

Cooperatives, concessions, and co-management on the Pacific coast of Mexico



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ABSTRACT

Ten fishery cooperatives of the Pacific coast of Mexico were studied to examine reasons for successful community-based management of the fishery commons. The cooperatives hold exclusive rights to ‘concession’ territories for major fisheries and are linked by geographic adjacency and through a federation. The case study underscores the role of factors such as smallness of scale; the productivity, visibility and legibility of the resources and fisheries involved; clarity of social and territorial boundaries; adjacency and linkages among territorial units; a strong sense of community. The cooperatives also made considerable investments in attaining high levels of knowledge, leadership, transparent and democratic decision-making, and “vigilance,” or enforcement of the rules and the running of the organization. The study also shows the workings of windows of opportunity and experience with environmental change in the development of strong and adaptive capacities for co-management between local organizations and government agencies. Although particular histories and larger legal, political, and cultural contexts matter, the Mexican case supports arguments for greater community-level engagement in “catch share” and territorial management throughout the Pacific.

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1. Catch shares and TURFs

Community-oriented fishery management is recognized in the United States within the framework of a national policy advocating the management of fisheries through “catch shares”: “Catch share” is a general term for several fishery management strategies that allocate a specific portion of the total allowable fishery catch to individuals, cooperatives, communities, or other entities. Each recipient of a catch share is directly accountable to stop fishing when its specific quota is reached [1].

Catch share-based management is often interpreted as a euphemism for using individual transferable quotas (ITQs), and a recent flurry of research papers on catch shares and their effectiveness in achieving the biological and ecological goals of fisheries management interpret them that way [2,3]. However, as noted in the quotation above, the policy opens the door to a broader interpretation: allocation can be to cooperatives, communities, and other entities besides individuals.

Concerns about the often negative effects of ITQ-based catch shares programs on communities have led to efforts to make allocations of shares of a fishing quota directly to community-based organizations and cooperatives [4]. Although the cooperative-like sectors recently implemented in New England’s groundfish fishery [5] have little explicit reference to community, some of the sectors are developing in ways intended to reflect and protect community resources and values [5–7]. On the U.S. Pacific coast, plans have appeared for Community Fishing Associations to hold shares of quota, as is already the case in certain Alaskan fisheries [8]. Somewhat surprisingly, the U.S. “catch share” policy statement explicitly included

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the possibility of TURFs, or Territorial Use Rights Fisheries, where by groups are granted exclusive privileges to fish in geographically designated fishing grounds ([1], p. 1), even though exclusive fishing area privileges are not the same as holding shares of a catch quota. TURF management has a long and widespread history, particularly in the developing world [9–12], but it has had limited application in the United States apart from some town-controlled coastal shellfisheries, individual shellfish leases, and the informal territories claimed and defended by some fishers [13].

The purpose of this essay is to offer a case study from the Pacific coast of Mexico as a source of ideas for community-oriented fisheries management in other regions of artisanal fisheries, particularly where some consideration is being given to community-oriented allocations of exclusive fishing privileges. The case, based on a study of a federation of 10 fishing cooperatives in western Mexico, is unique and deeply contextualized in a specific history, political culture, and environment but it offers instructive experience for other situations. Specifically, it reinforces the argument for the robustness of many “design principles” or contributing factors toward successful community-based management of the commons [14]. It also reinforces claims for the value of co-management arrangements in linking the scales, knowledge, and resources of local resource users with that of government [15–18], a claim which recently gained support from a large comparative study of co-managed fisheries [19] but requires further specification of mechanisms involved. The case goes further in highlighting the value of exclusive but community-held property rights for management of the fishery commons. Economists have long argued that exclusive property rights were needed for economically sensible fisheries management [20,21], and this argument has led to ITQs, which have been shown in another large comparative study to have some success in averting biological collapse of fisheries [2]. The TURF case suggests that communal property claims also may have beneficial ecological and social outcomes, where the scale of the territory is appropriate to the life histories of the marine resources involved, as in the case of Chilean artisanal coastal benthic fisheries [9,10,19,22–24]. Other factors that emerge from this case include the importance of functional connectivity among the territories, the human settlements, and the fishing organizations; participation of fishers in research, monitoring, and decision-making about resources; and commitments within the cooperatives to transparency, fairness, and organizational integrity [25,26].

2. Overview of the Pacífico Norte fisheries and fishing cooperatives

Baja California is a desert peninsula of western Mexico bounded by rich marine ecosystems of the Pacific Ocean to the west, and the Gulf of California to the east. The Pacífico Norte, a region encompassing the Vizcaíno peninsula on the Pacific side of the peninsula as well as the offshore islands of Cedros and Natividad,¹ is the site of an interdisciplinary and international research project carried out between 2005 and 2009. The project studied the ecological, economic and social performance of the fisheries that are worked by cooperatives with exclusive access rights. The harsh and majestic desert of the Vizcaíno is a UNESCO Biosphere Reserve. It is very sparsely populated by approximately 10,000 people, and the fisheries that directly or indirectly support most of them take place close to a few coastal settlements. In the 1930s and 1940s, when the fishing cooperatives were established,

these were isolated frontier settlements, dominated by foreign fishing and canning companies, and they remain relatively isolated today due to the scarcity of water and poor infrastructure. Paved highways and linkages to electrical grids have appeared only since around 2005–2006. Five settlements have year-round residents as well as churches, schools, some local government offices, and businesses; others are mainly seasonally occupied fishing camps.

Collectively the cooperatives have about 1200 members plus non-member employees and apprentices. They work as harvesters and in processing operations which together form the main economic activity of the zone [27,28]. The smallest of the cooperatives is solely a seafood processing organization; the rest combine harvesting with some kinds and degrees of processing and marketing. The cooperatives belong to “Fedecoop,” a federation with offices in the city of Ensenada, hundreds of miles from the fishing communities. The federation provides marketing services, technical expertise for fisheries management, and a venue for collective bargaining; it is a key liaison with government agencies. Variation in performance among the cooperatives reflects ecological differences [29] and differences in historical and current priorities and strategies among the cooperatives and communities [30], but the overall pattern is similar enough to warrant the generalizations that follow.

Spiny lobster (*Panulirus interruptus*), abalone (*Haliotis* spp.), turban snail (*Megastrea undosa*), and sea cucumber (*Parastichopus parvimensis*) are targeted by the fishers. Local fishers, both cooperative members and “free fishermen” also harvest kelp, octopus, and a large variety of finfish species, including California halibut (*Paralichthys californicus*). Metal traps are used for lobster; abalone and turban snails are harvested by divers using “hookah” systems; gill-nets and other gear are used for finfish. The boats are open, outboard motor-powered skiffs, about 7 m in length.

One of the distinctive features of the fishing cooperatives of the Pacífico Norte is that they are vertically integrated and have an unusually high degree of investment in the means of production. The cooperatives rather than individual fishers own the boats, gear, and other technologies needed for the fisheries, and the cooperative’s officers, in consultation with members, decide on seasonal and daily schedules and work assignments.

In addition, the fishing cooperatives are fully intertwined with the coastal communities in which they are located. With the exception of Isla de Cedros, which has a salt transport operation (external to the cooperatives), fishing is the only industry, and access to the more valuable fisheries is controlled by the cooperatives, as will be discussed in more detail below. Consequently, the cooperatives are the primary sources of livelihood. Moreover, some of the cooperatives supplement government programs, for example, running desalination and electricity-generation plants to compensate for the lack of freshwater and the unreliable connection to the electrical grid. The cooperatives have also built and maintained roads and taken the lead in pressuring government for more facilities.

The Pacífico Norte cooperatives have developed the reputation for productive and sustainable fisheries. This is clearest for their spiny lobster fishery, which is one of the two main fisheries in the study zone. The spiny lobster fishery’s distinction as the first artisanal, developing nation fishery worldwide to receive certification as a sustainable fishery is recent evidence. In 1999 the World Wildlife Fund (WWF) together with a local NGO, Comunidad y Biodiversidad (CoBi) initiated a program to use eco-certification as a method of helping small-scale, community-based fisheries receive recognition for and improve their management of local fisheries. WWF focused on the Pacific Norte cooperatives, hoping to help the cooperatives get financial benefits in exchange for their commitment to practices believed to ensure greater sustainability of fisheries [31]. The process also involved government and university scientists and of course the

¹ Isla de Cedros is in the Mexican state of Baja California; the rest of the Pacífico Norte region lies in the northwest corner of the state of Baja California Sur.

cooperatives themselves, mainly through their federation. In April 2004, certification for sustainable lobster fishing was granted by the Marine Stewardship Council (MSC), a non-profit international certifying body, to nine Pacifico Norte cooperatives involved in lobster fishing. The fishery was renewed annually to 2009, when it underwent reassessment, and it was recertified in July 2011 [32].²

2.1. History of concessions and cooperatives

The concession approach to fisheries governance has a long history in Mexico and Baja California, initially serving as incentives for intensive exploitation [33]. In the early twentieth century Japanese citizens and companies gained access to many concessions and invested in the development of abalone, tuna, shrimp, and other fisheries, essentially controlling the fisheries of the Pacifico Norte from 1914 to 1942 [34]. The fishermen were contract workers from Japan and, eventually, Mexican workers who migrated with their families to Bahía Tortugas, Isla de Cedros, and other fishing camps and canning towns. This situation lasted until World War II, when all Japanese fishing boats and enterprises were confiscated by the U.S. government [34].

In 1936 the federal government passed a general law of fisheries, which established a rule reserving certain species for fishing cooperatives. Part of agrarian reform measures that also created ejidos, this encouraged more permanent settlement in the zone. The initial cooperatives encompassed large areas. For example, the first cooperative in the area included fishers from four settlements along a large coastal area from La Bocana in the south to Bahía Tortugas in the north, who thereby had exclusive rights to abalone, lobster, and other concession species along that coast. Today the same area has five separate cooperatives and concessions.

Despite the law and the formal creation of cooperatives, there was little change in federal government practice of contracting with private entrepreneurs to promote the development of exports, and outside capitalist and foreign control remained [33]. The Mexican fishers typically lived in crude seasonal camps [35], worked under poor conditions and for little pay, and were mostly unaware that they were in a cooperative let alone that they had rights [36,37]. In the 1960s, when a labor union movement was gaining momentum in Mexico, conflicts had arisen between the cooperative members and the owners and managers of the companies that had replaced the Japanese firms.

By the 1970s the local members of the cooperatives gained control, including ownership of the processing plants, making them vertically integrated businesses. The Fisheries Law stipulated that cooperatives had perpetual rights to exclusive use rights for lobster, abalone, and certain other species, referred to as reserved species, through area-based fishing permits (concessions). But it was not until the 1980s, as will be discussed in the section on co-management below, that the cooperatives became active in government-led fisheries resource management.

In 1992, as part of sweeping changes in Mexico's political economy intended to reduce government subsidies and increase entrepreneurship in rural areas, the fishery concessions became competitive, conditional, and time-limited. Exploitation of the reserved species was no longer an exclusive right of the cooperatives. Concessions can now be awarded to private interests. For example, kelp concessions are held by private companies in the region. The Pacifico Norte cooperatives applied for and were granted new 20-year concessions for exclusive use of certain species (mainly abalone, lobster, and turban snail) within specified and charted geographic areas. Within

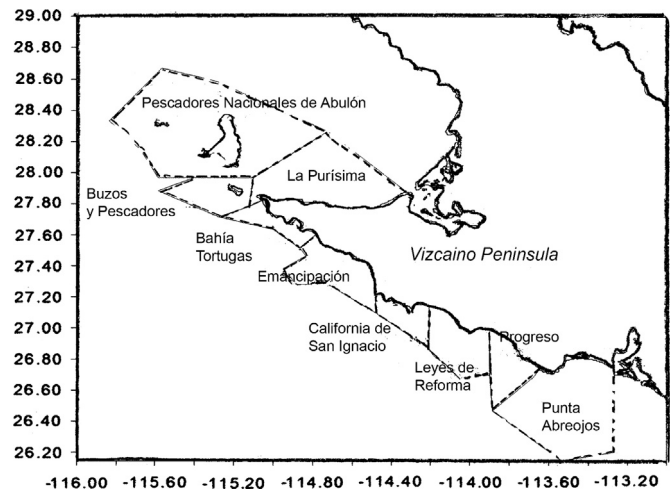


Fig. 1. Pacifico Norte Cooperatives and Concession Areas. Note: Latitude and Longitude Scales represent 10 international nautical miles, or approximately 18.52 km.

these concessions, species such as finfish continue to be available to other fishers. The concessions are renewable contingent on evidence of responsible management and continued productivity of target fishery stocks.

Today each of the fishing cooperatives has exclusive access and use rights to abalone, lobster, turban snail and a few other species within a clearly-defined territory. Once extremely large, the concessions are now roughly 500–1000 km² each and they extend 30–50 km along the coast or at variable distances around the offshore islands (Fig. 1), but close to the fishing communities. The fragmentation of the original concessions and their evolution to relatively small sizes, with close proximity to fishery-dependent communities, had occurred prior to the 1992 creation of time-limited, renewable concessions. It is another factor distinguishing these cooperatives from most others along the Pacific coast of the Baja California peninsula [38]. The relevance of smallness and other features of the community-oriented cooperatives are discussed below in relation to features of the ecosystem and resource and to the adaptive capacity of the cooperatives.

3. Productive and benthic resource base

The design and functioning of any management system should reflect and respond to critical features of the natural environment. In this case it is telling that fishery resources of the Pacifico Norte have been highly productive, although subject to disruptions, and that the more valuable resources are benthic invertebrates.

The fishing grounds are in the southernmost extent of the California Current Large Marine Ecosystem. They are strongly influenced by upwelling, which brings cold waters and nutrients up to the phototropic layer helping to create a dynamic and productive marine environment. Upwelling is periodically disrupted by ocean-wide dynamics known as El Niño, which can be devastating to abalone and other species. The coastal components within the boundaries of the concessions include turbulent rocky shores, extensive kelp forests (*Macrocystis pyrifera* and *Eisenia arborea*), and rocky reefs both of which are key habitats for fish and shellfish. The reefs within the Pacifico Norte are highly productive, although there is discernible variance in abundance, growth, and reproduction of species such as the turban snail, sea urchins, and sea cucumbers [29] and some sub-regional variation

² The 2011 recertification included a tenth cooperative, one formed for fishing abalone and lobster around remote Isla de Guadalupe, over 250 m from the coast. That cooperative was not part of the current study.

in productivity of lobster and abalone. For example, reefs are smaller and patchier in the southern part of the region, resulting in lower productivity of lobster and abalone. Overall, though, productivity is recognized as better than elsewhere along the Pacific and Gulf of California coasts of the Baja California peninsula.

The major fisheries of the study area are for species that are benthic and relatively sedentary in their adult stages (very much so for abalone, turban snail, sea cucumber, sea urchin and the red alga *Gelidium robustum*; somewhat so for lobsters). Only two cooperatives have sizeable fisheries for finfish in addition to benthic invertebrates. Moreover, both the lucrative abalone and the turban snail fisheries are for species characterized by short larval durations (5–10 days in the water column), limited dispersal away from adults and localized population dynamics [39–42]. These characteristics are particularly amenable to highly localized management regimes. In contrast, other target benthic invertebrates have longer larval durations (several weeks for sea cucumbers and sea urchins, months for spiny lobster) and their populations are likely connected over regional scales [43,44]. However, even for these species, adults are sedentary (sea urchins) or have relatively predictable association with reef habitat and seasonal migration patterns (sea cucumbers and lobster) that local fishermen are aware of and account for in their fishing strategies [30].

For all of the species, adult densities can be tracked and used as relatively good predictors of local fisheries productivity within each marine territory. For instance, lobsters are social, mobile animals that aggregate in rocky areas, generally hiding from larger predators during the day and foraging at night; they can travel tens to hundreds of meters [45,46]. The small home ranges for these species also provide a high level of predictability, an ability to monitor stock levels with confidence, and the expectation among fishers that stock conservation will pay off in the future. Therefore, the resources seem to be appropriate for management by small-scale concessions, which may not be the case for less predictable resources and for migratory and far-ranging species [47].

3.1. Adjacent and linked territories

As noted earlier, the cooperatives are part of a federation, which helps them relate to government and the markets. It also helps them coordinate their fisheries, aided by their geographic proximity, side-by-side along the coast (Fig. 1). Just as the effectiveness of “no-take” marine protected areas may be increased by being parts of closely linked networks due to the importance of connectivity [48], so networks of TURFs may improve the biological effectiveness of local control. To the extent that the cooperatives are adjacent to one another on the coast and represent a bloc held together by a sense of common interest, cooperatives have the security of knowing that their neighbors in the bloc at least are “caring for” lobster and abalone in similar ways and preventing incursions of poachers into the overall zone. Lobster population dynamics in the region also may help create a certain co-dependence among the cooperatives, as the amount of new lobster recruits that settle in each cooperative depends on the aggregate larval production across all the cooperatives. While lobster adults are benthic and relatively sedentary, the duration of the larval period is on the order of 8 months, allowing larvae to be transported significant distances before settlement [49]. Therefore, in theory, one cooperative could overharvest its own stock yet be replenished by neighboring cooperatives. In reality, over half of the 15 lobster captains we surveyed from two cooperatives said that if neighboring cooperatives reduced their level of lobster protection, they would as well. Several said explicitly that the system only works if all cooperatives participate in caring for the resource [50]. Hence the sustainability of the lobster fishery relies on a common

understanding and coordination of activities, not merely within each cooperative but among them as well.

3.2. Co-management

Benefits of the current concession system go beyond the exclusive fishing rights to include participation with federal authorities in resource management and research and the capacity to enforce internal rules [51]. The Pacifico Norte cooperatives are both co-managers and “self-” managers. They have little formal autonomy in fisheries management because the federal government reserves the power to manage natural resources as the patrimony of all Mexican citizens. However, the cooperatives, individually and through their federation, have created a strong basis for co-management with federal government scientists and managers.

They also have the capacity and, because of their concessions, the incentive to make more stringent resource management decisions than required by government. Economic modeling done for this research project shows that the community-based and relatively insecure (term-limited) rights as represented in the concessions can promote stewardship-related tradeoffs against immediate exploitation, depending to some degree on the life histories of the species in question and the likelihood of concession renewal. For instance, the 20-year concessions make more sense for lobsters than for abalone, for which longer concessions might be warranted [52].

Co-management does not flow naturally from the existence of either cooperatives or of TURFs like the concessions. In this case it came about in response to a threat of fishery closure in 1982–1983, due to a major El Niño condition that brought warmer waters through the disruption of local upwelling and caused decline of the kelp that sustains abalone. Combined with already declining catches in prior years, abalone stocks began a drastic rate of decline. The government fishery agency threatened the cooperatives with complete closure of the lucrative abalone fishery if they did not agree to severe austerity measures. The negotiated outcome of the government ultimatum was that cooperatives took on greater responsibility for sustainable and cooperative management of the fishery in exchange for being allowed to continue fishing but at a lower and more tightly regulated level. Conditions of the 1992 concessions further institutionalize co-management. They require the cooperatives to invest in fisheries management, including abalone and other hatcheries, cooperative monitoring of resource levels, and employment of biologists and engineers. The 2005–2011 Marine Stewardship Council certification and re-certification process also calls for cooperative investments in stewardship.

The cooperatives are thus embedded in a complex system with specific relationships that emerged from historic challenges. Their actions are controlled to a large degree by national laws of cooperatives and of fisheries as well as the specific conditions of their concessions, legal factors that provide both constraints and support. Within this context, the cooperatives have some autonomy to take their own resource management initiatives (Table 1). For example, whereas the federal government’s fisheries agency establishes minimum mesh sizes for gillnets, the cooperatives may elect larger sizes for their members. Whereas the government establishes the maximum number of lobster traps to be employed in each concession, the cooperatives will decide how to allocate them amongst members and where to deploy the traps within a concession. A cooperative may decide to close some abalone reefs but relies on the government to offer formal “reserve” protection to those reefs. The government recognizes boundaries and other rules but to a large extent monitoring and enforcement depends on the cooperatives, which are deputized to monitor boundaries and rule compliance.

Table 1
Fishery measures determined by cooperatives and by the Mexican Federal Government.

| Cooperatives | Federal Government (CONAPESCA) |
|--|---|
| Gillnet mesh sizes available to fishers (above legal minimum size) | Minimum mesh size for gillnets |
| More conservative size limits for abalone capture than mandated by CONAPESCA | Minimum size limits for lobster, abalone, halibut |
| Number of chambers in the traps, quantity and type of bait taking into account legal restrictions | Mandatory escape windows and biodegradable fasteners; prohibited to use chitons as bait |
| When to harvest abalone from each reef once the season opens and where and whether to leave “reserves” | Maximum number of abalone that can be harvested from each reef under a total annual quota in tons per cooperative; offering formal “reserve” protection to sites within concessions managed by cooperatives |
| Where to deploy traps within a concession, and how to divide up the fishing fleet | Maximum number of lobster traps within each concession |
| Which species are landed and sold, which gear types are used | Prohibited gears and species |
| Enforcing boundaries of concessions to exclude outsiders | Defining boundaries and authorizing cooperatives to enforce them. Granting the concessions |
| Internal enforcement to prevent black markets for lobster tails and abalone; conducting random checks on their own fishermen | Monitoring minimum sizes sold in market through random audits of product |

Administrative and operations-level decisions in the cooperative within the limits set by broader governmental authority can have important implications for local fisheries. The cooperatives can determine the dates when they will begin and end fishing as long as they stay within the legal season. For abalone, this means that cooperatives can and often do wait to harvest when abalone grow to optimal weight within the season, thus adding value to their product and helping sustain the resource by harvesting fewer and larger individual animals. They also have the power to allocate fishing opportunities among cooperative members and determine the levels of fishing effort allocated to different fisheries and they make decisions about how much and what kind of effort and money to invest in enforcement, marketing, and fishing technology.

Both individually and through their federation, the cooperatives work with the regional research arm of the national fisheries agency, Centro Regional de Investigaciones Pesqueras (CRIP; Regional Center for Fisheries Science), to conduct joint scientific monitoring. CRIP uses the results to make recommendations to the national fisheries authority, CONAPESCA, which promulgates fisheries regulations. Despite having little to no legal power to create the major rules that regulate their fisheries, the federated cooperatives shape those norms considerably, for example, by presenting scientific evidence for changing the opening and closing dates of the fishing season, and proposing certain kinds of changes in the national fisheries law which are then represented and debated at the level of congress.

To summarize, some fishery rules are locally derived, such as choosing to make the size limit for abalone even more stringent than the one recommended by CRIP to try to rebuild abalone populations faster. Other rules come about through negotiation with CRIP and CONAPESCA, such as when cooperatives argue to shift the date of the open season to be more in line with observed reproductive patterns of lobster. Still others come from top-down mandates, such as quota limits for abalone, which are based on a biomass model used by CRIP [53]. Relationship with the state (in this case, both state and federal governments) is critical, and that has been strengthened in the Pacifico Norte case by the existence and capacity of the federation, Fedecoop. Fedecoop plays an important role in fishery legislation at high levels, and its officers actively participate in proposing and responding to changes in legal frameworks that affect fishing, management plans for the region’s UNESCO Biosphere Reserve, and fishing norms.

3.3. Smallness

Relative smallness of size and scale is a key “design principle” or contributing factor toward successful local-level or community-based management of the commons [14]. The cooperatives and concession territories are relatively small in size. Membership in the

Table 2
Pacifico Norte cooperative membership, 2002 and 2009–2010.

| Cooperative | Members | |
|---------------------------------|---------|-----------|
| | 2002 | 2009–2010 |
| Abuloneros y Langosteros | 0 | 22 |
| Pescadores Nacionales de Abulon | 167 | 150 |
| Buzos y Pescadores | 86 | 80 |
| La Purisma | 96 | 94 |
| Bahía Tortugas | 87 | 92 |
| Emancipación | 77 | 84 |
| California de San Ignacio | 195 | 134 |
| Leyes de Reforma | 185 | 170 |
| Progreso | 210 | 180 |
| Punta Abrejo | 191 | 168 |
| Total | 1294 | 1174 |
| Average | 129 | 117 |
| Median | 131 | 114 |

Data from Marine Stewardship Council Assessments, 2004 and 2011.

cooperatives ranged from about 90 to nearly 200 members in 2002 [54] and from 80 to 170 members in 2009–2010 [28] (Table 2). At annual meetings, all members are expected to attend and participate and most do; our observations at some of these meetings indicate that these numbers are manageable for purposes of coming to agreement as a body and of managing the operation of the fisheries. Cooperatives have splintered in the past when this was not possible.

Size itself may be less important than whether or not it is something that can be and is controlled in relation to resources. The cooperatives have considerable control over the number of members. Expanding, stabilizing, or contracting membership is decided by members of the cooperatives who develop stringent membership rules, with apprentice periods of as long as 10 years or more. Table 2 compares cooperative membership between 2002 and 2009–2010, indicating a slight decline in overall membership, despite the addition of a new cooperative in 2010, and considerable variation among the cooperatives. Size reflects not only demand for membership from residents, but also the size and productivity of the territories held by the separate cooperatives and the desired share of the wealth for each member, as well as internal factors such as the proportion of members eligible for retirement. Cooperatives have changed in membership size in response to availability of resources and/or to make up for economic losses. For example, one of the study cooperatives lost membership after an El Niño-related abalone fishery crash. Another cooperative changed its rules to close membership until

its economic situation improved; when it stabilized it allowed in more members.

The condition of small and controllable size appears to be more effective if, as in this case, resource users live very close to the resource in question and are highly dependent on it. Adjacency, combined with a high level of community dependence on the fisheries and relatively small size of the adjacent fishing areas, means that people not only know each other, but they have a good chance of seeing and hearing what is happening both on land and at sea, and they are personally invested in reporting, formally and informally, events that potentially affect the resources.

3.4. Clearly defined boundaries

Clearly defined boundaries are another factor helping local communities manage their commons [14]. The Pacífico Norte fishery concessions have clearly defined legal qualities and physical boundaries which are built upon and sustained by major social boundaries. Access to the concession species is only available to legitimate members of the cooperative that holds the concession. Others cannot fish for the highly valued concession species (abalone, lobster, turban snail) nor can members of other cooperatives. It is locally very clear who is a member of a particular cooperative and who is not. Boats are readily linked to specific cooperatives, and lobster traps are marked with colored buoys that identify individual fishing teams. With regard to exclusion rules that distinguish those with and those without legitimate access rights, the relatively small sizes of the cooperatives, the discrete and spatially defined concessions, and the small size and closeness of communities in which they are located makes it relatively easy to see whether or not those working inside of the concessions are legitimately accessing the resources. Illegal fishers, whether community members who do not belong to the cooperatives, members of neighboring cooperatives, or outsiders, can be readily spotted, and members' activities are fairly visible.

An additional factor is the relatively small presence of “free fishers,” or people who do not belong to the local cooperative but exercise their constitutional rights to fish for subsistence or, in the case of finfish, economic gain. “Free fishing” is allowed only for non-concession species such as finfish, but the generally low market value of those products and the remoteness and underdevelopment of the zone have prevented the “free fisher” fisheries from becoming a major threat to cooperative activities. Nonetheless, cooperative members attest to considerable illegal harvest of abalone and lobster from both local people and illegal fishers who come from distant communities north and south, making enforcement a major cooperative function.

3.5. Leadership, fairness, and transparency

A worldwide review of the literature recently showed leadership as a key variable in local-level fisheries management [19]. In the Pacífico Norte cooperatives, it is closely intertwined with the values of fairness and integrity. Directors are cooperative members who are elected by the general membership to one of two executive councils: administration or enforcement. Each position is term limited, usually 2 years, although some cooperatives allow re-elections for additional consecutive terms. Rotating leadership helps ensure that leadership experience is dispersed among membership and likely improves understanding of cooperative principles and functions. However, periodic discontinuity in leadership, from frequent rotations, is a cost of the system that can work against capacity building; just as some people have learned what the leadership position is about, they are replaced by someone who may have to learn it all from the beginning. However, members of the cooperatives described the

system to us as preferable to situations where long tenure can result in favoritism and corruption.

Commitment to the cooperative and compliance with the rules are promoted by financial incentives: many benefits of membership are cumulative and increase with tenure, and the majority of the cooperatives offer retirement benefits for members. The high value of membership also increases rule compliance: loss of membership and associated benefits is one penalty for serious infractions, such as recurrent breaking rules about lobster fishing.

Controlled laboratory experiments on social dilemmas indicate that fairness is a powerful determinant of human behavior [55]. In the study cooperatives, fairness enhances commitment and compliance. At the broadest level, fairness and rules for achieving transparency regarding allocation and distribution decisions are mandated by the federal law on cooperatives but the way in which this is done is in practice left up to cooperatives. A sense of fairness among cooperative members emerges in large part through the use of regularly held, open meetings to make most major decisions.

3.6. High-quality knowledge and decision-making

The Pacífico Norte cooperatives, like other fishing organizations, face the challenges of understanding the biological complexities of fish stocks and marine ecosystems and developing the technical capacity to monitor resources and enforce property rights and boundaries. They have invested in the capacity to do so. Most of the cooperatives employ trained biologists or engineers as technicians, and the federation employs a fisheries scientist. Members may be asked to give time to the tasks of resource monitoring using transect surveys and other science-based methods; consequently, many are familiar with methods and data used, as indicated by one cooperative's chart of the reefs, according to productivity (Fig. 2).

At planning meetings and general assemblies, cooperative leaders and technicians present graphs, spreadsheets, and other data to explain and justify decisions they recommend to the voting membership. Members themselves may have very different understandings of the fisheries and may not be persuaded, particularly when a

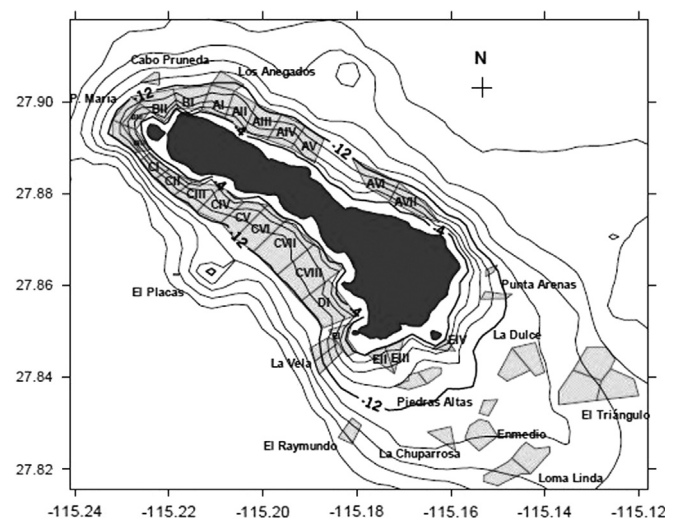


Fig. 2. Isla Natividad Abalone Reefs; Isobaths and Blocs Indicating Relative Abundance. [51]. Note: Scale of Latitude and Longitude is at intervals of two international nautical miles, or approximately 3.7 km.

Source: Martín Castillo Valdez C., La concesión pesquera y el manejo de los recursos en Isla Natividad, B.C.S. Sociedad Cooperativa de Producción Pesquera “Buzos y Pescadores de la Baja California” S.C.L. De Pescador a Pescador, La Paz, Baja California Sur. 2006.

reduction in harvest is being proposed, but the highly transparent and participatory approach helps legitimize and justify a course of action or a decision, even when the decision means reducing harvests or closing an area.

The fact that leaders and technicians explain the science behind some of these decisions – that they are accountable to the membership – may be more important than whether members are interested or understand. Transparency is high within the cooperatives, and the rotation of elected leadership positions serves as a mechanism to hedge against favoritism and corruption.

The cooperatives' experiences working with government and academic scientists and managers and with non-governmental organizations, together with their recognition of the value of good and tested information, have led to their interest in and capacity to undertake experiments in marine resource management. Notable is the case of the cooperative at Isla Natividad, which has worked closely with COBI, a regional NGO, to create experimental marine protected areas within their concession boundaries. The program evaluates the effectiveness of closures by monitoring the biological results but also by recording the economic costs of foregone harvests against the benefits if and when the reefs are reopened [56].

3.7. Vigilance

Vigilance, in the sense of the capacity of the cooperative and its members to monitor fishing activities and enforce rules, is essential. Monitoring and enforcement are directed not only at poaching outsiders but also at rule-bending cooperative members. In addition, vigilant oversight is directed at how the cooperative itself is administered and the behavior of its members.

The small size and hence visibility of the groups participating in the fisheries, the small size and well-defined boundaries of the concession areas, the near-shore feature of most harvesting practices, and the nature of the resources themselves contribute to effective monitoring and enforcement capacity. Nonetheless, enforcement is very costly, financially and in terms of effort and personal risk from apprehending poachers and sometimes even drug-runners. Although there is a high level of internal rule compliance, illegal fishing is rampant in the region, especially for the high-valued abalone and lobster, and it has a long history, abetted by poor government enforcement, overlapping access rights between cooperative members and "free fishers," and the high value of the resources [57]. In 2005 the abalone fishery is thought to have had an illegal catch of approximately 27% of the official catch, worth about \$U.S. 5 million. For lobster, the illegal catch was estimated as 6% of the official catch [58]. Illegal fishing is considered to be even worse elsewhere on the peninsula [59]. But the high value of the resources also helps justify the extremely high investments made by the cooperatives in enforcement, which go into millions of dollars per year. The ability to effectively patrol is another feature that distinguishes the *Pacífico Norte* cooperatives from others in the larger region, and it is considered part of the responsibility of members of the cooperatives to take part in patrols, or to hire apprentices or non-member employees to do so.

The cooperatives practice another kind of enforcement that protects their integrity as governing institutions. The cooperatives not only enforce regulations and borders on the water but also have the task of ensuring that people follow the rules in terms of how they conduct their work and themselves (showing up on time, being responsible, not using prohibited drugs, avoiding excessive drinking that can reduce productivity and teamwork). They also have the task of ensuring transparency and correctness in cooperative operations (making sure money is not being squandered or spent inappropriately, that leaders are doing their jobs, and that transparency in fact is happening through

appropriate reporting). Although distinct, the two kinds of enforcement work together and reinforce one another.

The effectiveness of the cooperatives in enforcement must, however, depend also on access to supportive external institutions. Sanctions for outsiders who break rules relating to the resources and the concession zones are outside the jurisdiction of the cooperatives, a fact which can lead to a lot of frustration, confusion and repeat offenses by illegal fishers. The cooperatives have authority to patrol their boundaries but have no official jurisdiction over the poachers themselves, a major limitation on their ability to enforce the concessions. This is one key point at which the larger governing apparatus of the state is important, as the only authority that can legitimately provide policing, courts, and punishment. The term-limited concession system is part of a larger process of government withdrawal from, or continued negligence of, its role in protecting natural resources [57], placing heavy burdens on the cooperatives and the fishing families. The high monetary and personal costs paid by the cooperatives for enforcement reflect that.

3.8. Sense of community

Shared norms, the social capital that emerges from repeated and extended interactions, interdependence among group members, and relative homogeneity of identities and interests are important conditions for viable governance of the local commons [60]. This set of variables characterizes "community": an emergent quality of people who share some elements of a common history and culture, interact with and depend on each other to some extent in the present, and anticipate doing so in the future. By these measures, the fishing towns and camps in which the cooperatives are located have high levels of community. Many residents are descended from the families that settled the area in the 1930s and 1940s³ and express shared identity through stories of the vicissitudes of pioneer life on this barren coast. The stories help sustain a sense of community as well as messages about the need for cooperation. Members of the cooperatives have similar educational, work history, and other identities and interests. Most fishers learned their skills from other cooperative members, often their parents or other relatives. The older members also have complex histories of interaction, including involvement in formative events such as the ousting of foreign companies in the 1960s, remembered as a time when local fishers made personal sacrifices to create viable cooperatives. Also evident is a strong sense of a shared future: surveys with cooperative members show that nearly all indicated that they planned to work their entire careers at the cooperative.

Cooperative spirit and a strong sense of community are intertwined, for example, in the involvement of the cooperatives in local fishing tournaments, funeral events, ball games, and politics. Community spirit is also expressed through key kinds of political solidarity, despite the fact that people belong to different political parties. The inattention of the government to enforcement problems drew one such event, in August 2006. People from communities throughout the region gathered to protest lack of support from government in preventing illegal fishers from entering the cooperatives' concessions. Teachers, shopkeepers and housewives of the local community, as well as fishermen representatives from

³ The pre-contact indigenous population of the region was very sparse, limited by water, and dependent on fishing and terrestrial foraging. Indigenous groups were virtually decimated by introduced disease and forced emigration to colonial centers by the 18th century [61,62], and resettlement of the coasts did not occur until the development of export-oriented fisheries in the early 20th century. Even then, water scarcity and control by outside firms proved barriers to population expansion until the mid-20th century.

nearly all the cooperatives in the region, stood with arms crossed before political representatives while members of the cooperatives set fire to a small skiff that had been confiscated from illegal fishers and left on the beach – a symbol (to them) of the authorities' neglect in enforcement. Equally important as an expression of community is the fact that the protest was followed by a barbeque where lobster – a valued gift within the communities – was served. Functioning cooperatives are not easily separated from functioning communities, and the latter may be important to the preservation of healthy fish stocks [61].

4. Discussion: adaptive capacity

The adaptive capacity of co-management institutions is central to their contribution to the resilience of socio-ecological systems [62]. Although decline in abalone populations since the 1960s has been dramatic, the fishery continues under strict but collaborative management. Until about 2009 or 2010, when major environmental changes occurred [63], the abalone population appeared to be stable or even increasing [64], unlike the situation of other abalone fisheries in North America, which are commercially and in some cases biologically extinct. The lobster fishery has seen increases in both effort and catches and is by all measures sustainable. No assessments have been done of the other fisheries, but it appears that the cooperatives have averted major fishery failures seen in cases like the northern cod of Newfoundland [65]. They appear to have the capacity to respond correctly to signals of environmental change through their co-management system.

As noted earlier, co-management itself arose as an adaptive response to environmental and political crisis, when the government threatened to close the abalone fishery due to the 1982–1983 El Niño. El Niños occurred again in the 1990s, and cooperatives had to adjust again to lean and uncertain times. In each case when quotas for lucrative abalone fisheries were severely reduced by government, cooperatives, family members, and anyone living in the communities felt the impact. To help tide families over, the cooperatives took on additional debt and gave credit to members to help them get through the worst times. Community cohesiveness and the degree to which the survival of the cooperatives is connected with the survival of its members made such critical institutional responses possible. Not to be discounted was the inherent lucrativeness of the fisheries, which allowed the cooperatives and their members to accumulate resources during good times.

Another response by some cooperatives during and after the El Niño events described was diversification to other fisheries, such as finfish, turban snail, and more recently sea cucumber and sea urchin which are sold to Asian markets. Diversification to other fisheries was initially thought of as a short term solution to the problem of economic crisis when abalone became scarce. But in fact the cooperatives have come to depend on them, and the finfish fisheries now fill a social niche in many cooperatives, particularly in the southern area, even though the cooperatives have no exclusive concessions for them. They keep more people gainfully employed than would be otherwise possible, and provide such work at times of year when more lucrative lobster and abalone are out of season and economically leaner times set in.

Longer term effects of diversification are still playing out. Greater effort in fishing for finfish may have implications for the ecological system, depending on the ecological impacts of the gill net fisheries which appear to have more substantial effects on kelp and gorgonian coral and other structures than the traps used for lobster [50], and the fin-fisheries are not part of the concessions. The willingness of the cooperatives to undertake the costs of carrying out responsibilities aimed at sustainable fisheries can

be traced to the incentives provided by the concessions [52]. The cooperatives have shown strong capacity for both reducing the threat of illegal fishing in the cooperatives' zones and enforcing the internal rules and standards for work within the cooperatives.

5. Conclusion

What are the essential features that enable the cooperatives to respond effectively to the needs of and demands from their members and others in local communities, on the one hand, and challenges presented by the natural environment and market conditions on the other? What lessons do they offer to other artisanal fisheries of the Pacific?

The Pacifico Norte cooperatives have shown the capacity to engage in effective co-management and to respond to environmental changes. Reasons include their strong and fair organizational structure and the degree to which they are embedded in the local communities, which have been poorly served by state and federal governments and greatly depend on the cooperatives for survival. They have had incentives to respond because of the very high value of the fisheries, their exclusive access rights, their high level of dependence on the resources, and their ability to claim and sustain some measure of autonomy to make and act on important fishery decisions. The case remains strong for community-based territorial concessions as models for coastal fisheries governance; they have proven to be part of the institutional basis for adaptive co-management in the face of variable and changing environmental conditions.

The case study provides further evidence for the importance of a number of “design principles” for successful small-scale commons management [14], including smallness of numbers and spatial scale; accountable leadership; persistent efforts to ensure fairness and transparency; major investments in the ability to learn from and interpret the natural environment; and high levels of internal as well as external vigilance. In addition, the case highlights the importance of a window of opportunity for policy change that emerges from the failure of previous policies; effective incorporation of scientific and technical knowledge into resource management; and the presence of strong but flexible institutions, capable of implementing corrective actions in response to change. These characteristics are also present in other communities of the Pacific region, including the Philippines [66] and Chile [24]. The accumulation of case studies gives credence to these factors as relevant to policy for artisanal and coastal fisheries elsewhere in the Pacific.

An obvious but important generalization emerging from this case study is that history and context matter. The management capacity of the Pacifico Norte cooperatives comes from and informs the local history of experience with environmental changes due to El Niño and overharvesting, as well as experience with changes in laws and fisheries governance. Dealing with such changes was critical to the emergence of co-management. Recurrent El Niño events in conjunction with politics helped facilitate adaptive co-management on the parts of the cooperatives and the government agencies, as well as recent experiments such as the pilot marine reserves of Isla Natividad. Such windows of opportunity can foster institutional innovation and reform in other regions as well. Longer-term climate changes may be at play, though. There is serious concern about the role of climate-related environmental changes in the decline of abalone stocks in the last few years [63,67]. Current institutions may be inadequate to the task if boundaries and other lines need to be redrawn and relationships reformed.

The larger political, legal, and cultural context is important to keep in mind when generalizing from a particular case. The Pacifico Norte

concessions build upon a tradition of cooperativism in Mexico that extends to the 1930s [68,69] and a tradition of fishery concessions that goes back to the 19th century if not farther. Legal structures, cultural expectations, and personal experiences strengthen the viability of fisheries cooperatives in Mexico, whereas in places without comparable histories and legal structures, the use of cooperatives for managing fisheries may be less likely to succeed. Similarly, the use of exclusive territorial concessions is well-entrenched in Mexican experience, whereas in other areas such a method of restricting access to marine resources may not be cultural or legally acceptable. This may be particularly true in the United States and its territories and possessions, given the overlay of American public trust notions of freedoms to fish and navigate [70,71]. However, local traditions and institutions, as well as the capacity for reform, are present throughout the Pacific region [72,73].

That the use of cooperatives for local-level fisheries is more or less taken for granted in Mexico should not diminish the efforts involved in keeping them viable. The *Pacífico Norte* cooperatives are no stranger to the problems faced by most worker-controlled organizations, such as difficulty in rule enforcement; lack of transparency; vulnerability to consolidation of elite power despite democratic procedures; and weak commitment to the organization during hard times. Indeed, most fishing cooperatives in western Mexico suffer from these and other problems [38] as do cooperatives elsewhere [74]. Nonetheless, strengthened by the wealth they can garner from their exclusive rights to valuable species within their concession territories and the interlinkages of those territories and the cooperatives themselves, and supported by government and non-government organizations, the *Pacífico Norte* cooperatives have been able to achieve viable and sustainable livelihoods from fishing.

The wealth available from the sea is indeed critical. The central part of the Baja California peninsula, essentially what is here called the *Pacífico Norte*, is also where red spiny lobsters are found in highest abundance throughout their range, from Central California to the Gulf of California [45,75]. Although the three abalone species have declined drastically throughout their ranges, this area remains one of the last where abalone can support a commercial fishery. This is either because fishing pressure on the abalone here has been comparatively light due in part to stringent management over the past 20 years, or because of exceptionally good conditions for abalone. The high if variable level of productivity and exceptional abundance of valuable species has made it worthwhile to invest heavily in scientific monitoring and enforcement as well as commitment to the institutions. In situations where the resources are less valuable or in poor condition, it is reasonable to hypothesize that community-based organizations are likely to have greater difficulty mustering the considerable economic as well as social and political resources involved in successful local-level management.

The *Pacífico Norte* cooperatives and their concessions have limitations, foremost among which is the fact that concession authority and power does not extend to fisheries for finfishes. In the *Pacífico Norte*, as is also the case for the TURFs of coastal Chile [23,76] and many of the cooperatives in Japan [77,78], the primary resources are benthic invertebrates; they are relatively sessile and their condition is relatively observable, which makes it easier to monitor them, understand some of their dynamics, and enforce regulations. The TURF model is less likely to work for more distant or migratory fish and fisheries.

However, having relatively open access to finfisheries has provided an important buffer for some of the cooperatives, allowing them to divert effort into those fisheries to compensate for reduced opportunities in the concession fisheries, which otherwise can cause divisiveness and claims of injustice, diminishing the authority of the cooperatives. Moreover, the use of concessions to protect

finfish is not out of the question although currently not undertaken in the study area. Several fish species associated with rocky and coral reefs, and with estuaries and lagoons, though potentially mobile, tend to exhibit site fidelity and low dispersal [79]. Thus, an ability to monitor and track changes in exploited populations, well developed in the study cooperatives for lobster and abalone, can be applied to a suite of reef-associated and estuarine fish and invertebrates.

The isolation of the *Pacífico Norte* cooperatives and fishing communities, far off major highways and hundreds of kilometers from large towns, may have played a role in their successes, particularly as they may affect the ability to control membership and enforce regulations. Enforcement costs and failures as well as pressures to open cooperative membership to newcomers are likely to increase with proximity to large towns and cities, as seems to be the case for cooperatives elsewhere along the Pacific coast of Mexico's Baja California peninsula [80]. However the smallness, accountable leadership, fairness and transparency, investments in the ability to learn from and interpret the natural environment, and high levels of internal as well as external vigilance that characterize the cases studied can also be found in communities that are close to large population centers. These circumstances are not exclusive to remote locations. However, controlled comparisons have yet to be done to explore whether features of the model represented by the *Pacífico Norte* cooperatives may be influenced by proximity to more urbanized areas or migratory populations.

A related question is the extent to which the evolution of significant local-level management capacity in the *Pacífico Norte* was both necessary and possible because the area's isolation also has meant little presence of state and federal governments. A TURF system with considerable local authority for monitoring and enforcement becomes particularly valuable in such circumstances, which may be found in the more remote western Pacific islands as well. The stronger message from this case study is that both government engagement and local commitment and involvement are critical. Effective management requires increases in both local institutional capacity and in government investments in science, technology, enforcement, and co-management.

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