía de Kino's situation resembles a de facto open-access. Interviewees expressed almost unanimously that, in spite of perceiving that local resources are severely overfished, they believe that anything left unexploited will be captured by others and this inevitably leads to overharvest. Also, because species that can be legally extracted have already become scarcer and are found at farther distances than before, banned resources (mainly sea cucumber) that command a high black market price are often harvested in conjunction with legal species to help the costs of fishing trips.<sup>20</sup>

## 7. Discussion

This paper illustrates the effect of institutions on social interactions and harvesting behavior in an important commercial diving fishery of the Gulf of California. Although only one fishing community was the focus of this study, this particular case provides lessons that go beyond its boundaries, illustrating the potential impacts of some of the most widely used fishery management tools throughout Mexico. However, this does not imply that the outcomes observed in Bahía de Kino's commercial diving fishery are representative of the condition of small-scale fisheries throughout the Gulf of California or anywhere else in Mexico.

Existing requirements to access fishing permits create an institutional environment in which people who are not necessarily closely attached to the fishing activity and/or community decide to enter the fishery for business purposes. Often, full time fishers do not have the means, the capacity, and/or the time to fulfill the requirements and successfully navigate through the bureaucracy in order to access a fishing permit. This sets a standard that is too high for direct users (fishers) to become formally involved in the fishery. Even if direct users get to access fishing permits, since there are no requirements forcing them to continue fishing, they tend to become intermediaries as a matter of convenience because to do so is more profitable and less risky than fishing. This has been the case of some of current buyers (also right holders) in Bahía de Kino who were previously fishers.

<sup>20</sup> About 30 kg of dried sea cucumber (obtained from about 150 kg of fresh, eviscerated, sea cucumber) sold at about US\$10/kg as of summer 2007 are needed to afford the cost of one fishing trip for one panga involving 3–4 days of camping (local diver, personal communication).

In addition, because several boats can be registered as part of a fishing permit, it is common that people requesting fishing permits do so for several boats, creating the need for additional people to operate these boats.

As a result, the system tends to promote the disconnection of right holders from the resource and intensify rent-seeking interests. Resources and markets tend to be monopolized in a few hands, and an informal system of production is created. This informal labor system is practically invisible to the federal government, resulting in the exclusion of most fishers (usually more closely attached to the resources and with the most at stake if resources are overfished) from management decisions concerning the fishery. This social structure creates the wrong incentives for effective fisheries management. With permit holders as intermediaries, they have little incentives to encourage fishers to catch less since the more they can sell the more they would earn. Because permit holders are the only ones who can provide legal invoices for the product extracted directly from sea, they are constantly tempted to shelter marine resources from boats not registered in their permits. This is somehow facilitated by the absence of additional restrictions associated to the permit system. The regulatory system for fisheries in Mexico is meant to limit access to the fishery by controlling the number of fishing permits to be issued. However, fishing effort or catch is not generally limited<sup>21</sup> and permit holders are allowed to harvest as much as they can handle using the pangas authorized in their permits. Under these conditions, while controlling the legal possession of fishing permits could be substantially improved with greater support from the government, verifying that the catch declared and processed by permit holders was harvested using only the authorized equipments is nearly impossible. While the number of fishing permits is what any administration intuitively would try to reduce to overcome resource depletion, this alone will not ensure that fishing effort and catches will be in fact reduced. Just by focusing on controlling the legal possession of fishing permits will not result in sustainable harvests. Furthermore, if fishers do not possess a legal right to fish, they will also not have incentives to pursue the common good or to limit fishing, even if perceiving that resources are increasingly scarce.

Independent fishers have the option to associate themselves into cooperatives or other forms of associations and thereby share the costs of access to fishing permits. However, this path is difficult to pursue by fishers alone without external economic and administrative support. Furthermore, the experience with fishing cooperatives in several places in the Gulf of California, like the ones from Bahía de Kino, has been generally disappointing (for a historical perspective on the cooperative system see [35,36]). In a study conducted in 2005 in 17 fishing communities in the Northern Gulf of California most fishers (63%) stated a preference for working as part of a group or cooperative rather than working as an independent fisher (34%) [37]. However, the most common incentive for fishers to access cooperatives was accessing fishing permits, reaffirming the point that obtaining permits as independent fishers is a difficult task. Nonetheless, this incentive is generally too weak to foster cooperation or collective action, not to mention sustainable harvests. Generally, fishing permits granted to individuals or cooperatives allow access to a large territory, not exclusive to one permit holder (there are overlapping jurisdictions). Since this territory is large and is shared with numerous fishers belonging to different fishing groups and even

<sup>21</sup> Unless the species is under a fishing concession or SEMARNAT's permit, for which a quota and management plan must be approved; or subject to a norm that limits the fishing effort or the type of gear to be used. These cases are uncommon in most commercial fisheries in the Gulf of California, except for species of high revenue to the nation.

communities, there is little incentive for responsible use and little possibilities to exercise control. In a large territory with an indeterminate number of users, fishers do not have the need or the incentive to work collectively, craft their own rules, or comply with externally established rules.

The existence of inappropriate incentives for sustainable management has been identified as one of the six<sup>22</sup> major causes for unsustainable fisheries around the world [5]. Fisheries failures are believed to be largely the product of institutional failures [38], the sum of the legal, social, economic and political arrangements used to manage fisheries which are directly linked to incentives [2,7,39–41]. Unfortunately, the case illustrated in this study presents many of the major characteristics associated with poor institutional performance worldwide [5]; like lack of incentives to comply with regulations; inefficient enforcement; lack of well defined rights; no incentives for cooperative behavior; poor involvement of major stakeholders in the elaboration of management instruments, decision making and implementation; and insufficient financial and human resources as well as information for proper management.

In this context, the need for a careful reexamination of current policies is suggested, particularly concerning the permit system and its potential consequences not only for Bahía de Kino but elsewhere in Mexico. In reexamining the system, considering alternative management approaches that tend to eliminate 'the race for fish' and provide incentives for fishery stakeholders to participate in management decisions and increase compliance with regulations is recommended [42,43]. These approaches entail vesting exclusive use or property rights on the users of resources [2,42–44] and may include rights to shares of fisheries in terms of areas (i.e. territorial use-rights in fisheries or TURFs,<sup>23</sup> marine protected areas<sup>24</sup> or MPAs), effort units (i.e. allowing the use of certain types of fishing gear) or catch [i.e. individual transferable or non-transferable quotas (ITQs or IQs)], granted to individuals, groups of individuals or communities [5,8]. However, we should be cautious that right-based approaches might also be subject to incentives' distortion if, for example, the rights' system tends to exacerbate wealth inequality and social division as has been the case in a number of ITQ systems (absentee quota owners, and contract harvesters with significantly less benefits than quota owners) [45–47]. Granting secure rights to resources to those actively involved in the fishery seems to be a necessary step for promoting sustainable-use.

In the fisheries addressed, the sedentary life-history characteristics of invertebrates and the nature of the fishing process<sup>25</sup> calls for management measures that explicitly acknowledge spatial structure [8,48]. These may include reproductive refugia and MPAs<sup>26</sup> (not only restricted to no-take zones) specifically designed to enhance fisheries (considering density-dependent and larvae advection-retention processes), territorial property or use rights

<sup>22</sup> Together with high demand for limited resources, poverty and lack of alternatives, complexity and inadequate knowledge, lack of governance, and interactions of the fishery sector with other sectors and the environment.

<sup>23</sup> This right may involve the use of the surface, the bottom, or the entire water column [43].

<sup>24</sup> Marine Protected Area (MPA) is often used as an umbrella term covering a wide range of marine areas with some level of restriction to protect living, non-living, cultural, and/or historic resources. The permissions given within an MPA often depend on the objectives.

<sup>25</sup> In spatially structured fisheries, time series of catch, effort, and composition of the catch are rarely available, and even if they are, they may be dangerously misleading because of the interaction between the spatial pattern of a stock and fishers' behavior (i.e. abundance tends to drop faster than CPUE as the stock is depleted) [47].

<sup>26</sup> Refugia and MPAs are recommended for fisheries that combine complex spatial structure, little available information, and enforcement difficulties [47].

(traditional tenure systems, TURFs); rotation of fishing areas, among others.

Tools like the ones described above are available in Mexican legislation including species-specific use-rights within an area (CONAPESCA's fishing concessions or SEMARNAT's permits), fishery refugia, and MPAs. In the Northern Gulf of California, the few cases where granting exclusive access to a controllable marine territory have been attempted, either formally or informally, have shown promising results as to be considered for wider implementation [16,19,20,23]. Chile has experience with this sort of systems on a larger scale, showing that granting TURFs to formalized groups of fishers does promote sustainable harvests within TURFs [49]. This, together with the need to perform collective activities such as monitoring studies and surveillance, and the fact that the benefits to be derived from these resources are held, and are required to be sold, by the group; have successfully encouraged collective action and implementation of sanctions<sup>27</sup> (Parma et al., in preparation). However, if enforceable restrictions to fishing outside TURFs are not applied as well, fishing effort is often displaced to less restricted areas (open access areas in the case of Chile), generating a patchy environment that may impact the sustainability of the fishery in question and other fisheries as well [49]. A similar effect is expected to occur with MPAs implementation, especially with highly restrictive ones, if realistic measures to regulate fishing and enforce regulations outside MPAs are not in place [50].

With this in mind, our main recommendations to encourage sustainable use and conservation in Bahía de Kino include granting secure rights to resources to those actively involved in the fishery, as part of a broader-higher level institutional framework.

Given the situation in Bahía de Kino's fishing grounds, it is suggested that an institutional tool that may provide exclusive access to the community within the limits of their fishing grounds, could serve as a protective umbrella to help avoid intrusions from outside. At the same time, providing secure individual or collective rights to local fishers for specific fisheries within these limits may provide additional incentives to avoid internal competition for resources among local groups or individuals. This set of measures may encourage and facilitate participation of fishery stakeholders in management decisions and implementation of measures to protect not only fishery but ecosystem values. Furthermore, the regulation of activities other than commercial fishing (i.e. aquaculture, sport fishing, land activities affecting marine environments) could be also facilitated by a broader institutional perspective, following the principles of coastal zoning or integrated coastal management [51].

This type of institutional umbrella could be locally approached using tools available in Mexico's fishery and environmental laws. For example, through implementation of: (1) 'regional fishery ordinance plans' as incorporated into the new fishery law,<sup>28</sup> for which the area to be incorporated into the plan, lists of users, the species subject to use, and the species-specific management plans available for this species must be provided; (2) MPAs covering the fishing grounds of the community and/or 'ecological ordinance plans' for land and/or marine environments, according to environmental legislation;<sup>29</sup> (3) or a combination of (1) and (2). Both laws state that preferred access to fishing

rights<sup>30</sup> (permits, concessions) and MPAs<sup>31</sup> should be provided to local people in the area to be managed or protected, and encourage participation<sup>32</sup> of municipal and state governments, and members of the community, in decision making. However, if tools typically associated to environmental protection (like MPAs) are to be used as a protective umbrella, defining and formalizing access rights should be one of the first and most critical steps, to engage and empower local people to manage and defend their resources [16,34,51].

In addition, independent fishers should be formally recognized as active and essential members of the fishing sector and provided with individual or collective fishing rights. In this process, independent fishers are likely to be challenged by existing permit holders who may want to continue being in control of extraction and commercialization. Fishers will need to be supported to acquire the means and develop the necessary skills to successfully commercialize their own product, and incentives should be established for existent permit holders who are following the law and act responsibly with fishers they employ.

In any case, whatever measures are to be considered for implementation, they should be carefully evaluated for each particular context (no one solution fits all situations) and, critically, with active stakeholders' participation, especially of fishers. A more supportive role for the government should be also encouraged, for which additional human and financial resources will be needed for researchers, managers and enforcers to be able to improve their response to fisheries issues. Also, fisheries authorities should take advantage and support fishers' efforts to regulate use or restrict access of outsiders to local fishing grounds [34].

More importantly, the informal labor system that hides behind the visible face of existing permit holders should be acknowledged by the federal government and steps taken to formalize it and prevent it from continuing. Unless these fishers are formally recognized and given a secure right to enjoy the benefits from their activity, they are unlikely to contribute to enhance the health of coastal fisheries and ecosystems.

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<sup>27</sup> Fines for infractions are discounted from the benefits each member is entitled to receive.

<sup>28</sup> 'Ley General de Pesca y Acuicultura Sustentables' (LGPAS), [www.conapesca.sagarpa.gob.mx](http://www.conapesca.sagarpa.gob.mx).

<sup>29</sup> 'Ley General del Equilibrio Ecológico y la Protección al Ambiente' (LGEEPA), [www.semarnat.gob.mx](http://www.semarnat.gob.mx).

<sup>30</sup> Art. 43, LGPAS.

<sup>31</sup> Art. 48 and 64 BIS-1, LGEEPA.

<sup>32</sup> Art. 13 and 14, LGPAS. Art. 67, LGEEPA.

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